Building Organic Bridges

Volume 1
Argentina – France

Proceedings of the 4th ISOFAR Scientific Conference
at the Organic World Congress 2014

13–15 October 2014 in Istanbul, Turkey

Gerold Rahmann and Uygun Aksoy (Editors)

Thünen Report 20

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ISOFAR

International Society of Organic Agriculture Reserach

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THÜNEN

IFOAM
INTERNATIONAL FEDERATION OF ORGANIC AGRICULTURE MOVEMENTS

EGE ÜNİVERSİTESİ 1955

International Society of Organic Agriculture Research

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'Building Organic Bridges' with Science

FOREWORD

Plants and animals or in a broader sense, mother-nature, has been serving mankind from time immemorial. If you consider agriculture, as cultivation or domestication of plants and animals then you may start evaluating the impact of mankind since the last 12,000 years. Today, still, agriculture provides food for all living organisms, and fibre and in some cases fuel for human beings. The World today nurture more than 7.2 billion as of April 2014 even if the ecological footprint has exceeded one.

According to UN databases[1], in 1980, out of 4.4 billion, rural population was 1.53 times more than the urban population. Those who were the producers were more than the consumers. In 2015, the rural/urban population ratio is estimated as 0.85 revealing that more will consume and less produce. If this ratio is dissected according to the regions of development: rural/urban population ratio is 0.27 in more developed regions, 1.05 in less developed and 2.30 in least developed regions of the World. Urban growth rate peaked (2.24 %) between 2000 and 2005. Rural growth rate that was 1.13 % between 1985 and 1990 is estimated to be 0.05 % between 2015 and 2020 and then at negative rates. By 2035, 61.7 % of the population will live in urban areas where as 38.3% in rural. So, less people in more and less developed regions of the world will try to supply food for more and more consumers or urban and peri-urban areas in developed regions will become more intensified for adequate agro-food production. Additionally, there are other major issues as changing life styles and consumption habits as higher calories and high consumption of animal products. Relationship between health especially of non-transmissible diseases and nutrition is a bottom-line for many, and new evidences strengthening these relationships appear through research as technology advances. Consumers in more developed regions of the world are becoming concerned about long-distance transfers of agricultural products, energy consuming distribution channels, loss of diversity, erosion of traditional foods or processing techniques. Agricultural land is threatened by intensification, urbanization, non-agricultural activities e.g. mass tourism, mining and climate change. How can agricultural production counteract these diverse issues and still be sustainable?

Organic agriculture rooting on health, ecology, fairness and care principles as defined by IFOAM is practiced in 164 countries according to 2012 data[2]. 88 countries possess a legislative framework for organic agriculture. How many have mutual recognition? Are there any derogations and why? The market size has reached to 63.8 billion US dollars. In all 164 countries data at least on production are collected. The product flows are still towards enlarging organic markets in more developed regions of the world e.g. US or Germany. Domestic markets are enlarging. Who consumes more organic and how much they spend? Why do the consumers prefer organic food/do they also prefer organic non-food products? Are they healthier? What are the health aspects? What are the quality attributes or is it the vital quality that makes it different than conventional systems? In which as-

[1] Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects, 2014: The 2010 Revision and World Urbanization Prospects: The 2011 Revision Monday, April 14, 2014; 7:13:02 AM

[2] Willer, H. an d J. Lernoud (Eds.), 2014: The World of Organic Agriculture. Statistics and Emerging Trends 2014. FIBL-IFOAM Report. Frick and Bonn

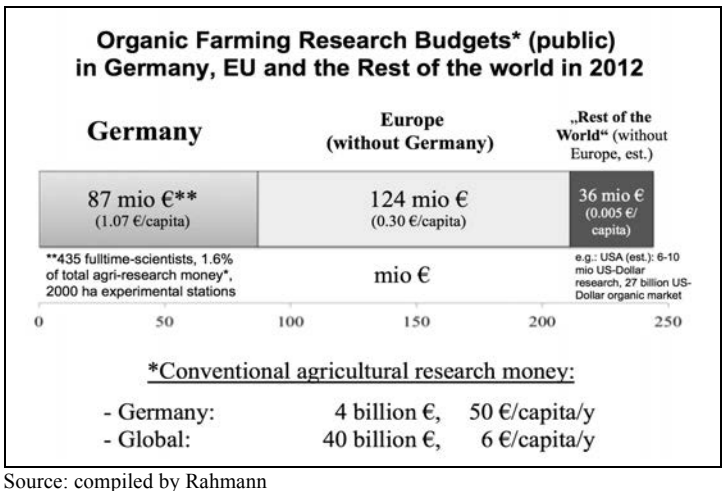
pects are organic more sustainable? Does sustainability of agricultural land differ from non-agricultural organic certified areas? How does organic system contribute to climate change?

Organic management systems aim for finding solutions to these and many other questions through research. The research objectives should derive from real-time or envisaged problems, and outcomes should find paths for quick implementation. Science is needed not only to prove its merits to the general public and lobby but also to put forward solutions to site specific problems. These can be exemplified as: Finding solutions for soil fertility management under arid conditions? How to increase yields; by developing high yielding varieties better adapted to organic conditions, by decreasing losses or by managing the value chains? What are the tools that organic farmers have in preserving animal health, which breed are resistant?

Research and innovation contributes to diversity, to competitiveness and to sustainability. In this respect, scientific meetings are major tools to establish fora to exchange results and experiences. Compared to conventional agriculture, the number of researchers and research projects and available funding is more limited in research on organic food and farming and the concept is much younger. These peculiarities enhance the importance of communication and interchanging among stakeholders. The IFOAM Organic World Congress is the unique opportunity for researchers, policy makers, extension specialists, practitioners and other stakeholders for exchanging knowledge and experiences; to share results and reversely to bring problems to the attention of world-wide research community.

The 18th IFOAM Organic World Congress held on 13-15 October, 2014 in Istanbul-Turkey targets to **'build organic bridges'**. The Scientific track will contribute to bridging not only scientists but also institutions and disciplines, and to linking more developed and less developed, rural and urban, research to extension, plant to animal, farm practices to world-wide problems and producer and consumers. Organic is a management system that requires a diversity of inputs from different disciplines, therefore, an international Congress is the best medium to blend them.

The Scientific Track is organized with special efforts of the co-organizers, International Society for Organic farming Research (ISOFAR; www.isofar.org) and EGE University (Turkey; www.ege.edu.tr). Organic e-prints (www.orgprints.org) acted as the hub for collection, revision and maintaining of all the papers. There were 568 manuscripts and abstracts received for the Scientific Track. Abstracts were not evaluated since the authors were obliged to submit full papers. About 96 reviewers - 37 from Turkey and 59 from all over the world (ISOFAR network) - contributed to the review process (double-blind: 1 reviewer international, 1 reviewer Turkish, final assessment and decision by the scientific board).



Source: compiled by Rahmann

At least, 300 papers have been accepted. They are from 51 countries and represent the countries, were 87 % of the global organic farm land and 75 % of the global organic farms are located (see table below the foreword). It is obvious, that organic farming is practiced world wide (but less the 1 % of the total farm land is managed organically), the organ-

ic markets are mainly in the western world (Europe, North America, Japan: 94 %) and the research is mainly done in Europe (publication share in web of science: 84 %, at the 4th ISOFAR congress: 69 %).

The global balance between organic production, consumption and research is not "fair" and "healthy" and has to overcome; a huge challenge for the organic world. The science can help, but the resources for organic farming research is in all regions of the world not sufficient to overcome the challenges and much less compared to the production, market or farmers numbers. Even in Europe, where organic farming research has left niches and became respected and reputable, the overall public funding for research is less than 1% of total public funded agricultural research, despite organic farm land has a share above 4% of the total farm land. This is not fair and politicians and decision makers in all countries on the world need to re-allocate the public research fund in direction to organic farming (see Figure).

All accepted papers are presented oral or as poster in 24 sessions and will try to help to

- bridge the gap between poor and rich areas of the world
- bridge the gap between scientific knowledge and practice
- bridge the gap between new and old technology

This 4th ISOFAR scientific congress will also bridge the knowledge presented in the 3rd ISOFAR Congress in 2011 in South Korea with the one to be organized in 2017. This Book of Proceedings will further help to disseminate and archive the accumulated vast information on organic agriculture.

We wish to express our sincere thanks to all who have contributed in organization of the 18th Organic World Congress (www.owc2014.org), namely IFOAM (www.ifoam.org) and BUĞDAY (www.bugday.org), and to those who delivered presentations or participated in the Congress, prepared manuscripts, reviewed, supported, and many others. Special thanks go to MILENA MATTERN and SYLVIA FENNERT from the Thuenen-Institute (www.ti.bund.de) who spent a lot of time to make the lay-out of this Proceeding and to the president of the Thuenen-Institute and therefore the German government, who gave the generous and valuable donation for printing and the facilities to do the work.

The papers are ordered by countries (country of the first author), not by sessions or disciplines. These decisions are made to make the proceedings affordable (all volumes can be purchased individually) and to merge and bridge the world and not split by disciplines and sessions. You find search facilities (indexes) to find all papers by discipline, eprint-number, keywords or sessions in each volume. A download of the full proceeding is possible under the webpage of ISOFAR (www.isofar.org) and as individual papers under organic eprints (www.orgprints.org). Due to the fact that all papers together comprise 1,300 pages, the printed Proceedings are split into four volumes. These proceedings comply all submitted, accepted for oral or poster presentation and revised manuscripts, but does not imply that they are all presented. The content of the papers are in responsibility of the authors and do not need to comply with the editors opinion.

Prof. Dr. GEROLD RAHMANN (Thuenen-Institute, Germany)
Prof. Dr. UYGUN AKSOY (EGE University, Turkey)

October 2014

Table: Comparison of the World of Organic Farming: Production, consumption, research and the representation of the countries on the 4th ISOFAR scientific congress 2014

Region / country	Organic farmland 2012 (ha) [1]	share on total (%)	Producers (certified farms) [1]	Share (%)	Sales (million Euro) [1]	share	4th ISOFAR papers [2]	share	Scientific publications [3]	share
Africa	1,073,657	3%	540,988	30%	1,000	1%	24	8.0%	221	4%
USA and Canada	2,790,162	7%	16,659	1%	23,000	48%	10	3.3%	459	8%
Latin America	6,857,611	11%	315,889	18%	1,000	1%	6	2.0%	245	4%
Asia	3,706,280	10%	619,439	35%	2,000	4%	49	16.3%	509	9%
Europe	10,637,128	29%	291,480	16%	21,000	44%	206	68.0%	4,676	84%
- only EU27	*9,518,234*	*26%*	*236,803*	*13%*	*19,000*	*40%*	*183*	*61.0%*	*4,330*	*78%*
Oceania	12,185,843	33%	14,138	1%	1,000	2%	5	1.7%	274	5%
World (Total)	37,245,686	100%	1,789,359	100%	48,000	100%	300	100%	5,569	100%
Data from participating countries (4th ISOFAR scientific congress 2014)										
Argentina	3,796,136	2.7%	1,699	0.1%	n.d.		1	0.3%	21	0.4%
Australia	12,001,724	2.9%	2,129	0.1%	942	2.0%	4	1.3%	169	3.0%
Austria	542,553	19.7%	11,575	0.6%	1.065	2.2%	7	2.3%	58	1.0%
Bangladesh	6,810	0.1%	9,335	0.5%	n.d.		2	0.7%	12	0.2%
Belgium	59,220	4.3%	1,274	0.1%	435	0.9%	4	1.3%	17	0.3%
Bolivia	32,710	0.1%	9,837	0.5%	n.d.		1	0.3%	4	0.1%
Brazil	687,040	0.3%	14,437	0.8%	n.d.		3	1.0%	113	2.0%
Bulgaria	25,022	0.8%	978	0.1%	7	0.0%	3	1.0%	3	0.1%
Canada	841,216	1.2%	3,718	0.2%	1.904	3.9%	6	2.0%	107	1.9%
China	1,900,000	0.4%	n.d.		791	1.6%	8	2.7%	209	3.8%
Colombia	34,060	0.1%	4,775	0.3%	n.d.		1	0.3%	7	0.1%
Denmark	162,173	6.1%	2,677	0.1%	901	1.9%	15	5.0%	109	2.0%
Estonia	133,779	14.8%	1,431	0.1%	12	0.0%	2	0.7%	5	0.1%
Ethiopia	140,475	0.4%	122,359	6.8%	n.d.		1	0.3%	13	0.2%
Finland	188,189	8.2%	4,114	0.2%	120	0.2%	8	2.7%	53	1.0%
France	975,141	3.6%	23,135	1.3%	3.756	7.8%	15	5.0%	109	2.0%
Germany	1,015,626	6.1%	22,506	1.3%	7.590	15.7%	58	19.3%	187	3.4%
Ghana	19,893	0.1%	3,464	0.2%	n.d.		1	0.3%	15	0.3%
Greece	309,823	3.7%	21,274	1.2%	58	0.1%	6	2.0%	45	0.8%
Hungary	124,402	2.9%	1,433	0.1%	n.d.		6	2.0%	4	0.1%
Iceland	8,246	0.4%	39	0.0%	n.d.		1	0.3%	4	0.1%
India	1,084,266	0.6%	547,591	30.6%	46	0.1%	16	5.3%	94	1.7%
Indonesia	74,034	0.1%	8,612	0.5%	n.d.		1	0.3%	9	0.2%
Iran	43,332	0.1%	6,120	0.3%	n.d.		4	1.3%	29	0.5%
Iraq	n.d.		n.d.		n.d.		1	0.3%	n.d.	
Italy	1,096,889	8.6%	42,041	2.3%	1.720	3.6%	19	6.3%	101	1.8%
Japan	9,401	0.2%	2,137	0.1%	1.000	2.1%	1	0.3%	52	0.9%
Kenya	4,969	0.0%	12,647	0.7%	0	0.0%	1	0.3%	36	0.6%
Luxembourg	3,720	2.8%	96	0.0%	68	0.1%	1	0.3%	n.d.	
Morocco	17,030	0.1%	120	0.0%	n.d.		1	0.3%	4	0.1%
Netherlands	47,205	2.5%	1,672	0.1%	761	1.6%	8	2.7%	120	2.2%
New Zealand	133,321	1.2%	1,365	0.1%	205	0.4%	1	0.3%	105	1.9%
Nigeria	9,473	0.0%	597	0.0%	n.d.		14	4.7%	64	1.1%
Norway	55,500	5.4%	2,725	0.2%	160	0.3%	7	2.3%	43	0.8%
Philippines	96,317	0.8%	3,010	0.2%	n.d.		1	0.3%	37	0.7%
Poland	609,412	3.9%	23,430	1.3%	120	0.2%	2	0.7%	26	0.5%
Portugal	201,054	5.8%	2,434	0.1%	21	0.0%	6	2.0%	20	0.4%
Slovenia	32,149	6.6%	2,363	0.1%	38	0.1%	1	0.3%	10	0.2%
South Korea	19,312	1.0%	13,376	0.7%	343	0.7%	2	0.7%	18	0.3%
Spain	1,621,898	6.5%	32,195	1.8%	965	2.0%	8	2.7%	150	2.7%
Sri Lanka	19,496	0.8%	403	0.0%	n.d.		3	1.0%	8	0.1%
Sweden	480,185	15.4%	5,508	0.3%	885	1.8%	4	1.3%	98	1.8%
Switzerland	123,000	11.7%	6,060	0.3%	1.411	2.9%	15	5.0%	71	1.3%
Syria	19,987	0.1%	2,458	0.1%	n.d.		1	0.3%	11	0.2%
Tanzania	115,022	0.3%	145,430	8.1%	n.d.		1	0.3%	14	0.3%
Tunisia	178,521	1.8%	2,396	0.1%	n.d.		1	0.3%	7	0.1%
Turkey	442,582	1.8%	2,396	0.1%	n.d.		7	2.3%	73	1.3%
Uganda	228,419	1.6%	188,625	10.5%	n.d.		4	1.3%	11	0.2%
UK, Great Britain	638,528	4.0%	4,650	0.3%	1.882	3.9%	10	3.3%	88	1.6%
USA	1,948,946	0.6%	12,941	0.7%	21.038	43.6%	4	1.3%	77	1.4%
Vietnam	23,400	0.2%	4,385	0.2%	n.d.		2	0.7%	20	0.4%
Sum	32,381,606	100%	1,339,972	100%	48.244	100%	300	100%	2.660	100%
Share of World	87%		75%		99%		100%		48%	

[1] Data from IFOAM/FibL survey "Statistics of the Organic World". 2013; [2] Number of papers accepted for the 4th ISOFAR organic congress 2014.
[3] Papers found in scientific journals with impact factor, search done in June 2014 in the Web of Science with the keywords „organic farming" and „organic agriculture" with Endnote® software; n.d.: no data

Scientific board (coordinators)

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Prof. Dr. UYGUN AKSOY, EGE-University, Turkey

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Evaluation of tomato varieties for their use by small organic farmers in Buenos Aires, Argentina

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Key words: tomato, horticulture, heirloom, varieties, Argentina

Abstract

Argentina is experiencing a significant increase of the domestic organic market. Vegetables make up a large percentage of the organic volume traded, and an increasing interest in heritage type products is noticed. Being yet the development of such kind of goods almost incipient a number of tomato cultivars were recovered in order to characterize its production profile and asses their potential adoption by organic vegetables farmers. A greenhouse trial with 12 tomato cultivars was conducted: Peace Vine, Red and Yellow Ildi, Black Plum, Chadwick, Saint Pierre, Thessaloniki, TSW10, Platense Gentile, Moneymaker, Mars and Uco Plata, and commercial hybrids were used as controls. Phenological and reproductive characteristics were evaluated and a profile of each cultivar was established. The results show that some cultivars are suitable to be included in the organic vegetables trade, such Ildi cultivars, Black Plum, and Chadwick. Platense Gentile and Uco Plata would need further research.

Introduction

Argentina occupies the second place worlwide for its organic certified production area (9), but its domestic market is still small (7). Vegetable production has been the mainstay of organic consumption in commercial channels of Buenos Aires area (1, 6, 8, 7). The organic consumption was affected by Argentine economic crisis. However, since 2010 this products are involved in a consumer boom (2),and some kinds of heirloom products are also valued. This includes varieties, which were reappraised by their shapes, colors or flavors, different from those massively consumed today (4). Organic techniques for this kind of goods have also become widespread among farmers prompted to seek consumer niches as natural marketplaces and to look for consumers who appreciate this products (3). Consumers regard tomato as one of the most esteemed product. Therefore tomatoes from organic collections were evaluated, in order to assess their adoption by organic farmers in Horticultural Zone of Buenos Aires.

Material and methods

Twelve non-commercial tomato *(Solanum lycopersicum* L.*)* cultivars collected worldwide were evaluated. This included five cherry type ('Peace Vine', 'Red Ildi', 'Yellow Ildi', 'Black Plum' and 'Chadwick'), seven round tomato type ('Saint Pierre', 'Thessaloniki', 'TSW10', 'Platense Gentile', 'Moneymaker', 'Mars' and 'Uco Plata') and two commercial hybrids, cherry-type Koyi F1® (De Ruiter Seeds Group Co. Ltd., Netherlands), and round-type Elpida F1® (Syngenta AG, Switzerland), were included in order to have a pattern for comparison. The trial was carried out in 2013 in a metal parabolic greenhouse in Gorina Experimental Station (Ministerio de Asuntos Agrarios of Buenos Aires Province). A randomized complete block design with three replications per Treatment was adopted. Transplant was made on January 21st. Plants were placed in a 0,4 x 1 m planting frame, each experimental unit including five plants of which only three central plants were evaluated in order to avoid border effects. All cultivars were vertical trained and permanent pruned to single stem, except for 'Peace Vine', that was pruned to three stems. The 28th March were recorded data at the vegetative and reproductive stages: leaves number and height at anthesis, distance between clusters, growth type, plant height, clusters number, flowers number per cluster, fruit set percentage, and referrals to fruit weight and occurrence of disorders. Yield per hectare and percentage of dead plants (May 17th) were estimated. Effect of cultivar on each one of the evaluated variables was made by ANOVA and comparison of means (LSD Test, $P < 0,05$) with the statistical package Infostat. Different varieties were classified according to their agronomic profile.

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Results and discussion

All the evaluated tomatoes achieved a suitable performance and reached a production profile according to their potential and the prevailing environmental conditions throughout the production cycle (January 21st to June 6th). Evaluation of 'Mars' and 'TSW10' lead to their classification as determinate varieties, type not recommended for greenhouse production in Buenos Aires. 'Peace Vine' resulted the earliest cultivar, since anthesis and harvest occurred 14 days at 53,8 days after planting respectively. Other small fruit size cultivars (cherries cv.), (Koyi F1, 'Red Ildi' and 'Yellow Ildi') followed it (Table 1 and 2). 'Mars' (determinate) followed them in precocity, and the rest were grouped as later. Medium sized cherries ('Black Plum', 'Chadwick' and 'Moneymaker') were not earlier in anthesis, but they exceeded larger round tomatoes in precocity at harvest time (Table 1 and Table 2). These varieties were also characterized by having the largest height (122,33 to 142,78 cm) and the greatest number of clusters (from 6 to 7,44) at March 28th. The other indeterminate varieties ('Platense Gentile',' Uco Plata', 'Thessaloniki', 'Saint Pierre') reached a lower height (65,46 cm) and a lower number of flowers per cluster (3,57). The quantity of flowers and the fruit set percentage are good yields components. In this regard, the cultivar with the highest average number of flowers per cluster was Koyi F1 with 14,07 flowers per cluster. None of the cultivars presented a very large amount of flowers except for TSW10. This variety presented even some clusters with more than 30 flowers. A great variability between clusters and plants was observed. When considering all the cultivars the average number of flowers per bunch ranges from 4,76 to 14,67. Nonetheless this information is played down by the percentage of fruit set per cluster (Table 1).

Fruit shapes of several cultivars resulted attractive. Among them 'Black Plum' (famous mahogany color tomato with green and persistent shoulder tomatoes and ovate form), 'Red Ildi' (small piriform red cherry) and 'Yellow Ildi' (small piriform yellow cherry) were the most prominent. All of them showed good agronomic and marketing characteristics. On the other hand Mars, 'Saint Pierre', 'Thessaloniki', 'TSW10', 'Platense Gentile' and 'Uco Plata' stood out for the low plant survival. 'Uco Plata', a typical tomato in Argentina selected for its resistance to insect pests, produced fruits with an heterogeneous forms, being some of them ribbed and flattened but other globular and smooth. The 'Thessaloniki' accession evaluated in this trial did not show good production profile under our assay conditions. Elpida F1 showed the greatest yields, followed by cherry Koyi F1 and by middle sized tomatoes fruits like 'Moneymaker' ' Black Plum' and finally 'Chadwick'. Ildi varieties also showed high yields (Table 2) and on this point can even be compared with commercial tomatoes grown in the area at the same season (MCBA, 2008).

Table 1: Main characteristics of the evaluated cultivars.

Cv.	Days to flowering	Days to harvest	Height (28-3-13)	Clusters nr. (28-3-13)	Flowers per cluster	% Fruit set/cluster
Peace Vine	14,57 A *	53,80 A	138,22 AB	7,44 A	11,25 DEF	89,24
Koyi F1	22,67 B	58,00 A	142,78 A	6,00 B	14,07 EF	75,27
Red Ildi	24,22 B	64,00 B	130,44 AB	6,89 AB	10,31 DE	63,34
Yellow Ildi	25,78 B C	69,00 B	122,33 B	6,56 AB	9,52 BCD	67,44
Mars	28,89 C D	71,22 C D	42,56 F	2,78 E	5,30 AB	60,75
Uco Plata	30,44 D	77,00 DEF	95,56 C	3,56 CDE	10,91 DEF	49,77
Moneymaker	30,44 D	72,89 CD	132,67 AB	6,33 B	12,24 DEF	78,02
Black Plum	30,44 D	73,78 CDE	127,67 AB	6,44 B	9,80 CD	85,00
Elpida F1	32,00 D	79,67 EFG	126,89 AB	4,00 CDE	4,76 A	78,15
Saint Pierre	32,00 D	80,89 FG	92,56 CD	3,78 CD	11,63 DEF	48,41
Thessaloniki	32,00 D	84,78 G	91,33 CD	3,56 CDE	10,65 DE	42,07
Platense Gentile	32,00 D	81,00 FG	77,89 DE	3,56 CDE	5,78 ABC	47,92
TSW10	32,00 D	84,56 G	73,00 E	2,89 DE	14,67 F	36,61
Chadwick	32,00 D	70,22 C	141,56 A	6,22 B	10,09 D	74,63

* Means followed by the same letter are not significantly different among them (Fisher's LSD Test, $P< 0,05$)

Table 2: Main productive characteristics of the evaluated cultivars.

Fruit Type	Cv.	Yield (t/ha)	Weight (g)	Equatorial diameter (cm)	Polar diameter (cm)
Large-size	Elpida F1	62,6 A*	203,1 A	7,3 A	5,9 A
	Platense Gentile	39,0 B	173,5 B	7,4 A	5,1 B
	UcoPlata	37,1 BC	148,3 BC	7,1 A	4,6 C
	TSWV10	33,1 BC	141,0 CD	6,6 B	5,0 B
	Thessaloniki	30,7 BC	127,9 CD	5,8 C	4,5 C
	Mars	22,1 C	113,8 DE	5,8 C	5,2 B
	St Pierre	35,5 BC	88,4 E	5,5 C	4,4 C
Medium-size	Black Plum	42,1 A	38,9 A	3,6 A	4,8 A
	Moneymaker	36,0 AB	27,7 C	3,6 A	3,3 B
	Chadwick	30,0 B	32,7 B	3,8 A	3,4 B
Small-size (Cherry type)	Koyi F1	27,9 A	19,6 A	2,8 A	3,8 B
	Peace Vine	24,3 AB	5,4 C	2,0 C	2,0 C
	Yellow Ildi	16,8 B	15,7 B	2,7 B	2,7 A
	Red Ildi	15,6 B	16,5 B	2,8 A	4,2 A

* Means followed by the same letter are not significantly different among them (Fisher's LSD Test, *P*< 0,05)

Conclusions

Heirloom tomatoes represent a new niche market in Buenos Aires. From the results of our trial, it can be suggested the incorporation to this market of 'Yellow Ildi" and 'Red Ildi' (for their fruit quality fitness), 'Black Plum' (for its color fruit and performance) and 'Chadwick' (for its fruit quality and performance). Further studies on 'Platense' varieties are suggested: this landrace tomato is the most appreciated by the inhabitants of the Buenos Aires city, and, on the other side, has shown an acceptable production profile.

Acknowledgments

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References

1. Biffaretti A, Hang G, del Pino M (1998). Estructura y funcionamiento de los canales de comercialización de productos orgánicos en Argentina, 12º Congreso Científico de IFOAM, Mar del Plata, Argentina.
2. Boyadjián C (2013). Orgánicos: boom en la mesa, Diario Clarín 30 de junio de 2013, Argentina.
3. Duree S (2013). Tesis final de Carrera: "Caracterización de estrategias comerciales de pequeños productores del cinturón hortícola del Gran La Plata". Análisis a partir de estudios de caso", Facultad de Ciencias Agrarias y Forestales, UNLP, Argentina.
4. Gettle J & Gettle E (2011). The heirloom life gardener, Hyperion.
5. Mercado Central de Buenos Aires (2008):Boletín electrónico del tomate, nº 9.
6. Pais M (2002). El nacimiento de un nuevo mercado. En: La producción orgánica en Argentina, MAPO. Bs As, Argentina.
7. SENASA (2013): "Situación de la Producción Orgánica en la Argentina durante el año 2012", Servicio Nacional de Sanidad y Calidad Agroalimentaria, Buenos Aires, Argentina.
8. Tarraubella R (2010). Desarrollo de una estrategia para incrementar el mercado interno de productos orgánicos. Manuscrito, informe PRODAO, Programa de Desarrollo de la Agricultura Orgánica Argentina.
9. Willer H (2012). Organic Agriculture Worldwide: Current Statistics, Research Institute of Organic Agriculture (FiBL), Frick, Switzerland, BioFach Congress 2012, Nürnberg, Session «The World of Organic Agriculture» 15.2.2012.

Strengthening the bridge between consumers and their organic food choices

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Key words: organic food, market research, attitude-behaviour gap, consumer value.

Abstract

Over the last 50 years the organic food movement has developed into the most visible global brand for consumers when they wish to choose products that are healthier and come from a more environmentally sustainable food system. However, organic products need to be a more viable option for consumers if they are to achieve their full potential. After reviewing key research on why consumers purchase organic products, including results from a recent study in Australia (N=1011), the paper concludes that the key challenge is to convince consumers of their superior 'value' – where enhanced health and environmental credentials overcome the higher price of organic products.

Introduction

As the negative environmental and human health impacts of industrial agriculture have become evident, organic agriculture is increasingly recognised as one of the most viable food provisioning models that addresses emerging concerns with global population growth, food security and environmental degradation. However, despite improved product availability and greater recognition by consumers over recent decades in many countries, organic still only accounts for 1% of all products sold (Willer and Kilcher 2011).

Due to improved production knowledge and development of organic supply chains in many countries it is now possible to purchase most food items in an organic form year round. However, the literature fails to explain the discrepancy between consumers' generally positive attitude towards organic food and their relatively low levels of purchase, also known as an attitude - behaviour gap (Pearson et al. 2008).

Literature review

Most consumers in developed countries do not purchase organic exclusively, but switch between conventionally produced and organic products. Hence their 'basket' of food purchases includes a few organic products. This observation is supported by evidence where the percentage of organic product sales is less than the percentage of consumers who purchase them. For example, in Australia, it has been estimated that around 60% of consumers purchase organic products, although organic sales are less than 1% of total sales. Similarly, in the United Kingdom 70% of consumers buy organic yet it represents around 1.5% of sales (Pearson et al. 2011).

The existence and credibility of organic certification, followed up with branding that assists consumers to identify organic products, is vital to achieving sales. There is a general consensus in research on why people buy organic food. Despite slight differences related to cultural and product specific factors, the priorities driving people to purchase organic products include, in order: personal health; product 'quality'; and concern about environmental degradation (Hughner et al. 2007).

Although the scientific evidence to support a superior health claim in inconclusive (Smith-Spangler et al. 2012) consumers remain motivated by the perceived health benefits of organic food. Quality is another significant motivator, such as improved taste and freshness in case for purchases of fresh fruit and vegetables. Consumers also report that they purchase organic food to support a production system that is more sustainable in terms of its impact on the natural environment.

The two key reasons preventing consumers from purchasing organic products, or more of them, are not available where they do their shopping and in situations where they are available, they are often significantly more expensive. In general, organic products sell at a higher price than conventionally produced equivalents. However, research suggests that higher prices may not act as a deterrent to the increased consumption of organics in certain product categories and/or retail contexts. For example with some consumers in some situations, price signifies quality. Therefore, for those consumers whose purchases are motivated by product

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quality, and think that organic falls within a high quality category, somewhat surprisingly an increase in product prices may lead to an increase in the amount purchased.

This analysis suggests that the 'value' consumers place on organic products is a key issue. That is, the reasons people choose conventional over organic is not always unaffordability, but more because they are not 'valuing' organic at its higher price. A significant marketing challenge is, therefore, to demonstrate that the benefits from purchasing organic products are worth its higher price.

Material and methods

This paper continues by contributing to the literature through reporting the findings from one section of a larger study investigating the role of marketing communications in consumer satisfaction with organic foods undertaken in Australia. A structured questionnaire was developed and pre-tested with 12 respondents. Subsequently a pilot study was conducted by a research agency with a sample of 37 subjects. A total of 1011 online respondents were randomly recruited from a national research only panel of consumers to provide a demographically representative sample of the Australian population (22 million). The only qualifying prerequisite for respondents was they had purchased organic products sometime in the past. Data was collected during November 2012.

There are methodological issues relating to this research (and many other projects) that limit creation of a ubiquitous understanding of organic consumers. One is the reliance on consumer's self-reporting of what they think their purchases are, or their intentions in relation to future purchases, both of which may be misleading, rather than recording actual purchases (Oates et al. 2012).

Research results generally indicate that the demographic profile of consumers does not vary. Hence the following results explore whether level of consumption - from heavy through to light - provides relevant insights. Further research could explore recently identified variables that may alter behaviour between shopping trips, such as 'who the consumer is buying for' and 'whether they are shopping alone' (Henryks and Pearson 2012) that may further contribute to explaining the attitude – behaviour gap.

Results

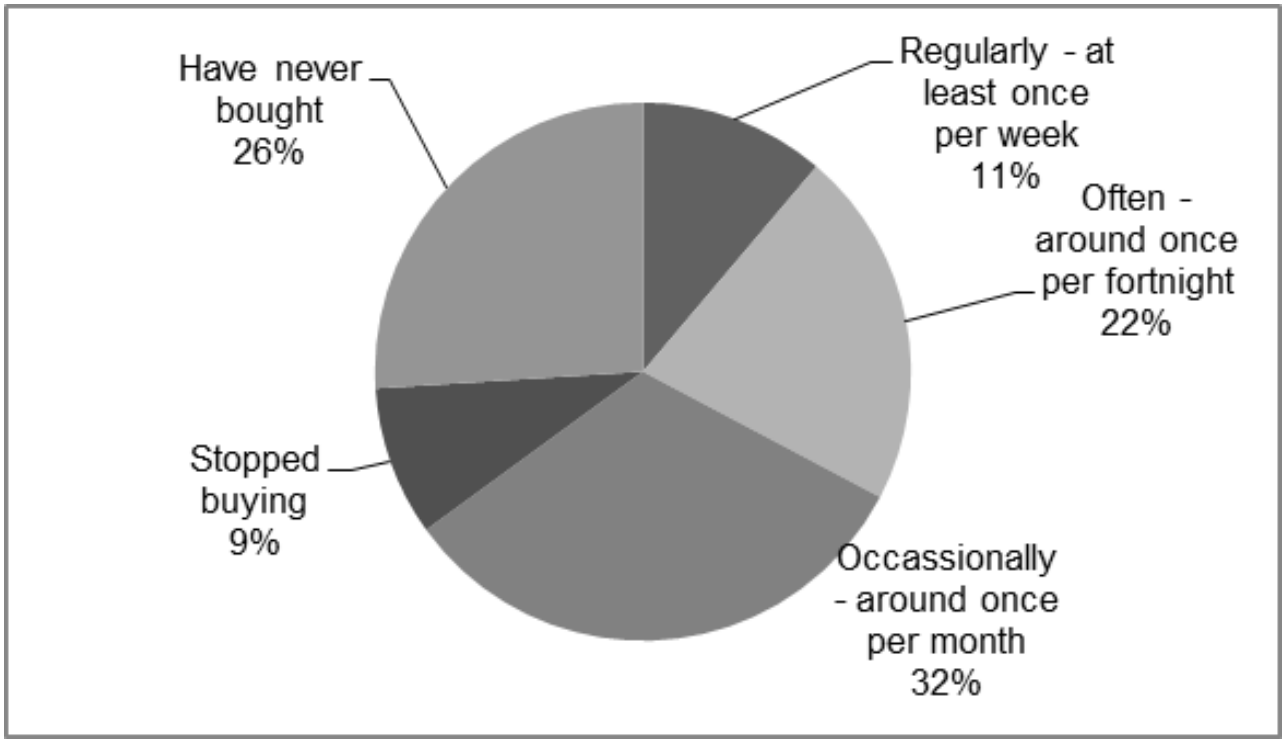


Figure 1. Frequency of organic food purchases (BFA 2012 and Questionnaire N=1011)

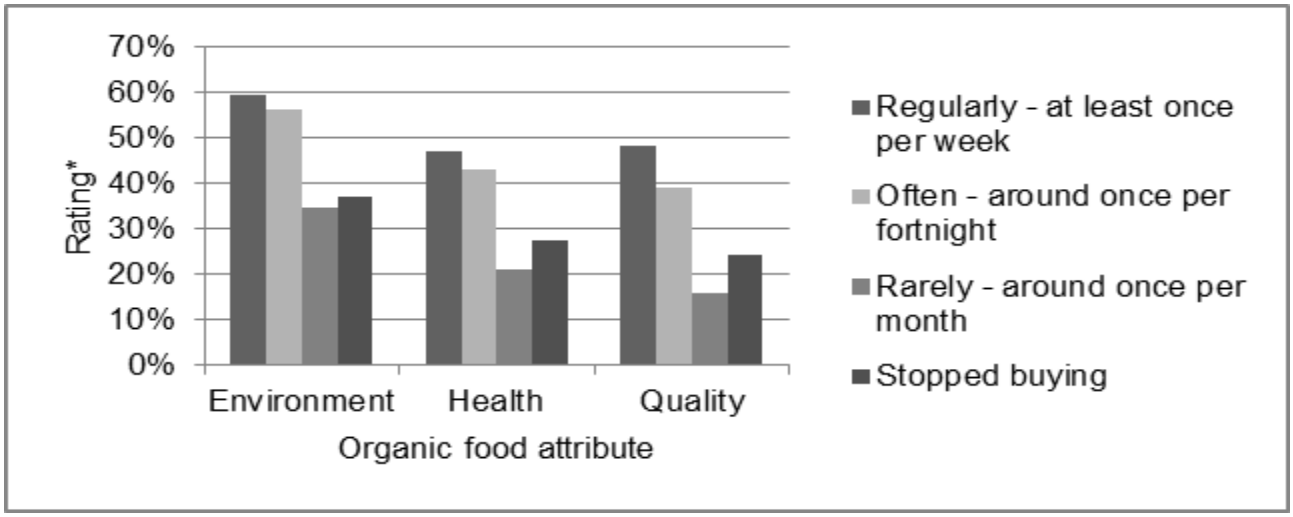


Figure 2. Rating of organic food attributes (Questionnaire N=1011)

*Based on percentage of respondents who 'strongly agreed' or 'agreed' that the attribute was important on a seven point scale that spanned to 'strongly disagree'. The specific questions were: Organic food is good for the environment, Organic food enhances my health, Organic foods have superior quality.

Discussion

The results as shown in Figure 1 indicate that the frequency of organic food purchases varies significantly. Just over half (two in every three) consumers the total population are currently purchasing organic food (ranging from regularly through to occasionally).

The results as shown in Figure 2 indicate that concern for the 'Environment' is the most important motivation, followed closely with 'Health', and 'Quality' being of less importance. Although these three attributes maintain the same ranking across all levels of purchase frequency, as it declines, so does importance of these attributes. This is consistent with the assumption that higher purchase frequency results from a higher importance being placed on the attributes that differentiate organic products from conventional alternatives.

The fact that those who have 'Stopped buying' organic products rate attributes higher than those who purchase 'Rarely', but below those who purchase 'Often', suggests that other factors are dominant drivers for them. These may be changing life circumstances which result in shifts towards issues such as less time for food provisioning or more difficult access to organic food.

Research shows that despite continued growth in sales and increasing integration into more mainstream retailing outlets, the amount of organic products purchased, relative to conventional products, is still low. In order to continue expanding as a viable alternative to conventional agriculture, it is vital for the organic food movement to entice consumers by convincing them of its superior 'value' – where health and environmental credentials overcome its higher price. Recognition and proactive management of this challenge may assist in maintaining integrity with consumers and fending off challenges from conventional as well as other complementary food systems such as local food movement. And finally to achieve these market growth strategies the organic food movement will need to cope with its diverse constituency - ranging from global corporates through to local production and consumption - and provide attractive opportunities to individuals and business at all stages in supply chain whilst retaining credibility with government to ensure ongoing policy and research support.

Suggestions to tackle challenge of increasing sales of organic food

To achieve their full potential organic products need to be a more viable option for consumers. The key challenge is to convince consumers of their superior 'value' – where enhanced health and environmental credentials overcome its higher price.

References

BFA (2012) Australian Organic Market Report. Brisbane, Australia, Biological Farmers of Australia.

Henryks J & Pearson D (2012): Retail outlets: Nurturing organic food customers. Organic Agriculture 1(4), 247-59.

Hughner R S, McDonagh P, Prothero A, Shultz C J & Stanton J. (2007): Who are organic food consumers? A compilation and review of why people purchase organic food. Journal of Consumer Behaviour 6(2/3), 94-110.

Oates L, Cohen M & Braun, L. (2012): Characteristics and consumption patterns of Australian organic consumers. Journal of the Science of Food and Agriculture 92(14), 2782-7.

Pearson D & Henryks J (2008): Marketing organic products: Exploring some of the pervasive issues.Journal of Food Products Marketing. 14(4), 95-108.

Pearson D, Henryks J & Jones H (2011): Organic Food: What we know (and don't know) about consumers. Renewable Agriculture and Food Systems. 26(2), 171–7.

Smith-Spangler C. et al (2012): Are Organic Foods Safer or Healthier Than Conventional Alternatives? A Systematic Review. Annals of Internal Medicine 157(5), 348-66.

Willer H & Kilcher L Eds. (2011): The world of organic agriculture: Statistics and emerging trends, IFOAM, Bonn, and FiBL, Frick.

The Health and Wellness Effects of Organic Diets

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Key words: health, wellness, organic diets, organic food, organic consumers

Abstract

Consumers of both conventional and organic food believe that organic foods are healthier yet research supporting these beliefs is limited. The Organic Health and Wellness Survey (OHWS) aimed to gain a better understanding of the beliefs, personal wellbeing and health experiences reported by regular organic consumers in Australia. Respondents (n=404) were predominantly female, tertiary educated, in a healthy weight range; and rated higher than average on the Personal Wellbeing Index. The OHWS found that 75.7% of respondents perceived their overall health to be better since moving to an organic diet, with an average improvement of 2.5 points on a 10-point scale (p<0.001). Respondents reported that increased consumption of organic food was associated with health improvements including resistance to and recovery from illness, physical energy and mood. Many respondents referred to psychological benefits from purchasing products they believe reflect their values. These results are consistent with similar studies in Australia and abroad and suggest that organic food has multidimensional benefits to human health.

Introduction

The commonly held views that health is simply the absence of disease and diets are the sum of their nutrient content discounts important social, environmental and psychological aspects of food and the potential for organic agriculture to impact on wellness.

Consumers of both conventional and organic food believe that organic foods are healthier than conventional foods (Lockie et al. 2002, Lea and Worsley 2005). Yet despite these beliefs, there has been very little prospective research documenting specific health benefits of organic diets (Dangour et al. 2010, Smith-Spangler et al. 2012) and this may affect consumers' willingness to pay the price premiums for organic food.

Retrospective studies of dedicated organic consumers in Europe report many perceived benefits from moving to an organic diet including improved resistance to and recovery from illness, a positive effect on mental wellbeing and fewer digestive complaints (Huber et al. 2005, Rembialkowska et al. 2008, van de Vijver and van Vliet 2012).

We conducted the Organic Health and Wellness Survey (OHWS) to gain a better understanding of the beliefs, personal wellbeing and health experiences reported by regular organic consumers in Australia.

Methods

A preliminary set of questions was developed based on a review of the existing literature and results from a previous Australian survey conducted by the researchers (Oates et al. 2012). Feedback on the study design was also sought from the primary author of a similar Dutch study (van de Vijver and van Vliet 2012) and other colleagues working in the field. A combination of closed and open questions were used to provide both quantitative and qualitative data regarding the perceived health and wellness experiences of organic consumers. The OHWS also included questions about food consumption and purchasing behaviour as well as basic socio-demographic characteristics.

Following ethics approval from the RMIT University Human Research Ethics Committee, the OHWS survey was conducted over a two month period from mid-October to mid-December 2011 using the Survey Monkey® online survey tool. Dedicated organic consumers were recruited through advertisements in retail outlets and websites that sell or promote organic produce. All participants were asked to confirm that they were over 18 years of age and agreed with the statement 'I make a deliberate choice to consume at least some organic foods on most days'.

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Results

A total of 404 useable surveys were submitted. The majority of OHWS respondents were female (81.4%), tertiary educated (73.4%), in a healthy weight range (59.7%), with a mean age of 41.2 years. Based on self-estimation reports, the percentage of people in the OHWS that consumed most or all (i.e. >65%) organic food in the previous 12 months was 50.1% for certified organic food and 68.1% when 'likely' organic foods were included. More than half of the respondents (56.8%) reported that they had consumed organic food for more than 5 years. The mean estimated weekly expenditure on organic food (either certified or 'likely') was 70.4% (SD=23.0) of the household food budget.

Beliefs

Respondents held strong beliefs around the ability of organic diets to prevent a range of conditions including cancer (80.2%), allergic conditions (75.6%) as well as behavioural (74.8%) and developmental problems (71.9%) in children. When asked why they thought organic food was healthier, and what influence that belief had on their decision to consume organic food, they generally rated avoidance of negative traits more highly (Figure 1). In other words they believed the health benefits were related to what was not in their food, such as pesticides, hormones and veterinary medicines; rather than any nutritional superiority.

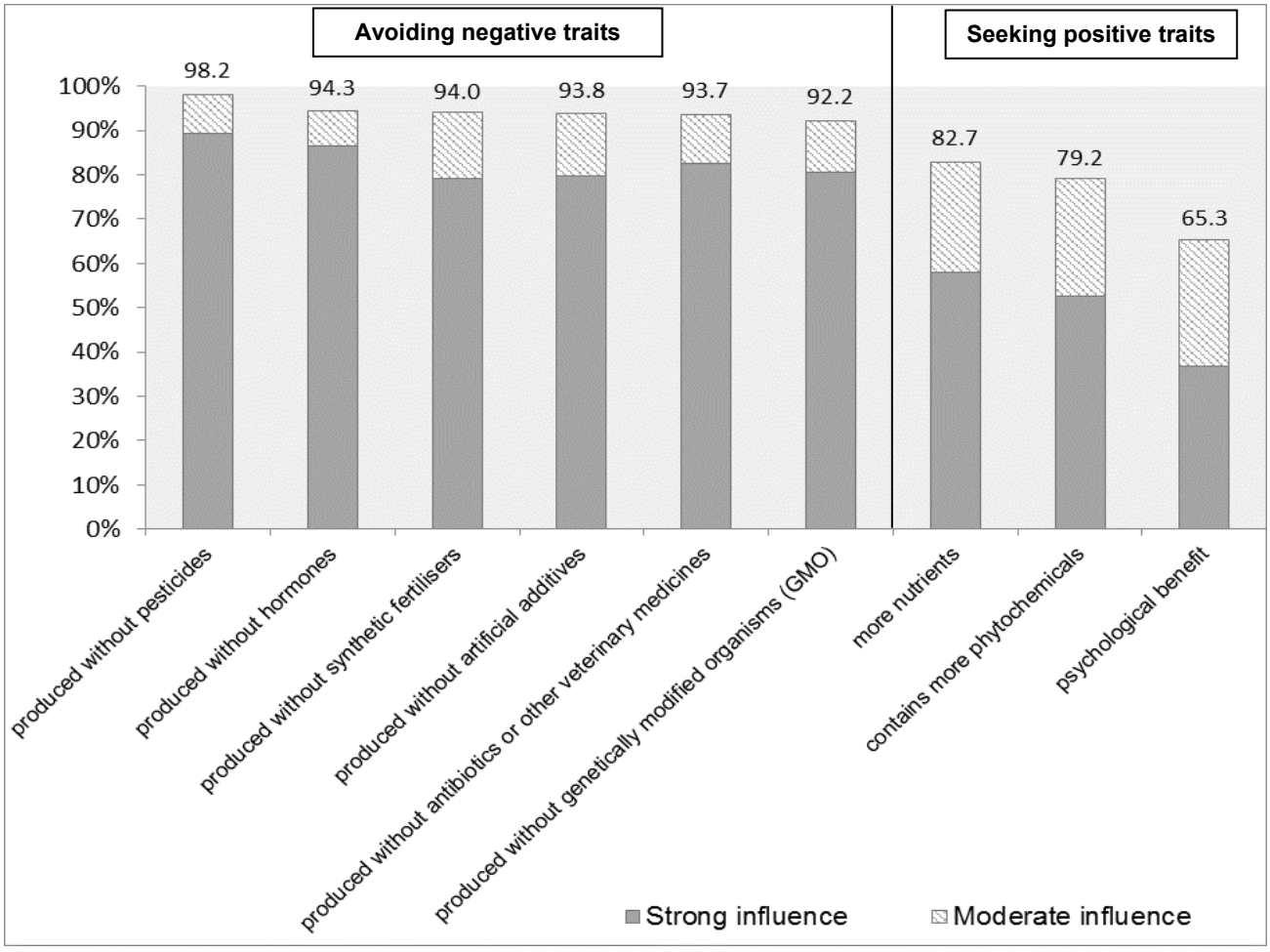


Figure 1. Health beliefs influencing purchasing behaviour (n=404).

Personal Wellbeing

Respondents generally scored well on the Australian Unity Personal Wellbeing Index for adults (PWI-A), a measure of subjective wellbeing (M=77.5; 95% CI [76.2, 78.8]). This was above the mean for the Australian population (75.4 points, standardised on a 0-100 scale) and above the upper end of the Australian adult normative range (73.7-76.7) which has been calculated using data collected from over 60,000 representative

adults over the years 2001-2012 (Cummins et al. 2012). Differences in the means (Figure 2) were particularly apparent in the domains of community connectedness (4.83 points higher in the OHWS respondents), achieving in life (4.46) and health (4.22).

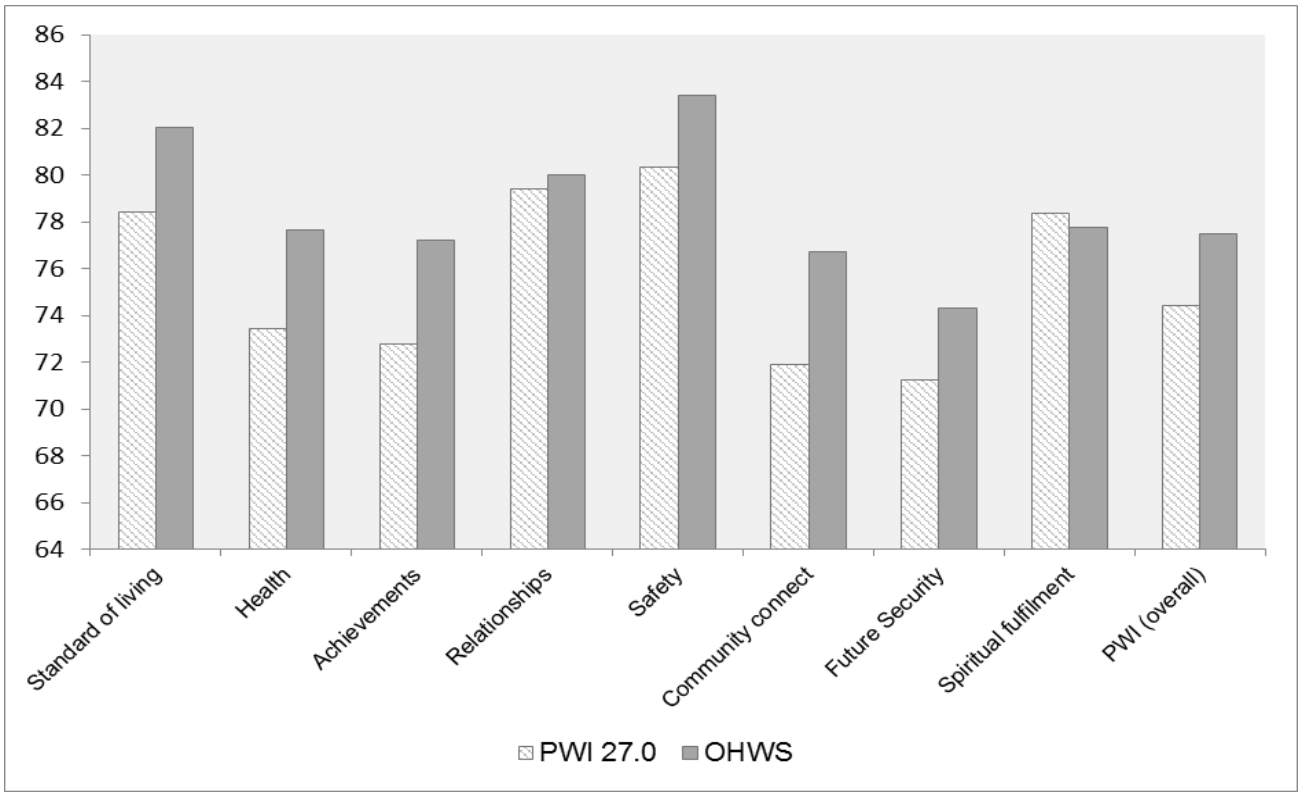


Figure 2. Comparison between Australian averages (PWI 27.0) and OHWS respondents (n=373) for the different domains of the PWI-A.

Health Experiences

Overall 75.7% of respondents perceived their health to be better since moving to an organic diet with the average improvement being around 2.5 points on a 10-point scale ($p<.001$). The health benefits most commonly reported by respondents were improvements in: resistance to and recovery from illness (71.1%), physical energy (61.1%), condition of skin/ hair/ nails (58.4%), mental alertness (56.7%), mood stability (56.3%), and sense of satiety (55.4%). Of the 24% who reported pre-existing health conditions, 96% believed that the condition improved since moving to organic food. Many respondents referred to psychological benefits from purchasing products they believe reflect their values and 62.5% reported making additional dietary or lifestyle changes around the time they moved to an organic diet that may have had an impact on their health.

Discussion

The results of this survey do not necessarily represent all organic consumers. Nevertheless the socio-demographic and consumption characteristics of respondents are highly consistent with those from recent Australian and European studies (Oates et al. 2012, van de Vijver and van Vliet 2012). Beliefs around the ability of organic diets to prevent a range of conditions are consistent with the current scientific literature (Alfvén et al. 2006, Kummeling et al. 2008, Bouchard et al. 2010, Bouchard et al. 2011, Alavanja and Bonner 2012) and decisions to purchase organic food were driven more by risk aversion (especially to pesticides) than nutritional superiority.

Perceived health and psychological benefits resulting from a move to an organic diet are similar between participants in the OHWS and a similar Dutch study (van de Vijver and van Vliet 2012) and further research

across geographical locations is now required to corroborate these findings and determine their clinical relevance.

When assessing the benefits to consumers from purchasing organic food the full spectrum of nutritional, social, environmental and psychological benefits need to be considered. It is therefore recommended that future research incorporates a holistic approach to fully capture the potential of organic diets to positively impact health and wellness.

References

Alavanja MC & Bonner MR (2012): Occupational pesticide exposures and cancer risk: a review. Journal of Toxicology and Environmental Health Part B: Critical Reviews 15(4), 238-263.

Alfvén T, Braun-Fahrländer C, Brunekreef B, von Mutius E, Riedler J, Scheynius A, et al. (2006): Allergic diseases and atopic sensitization in children related to farming and anthroposophic lifestyle – the PARSIFAL study. Allergy 61(4), 414-421.

Bouchard MF, Bellinger DC, Wright RO & Weisskopf MG (2010): Attention-Deficit/Hyperactivity Disorder and Urinary Metabolites of Organophosphate Pesticides. Pediatrics 125(6), e1270 -e1277.

Bouchard MF, Chevrier J, Harley KG, Kogut K, Vedar M, Calderon N, et al. (2011): Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year Old Children. Environmental Health Perspectives 119(8), 1189-1195.

Cummins RA, Woerner J, Weinberg M, Collard J, Hartley-Clark L, Perera C, et al. (2012): Australian Unity Wellbeing Index: Survey 27.0. from http://www.deakin.edu.au/research/acqol/auwbi/survey-reports/index.php.

Dangour AD, Lock K, Hayter A, Aikenhead A, Allen E & Uauy R (2010): Nutrition-related health effects of organic foods: a systematic review. American Journal of Clinical Nutrition 92(1), 203-210.

Huber K, Henning J, Dlugodsch G & Fuchs N (2005). Ernährungs-Qualitätsstudie (Klosterstudie)(in German). Ende der Nische. Beiträge zur 8. Wissenschaftstagung Ökologischer Landbau.

Kummeling I, Thijs C, Huber M, van de Vijver LP, Snijders BE, Penders J, et al. (2008): Consumption of organic foods and risk of atopic disease during the first 2 years of life in the Netherlands. British Journal of Nutrition 99(3), 598-605.

Lea E & Worsley T (2005): Australians' organic food beliefs, demographics and values. British Food Journal 107 (11), 855-869.

Lockie S, Lyons K, Lawrence G & Mummery K (2002): Eating 'Green': Motivations behind organic food consumption in Australia. Sociologia Ruralis 42 (1), 23 - 40.

Oates L, Cohen M & Braun L (2012): Characteristics and consumption patterns of Australian organic consumers. Journal of the Science of Food and Agriculture 92(14), 2782-2787.

Rembialkowska E, Kazimierczak R, Srednicka D, Bienko K & Bielska M (2008): Different aspects of organic and conventional food consumers' lifestyle. New Medicine 12(1), 16-19.

Smith-Spangler C, Brandeau ML, Hunter GE, Bavinger JC, Pearson M, Eschbach PJ, et al. (2012): Are organic foods safer or healthier than conventional alternatives?: a systematic review. Annals of Internal Medicine 157(5), 348-366.

van de Vijver LPL & van Vliet MET (2012): Health effects of an organic diet—consumer experiences in the Netherlands. Journal of the Science of Food and Agriculture 92(14), 2923-2927.

Organic Diets Reduce Exposure to Organophosphate Pesticides

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Key words: organic diets, organic food, organophosphate pesticides, organophosphorous pesticides, biomonitoring

Abstract

To determine whether consuming a largely organic diet reduces organophosphate (OP) pesticide exposure in adults, a prospective, randomised, single-blinded, crossover, biomonitoring study was performed. The study involved 13 Australian adults who consumed a largely (>80%) organic diet or a largely conventional diet for 7 days and were then crossed over to the alternate diet for a further 7 days. Urinary levels of six dialkylphosphate (DAP) metabolites produced from OP pesticides, were analysed in first-morning voids collected on day 8 of each phase using GC-MS/MS. The consumption of organic food for 7 days resulted in a statistically significant reduction in urinary OP metabolites. The mean total DAP results in the organic phase were 89% lower than in the conventional phase (M=0.032 and 0.294 respectively, p=.013) and there was a 96% reduction in urinary dimethyl DAPs (M=0.011 and 0.252 respectively, p=.005). Large scale studies are now required to confirm these results and determine their clinical relevance.

Introduction

A key factor driving organic food consumption is the belief that organic food is healthier than conventionally grown food because it contains fewer pesticide residues (Oates et al. 2012). While there is increasing evidence of adverse health effects from pesticides (Sanborn et al. 2012), studies demonstrating clear harm as a result of dietary pesticide exposure are lacking, as are studies investigating the ability of organic diets to mitigate such harm. Organophosphate pesticides (OP) are of particular concern because of their prevalence of use, high detection rates in the general population (Barr et al. 2004, Babina et al. 2012), and associations with negative effects on human health even at low doses (Bouchard et al. 2010, Bouchard et al. 2011, Ross et al. 2013). A few studies have demonstrated reduced OP metabolites in the urine of children eating mostly organic diets (Curl et al. 2003, Lu et al. 2006) but children are disproportionately exposed to pesticides due to differences in body weight, behaviour and metabolism (NRC 1993, Huen et al. 2009).

Material and methods

A prospective, randomised, single-blinded, crossover, biomonitoring study was performed to determine whether consumption of a mostly organic diet for 7 days would reduce urinary dialkylphosphate (DAP) metabolites (markers of OP pesticide exposure) in Australian adults. The study involved thirteen Australian adults who consumed a largely (>80%) organic diet or a largely conventional diet for 7 days and were then crossed over to the alternate diet for a further 7 days.

Following ethics approval from RMIT University's Human Research Ethics Committee, prospective participants were screened by telephone to confirm their eligibility for the study and randomly assigned to either a largely organic or conventional diet for 7 days. They were asked to complete a food intake survey during each period, and on day 8, provide a first morning urine sample and complete an additional survey to record other factors that may affect pesticide exposure, such as non-dietary pesticides and food preparation behaviours. After day 8 participants were then crossed over and directed to undertake the alternate diet for a 7-day period and then provide a second urine sample and completed survey. Prior to commencement, all participants were provided with copies of necessary documents and equipment including clear written instructions on how to complete documents and collect urine samples. All documents and specimen containers were coded to protect the participants' identity and to blind laboratory technicians to the phase allocation of participants' urine samples.

Urinary levels of six DAP metabolites (Dimethylphosphate [DMP], Diethylphosphate [DEP], Dimethylthiophosphate [DMTP], Diethylthiophosphate [DETP], and Dimethyldithiophosphate [DMDTP] and Diethyldithiophosphate [DEDTP]), were analysed in first-morning voids collected on day 8 of each phase

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using gas chromatography tandem mass spectrometry (GC-MS/MS). Samples were transported to the AsureQuality Wellington (NZ) laboratory and remained frozen (-18ºC) or cold (4ºC) prior to analysis. The limits of detection were 0.11-0.51 µg/L and results were creatinine corrected to account for the effects of urine dilution or concentration in spot samples.

Data analysis was conducted using SPSS for Windows statistical software (version 18). As the distributions of the metabolite levels were not normal, the non-parametric Wilcoxon matched pairs signed-ranks test was used for paired samples to determine whether there were significant differences between phases.

Results

The majority of participants were female (69%) with a mean age of 42 years (SD=10 years). They lived in urban and periurban (suburban or semi-rural with no nearby agriculture) areas, although some travelled to rural areas during the study period.

Participants consumed an average of 93% of their food servings from organic produce in the organic phase (this included 83% certified organic produce) and 96% conventional produce during the conventional phase. The overall number of food servings in each phase was very similar, and the average number of servings from each food category was similar, with the exception that participants consumed significantly less animal protein during the organic compared to the conventional phase (-36%, p=.006).

A total of 13 matched samples were available for comparison. Differences in mean urinary DMP and DMTP levels were statistically significant between the conventional and organic phases and there was a trend towards significance for differences in DMDTP (Table 1). None of the diethyl DAPs (DEP, DETP or DEDTP) differed significantly between phases. DMP returned no quantifiable results in the organic phase and overall there were only three quantifiable detections for any of the dimethyl DAPs during the organic phase.

Table 1. DAP Results for Individual Metabolites (Creatinine Corrected µg/ g) N=13

Metabolite	Mean(SD) µg/ g		Sig[a]	Maximum µg/ g		Frequency of quantifiable detections (%)	
	Con	*Org*		*Con*	*Org*	*Con*	*Org*
DMP	3.9(6.7)	ND(-)	.028*	23	ND	38	0
DEP	4.8(4.5)	2.8(2.6)	.221	12	7.4	62	46
DMTP	29(48)	0.98(2.3)	.005*	160	8.5	92	15
DETP	1.8(3.4)	0.56(0.97)	.263	10	3.6	54	38
DMDTP	2.3(3.9)	0.35(1.0)	.051[b]	14	3.7	54	8
DEDTP	0.12(1.2)	0.068(0.046)	.144	0.33	NQ	23	0

Note: Results reported to two significant figures; Con – Conventional Phase; Org – Organic Phase; ND = Not Detectable, levels below the LOD; NQ = Not Quantifiable, levels greater than or equal to the LOD but less than the LOQ

[a]Significance of the difference between the conventional and organic phase; [b] Trend towards significance

*p<.05 (Wilcoxon Signed-Ranks Test)

As with a previous study conducted in children (Curl et al. 2003) total molar metabolite quantities (µmol/ g) were determined for each participant. To calculate the total DAPs (ΣDAP), total dimethyl DAPs (ΣMP) and total diethyl DAPs (ΣEP), the individual DAP result (µg/ g) was divided by its molecular weight (g/ mol) before being added together. DEDTP was not included in the calculations due to the extremely low frequency of detection and because it had not been used in the aforementioned study.

Both total DAPs and total dimethyl DAPs were significantly lower in the organic phase than the conventional phase (Table 2). The mean total DAP results in the organic phase were 89% lower than in the conventional phase and the total dimethyl DAPs were 96% lower. There was also a non-significant 49% reduction in the mean total diethyl DAP levels.

Table 2. Results for Summed DAP Metabolites (µg/ g) N=13

Summed Metabolites	Mean(SD) µmol/ g		Sig	Minimum µmol/ g		Maximum µmol/ g	
	Con	*Org*		*Con*	*Org*	*Con*	*Org*
ΣDAP	0.29(0.44)	0.032(0.038)	.013*	0.014	0.0053	1.5	0.14
ΣMP	0.25(0.40)	0.011(0.023)	.005*	0.0066	0.0031	1.32	0.086
ΣEP	0.42(0.038)	0.21(0.020)	.170(NS)	0.0070	0.0021	0.14	0.059

Note: Results reported to two significant figures; Con – Conventional Phase; Org – Organic Phase

*p<.05 (Wilcoxon Signed-Ranks Test)

For the purpose of determining central tendency and dispersion (variability) numerical figures are required so assumptions were made to deal with non-detectable (ND) and non-quantifiable (NQ) results. These dose estimation methods, the choice of nonparametric tests for statistical analysis and the use of creatinine correction did not appear to influence the direction of the findings.

Discussion

The consumption of a largely organic diet resulted in a statistically significant reduction in organophosphate pesticide exposure. These findings are consistent with a previous study of DAPs in children aged 2-5 years (Curl et al. 2003) despite differences in exposure and metabolism between children and adults. Children consuming organic fruit, vegetables and juice had significantly lower levels of urinary ΣMP than those consuming conventional produce (p=.0003) but ΣEP did not differ significantly across the two groups (p=.13).

The sample size was small and pesticide use and food availability differ from region to region. At this time no reference doses exist to indicate the level at which a specific DAP or combination of DAPs may incur risk (Sudakin and Stone 2011) so deriving meaning from the results that is relevant to consumers is difficult. Larger studies across geographical locations are required to corroborate the findings and determine their clinical relevance. Future research should investigate the relationship between exposure and well-chosen health outcomes.

References

Babina K, Dollard M, Pilotto L & Edwards JW (2012): Environmental exposure to organophosphorus and pyrethroid pesticides in South Australian preschool children: a cross sectional study. Environ Int 48, 109-120.

Barr DB, Bravo R, Weerasekera G, Caltabiano LM, Whitehead RD, Jr., Olsson AO, et al. (2004): Concentrations of dialkyl phosphate metabolites of organophosphorus pesticides in the U.S. population. Environmental Health Perspectives 112(2), 186-200.

Bouchard MF, Bellinger DC, Wright RO & Weisskopf MG (2010): Attention-Deficit/Hyperactivity Disorder and Urinary Metabolites of Organophosphate Pesticides. Pediatrics 125(6), e1270 -e1277.

Bouchard MF, Chevrier J, Harley KG, Kogut K, Vedar M, Calderon N, et al. (2011): Prenatal Exposure to Organophosphate Pesticides and IQ in 7-Year Old Children. Environmental Health Perspectives 119(8), 1189-1195.

Curl C, Fenske R & Elgethun K (2003): Organophosphorus pesticide exposure of urban and suburban preschool children with organic and conventional diets. Environmental Health Perspectives 111(3), 377-382.

Huen K, Harley K, Brooks J, Hubbard A, Bradman A, Eskenazi B, et al. (2009): Developmental Changes in PON1 Enzyme Activity in Young Children and Effects of PON1 Polymorphisms. Environmental Health Perspectives 117, 1632-1638.

Lu C, Toepel K, Irish R, Fenske RA, Barr DB & Bravo R (2006): Organic diets significantly lower children's dietary exposure to organophosphorus pesticides. Environmental Health Perspectives 114(2), 260-263.

NRC. (1993): Pesticides in the diets of infants and children. Retrieved 28 January, 2014, from http://www.nap.edu/openbook.php?isbn=0309048753.

Oates L, Cohen M & Braun L (2012): Characteristics and consumption patterns of Australian organic consumers. Journal of the Science of Food and Agriculture 92(14), 2782-2787.

Ross SM, McManus IC, Harrison V & Mason O (2013): Neurobehavioral problems following low-level exposure to organophosphate pesticides: a systematic and meta-analytic review. Critical Reviews in Toxicology 43(1), 21-44.

Sanborn M, Bassil K, Vakil C, Kerr K & Ragan K. (2012): 2012 Systematic Review of Pesticide Human Health Effects. Retrieved 25 January, 2013, from http://www.ocfp.on.ca/docs/pesticides-paper/2012-systematic-review-of-pesticide.pdf.

Sudakin DL & Stone DL (2011): Dialkyl phosphates as biomarkers of organophosphates: The current divide between epidemiology and clinical toxicology. Clinical Toxicology 49(9), 771-781.

GMO agriculture versus organic agriculture – Genetic trespass, a case study

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Key words: genetically modified organisms, genetically modified crops, GM canola, GMO contamination, loss of certification, legal action.

Abstract

Western Australia (WA) has maintained a moratorium on the growing of genetically modified crops since 2003. An exemption was granted in 2008, for growing GM cotton, only in a specified remote region of the state. A general exemption was declared in 2010 for growing GM canola anywhere in WA. In a public review, over 400 submissions were received by the government with over ninety percent arguing for retaining the ban on GM crops, while Monsanto, Dow Agrosciences and the Grain Research and Development Corporation argued for lifting the moratorium. Many submissions argued that segregation of GM and non-GM crops would fail and that the doctrine of "mutual co-existence" was unsafe. In the first year of GM canola in WA, the certified organic mixed farm of Steve Marsh was contaminated with GM canola seed which was allegedly dispersed from a neighbouring farm which had planted GM canola in 2010. Marsh lost his organic certification due to GM contamination. Marsh has sought redress by consensus and via the courts.

Introduction

Clause 12 of Monsanto's so called 'stewardship' agreement and signed by each of its customers for genetically modified (GM) seeds states that: "In no event shall Monsanto or any seller be liable for any incidental, consequential, special, or punitive damages" (Monsanto, 2010, p.4). It is a corporate ploy calculated to embrace the profits and eschew the problems - to Monsanto the profits, to farmers and consumers whatever the problems.

In Australia, it is the Office of the Gene Technology Regulator (OGTR), established in 2000, that approves the release of GM varieties, and currently only GM varieties of cotton, canola and rose are approved (OGTR, 2013). It is however the prerogative of the Australian states to allow or disallow any such plantings. With the exceptions of Queensland and Northern Territory, all states and territories have imposed moratoria on GM crops (DoA, 2008). Tasmania and South Australia maintain robust moratoria. NSW and Victoria allow GM canola.

Western Australia (WA) passed the Genetically Modified Crops Free Areas Act in 2003. In November 2008 WA exempted GM cotton in the Ord River irrigation area (ORIA) from the moratorium (WADAF, 2010). In January 2010 WA exempted GM canola from the moratorium. This was despite that the WA Department of Agriculture and Food (WADAF) admitted that "since the advent of GM canola in Canada farmers can no longer grow organic canola in Western Canada" (WADAF, 2010, p.2). The WADAF proposed some faith in, but no evidence for, the capacity for a "mutual co-existence of GM crops and organic farming" (p.2) and declared that "common law allows for effective remedies for persons incurring damage from GM crops" (p.3).

Genetically modified organisms (GMOs) are excluded from organic agriculture production (Paull & Lyons, 2008). However, the resistance to GM crops extends well beyond organic producers and consumers. GMOs remain under a multilayered cloud from skeptical consumers expressing resistance and rejection, and that due to a lack of labelling, concerns over health and safety, concerns of genetic contamination and the irreversibility of release, suspicion of crops that are patented by pesticide multinationals and are marketed in conjunction with prescribed herbicides, concern that farmers cannot save seed and are beholden to multinationals, that biodiversity is reduced, and there is the concern that GM multinationals reap all the profit while dispersing all the risk.

The introduction of GM canola to WA has had an immediate impact on two neighbouring WA farmers who are locked in a legal tussle over GM contamination of a certified organic farm that has been decertified due to GM contamination (Martin, 2013). This paper examines the context, the progress and the ramifications of that GM contamination and the pursuit of common law remedies.

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Material and methods

The present account draws on court documents, Parliament transcripts and other documents to track the introduction and the aftermath of the release of GM canola into WA, and in particular the fate of the certified organic farm at Kojonup, Western Australia, of Steve Marsh, and his ongoing efforts to seek remedies and recompense for harms and damages due to the genetic trespass of GM canola.

Results

The WA Minister for Agriculture and Food, Terry Redman, announced on 25 January 2010 a relaxation of the WA moratorium on GM crops. GM canola varieties modified to withstand the herbicides triazine, imidazolinone and glyphosate were exempted from the provisions of the Genetically Modified Crops Free Areas Act 2003 (WADAF, 2012, p.1).

Prior to the relaxation of the moratorium, the WA Government was warned in submissions and petitions that GM contamination and non-containment were issues of concern. "The great majority" (over 90%) of submissions to the review of the Genetically Modified Crops Free Areas Act 2003 were pro-moratorium (Calcutt, 2009, p.13). Such submissions made the point that: "Contamination from GM crops is inevitable and segregation of GM seed is impossible so the ban on growing GM crops must be retained to preserve the State's 'clean green' image and protect the status of producers marketing their produce as 'organic'" (Calcutt, 2009, p.16).

Petitions signed by more than 25,000 people were submitted to the Western Australia Parliament (Murray, 2010, p.471). Petitioners specifically identified the issue of the risk of organic farmers losing their certification:

"We, the undersigned, say that as Genetically Modified (GM) canola seeds and pollen cannot be contained, the decision to allow commercial growing will invariably contaminate all non-GM crops. If contaminated with GM, non GM farmers will lose their markets, organic farmers will face loss of certification and consumers will not be able to actively avoid GM foods because of current inadequate labelling regulations. Now we ask the Legislative Assembly to revoke the decision on allowing commercial growing of GM canola in Western Australia and renew the moratorium on GM crops in this state" (Murray, 2010, p.471).

Monsanto had apparently anticipated the lifting of the moratorium by offering Roundup Ready GM canola seed in 2009 (Murray, 2009). Michael Baxter, a farmer of Kojonup, 250 km southeast of Perth, took advantage of Monsanto's seed offering and planted GM canola on or about Anzac Day 2010 (viz. 25 April). By November 2010, on the neighbouring organic farm, Steve Marsh detected stray canola on his property. Testing proved it to be GM canola. He notified his organic certifier the National Association for Sustainable Agriculture Australia (NASAA) as well as the WA Department of Agriculture and Food. NASAA withdrew organic certification from the contaminated 325 hectares (out of 478 ha.) of the Marsh farm.

For the next two growing seasons, 2011 and 2012, Marsh and Baxter agreed (in 2011) that Baxter would maintain a buffer zone of 1.1 km between his GM canola and Marsh's farm. In April 2012 Marsh initiated legal action against Baxter for loss and damage. For the 2013 planting, Baxter indicated his intention to reduce the previously agreed buffer distance of 1.1 km to 300 metres. This precipitated an application from Marsh for an interlocutory injunction to stop Baxter planting GM canola within 2.5 km of the Marsh farm (Eagle Rest) and to stop the harvesting by Baxter's preferred method of swathing (Martin, 2013).

In response to the application for the injunction, Baxter undertook to not harvest by swathing, a harvesting method which disperses more material than alternative methods, and Marsh's lawyer's relented on the 2.5 km buffer and instead sought to reinstate the prior 1.1 km consensual buffer for the 2013 growing season. In contrast, the Monsanto licence requires a 5 metre buffer zone. The injunction however failed for want of evidence with the judge commenting that: "they express opinions, without a requisite basis in expertise in my view, it is unconvincing, as regards the present efforts to impose a buffer zone of beyond the given 300 m" (Martin, 2013, para.51).

The case of Marsh v Baxter is scheduled for a trail early in 2014, is expected to last two to three weeks, and to conclude prior to the 2014 canola planting season. In the meantime the bulk of the Marsh farm remains decertified since 2010 with the presiding judge stating that "The only consequence for the plaintiff is economic" (Martin, 2013, para.27) and the evidence regarding the future prospect of regaining certification is "somewhat speculative" (para. 35).

The Judge observed that a statement of "the plaintiff's claimed damages in the period 2010 and there after has not been filed with the court there is no such document" (Martin, 2013, para.36). The Judge

accepted that Baxter had "some very plausible and legitimate reasoning for wanting to grow GMC [GM canola] to address that weed problem by growing GMC in 2013 in the paddocks, then subsequently applying a herbicide Roundup, in order to tackle the rye grass weed problem" (para.38).

There has been little joy for Marsh as the plaintiff in the years since the initial GM contamination with perhaps the exception that the Supreme Court Judge has recognised that "this tort case falls into a somewhat pioneering class of case" and that it is "factually somewhat novel" (Martin, 2013, para.30) and that it "is unlike prior cases known to the law" (para.28) with the implication that this be a land mark case which can potentially create new law with broader food and agricultural implications.

Discussion

None of the issues besetting Steve Marsh's farm were unanticipated in the submissions to the review of the WA moratorium on GM crops, and to date none of them have been resolved. The five metre buffer zone between GM and non-GM crops is demonstrably inadequate. Remedies under the law can be cumbersome, slow, challenging, and expensive, and in this case they pit farmer versus farmer, and the high cost of lawyers together with the risk of losing and having costs awarded mean that the farm is 'on the line' in such an action. The farm of Steve Marsh has not achieved a reinstatement of its certified organic status. The case has been legally framed as an issue of nuisance and negligence. The case offers some potential to explore the topic of genetic trespass, the intrusion of genes into a property, in the present case causing immediate harm to the owner or occupant, and the intrusion of novel genes into the commons. The case of Marsh v. Baxter presages forthcoming challenges to organic standards and certification, and will throw some light on the practicality of the doctrine of mutual coexistence and, more generally, the continuing viability of organic production.

References

Calcutt, G. (2009). *Genetically Modified Crops Free Areas Act 2003, Report on the Review of the Act under Section 19*. Perth: Western Australia Department of Agriculture and Food.

DoA (2008). *Genetically Modified Crop fact sheet*. Canberra: Australian Government Department of Agriculture (DoA). www.daff.gov.au

Martin, K. (2013). *Unreported Judgements WA: MARSH v BAXTER - BC201302729; CIV 1561 of 2012*. Perth: Supreme Court of Western Australia.

Monsanto (2010). *Monsanto Technology/Stewardship Agreement*. St. Louis, MO: Grower Licensing, Monsanto.

Murray, M. P. (2009). Genetically Modified Canola - Commercial Production. *Hansard,* 25 November, 9848.

Murray, M. P. (2010). Genetically Modified Canola - Moratorium. *Hansard,* 9 March, 471-472.

OGTR (2013). *Current licences for commercial releases of GM crops (subset of list of licences involving Intentional Release)*. Canberra: Office of the Gene Technology Regulator (OGTR). www .ogtr.gov.au

Paull, J., & Lyons, K. (2008). Nanotechnology: the next challenge for organics. *Journal of Organic Systems,* 3(1), 3-22.

WADAF (2010). *Organic farrming and genetically modified crops*. Perth: Western Australia Department of Agriculture and Food (WADAF).

WADAF (2012). *GM crops and local government*. Perth: Western Australia Department of Agriculture and Food (WADAF).

Grass pea seeds as protein-rich feed for weaned piglets

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Key words: grass pea, protein, piglets, legume

Abstract

Under the conditions of organic agriculture, a feeding trial was conducted in order to test raw and toasted grass pea seeds as protein-rich feed for weaned piglets. Toasted grass pea seeds at inclusion rates of 20-30% (as fed basis) in diets were found to be a palatable protein-rich feed, resulting in feed intake and body weight gain similar to the control diet. Including 20% raw grass pea seeds, however, led to significantly lower body weight gain and consequently a significantly higher feed conversion ratio. Therefore, if 20% or more raw grass pea seeds are included in diets for weaned piglets, toasting of grass pea seeds prior to feeding is recommended in order to avoid performance deficits.

This research is part of the ICOPP project, funded by the ERA-NET CORE Organic II program.

Introduction

The European market for organically produced pork is still a small niche, partly due to the inadequate supply with cost-efficient high-quality protein feeds. The research project ICOPP (Improved contribution of local feed to support 100% organic feed supply to pigs and poultry) is addressing this issue, and is helping to further develop organic pig and poultry production in Europe. As part of ICOPP, a feeding trial was conducted in which grass pea seeds were included in diets for weaned piglets. The grass pea (*Lathyrus sativus*) is a grain legume that prospers both under drought and waterlogged conditions and produces seeds with crude protein contents between 200 and 300 g kg^{-1} (as fed). Unfortunately, it contains the neurotoxin ODAP, which causes nerve damage after prolonged and/or intensive feeding. Since ODAP is water-soluble and susceptible to heat, hydrothermal treatment (=toasting) greatly reduces toxicity. Therefore both raw and toasted grass peas were fed in the feeding trial.

Animals, material and methods

Grass pea seeds were purchased from an organic farmer in the Austrian province of Burgenland, and toasting was done at 98° C for 20 minutes. The feeding trial took place at the Austrian Research and Education Center, Institute of Biological Agriculture and Biodiversity of Farm Animals in Wels, Austria, between May and November 2012. The experimental design was a complete 4 x 4 latin square with 4 diets, each fed to one group of piglets per replicate, and four replicates. Diets were fed to a total of 144 piglets (crosses of [Landrace*Large White]*[Pietrain*Duroc]) during the 4-week rearing phase which started immediately after weaning at 47 ± 5.5 days. Division into four equally large groups was done based on body weight, sex, sow and blood haptoglobin level. No piglet died throughout the feeding trial, but 4 piglets suffering from severe diarrhoea were removed from the trial as a precaution. Each group of piglets was housed in a straw bedded pen of 5 x 1.7 m equipped with a creep area, drinkers and an outdoor area of 3 x 1.7 m. Feeding was restricted, using an automatic feeding system programmed to supply feed 5 times a day, in amounts slightly increasing every day. Four isocaloric diets with a similar lysine content were compared: A control diet (C), one diet containing 20% raw grass pea seeds (R 20), and two diets with toasted grass pea seeds (20 [T 20] and 30% [T 30], respectively; as fed basis). While the control diet contained 19% peas and 17% soybean cake, grass pea seeds completely replaced the peas in all experimental diets, and soybean cake was reduced to 13% in diets R 20 and T 20, and further to 7% in diet T 30. In Table 1, the nutrient contents of the diets are summarised.

Table 1: Nutrient contents of the diets, g kg^{-1} (as fed) unless stated otherwise

	C	R 20	T 20	T 30
Crude protein	182	178	180	177
Lysine	9.7	9.2	9.5	9.4

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Lys:Meth+Cyst: Thr:Try	1:0.61: 0.64:0.21	1:0.62: 0.65:0.21	1:0.60: 0.64:0.20	1:0.60: 0.64:0.20
NDF[a]	118	115	114	117
ADF[b]	61	62	61	64
Starch	401	412	412	421
Sugar	42	42	42	39
Energy, MJ ME[c]	13.5	13.6	13.6	13.5
g Lys / MJ ME	0.72	0.68	0.70	0.70
Calcium	7.6	6.8	7.2	7.0

[a] Neutral detergent fibre; [b] Acid detergent fibre; [c] Metabolisable energy

Piglets were weighed weekly, and feed intake was automatically documented by the feeding system. Whenever symptoms of diarrhoea were observed, all piglets were given tea of *Cortex quercus*, dry peat and an electrolyte solution. Persisting diarrhoea in individual piglets was treated with antibiotics (Baytril®). Statistical analysis of body weight data was performed using SAS 9.1 procedure MIXED with a model including the random effect of piglet nested within treatment, the fixed effects diet, pen, replicate, sow nested within replicate, day, body weight at weaning, and the interaction diet*day. The covariance structure TOEP (Toeplitz) was used. For analysis of feed intake and feed conversion ratio procedure GLM was used, with a model including the fixed effects of treatment, pen, replicate, day and day*day. Pairwise comparison of means was done using the Tukey Test. Statistical differences were considered to be significant at $P<0.05$, and differing superscripts indicate significant differences. Tables 2 and 4 show ls-means for diets from regression analysis, P values for the effect of diet and R^2 values. Table 3 gives the ls-means and the P value for the interaction diet*day and the residual standard deviation (s_e).

Results

Including grass pea seeds in the diet had no significant influence on feed intake of the piglets, even though feed intake was numerically lowest for diet R 20 (see Table 2). On average, piglets consumed 731 g feed day^{-1} (as fed basis).

Table 2: Average feed intake of piglets, g d^{-1} (as fed)

	Diet					
	C	**R 20**	**T 20**	**T 30**	P value	R^2
Week 1	355	296	321	336		
Week 2	652	593	617	633		
Week 3	895	836	860	876	0.102	0.75
Week 4	1085	1026	1050	1066		
Total	758	701	723	742		

The body weight development of the piglets did not differ between the control diet and the two diets containing toasted grass pea seeds, whereas including raw grass pea seeds in diet R 20 had a significantly negative effect, as shown in Table 3: Two weeks after weaning, piglets fed diet R 20 weighed significantly less than all other groups, and this difference became even more pronounced with time. At the end of the rearing phase, piglets fed the control diet had reached an average body weight of 24.3 kg, while piglets fed diet R 20 only weighed 21.6 kg.

Table 3: Body weight of piglets, ls-means of interaction diet*day, kg

	Diet					
	C	**R 20**	**T 20**	**T 30**	P value	S_e
Day 1	13.0	12.9	12.9	12.9		
Day 8	13.5	13.2	13.3	13.4		
Day 15	15.9^{b}	15.1^{a}	15.7^{ab}	16.0^{ab}	<0.001	1.44
Day 22	20.2^{b}	18.3^{a}	19.5^{b}	19.5^{b}		
Day 29	24.3^{c}	21.6^{a}	23.7^{bc}	23.4^{b}		

Feed conversion ratio was similarly affected by dietary treatment, and feeding raw grass pea seeds led to a significantly higher feed conversion ratio (see Table 4). Over the whole rearing phase, 2.28 kg of diet R 20, but only 1.96 kg of diet C was needed to achieve 1 kg of body weight gain. The diets containing toasted grass peas did not differ from the control diet.

Table 4: Average feed conversion ratio of piglets, kg feed intake / kg body weight gain

	Diet					
	C	**R 20**	**T 20**	**T 30**	P value	R^2
Week 2	1.78	2.13	1.75	1.83		
Week 3	1.71	2.06	1.68	1.76	0.007	0.39
Week 4	1.88	2.23	1.84	1.92		
Total	1.96a	2.28b	1.92a	2.00a	0.001	0.95

Discussion

Toasted grass pea seeds at inclusion rates of 20-30% (as fed basis) in diets for weaned piglets resulted in feed intake and body weight gain similar to the control diet. However, including 20% raw grass pea seeds led to significantly lower body weight gain and consequently a significantly higher feed conversion ratio. This observation is in accordance with Schipflinger et al. (2011), who found a slightly higher body weight gain in piglets when 20% toasted grass pea seeds were included in the diet (as fed basis) instead of raw grass pea seeds. When feeding diets with 10-40% (as fed basis) raw grass pea seeds to conventionally reared piglets, Castell et al. (1994) observed a significant reduction in feed intake and body weight gain that increased proportionally with the share of grass pea seeds in the diet. For fattening pigs, Winiarska-Mieczan and Kwiecien (2010) recommend that raw grass pea seeds should not exceed an inclusion rate of 50% of the protein-rich feeds (as fed basis) in the diet. In the presented trial, this would have translated to 19.5% (as fed basis) grass pea seeds in the diet. Assuming that newly weaned piglets react more sensitively to anti-nutritive factors than fattening pigs, the current observations complement the recommendation by Winiarska-Mieczan and Kwiecien (2010) quite well. Because neither ODAP nor trypsin inhibitors or other anti-nutritive factors were analysed in the grass pea seeds, the negative effect of raw grass pea seeds cannot be directly ascribed to ODAP. The observed negative effects will more likely have been the combined result of all anti-nutritive factors present in grass pea seeds.

References

Castell AG, Cliplef RL, Briggs CJ, Campbell CG & Bruni JE (1994): Evaluation of lathyrus (*Lathyrus sativus* L.) as an ingredient in pig starter and grower diets. Canadian Journal of Animal Science 74, 529-539.

Schipflinger M, Gallnböck M, Zollitsch W & Hagmüller W (2011): Platterbse in der Ferkelaufzucht. Tagungsband Bio Austria Bauerntage 2011, 59-61.

Winiarska-Mieczan A & Kwiecien M (2010): The influence of raw grass pea (*Lathyrus sativus* L.) seeds on growth performance and biochemical and haematological parameters in the blood of grower-finisher pigs. Agricultural and Food Science 19, 223-232.

Adapted vs. conventional cattle genotypes: suitability for organic and low input dairy production systems

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Key words: dairy cow, breed, adaptation, milk yield, reproduction

Abstract

In this study the response of different dairy genotypes is examined to a systematic restriction of nutrient and energy supply. This shall indicate the ability of different breeds or strains to adapt to an important aspect of organic and low input systems. While differences exist between genotypes in some traits, it is difficult to derive a clear conclusion on general differences regarding their suitability for organic and low input dairy production systems at this stage.

Introduction

Conventional genotypes have been bred by selecting primarily for milk production within high concentrate input systems where forages, especially pasture, have accounted for only 50 % or less of the total ration. Dairy cow strains arising from these breeding programmes are often perceived unsuitable for organic and low input milk production systems. While farmers have identified a number of breeds and strains as being 'adapted' to low input systems, there is often little scientific evidence to prove that these breeds are more appropriate than conventional genotypes.

The purpose of this study (part of FP7-project "SOLID", g.a. n° FP7-266367) is to examine the response of "conventional" versus "adapted" dairy genotypes to a systematic restriction of nutrient and energy supply, including metabolic response traits. This would indicate the extent to which different breeds or strains can adapt to an important aspect of organic and low input systems.

Material and methods

Genotypes identified by organic and low input producers as being adapted to these systems were compared with conventional breeds in studies in Austria, Finland and Northern Ireland. The studies undertaken in each country examined productivity and several other traits of adapted and conventional genotypes when managed on diets supplying either normal (i.e. system-specific levels) or reduced quantities of energy and nutrients. These three cases serve as examples of different approaches to breeding for adaptation to low input milk production systems.

- Adaptation through selection for lifetime performance: a strain of Holstein cattle selected on low input farms for lifetime performance for more than 50 years (HFL) was compared with conventional Brown Swiss cattle (BS) in an organic, low-input milk production system within an alpine environment in Austria. Data from 30 and 21 lactations were included in the study for HFL and BS, respectively.
- Adaptation through crossbreeding: 36 Jersey x Holstein x Swedish Red crossbred dairy cattle were compared with 36 conventional Holstein cows in an intensively managed grassland based system in Northern Ireland.
- Adaptation through selection for fertility and health traits: 16 Nordic Red (Finnish Ayrshire) cows, which had been selected within a controlled multi-trait selection programme for over 30 years were compared with 32 conventional Holstein cows in a Finnish milk production system.

Within each experimental site, cows of each genotype were managed within one experimental herd. Half of the cows of each genotype were assigned to either a control diet or a diet in which concentrate inputs had

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been reduced by at least 40 % (low input). Traits analysed include forage and total feed intake for the indoor period, milk production and quality, milk fatty acid profiles, milk somatic cell count, body condition changes, animal health and selected metabolic indicators and cow fertility. Samples of venous blood of each cow were taken 14 days pre calving and on days 4, 15, 29 and 43 post calving and were analysed for indicators of energy status, urea and uric acid contents. Milk samples were collected at 4 times during early lactation for fatty acid analysis.

Results

As the experiments and analyses have just been completed, or are in their final stages, preliminary results are presented (Tables 1, 2 and 3 for the experiments conducted in Austria, Northern Ireland and Finland, respectively). Statistically analysed results and conclusions based on the analysis of the final data sets will be presented at the conference.

Differences in productive performance reflect the effects of both breed and feeding regime in the Austrian trial, but do not seem to indicate an interaction between those (Table 1). There was a breed × feed effect on milk palmitic acid (C16:0) proportion, a significant treatment effect on oleic acid (C18:1), but no effects on stearic acid (C18:0). Based on blood NEFA values, it seems that cows with reduced dietary concentrate supplementation on average mobilized fatty tissue at a higher rate than the control cows, while the BS showed lower average values than HFL. Both NEFA and BHB values showed a high variability across all treatments. Results for NAGase (mastitis indicator) appear to be driven by breed effects, rather than by feeding regime.

Table 1: Production traits and milk fatty acids for conventional and "adapted" dairy cows under a control and a low input feeding regime in Austria

	Brown Swiss (conventional)		Holstein (adapted)	
Trait	Control diet	Low input	Control diet	Low input
Concentrate per lactation, kg	686 ±250.3	285 ±125.5	625 ±207.2	286 ±80.8
Lactation milk yield, kg	6371 ±1833.5	5716 ±1192.7	5840 ±759.5	5384 ±838.0
Milk solids, kg	467 ±131.9	409 ±77.1	422 ±66.2	393 ±63.6
Milk C16:0, g/g	0.39 ±0.039	0.35 ±0.042	0.36 ±0.038	0.36 ±0.030
Milk C18:0, g/g	0.11 ±0.026	0.11 ±0.027	0.10 ±0.026	0.12 ±0.032
Milk C18:1, g/g	0.16 ±0.031	0.20 ±0.064	0.16 ±0.043	0.19 ±0.051
Ø BW, kg	606 ±80.5	613 ±63.0	540 ±60.3	544 ±53.8
Days to concept.	76 ±37.3	64 ±34.9	78 ±39.9	74 ±40.4

Crossbred cows had a lower lactation milk yield than the conventional Holstein cows in the experiment in Northern Ireland, with a trend towards a breed x system interaction (Table 2). However, the crossbred cows produced milk with a higher fat and protein content, the overall effect being that milk solid yield was similar for both breeds, while being higher with cows offered the control diets. Milk proportions of C16:0 and C18:0 were significantly affected by diet but not breed, whereas breed affected C18:1. Reproductive performance was the same for both genotypes.

Table 2: Production traits and milk fatty acids for conventional and "adapted" dairy cows under a control and a low input feeding regime in Northern Ireland

	Holstein (conventional)		Swedish Red x Jersey x Holstein (adapted)	
Trait	Control diet	Low input	Control diet	Low input
Concentrate per lactation, kg	1670	713	1644	720
Lactation milk yield, kg	7647 ±1298.2	6368±1209.5	7118 ±1358.7	5324 ±939.9
Milk solids, kg	511 ±101.1	410 ±95.4	526 ±103.3	395 ±75.1
Milk C16:0, g/g	0.34 ±0.041	0.37 ±0.037	0.36 ±0.032	0.39 ±0.043
Milk C18:0, g/g	0.10 ±0.022	0.11 ±0.016	0.10 ±0.019	0.11 ±0.014
Milk C18:1, g/g	0.21 ±0.040	0.20 ±0.033	0.19 ± 0.038	0.19 ±0.037
Ø BW, kg	574 ±59.3	551 ±48.0	548 ±41.0	515 ±36.8
Days to concept.	91		91	
SCC (1000/ml)	82	135	206	121

Preliminary results from the Finnish experiment (first 100 days of lactation; Table 3) indicate that the the adapted Nordic Red cows had a lower milk yield than the Holstein cows (29.2 vs. 31.5 kg/day), but fewer claw disorders. There was no significant effect of breed or treatment on milk C16:0, C18:0, but breed tended to have an effect on C18:1.

Table 3: Production traits and milk fatty acids for conventional and "adapted" dairy cows under a control and a low input feeding regime in Finland

	Holstein (conventional)		Nordic Red (adapted)	
Trait	Control diet	Low input	Control diet	Low input
Concentrate per lactation, kg	2833 ±102.9	1395 ±99.0	2926 ±138.4	1323 ±154.1
Lactation milk yield, kg	9997±279.7	8516±282.0	9089±399.6	7970 ±428.8
Milk solids, kg	1373±35.6	1158.8±35.9	1306±50.8	1092±54.6
Milk C16:0, g/g	0.32 ±0.033	0.34 ±0.040	0.35 ±0.034	0.33 ±0.046
Milk C18:0, g/g	0.13 ±0.018	0.13 ±0.027	0.12 ±0.016	0.13 ±0.020
Milk C18:1, g/g	0.27 ±0.077	0.25 ±0.069	0.20 ± 0.047	0.24 ±0.059
Day to concept.	113±38.6	94±38.6	130±59.7	101±15.4

Discussion

The preliminary data available appears to confirm that a reduction in concentrate supplementation reduces milk yield, but does not have a detrimental effect on health and reproductive traits. The responses of different genotypes to a reduced nutrient and energy intake were not consistent across the different studies. This is likely due to varying degrees of differences between both the genotypes studied and the feeding regimes implemented. Published studies examining possible genotype by feeding system interactions have also

found inconsistent results (Delaby et al. 2009, Hammami et al. 2009, Horan et al. 2005), and this makes it difficult at this stage to derive a clear conclusion on general differences between conventional and alternative genotypes with regards to their suitability for organic and low input dairy production systems.

Suggestions for tackling the future challenges of organic animal husbandry

In pasture and forage-based systems, concentrate input can be reduced without affecting reproductive and health traits. The associated loss in milk yield presents an economic challenge unless balanced by lower production costs.

Efforts to identify genotypes that fit better to organic and low-input dairy production systems are still important and are likely to become even more relevant as production environments (i.e. conventional vs. organic/low input) and breeding goals (i.e. conventional vs. adapted) diverge.

References

Delaby L., Faverdin P., Michel G., Disenhaus C. and Peyraud J.L., 2009. Effect of different feeding strategies on lactation performance of Holstein and Normande dairy cows. Animal, 3, p. 891-905.

Hammami H., Boulbaba R. and Gengler N., 2009. Genotype by environment interaction in dairy cattle. Biotechnology, Agronomy, Society and Environment, 13, p. 155-164.

Horan B., Dillon P., Faverdin P., Delaby L., Buckley F. and Rath M., 2005. The Interaction of Strain of Holstein-Friesian Cows and Pasture-Based Feed Systems on Milk Yield, Body Weight, and Body Condition Score. Journal of Dairy Science, 88, p. 1231-1243.

SOLID-DSS – an online application balancing forage supply and demand in organic low-input dairy farming

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Key words: sustainable, organic, grass growth model, feed value grazing, decision support

Abstract

As part of the EU research project SOLID, a decision support system called SOLID-DSS is currently being developed. SOLID-DSS will offer decision support to organic low-input dairy farmers by modelling both the status quo of the dairy herd as well as future scenarios, and then evaluating all changes regarding the risk of feed shortages. Thereby, the user will be able to compare management changes with regard to their ability to lower the risk of feed shortages. SOLID-DSS consists of three sub-models: a crop model simulating forage growth and quality throughout the year, a herd model describing the herd structure, and a diet model suggesting diets for all groups of cows throughout the year. Work on SOLID-DSS is still ongoing, with the final aim of an online-application usable in many European countries.

Introduction

In organic low-input dairy farming, the forage proportion of the cows´ diets is usually higher than on conventional farms, and the herd´s requirements are largely met by grazing and conserved forage from permanent grassland or perennial leys. The risk of weather induced on-farm feed shortages is therefore of greater importance, and optimal use of home-grown forages improves the independence from the price volatility of feed markets.

As part of the EU research project SOLID (Sustainable Organic and Low Input Dairy Systems; www.solidairy.eu), a decision support system is currently being developed which will evaluate dairy farm management with regard to the risk of feed shortages. By simulating management changes, this online application shall offer support for management decisions and help balance forage supply and demand to reduce the risk of feed shortages. This research has received funding from the European Community´s 7th Framework Programme (FP7/2007-2013) under the grant agreement number FP7-266367.

Description of SOLID-DSS and the underlying models

Input

In order to describe the current situation of a farm, the user has to provide information on the location, the area and type of farm land, details of plant production and grazing management, and characteristics of the dairy herd.

Modelling

SOLID-DSS then simulates the farm using the two sub-models crop model (feed supply) and herd model (feed demand). The third sub-model, the diet model, connects supply and demand and produces the output for the user.

The crop model simulates forage (grassland and a set of arable crops) growth and quality throughout the year, based on climate data derived from ECA&D (European Climate Assessment & Dataset 2014) data. The crop model is derived from MONICA (Nendel et al. 2011), a dynamic soil and generic crop growth model, extended with an implementation of the crop model of SGS Pasture Model (Johnson 2013). The data produced by the crop model are the amount (dry matter) and quality (contents of energy and protein) of feed available in all given time periods throughout the year.

The herd model describes the herd structure, including number and categories of cows and their calving pattern. For most parameters, e.g. the lactation curve (both milk yield and milk solids), the herd model will offer default values that can be adjusted by the user. The data supplied by the herd model is a description of all groups of cows (dry, lactating, young stock), including the number of cows and their production level in all given time periods throughout the year, and their requirements of energy and protein. Because the decision

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support system should be usable throughout Europe, energy requirements will be calculated according to several national systems of feed evaluation (United Kingdom, France, Germany,). In the prototype, only dairy cows will be considered, but later-on other animal categories will be added (heifers, calves, beef cattle,)

The data supplied by the crop and the herd model are then connected in the diet model. Both over- and undersupply of energy and protein are minimized using a linear solver and diets for all groups of cows throughout all periods of the year are suggested. The user can then test these diets in specialized diet optimisation programs for further detailing. The feed intake of the cows will be predicted using the model GrazeIn (Faverdin et al. 2011, Delagarde et al. 2011), and will be treated as a constraint when formulating the diets.

Output

The output of SOLID-DSS will include the suggested diets throughout the year, and an indicator reflecting the risk of feed shortages that the farm is currently facing. An example: In one out of ten years, the forage supply in early spring is not sufficient to satisfy the herd´s requirement due to a long winter and a delayed first turn out to pasture.

Area and limits of utilization

SOLID-DSS can assist both in regard to short-term management questions as well as to long-term strategic planning. In the short term, SOLID-DSS can simulate just one year of the current management, and the resulting diets for the different groups of cows can then be used as recommendations to distribute the available feeds optimally throughout the year.

For long-term strategic planning, simulations of the status quo and the situation originating from different management changes, both over numerous years, can be compared and all changes can be evaluated against the status quo. Because SOLID-DSS will not be able to predict e.g. harvest dates and yields exactly, and in reality it is not possible to manage a farm in an ideal manner (optimum harvest date plus optimum grazing day plus ideal herd structure etc.), all management options will be evaluated in their probability to lower the risks: How much would an improvement in management towards an ideal situation reduce the risk of forage undersupply?

Basically there are three possible areas of intervention to reduce the risk of a feed shortage: An increase on the supply side, a reduction on the demand side, and a better balance of demand and supply. To increase the feed supply, additional land for forage production can be acquired, cash crops can be substituted with forages or intermediate crops can be grown. Therefore a possible question might be which forages should be grown on additional land to minimize the required area. A reduction on the demand side can be achieved by altering the herd structure, e.g. changing the number and production potential of cows or keeping cows longer to reduce the proportion of non-producing heifers. The third intervention area is the better allocation of feeds. The reduction of waste due to improper diets can be an important factor for reaching a better feed security. Possible questions could be how grouping of cows affects feed allocation and the reduction of over-supply of energy and protein, and the optimal supplementation of available forages.

Outlook

In an agricultural production influenced by a changing climate and changing perceptions of the general public towards farm animals, we believe that flexible production systems and open communication with consumers will be the main factors of success. In this regard, we see SOLID-DSS as a valuable tool that offers decision support to farmers and can also be used for easy communication of the characteristics of grassland-based dairy farming. Work on SOLID-DSS is still ongoing, and as soon as the prototype is running, all further development will be assisted by evaluation with real data and case studies.

References

Delagarde R, Faverdin P, Baratte C & Peyraud JL (2011): GrazeIn: a model of herbage intake and milk production for grazing dairy cows. 2. Prediction of intake under rotational and continuously stocked grazing management. Grass and Forage Science 66, 45-60.

European Climate Assessment & Dataset (2014): Last retrieved on January 27, 2014 from http://www.ecad.eu/download/ensembles/download.php#citation

Faverdin P, Baratte C, Delagarde R & Peyraud JL (2011): GrazeIn: a model of herbage intake and milk production for grazing dairy cows. 1. Prediction of intake capacity, voluntary intake and milk production during lactation. Grass and Forage Science 66, 29-44.

Johnson IR (2013): DairyMod and the SGS Pasture Model: a mathematical description of the biophysical model structure. IMJ Consultants, Dorrigo, NSW, Australia.

Nendel C, Berg M, Kersebaum KC, Mirschel W, Specka X, Wegehenkel M, Wenkel KO & Wieland R (2011): The MONICA model: Testing predictability for crop growth, soil moisture and nitrogen dynamics. Ecological Modelling 222, 1614-1625.

Welfare state of dairy cows in three European low-input and organic systems

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Key words: animal welfare, Welfare Quality, assessment system, critical points, injuries, pasture

Abstract

Animal welfare in organic and low-input dairy cow systems is commonly expected to achieve at least satisfactory levels. This assumption is based on the regulations regarding housing and management of the animals and/or the access to pasture. The aim of the present study was to evaluate 30 dairy farms in three European countries using the Welfare Quality® assessment protocol in order to characterize these systems and evaluate whether expectations regarding the state of welfare are met. Farms were found to have mainly an acceptable and enhanced overall welfare state. In general, weak points found related to the presence of injuries and discomfort of the lying areas of the cows. In some countries, specific problems such as mutilations, poor human-animal relationship or insufficient water provision were identified. Variation between farms showed that on one hand farms could benefit from intervention studies and on the other hand that good and even excellent results are possible in organic and low-input dairy systems.

Introduction

Low-input and organic dairy systems are known to be managed differently than intensive and conventional production units. Sustainability aspects of these systems are often pointed out and discussed (Leach, 2012). Especially the fact that pasturing is frequently used in these systems is perceived as more animal friendly (Reijs et al., 2013), but only limited information is available on the welfare of dairy cows in low-input systems. In recent years, comprehensive, mostly animal-based on-farm welfare assessment systems have been developed. For example, the Welfare Quality® (WQ) assessment protocol combines a range of animal-based measures and information on management and resources (Welfare Quality®, 2009). The data are collected during on-farm visits and can be used for providing feedback to the farmer on the welfare state as a basis for improvement (Gratzer, 2011). The single measures are further aggregated into twelve criteria and four principle scores. An overall classification may also be obtained for the farm. The aim of this study was therefore to apply the WQ protocol to low-input and organic dairy production systems in three European countries in order to evaluate the welfare state of the dairy cows in these systems.

Material and methods

Ten low-input and/or organic dairy farms each in Northern Ireland (NI), Romania (RO) and Spain (SP) were assessed in the late winter and early spring of 2013 using the WQ assessment system (Welfare Quality, 2009). The farms were identified by local research partners and farming associations. Scores for twelve WQ criteria and four WQ principles were calculated from the measures according to the WQ protocol. They may range from 0-100 (poor-good, with a score of 50 indicating a somewhat 'neutral' situation). For the identification of welfare problems, we applied a threshold of 40.

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Table 1: Mean ± standard deviation (SD) of Welfare Quality principle (in italics) and criterion scores in the three farming systems investigated.

WQ Principle	WQ Criterion	Northern Ireland	Romania	Spain
		Mean ± SD		
Good feeding		*35.9 ± 31.7*	*51.2 ± 26.1*	*61.3 ± 16.5*
	1. Absence of prolonged hunger	86.2 ± 23.1	41.8 ± 27.3	50.6 ± 16.6
	2. Absence of prolonged thirst	33.8 ± 41.9	83.5 ± 35.5	90.0 ± 21.6
Good housing		*49.8 ± 10.2*	*50.2 ± 15.6*	*65.7 ± 17.6*
	3. Comfort around resting	20.4 ±16.2	42.2 ± 27.5	48.0 ± 22.9
	4. Thermal comfort	100.0 ±0.0	71.1 ± 16.6	96.0 ± 12.7
	5. Ease of movement	100.0± 0.0	68.0 ± 16.9	96.0 ± 12.7
Good health		*41.2 ± 8.0*	*43.5 ± 17.0*	*31.3 ± 9.8*
	6. Absence of injuries	36.7 ± 14.5	34.9 ± 15.9	31.5 ± 11.8
	7. Absence of disease	71.7 ± 17.6	70.7 ± 24.5	58.7 ± 21.0
	8. Absence of pain induced by management procedures	38.6 ± 10.5	74.0 ± 36.2	26.4 ± 28.6
Appropriate behaviour		*51.7 ± 17.7*	*49.5 ± 21.8*	*42.0 ± 12.9*
	9. Expression of social behaviours	57.8 ± 25.3	75.4 ± 26.8	72.9 ± 24.8
	10. Expression of other behaviours	78.9 ± 7.3	64.0 ± 24.2	83.4 ± 29.9
	11. Good human-animal relationship	54.3 ± 20.3	62.6 ± 16.1	27.7 ± 8.0
	12. Positive emotional state	53.8 ± 22.5	48.8 ± 35.0	58.8 ± 27.3

Results

In five out of the 12 criteria the average score was below 40 in at least one country; at the principle level this was the case for 2 principles (Table 1). With regard to 'Good feeding' this was mainly due to an on average non-satisfactory water provision ('Absence of prolonged thirst': e.g. too few water points per animal, cleanliness of water points) in NI, while body condition of the cows as a measure of 'Absence of prolonged hunger' was less of a problem. The average principle scores for Good Housing all exceeded the threshold of 40, but the criterion 'Comfort around resting' (referring to lying down movement and cleanliness of the animals) scored lowest in NI. The principle 'Good Health' scored rather low in all production systems, but especially in farms in Spain. At the level of the three corresponding criteria, 'Absence of injuries' which includes lameness and skin alterations was the weakest criterion for all countries. While 'Absence of disease' achieved on average high scores, in the criterion 'Absence of pain induced by management procedure' countries again differed markedly. Due to the dehorning and partly tail-docking practices NI and SP farms did not exceed the above mentioned threshold, whereas such procedures were much less frequent in RO.

In all countries, the threshold was exceeded for the 'Appropriate behaviour' principle, but in SP farms the criterion scores for 'Good human-animal-relationship' (resulting from avoidance distance testing at the feeding place) were low. At overall classification level half of the farms were graded as 'Acceptable', 43% achieved an 'Enhanced' welfare state and one farm was classified 'Excellent'; one farm ended was 'Not classified' (Figure 1).

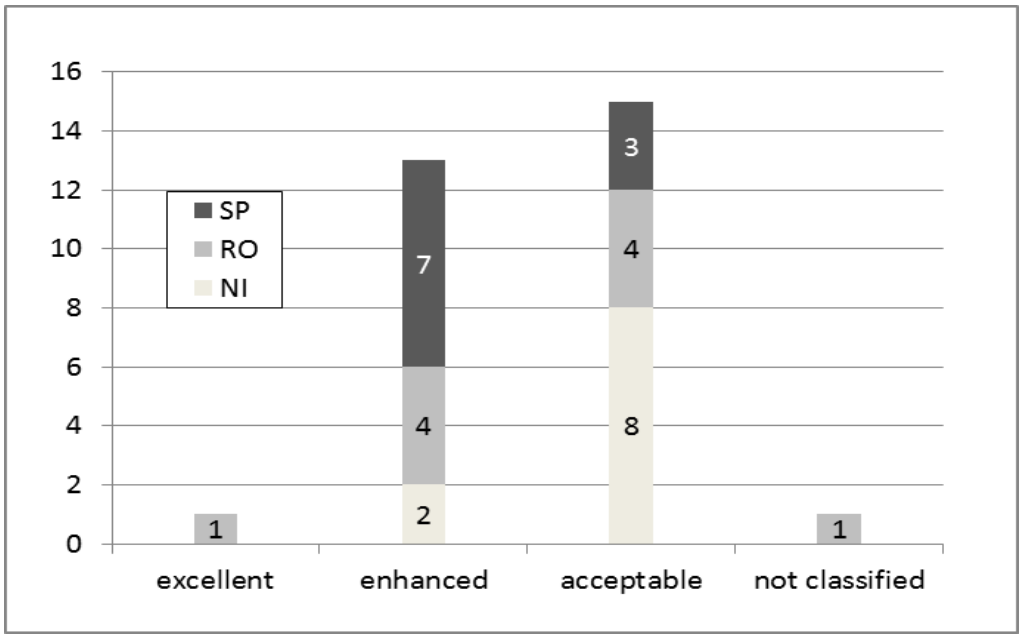


Figure 1. Number of farms in Northern Ireland, Romania and Spain within respective category of overall classification according to the Welfare Quality assessment system.

Discussion

Across the production systems investigated the presence of injuries in the cows may be regarded a general welfare problem. Furthermore, 'Comfort around resting' and 'Absence of pain induced by management procedures' were identified as unsatisfactory in at least two countries. 'Thermal comfort', 'Ease of movement', 'Absence of disease' as well as most of the criteria related to 'Appropriate behaviour' may be considered at least acceptable.

It was remarkable that even in the low-input systems investigated the criterion 'Other behaviour', which refers to access to pasture, did not achieve excellent scores (on average). This indicates that the amount of days and hours in a year spent on pasture regarded 'Excellent' by animal welfare experts (Welfare Quality, 2009) does not match with what can be found in at least some of the low-input farms in the present study. It remains open if the expert opinion regarding animal welfare is too ambitious or if this small sector of the dairy industry follows the general trend of reducing access to pasture as recently discussed by Reijs et al. (2013).

Suggestions to tackle with the future challenges of organic animal husbandry

In conclusion our results show that the expectations regarding a very high state of animal welfare were not met at least for half of the investigated farms. There were some common, major problem areas across countries and some were only country-specific. This proofed that there is room and need for improvements and implementation of intervention measures are highly recommended. Nonetheless a substantial part of the farms demonstrated that an 'enhanced' or even 'excellent' state of animal welfare is possible in low-input and/or organic systems.

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References

Gratzer ET 2011. Animal health and welfare planning in Austrian organic dairy farming. Doctoral thesis. University of Natural Resources and Life Sciences (BOKU), Vienna.

Leach K 2012. Assessing the sustainability of EU organic and low input dairy farms. Organic Research Centre Bulletin 111, 9-10.

Reijs JW, Daatselaar CHG, Helming JFM, Jager J and Beldman ACG 2013. Grazing dairy cows in North-West Europe - Economic farm performance and future developments with emphasis on the Dutch situation. In LEI Report 2013-001 (Ed. LCv Staalduinen), p. 126. LEI Wageningen UR, The Hague.

Welfare Quality® 2009. Welfare Quality® assessment protocol for cattle. Welfare Quality(R) Consortium, Lelystad, Netherlands.European Commission (2007): A new health strategy for the European union (2007-2013) where “Prevention is better than cure”, Bruxelles, 26p

Need for phosphorus input in Austrian organic farming?

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Key words: phosphorus cycle, P balance, farm production types, production areas, p mobilisation, farm management

Abstract

On organic farms, phosphorus (P) balances are often negative because no or little P is imported into the farms. Negative P balances may deteriorate P availability over time. We calculated P balances of the main farm production types in organic farming for the main Austrian production areas. Using data from various data bases and expert knowledge, calculations were made by the sustainability assessment tool REPRO. Results can be regarded as balanced to slightly deficient for organic forage dairy farms, cash crop farms and permanent crop farms, and as slightly to highly surplus on organic refinement farms. Slightly deficient P balances, mainly on organic cash crop farms, call for P input, especially on farms where available P fractions in the soil are very low and / or P stocks in the soils and hence the potential for P mobilisation are low. On individual farms where more negative P balances occur, farm management needs to be optimised.

Introduction

Phosphorus (P) is an essential constituent of the metabolism of crop plants, animals and men. World P resources under current demand are predicted to be depleted in the 21st century. In organic farming, both renouncement of readily available P fertilisers and closing nutrient cycles on the farms as far as possible contribute to a sustainable use of this scarce nutrient. Analyses in Austrian farmland soils show a low or very low P availability for a high percentage of soil samples from organic farms (Lindenthal, 2000). Little fertiliser input from outside the farms and negative P balances may deteriorate P availability over time in organic farming. Therefore, our objective was to get an overview of recent P balances on Austrian organic farms and to test if and where additional P input is required. For this, we calculated P balances of the main production types in organic farming for the main Austrian production areas.

Material and methods

Due to varying natural conditions of the eight Austrian Main Production Areas (MPAs), different farm production types (PTs) evolved in Austria. These were defined in the INVECOS data set (Integrated Administration and Control System of the EU) (BMLFUW, 2007). For this study, the agricultural area of "forestry" farms, being mainly grassland and pastures, was designated to "forage production". In each MPA between one and three predominant production types occurred (Table 1).

Table 1: Austrian Main Production Areas (MPAs) with their predominant production types

MPA	Main production area	Production type
1	Alps	Forage production
2	Pre-Alps	Forage production
3	Eastern Alpine Foothills	Forage production
4	Bohemian Massif	Cash crop; Forage production
5	Carinthian Basin	Forage production; Cash crop; Refinement
6	Alpine Foothills	Cash crop; Forage production; Refinement
7	South-Eastern Plains and Hills	Cash crop; Forage production; Refinement
8	North-Eastern Plains and Hills	Cash crop; Permanent crops (wine)

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Table 2: Details of agricultural areas covered and crop distribution of each production type

Area		MPA 1&2	MPA 3	MPA 4		MPA 5	
Production type		**F**	**F**	**F**	**C**	**F**	**C**
Agricultural area covered	1000 ha	129	39	46	18	6	2
Cereals	%	0.6	6.5	21.3	52.3	17.8	36.5
Grain maize	%					6.8	21.7
Oil crops	%			1.8	11.7	3.5	16.3
Root crops	%			1.1	3.8		
Forage (incl. SM)	%	3.2	15.2	20.6	18.3	21.3	12.2
Fallow	%				1.8	1.0	2.1
Intensive pasture	%	80.6	67.2	53.2	9.1	42.3	7.7
Extensive pasture	%	15.4	10.4	0.9	0.7	6.7	0.8

Area		MPA 6			MPA 7			MPA 8	
Production type		**F**	**C**	**R**	**F**	**C**	**R**	**C**	**P**
Agricultural area covered	1000 ha	27	8	2	5	6	2	5	9
Cereals	%	10.6	44.3	39	17.6	44.1	22.3	47.2	29.2
Grain maize	%		5.1	11.3	1.4	2.1	25.2	7.2	4.6
Oil crops	%	0.9	18.4	15.4	4.6	21.6	15.3	14.4	12.3
Root crops	%		2.1	0.7				2.1	
Forage (incl. SM)	%	13.7	13.3	9.1	23.7	15.2	11.4	13.9	10.5
Fallow	%		3.4	1.7	1.6	5.4	4.3	5.7	4.8
Intensive pasture	%	72.2	7.7	18.8	47.7	5.1	16.9		
Extensive pasture	%	1.7	0.9	1.3	2.1	2.3	3.7	2.6	4.7
Wine	%								25.1

MPA: Main production area, see Table 1; F: forage; C: cash crops; R: refinement; P: permanent crops (wine); SM: silage maize

In all MPAs, model farms were constructed for the predominant production types. All crops or crop groups that covered at least 1 % of the agricultural area were considered (Table 2). For these species, detailed information was obtained, e.g. the amount and kind of fertilizer applied, yield of main crops / catch crops / undersown crops corresponding to regional mean values, dung delivery according to livestock numbers. Information on animal husbandry, feeding, pasture and animal housing was also considered in the calculations. Data were collected from the INVECOS database (BMLFUW, 2007), from the catalogue of marginal returns (BMLFUW 2008), from regional advisory boards, and other sources. The model farms had a size of 100 ha. The field size corresponded to the area-% covered by the crops. Details on plant production, machinery and tillage operations were obtained and regarded for each region and farm type individually. Nutrient cycles on the farms were calculated with the REPRO (Reproduction of Soil Fertility) sustainability assessment tool for farm management and consultation (Hülsbergen, 2003). Site characteristics are considered in the calculation via the precipitation and the soil quality.

Results

Phosphorus balances were moderately negative on “forage production” farms with values ranging from -3.7 to -5.8 kg P ha^{-1} yr^{-1} (Table 3). “Cash crop” farms reached higher P deficits from -3.7 to -11.4 kg P ha^{-1} yr^{-1}. “Refinement” farms types had positive P balances from 6.1 to 14.2 kg P ha^{-1} yr^{-1}. “Permanent crop” farms, producing a combination of wine and cash crops, were in the range of the cash crop farms. Most negative values on cash crop producing farms can be attributed to export of nutrients with the cash crops without nutrient input by fertilisers or fodder. Highly positive values on refinement farm types are due to nutrient input by fodder from outside the farm.

Discussion

Freyer and Pericin (1993) regard balance results of ±4.5 kg P ha^{-1} yr^{-1} as balanced. Values from -4.5 to -13 kg P ha^{-1} yr^{-1} are valued as "slightly deficient", below -13 kg P ha^{-1} yr^{-1} as "highly deficient", with a related valuation of positive balance values. According to this valuation, results in our study can be regarded as balanced to slightly deficient for organic forage dairy farms, cash crop farms and permanent crop farms, and as slightly to highly surplus on organic refinement farms. Calculations of P balances for Austrian organic forage dairy farms by Weißensteiner et al. (2013) showed balanced results with minimum values of -2 kg P ha^{-1} yr^{-1} at a varying intensity level equivalent to 4000 to 6000 L milk per cow and year. Values in this study are less negative than our results.

Slightly deficient P balances, mainly on organic cash crop farms, call for P input especially on farms where available P fractions in the soil are very low and / or P stocks in the soils and hence the potential for P mobilisation are low, i.e. on sandy soils and on some calcareous soils. On individual farms, more negative P balances can occur than reported in the above-mentioned studies, e.g. on forage dairy farms where no mineral nutrients containing feedstuffs additives are applied. Here, farm management needs to be optimised.

Suggestions to tackle with the future challenges of organic animal husbandry

There is an urgent need to close nutrient cycles on the farm and regional scale and to substitute P from rock phosphate reserves by alternative P fertilisers in the next decades also in organic farming (see also: IMPROVE-P, 2013).

Table 3: Phosphorus balances (kg P ha^{-1} yr^{-1}) of the main production types in organic farming in the Austrian Main Production Areas

MPA	1&2	3	4		5	
Production type	**F**	**F**	**F**	**C**	**F**	**C**
P output	25.7	28.1	26.6	20.0	24.2	27.0
Main products	*25.7*	*27.8*	*25.4*	*16.8*	*22.0*	*20.4*
By-products	*0.0*	*0.3*	*1.1*	*3.2*	*2.2*	*6.5*
P input	20.5	22.7	20.8	16.3	19.6	15.6
Seeds	*0.0*	*0.1*	*0.2*	*0.5*	*0.2*	*0.6*
Mineral fertilizer	*0.0*	*0.7*	*1.5*	*4.1*	*1.5*	*0.4*
Organic fertilizer	*20.5*	*22.0*	*19.1*	*11.8*	*17.9*	*14.6*
P balance	-5.3	-5.4	-5.8	-3.7	-4.6	-11.4

MPA	6			7			8	
Production type	**F**	**C**	**R**	**F**	**C**	**R**	**C**	**P**
P output	30.2	22.3	25.0	24.3	19.1	24.4	20.4	18.0
Main products	*29.6*	*18.0*	*19.8*	*23.0*	*15.8*	*19.3*	*16.0*	*13.8*
By-products	*0.6*	*4.3*	*5.2*	*1.3*	*3.3*	*5.1*	*4.4*	*4.1*
P input	24.9	15.4	31.1	20.6	11.5	38.6	10.7	11.3
Seeds	*0.1*	*0.5*	*0.4*	*0.2*	*0.5*	*0.3*	*0.5*	*0.4*
Mineral fertilizer	*0.3*	*2.1*	*1.4*	*2.0*	*1.4*	*2.8*	*0.0*	*0.0*
Organic fertilizer	24.5	12.8	29.3	18.5	9.6	35.6	10.2	10.9
P balance	-5.3	-6.9	6.1	-3.7	-7.6	14.2	-9.7	-6.7

Legend see Table 2.

References

BMLFUW (2007): Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, INVEKOS – Datenpool.

BMLFUW (2008): Deckungsbeiträge und Daten für die Betriebsplanung 2008. 2. Auflage.

Freyer B & Pericin C (1993): Methoden der Nährstoffbilanzierung und ihre Anwendung am Beispiel von drei Bio-Betrieben. Landwirtschaft Schweiz 6 (10), 611-614.

Hülsbergen KJ (2003): Entwicklung und Anwendung eines Bilanzierungsmodells zur Bewertung der Nachhaltigkeit landwirtschaftlicher Systeme. Habilitationsschrift, Verlag Shaker, Aachen.

IMPROVE-P (2013): IMproved Phosphorus Resource efficiency in Organic agriculture Via recycling and Enhanced biological mobilization. https://improve-p.uni-hohenheim.de/ (accessed: 2013-09-24).

Lindenthal T (2000): Phosphorvorräte in Böden, betriebliche Phosphorbilanzen, und Phosphorversorgung im Biologischen Landbau - Ausgangspunkte für die Bewertung einer großflächigen Umstellung ausgewählter Bundesländer Österreichs auf Biologischen Landbau hinsichtlich des P-Haushaltes. Dissertation, Univ. f. Bodenkultur Wien. 290 pp.

Weißensteiner C, Bohner A, & Friedel JK (2013): Phosphor in österreichischen Grünlandböden. In: ALVA (Arbeitsgemeinschaft für Lebensmittel-, Veterinär- und Agrarwesen; 2013): Pflanzenschutz als Beitrag zur Ernährungssicherung. Tagungsberichte zur 68. ALVA-Tagung, Mai 2013, Klosterneuburg. 189-191. ISSN 1606-612X. Online: http://www.alva.at/images/Publikationen/Tagungsband/tagungsband_2013_fr homepage.pdf (accessed: 2013-09-24)

Merging Ethics and Economies: Modernizing Values in Viennese Farmers' Markets

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Key words: Farmers' Markets, Values, IFOAM, Generative Economy

Abstract

With the recent rise in farmers' market popularity and their linkages in offering an alternative economic market place for many small farmers and start-up ventures for those in the alternative food community, it is curious that Viennese markets in Austria are experiencing a slower if not stagnant farmers' market following. Additionally, many specific values are associated to different markets in differing regions, yet there has been limited research done in examining the values in farmers' markets as individual entities. In this paper the initial results of a farmers' market comparison in Vienna and Minneapolis, Minnesota focusing on the role of values in the farmers' market arena are taken in consideration, specifically in the possibility of encouraging the integration of more modern values in Viennese farmers' markets.

Introduction

Among others, the rise in farmers' market popularity in the US and certain parts of Europe has been attributed to a want of local, quality products, small farmer support and a push against industrialized food procurement (Alkon, 2008; Brown & Miller, 2008; Byker et al., 2012). Along with the rise in farmers' market (FM) popularity among consumers and vendors, there has also been a surge of FM research. This growing body of FM literature, however, proposes few systematic assessments of the values embodied in FMs and the role such values might have in the market's economic architectures (Alkon, 2008). The IFOAM[4] organic principles[5] offer a normative framework of values with which to organize and analyze the interactions of FM economic architectures—as in the structure and logistics of farmers' markets—and their values.

Viennese FMs have a long tradition of civic policy assuring food access for city residents, yet during the past two decades, FMs there has been a shrinking in size, a reduction in the amount of days they are open, and a rise in the number of resellers than actual farmers as well as a general decline in overall direct market sales country wide (Schermer, 2008). This paper focuses on the role additional values might have in modernizing Viennese farmers markets and perhaps the possibility of integrating values of other successful markets in order to bolster popularity for both consumers and farmers.

While the focus of this paper is on FMs in Vienna, it stems from research that uses a value-based conceptual framework based on the IFOAM organic principles and those of the Generative Economy[6] to examine the ethics and economics of farmers' markets in two major metropolitan areas, Vienna and Minneapolis. These two developed regions with a large farmers market history and fairly similar climactic and growing seasons exhibit different historical contexts and social situations, and thus offer an interesting comparison of social and environmental values embodied by these markets as economic activities. For the purpose of this preliminary paper, a plethora of values and differing situations of Minneapolis FMs are used to visit the possibility of Viennese markets adopting such values to accommodate a changing customer base. This paper also illustrates the possible benefit of applying and integrating IFOAM principles in the economic

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[4] The International Federation of Organic Movements
[5] The 4 IFOAM principles: **Health**: Organic Agriculture should sustain and enhance the health of soil, plant, animal and human as one and indivisible. **Ecology**: Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them. **Fairness**: Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities. **Care**: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment (IFOAM, 2009).
[6] Generative Ownership Principles**: Living Purpose:** Ownership alternatives to create the conditions for life over long term—i.e. social enterprises, community land trusts, cooperatives, etc**; Rooted Membership:** Ownership in human hands, as opposed to corporations today that have absentee ownership**; Mission-Controlled Governance:** Control by those dedicated to social mission as opposed to governance by markets, where control is linked to share price; **Stakeholder Finance:** Capital as long-term friend as opposed to casino finance of traditional stock market ownership; **Ethical Networks**: Collective support for ecological and social norms (Kelly, 2012).

architectures of farmers' markets and other alternative food outlets around the world, showing the opportunity of extension the organic movement, not only in practices but also in values, may have. Additionally, Viennese markets and Austrian FM in general have seldom been included in scientific literature, therefore this study also aims to add to the very limited literature base on Austrian FMs.

Theoretical framework

While most studies of FMs look more at organizational FM analyses (Stephenson, 2008), by primarily focusing on values when examining FMs, this study uses an analytic framework that draws our attention to the ways in which specific values become rules and norms within the markets' operational architectures. These values, especially organized around Health, Ecology, Fairness and Care (see IFOAM) are expressed in what Kelly refers to as the "ownership design" of markets defined by the their Purpose, Membership, Governance, Finance and Networks (see Generative Economy).

This analytic framework is illustrated in Figure 1. Here, the 5 'principles' of Generative Economy outline the operational architecture—the structure, logistics, and functions of the markets—and are embedded within the IFOAM values. The concept of Generative Economy was used by Kelly to examine ethical businesses; therefore implying a framework that is already value-based. In adding the IFOAM principles to this structure another level of depth helps to understand and assess the predominant values within FMs. This framework has shaped this study. It has influenced how the qualitative interviews have been structured, which key observation points in the participatory observation were selected and has influenced the analysis.

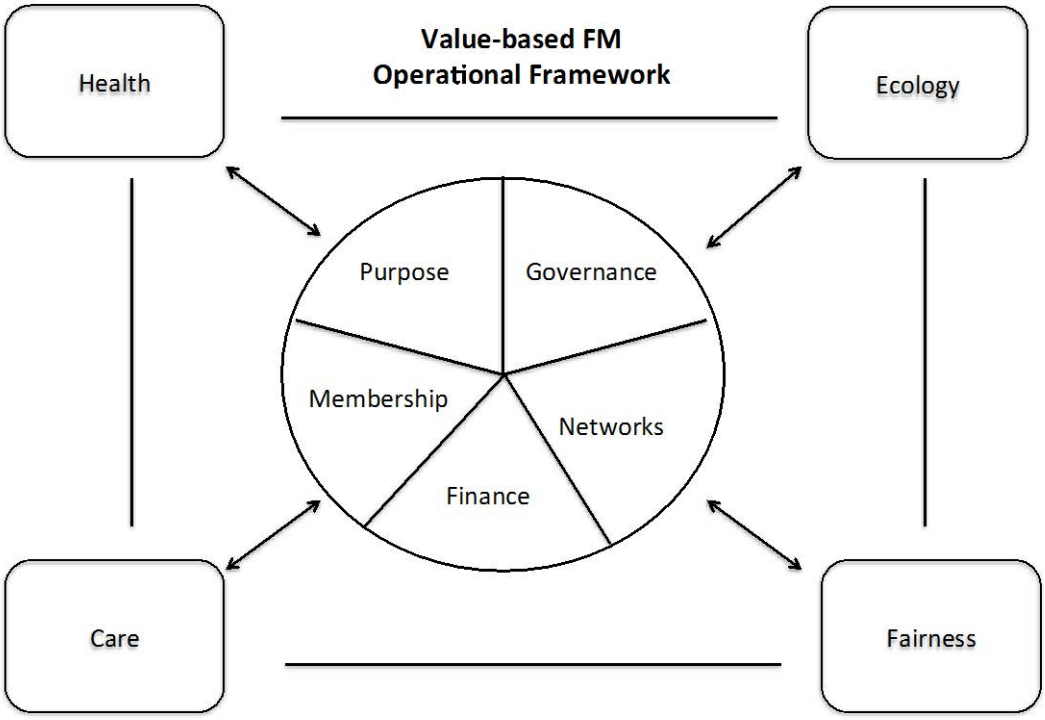


Figure 1. The Value-Based Farmers' Market Operational Framework used

In order to understand the evaluation of FMs better, two examples of Generative Economy principles applied to the operational architectures of farmers' markets would include: for Purpose—mission statements, goals, atmosphere, marketing, etc; for Governance—how is the market run, how is it organized, who makes the decisions, what is the vendor criteria? Moreover, the boundaries of the IFOAM principles are defined in relation to FMs and their accompanying values. These include examples such as: Health—food safety, healthy food, information about nutrition; Ecology—recycling, composting, supporting organic and sustainable practices; Fairness—food access, vendor selection, EBT use (electronic food stamps); Care—community issues, decision making processes, community education.

In addition to adding a level of depth in understanding FM values in the analysis, the IFOAM principles help organize the values to find which ones are acknowledged by the markets in becoming rules and norms. Finally, the principles are also embedded in an agricultural background, specifically an organic one that resonates in a FM context because of the high organic farming participation rate in FMs (Dimitri & Greene, 2000; Trobe, 2001; Rainey et al., 2011).

Methods

Data collection occurred during 2012-2013. 12 farmers' markets, 6 from Vienna and 6 from Minneapolis have been studied. Qualitative interviews, participatory observation and a reoccurring exchange between the researcher and key stakeholders were organized around the Generative Economy principles to be used as guiding categories.

The FM case studies have been preliminarily analyzed using the framework stated above to offer a value-based approach for an exchange of information and ideas between markets within the individual cities and between the markets of Minneapolis and Vienna. To create a holistic picture of the markets a wide-variety of stakeholders—from professionals in the farmers' market field, to market managers, vendors and consumers—as well as repeated meetings with key actors to discuss findings, meanings and relativity to market situations were arranged.

Results

The values, goals and mission statements described by FM managers and individual vendors have been examined to understand their role within FMs and how they may affect or what they may have to offer FMs in Austria and Minnesota.

Initial results for the purpose of this paper show that each of the 6 FMs examined in Vienna illustrated differing and rich characters due to their varied surroundings, vendors and customer basis. However, due predominantly to their governance structure—all city run—nearly every market has the very same goals and values and share these with their permanent market partners (in Vienna almost all FMs have a space to temporarily set up within a permanent market setting that includes textiles and restaurants open every day and also run by the city government), with the exception of the one strictly organic market exhibiting additional values of environmental and social health associated with organic.

The main purpose of the Viennese markets, including the farmers' markets, is the local availability of food. While also important, this purpose does not particularly support an agenda of local, fresh, small farmer products or their producers' values. The fact that FMs are seen as part of an existing permanent market sharing the same purpose and governance structures, inhibits the building of values and goals associated to actual farmers, food and farming rather than traders and resellers of all types of goods. The limited IFOAM principles seen from the market governance are health, in terms of food safety and hygiene and fairness concerning vendor participation due to a lottery system. Among the dwindling individual farmers a few innovative vendors exist that have added environmental and social pieces to their businesses, yet they tend to stand alone or partake in the specific organic market designations.

All 6 of the Minneapolis FMs studied exhibit a plethora of values. Most markets are organized around neighborhoods that rally together and organize and express their values including supporting their small, local farmers. This leads to innovative marketing campaigns and values focused on holistic health—healthy food, environment, farmers and communities. Collectively, the Minneapolis FMs and most of their individual vendors share and uphold a variety of the IFOAM principles, heavily reflecting the surrounding neighborhoods and customer values in which they partake.

Discussion

Initially, the strong following of FMs, sharing the values of the IFOAM normative principles in Minnesota, offers many possibilities to bolster popularity and support for small farmers and FMs in general and could be applicable to Viennese markets. Using this particular theoretical framework, the Value-Based Farmers' Market Operational Framework, offers FM managers and others in the alternative food movement to reflect and evaluate their own practices in a way to connect or reconnect to the original values behind their food communities and membership or customer base.

Viennese farmers' markets may be able to gather support for farmers and communities alike if FMs would be seen as independent entities from the more permanent Viennese markets. This would also allow for a separate purpose with different goals and values influencing the markets daily actions. Tradition is important

in Viennese culture, yet the customer base is changing and many younger and new customers are attracted to a global palate of taste and culture as well as values. The following offers more specific suggestions, taken from many of the Minneapolis observations and interviews that may help to modernize the traditional Viennese markets:

Purpose: Keeping a unified mission may be valuable, especially if it is updated towards more modern values and goals. Yet In order to meld tradition with modern possibilities, encouraging separate purposes or sub-purposes and missions for each individual market, catering to their differing surroundings and a specific customer-base may be beneficial, emphasizing traditional differences of each market yet allowing for new innovation and education.

Governance: The governance of the Viennese markets is often used here as justification for a less-than booming FM atmosphere, yet a motivated and liberated governance structure, of unnecessary bureaucratic technicalities would allow for partnerships to be made and higher involvement in marketing issues, selection, customer input, and vendors.

Membership: Increased small farmer integration can be instilled with more benefits as being part of a member i.e.—marketing, publicity, steady customer flow, and allowance of vendor participation in some market affairs.

Finance: Some of the finances could be covered by an organizational allowance—i.e. a farmers association, or organization of the farmers in the market—or through external sponsors with similar values that are allowed to participate in educational opportunities at the market.

Networks: Closer networks to the department of agriculture and the economic chamber of trade could be made to increase small farmer awareness and aid as well as marketing, and additionally invaluable would be networking with local businesses, restaurants, schools and organizations near and around each individual market.

These comparative farmers' market case studies permit the understanding of the logistics and values of farmers' markets in two cities independent of each other and across two continents. Preliminarily, a lack of prevalent values and ethics in Viennese markets due to the predominant market governance structure lead to a fragmented identity and purpose. The shared knowledge of this research should help both researchers and farmers' market managers to exchange information and ideas, specifically the modernization of the current FM instilled values in Vienna, which may contribute to the needed support of smaller farmers and ultimately the success of the FMs.

References

Alkon, A. H. (2008). From value to values: Sustainable consumption at farmers markets. *Agriculture and Human Values 25*/4, 487-498.

Brown, C., & Miller, S. (2008). The impacts of local markets: a review of research on farmers markets and community supported agriculture(CSA). *American Journal of Agricultural Economics 90*/5, 1298-1302.

Byker, C., Shanks, J., Misyak, S., & Serrano, E. (2012). Characterizing Farmers' Market Shoppers: A Literature Review. *Journal of Hunger& Environmental Nutrition 7*/1, 38-52.

Dimitri, C., & Greene, C. (2000). Recent growth patterns in the US organic foods market. *Agriculture information bulletin 777*.

IFOAM. (2009). The Principles of Organic Agriculture. Retrieved 07/09, 2011, from http://www.ifoam.org/about_ifoam/principles/index.html

Kelly, M. (2012). *Owning Our Future: The Emerging Ownership Revolution*: Berrett-Koehler Publishers.

Rainey, R., Crandall, P. G., O'Bryan, C. A., Ricke, S. C., Pendleton, S., & Seideman, S. (2011). Marketing Locally Produced Organic Foods in Three Metropolitan Arkansas Farmers' Markets: Consumer Opinions and Food Safety Concerns. *Journal of Agricultural & Food Information 12*/2, 141-153.

Schermer, M. (2008, 6-10 July). *The Decline of Farmers Direct Marketing in Austria: consequences and counter strategies.* Proceedings of the 8th European IFSA symposium

Stephenson, G. O. (2008). *Farmers' Markets: Success, Failure, and Management Ecology*: Cambria Press.

Trobe, H. L. (2001). Farmers' markets: consuming local rural produce. *International Journal of Consumer Studies 25*/3, 181-192.

The Deeper Meaning of Growth in an Organic Context

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Key words: organic, growth, IFOAM Principles, markets, plants

Abstract

In this paper, which represents parts of a broader study on growth, we reflect upon the notion of growth in the organic agrofood chain from a philosophical point of view. Our objective is to identify characteristics of growth in an organic context. We first look at growth of the organic movement as a whole, and demand and supply. We then study the meaning of growth in the context of soils and plants. The IFOAM Principles orient the meaning of growth in the organic agrofood system. With these reflections we wish to initiate a debate on a deeper understanding of growth in the organic movement.

Background

We are living in a time of rapid intensification of agricultural production, which is accompanied by many negative consequences for environmental, social and economic justice (e.g. Stoate et al., 2001; Trigo & Cap, 2004). Different concepts are debated about how to establish sustainable agriculture (Rigby & Cáceres, 2001) and redefine growth (Pretty, 2008). There is a need to critically discuss what kind of production growth is needed to feed the world (Ehrlich & Ehrlich, 2013; Seufert, Ramankutty, & Foley, 2012). We therefore ask, if the organic movement could provide an alternative understanding and practice of growth, that contributes to a more sustainable agriculture and food production?

Methods

Our understanding of growth is framed by the IFOAM Principles, thereby defining growth in an organic context (IFOAM, 2009). In order to understand how the term growth is applied in the organic agrofood chain, we study the growth of organic farms, market supply and demand as one socio-economic case, and soil-plant-interactions and related management as a second production oriented case. Each analysis represents only a part of a broader ongoing transdisciplinary discourse on growth in our working group and with colleagues from other disciplines[3].

IFOAM Principles and the meaning of growth

From an ethical point of view, the characteristics of growth in organic should align with the ethical foundation of organic, i.e. the IFOAM Principles (Luttikholt, 2007). Consequently, each sector of the organic agrofood chain should apply the principles in order to generate their specific interpretation of growth.

Table 1: IFOAM Principles

Principle of health: Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.
Principle of ecology: Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
Principle of fairness: Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
Principle of care: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

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Growth of the organic movement within a supply and demand system

A preliminary search for "organic agriculture and growth" in Google™ is enough to supply instructive themes to structure our debate. There is first the statistics on organic growth worldwide (Willer & Kilcher, 2012). This report informs us e.g., about the growth rates of organic farms in more than 100 countries. Scialabba and Hattaam (2002) provide insights into the meaning of growth in the organic system: growth rates on farms, markets, production. If annual growth rates of organic farms of 100% represent a growth dynamic that fits into the IFOAM Principles, depends on the base level of farms, demand and supply characteristics and quality of farmer practices. For example, soil degradation and water polluted by pesticides in many areas of the world (Pimentel et al., 1995) could be, from a moral point of view, a duty to ask for a rapid growth of organic farms. So far 100% increase of organic farms per year are from that perspective acceptable growth rates to solve an environmental conflict. A rapid growth of organic product supply without growth of demand for organic products would weaken the producer's economic security. Several authors introduce that growth of production and supply not only has positive impacts. Obach (2007) argued based on treadmill theory that the risk of decreasing environmental benefits resulted from the economization of the organic agrofood chain. Furthermore, the industrialization and commodification of organic production has been criticized as contradicting the principle of fairness (Allen & Kovach, 2000; Dimitri, Oberholtzer, & Wellson, 2007; Guthman, 1998; Obach, 2007). Both intensification and industrialization of organic production reduces the good reputation of organic as the most environmentally sustainable agricultural food system (SRU, 1987) and could result in de-growth in the sector.

A further central element to discuss growth is the organic price. The picture about organic price development in terms of growth is rather unclear. While distribution channels in non-supermarket structures take a great risk when they offer product prices only for high income consumers (Michelsen, Hamm, Wynen, & Roth, 1999), discounters price level for organic products and payment for organic farmers is decreasing. There is still debate about how to determine what price for organic products will motivate farmers, traders and consumers to convert to organic and thereby contribute to further growth of the organic agrofood chain (Browne, Harris, Hofny-Collins, Pasiecznik, & Wallace, 2000). Concentration of market structures increases the dependence of farmers upon those structures (Lockie & Halpin, 2005) empowering the growth from a minority, and limit that of smallholders. Contrary diverse direct market structures also provide diverse opportunities for the growth of smaller production and market units (Buck, Getz, & Guthman, 1997; Gil, Gracia, & Sanchez, 2000). Higher demand than supply would increase organic prices leading to unjust market conditions for consumers and increase the risks of fraud. Growth in the organic context, therefore, asks for diversified market structures, distributed power and growth rates between supply and demand coordinated as a balanced process. Farmers converting to organic must develop their own market actively, instead of simply throwing products onto the market. They become more responsible for their products from the beginning of production until they have reached the consumer. Furthermore, conversion includes a long learning process and systems change, which teaches us that in order to be sustainable, the growth of the organic agrofood chain from that perspective is a slow process.

Growth of plants

Humus content as one of the main factors for defining soil fertility is a result of a long-term processes (Berg, Hannus, Popoff, & Theander, 1982). The humus level of a soil built over ten years could be destroyed in one season, meaning that a long-term (slow) growth of humus faces a short-term (rapid) de-growth. In contrast to non-organic high soluble fertilizers, the bound and less soluble provision of soil minerals, their availability through soil organisms (e.g. Fließbach, Mäder, & Niggli, 2000; Gosling & Shepherd, 2005), slow release and cycling of nutrients (Altieri, 1999; Tilman, Cassman, Matson, Naylor, & Polasky, 2002) and dominance of organic matter as nutrient source, all lead to slower plant growth processes than in a non-organic farming system (Stockdale, Shepherd, Fortune, & Cuttle, 2002). The demand for long-term trial research in organic is the logical consequence to the slow growth processes of change from a non-organic to an organic soil quality (Birkhofer et al., 2008; Heinze, Raupp, & Joergensen, 2010; Watson, Atkinson, Gosling, Jackson, & Rayns, 2002). Plant yields in organic is based on living ecological systems and cycles, which are expressed through the distribution of energy from sun through photosynthesis into harvest products as well as soil fertility via root biomass. The broader idea beyond this practice is ensuring the well being of current and future generations and the environment. This makes explicit that growth is rooted in the idea of budgeting in a long-term perspective; and it is about diversity to ensure a healthy system (IFOAM, 2009).

Conclusion

Organic is not about "without growth" or "de-growth". However it is about what kind of growth and under which conditions (c.f. Jackson, 2011). The understanding of growth is systemic and case specific, based on one's own resources, interactions and feedback loops between a system and its environment, a long term adaptation process, a harmony and "dynamic equilibrium" between human and nature (Magdoff, 2012), where overall orientation is given by the IFOAM Principles. Obviously there is a potential for growth through further developing the organic system: the number of farms could, for example, increase together with an investment into trade forms that do not contradict the principles on social justice; and through practices, e.g., through recycling organic matter and nutrients (Haq & Cambridge, 2012) without harming the Principles. These reflections should open a debate on an organic standpoint of the meaning of growth that could serve for further critical thoughts and provide impulses for the societal debate on growth. However, these reflections represent preliminary thoughts on this topic.

References

Please contact the main author for detailed reference list.

Effects of organic fertilizers on the seed germination and seedling vigour of tomato

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Key words: trichocompost, vermicompost, kitchen waste compost and tomato seedling

Abstract

An experiment was carried out in the net house at Bangladesh Agricultural Research Institute, Gazipur during the season, 2011 to evaluate the seed germination and seedling growth of tomatoes as affected by different organic fertilizers. There were five treatments viz. trichocompost, vermicompost, kitchen waste compost, cowdung based bioslurry and control (soil). Treatments significantly influenced the germination and seedling growth. The results showed germination percentage and co-efficient of germination were significantly higher in trichocompost which was identical with vermicompost and cowdung based bioslurry but different from kitchen waste compost and control, Similarly the seedling growth characters like root length, shoot length, number of leaves, number of roots, fresh and dry weight of 10 seedlings and effectiveness against damping off disease were significantly highest in the treatment media of trichocompost which reflected on higher vigour index in the same treatment. However, there was no significant variation among the treatments in respect of root and shoot length ratio. The results suggest that trichocmpost and vermicompost are suitable for raising healthy seedlings in organic tomato production.

Introduction

The prerequisite for successful organic tomato production is to have strong and healthy seedlings in due time. Accordingly, usages of organic growth media like trichocompost, vermicompost, cowdung etc. in pot could possibly be one of the effective techniques for rasing seedlings in organic production system. Such organic fertilizers can be an effective alternative to chemical fertilizers as they contain high levels of nutrients and organic matter (Shabani *et al*., 2011). Sometimes farmers face problems to raise tomato seedlings in due time due to adverse environmental conditions like rainfall. This technique has the potential to use in adverse condition as the pots can be easily moved in safe places and ultimately facilitates the production of tomato seedlings in due time. Hence, this study was undertaken to evaluate the effect of organic fertilizers as potting amendment on seed germination and production of healthy tomato seedling.

Material and methods

The experiment was conducted at the central farm of Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, Bangladesh in 2011. The experiment was laid out in a randomized complete block design with three replicates. This experiment included five different treatments like Kitchen Waste Compost, Vermicompost, Trichocompost, Cow dung based Bioslurry, and Soil (control**).** They were analyzed following proper methods just after have been received. Plastic pots measuring 15 cm x 12cm x 7 cm (1260 cm^3) were used for raising the seedlings. 10 pots were used for each of treatment and thus fifty pots for each replication. Sterilized soils were mixed with individual organic fertilizer at the ratio of 50:50 (Soil:Fertilizers by volume) for potting. Ten (10) seeds were sown in each pot. The speed of emergence was determined by counting the number of seeds emerged at twenty four (24) hours interval immediately after sowing. The criterion used for seed germination was taken as emergence of 2 mm radicle at the time of observation (Odoemena, 1988). Germination counts were recorded until 21 days after sowing. The germination percentage of the seeds was finally determined for each of the treatments. Co-efficient of germination was calculated using the following formulae (Copeland, 1976). Coefficient of Germination, $CG = (A_1 + A_2 + \ldots + A_x)/ (A_1T_1 + A_2T_2 + \ldots + A_xT_x)100$. Where, CG = Co-efficient of Germination (%), A = Number of seeds germinated, T = time corresponding to A, X = number of days to final count. For determination of seedling vigour index 10 seedlings were randomly selected from each treatment and their individual shoot and root length were measured. The vigour of the seedlings was determined by following the formula of Abdul-Baki and Anderson (1973). Vigor index = [mean of root length (cm) + mean of shoot length (cm)] × percentage of

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seed germinations. After 21 days, the growth parameters were estimated after uprooting and cleaning the seedlings. Different parameters were recorded with appropriate measures. The fresh weight and dry weight (in grams per 10 seedlings) was measured with a digital weighing balance. Damping off disease incidence of infected seedlings was recorded and calculated by using the following formula, % Disease incidence = (Number of infected seedling) x 100/Number of inspected seedling. Percentage data were transformed to square root and were analyzed including other data by using MSTAT-C program.

Results

The analyzed report of different compost materials is furnished in Table 1 and it revealed that trichocompost contained more nutrients which was followed by vermicompost.

Table1. Result of the chemical analysis of different kinds of compost

Types of compost	Nutrient content					
	N (%)	P(%)	K(%)	S(%)	Ca (%)	Zn (ppm)
Trichocompost	1.63	1.18	1.46	0.52	1.73	186.0
Vermicompost	1.71	1.07	1.31	0.44	1.43	139.0
Paragon compost	1.57	0.87	1.04	0.37	1.03	112.0
Kitchen waste compost	1.38	1.09	1.12	0.41	0.89	136.0
Cow dung based bioslurry	1.42	0.93	1.25	0.33	0.92	126.0

The seed germination percentage was significantly (P=0.05) affected by different types of organic fertilizer and ranged from 65.3 to 94.0 (Table 2). The highest seed germination was recorded in trichocompost which was statistically similar to vermicompost and the least performance was observed in case of kitchen waste compost which was identical with control (soil). Significant variation was also observed in case of co-efficient of germination (%). Trichocompost gave the best performance in co-efficient of germination velocity (12.9) which was statistically similar with vermicompost and cow-dung based bioslurry while poor performance (8.9) was observed in case of kitchen waste compost even less than the control. The longest root (16.0 cm) was found in trichocompost which was followed by vermicompost and the shortest root (6.0 cm) was appeared in case of kitchen waste compost.

Table 2. Effect of organic fertilizers on germination and seedling growth of tomato

Treatment	% Germination	% Co-efficient of Germination	Root length (cm)	Shoot length (cm)	Vigour index
Kitchen Waste Compost	65.3 c (8.1)	8.9 c (2.9)	6.0 c	3.0 c	587.9 e
Trichocompost	94.0 a (9.7)	12.9 a (3.6)	16.0 a	9.0 a	2351. 0a
Vermicompost	90.0 ab (9.5)	11.8 ab (3.4)	13.3 a	7.8 a	1899.0 b
Cowdung based bioslurry	86.0 ab (9.3)	11.4 ab (3.4)	10.2 b	5.4 b	1340.0 c
Control (Soil)	77.3 bc (8.8)	10.8 b (3.3)	8.3 bc	4.0 bc	939.0 d
CV(%)	6.2	8.6	10.3	11.0	13.1

Figures in the parenthesis indicate the transformed value; in a column, figures having the same letter(s) do not differ significantly by DMRT at the 5% level; NS – Not Significant.

Table 2. Contd.

Treatments	No. of leaves	No. of roots	Fresh wt. of 10 seedlings (g)	Dry wt. of 10 seedlings (g)	Root/ shoot length ratio (NS)	% Damping – off infected seedling
Kitchen Waste Compost	3.1 c	4.0 c	1.5 c	0.15 e	2.02	16.30 b (4.037)
Trichocompost	6.1 a	12.3 a	7.8 a	0.71 a	1.78	5.200 d (2.27)
Vermicompost	5.3 ab	9.4 b	6.6 a	0.61 b	1.73	12.40 c (3.518)
Cow dung based bioslurry	4.3 bc	11.5 a	3.5 b	0.37 d	1.88	15.10 b (3.886)
Control (Soil)	4.1 bc	9.1 b	3.5b	0.46 c	2.06	19.50 a (4.413)
CV(%)	9.2	7.6	9.7	7.70	9.56	8.48

Shoot length followed the similar trend and ultimately these impacts were significantly attributed in case of vigour index. It ranged from 2351.0 to 587.9 and the highest vigour index was found in case of trichocompost while kitchen waste compost gave the lowest vigour index. More or less similar trends were observed in case of root and shoot number, fresh and dry weight of 10 seedlings. However, no significant difference was observed among the treatments in case of root and shoot length ratio although highest ratio (2.06) was found in case of control. Irrespective days after sowing, the highest effect against damping off disease was recorded in trichocompost (5.20%) and was followed by vermicompost while the poor performance (19.5%) was found in control.

Discussion

Trichocompost gave the best performance might be due to the synergistic effect of compost and trichoderma in increasing the root surface area per unit of soil volume, water use efficiency and photosynthetic activity of seedlings in addition of higher nutrient contents in trichocompost which had been reflected in sample analysis. It also gave the better performance against damping off disease which is in agreement with the findings of Islam *et al.,* 2007; and Manoranjitham *et al.,* 2000. In most cases, the performance of trichocompost was followed by vermicompost. This finding was supported by many investigators (Arancon *et al.,* 2003; and Atiyeh *et al*., 2002) who reported that worm worked waste and their excretory products (vermicast) can induce excellent seed germination and enhanced rate of tomato seedling growth. However, kitchen waste compost gave the poor performance could be due to presence of heavy metal like lead and copper which was observed by Jaja and Odoemena (2004).

Suggestions to tackle with the future challenges of raising seedlings in organic tomato production

The findings of the present study concluded that potting media with trichocompost and vermicompost offered better performance in producing faster emergence of seedling with higher vigority and healthy those had the potential against damping off disease in tomato.

References

Abdul-Baki A & Anderson JD (1973). Vigour determination of soybean seed by multiple criteria. Crop Science 3, 630-633.

Arancon NQ, Edwards CA, Biennan P, Metzger JD, Lee S & Welch C (2003). Effects of vermicomposts to tomatoes and peppers grown in the field and strawberries under high plastic tunnels. Pedobiologia 47, 731-735.

Atiyeh RM, Lee S, Edwards CA, Arancon NQ, & Metzger JD (2002). The influence of humic acids derived from earthworm-processed organic wastes on plant growth. Bioresource Technology 84, 7-14.

Copeland LO (1976). Principles of seed science and technology. Burgess Pub. Com., Minneapolis, Minnesota, pp 164 - 165.

Islam MT, Islam MR, Aminuzzaman FM & Yesmin S (2007). Management of Damping off of Vegetable seedlings through some selected Soil amendments and Chemicals. Journal of Agricultural Science and Technology 8(2), 27-31.

Jaja ET & Odomena, CSI (2004). Effect of Pb, Cu and Fe on the germination and early seedling growth of tomato varieties. Journal of Applied Science and Environment Management 8(2), 51 – 53.
Manoranjitham SK, Prakasan V, Rajappan K & Amutha G (2000). Effect of two antagonists on damping off disease of tomato. Indian Phytopathology, 53 (4), 441-443.
Odoemena CS (1988). Breaking of seed coat dormancy in a medicinal plant *Tetrapleura tetraptera.* Journal of Agricultural Science (Cambridge) 111 (2), 393 – 394.
Shabani H, Peyvast G, Olfati JA & Ramezani PK (2011). Effect of municipal solid waste compost on yield and quality of eggplant. Comunicata Scientiae 2(2), 85-90.

Participatory Videos: A New Media for Promoting Organic Farming in Northern Bangladesh

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Key words: media, participatory, video, organic, farming & Bangladesh

Abstract

Organic farming in Bangladesh is still operated by NGOs and private sector due to lack of proper attention from public sector. Thus, use of effective media is very essential in its mass promotion. The present study showed that farmers led participatory videos have the potentials to show the worth of organic farming (i.e., vermi-compost & botanical pesticides) as well as convincing the farmers towards adopting organic farming as these sorts of videos are made on their voices and actors are also their peer groups.

Introduction

Bangladesh is a very small country in South Asia with 160 million people. Agriculture is the lifeblood of its economy which contributes 19.95% in GDP and 21.34% in total employment (BBS, 2011). However, sustainability of agricultural system, poverty and food security is great concerns in the country. Department of Agricultural Extension is the leading organization here in responsible for promotion of latest agricultural technologies to ensure sustainable agricultural growth. To fulfill this goal DAE adopted the New Agricultural Extension Policy (NAEP) in 1999 targeting *"Integrated Environmental Support"* as one of the major components.

However, it is observed that total consumption of pesticides has doubled in the last two decades (MOA, 2010). The use of pesticide is much higher in vegetable which are harmful for human health. The chemical based agricultural system of the country is aggravating environmental degradation and cause of 5-10% of the GDP cost (BBS, 2011). On the other hand due to increasing health awareness among the consumers demand of organic food is increasing sharply both in national and international context.

Organic farming movement has been started in Bangladesh in 1978 with the support of few NGOs. However, the public sector extension organizations don't have any initiative to promote organic farming in Bangladesh. This is due to misperception of the policy makers and partly due to lack of creative and innovative ways to support farmer-to-farmer learning. However, poverty elimination through rice research assistance (PETRRA) project has successfully used videos in disseminating innovation in rural extension program in Bangladesh (Salahuddin *et al.*, 2008). Video is not a new media used for agricultural extension activities in Bangladesh. However potential use of this media is more often remained within mass media (e.g. TV) and classroom training material in Bangladesh (DAE, 1999). PETRRA introduced video mediated learning approach in combination with participatory learning and action research (PLAR) and FFS to reach out poor men and women rapidly (Van Mele & Braun, 2005). Thus, the researchers decided to use participatory videos as a medium of extension to promote organic farming in northern Bangladesh and took the project entitled "Fostering Women Voices through Videos in Bangladesh" which is organizing the female farmers under the umbrella of participatory rural video centre (from hereafter PV centre). Use of videos in the extension services is not merely new, however the concept of participatory video is really new in the context of Bangladesh. Participatory video is a form of participatory media in which a group or community creates their own film. The idea behind this is that making a video is easy and accessible, and is a great way of bringing people together to explore issues, voice concerns or simply to be creative and tell stories. PV process can be very effective in empowering, enabling a group or community to take their own action to solve their own problems, and also to communicate their needs and ideas to decision-makers and/or other groups and communities. Thus the project promotes farmers' innovation (botanical pesticide) through videos for its rapid expansion in the study area for curbing down environmental pollution and enhances household food production.

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Material and methods

The project entitled "Fostering Women Voices through Videos in Bangladesh" has been implemented in the north-west region of Bangladesh since 2010. One of the project is village Kamarpara under Bogra district which is famous for vegetable cultivation. Farmers of this village were completely dependent on using chemical fertilizers and pesticides while cultivating vegetables and other crops. Due to over utilization and regular price hike of agro-chemicals many of them led to quit farming in the recent years. Thus the project took the initiative to train up the local farmers especially women regarding utilization of alternatives of agro-chemicals. After attending the training program PV team members concentrated on participatory research to solve their problems of chemical pesticides and develop a botanical pesticide from locally available plants (i.e., *Azadirachta indica, Polygonum tomentosum, Adhatoda vasica, Aphanmixis polystachya and Swietenia mahagoni)* for insect and disease pest management of their crops. Video developed through ZIZO has been coined as farmer-to-farmer video in recent publications (Van Mele, 2006).

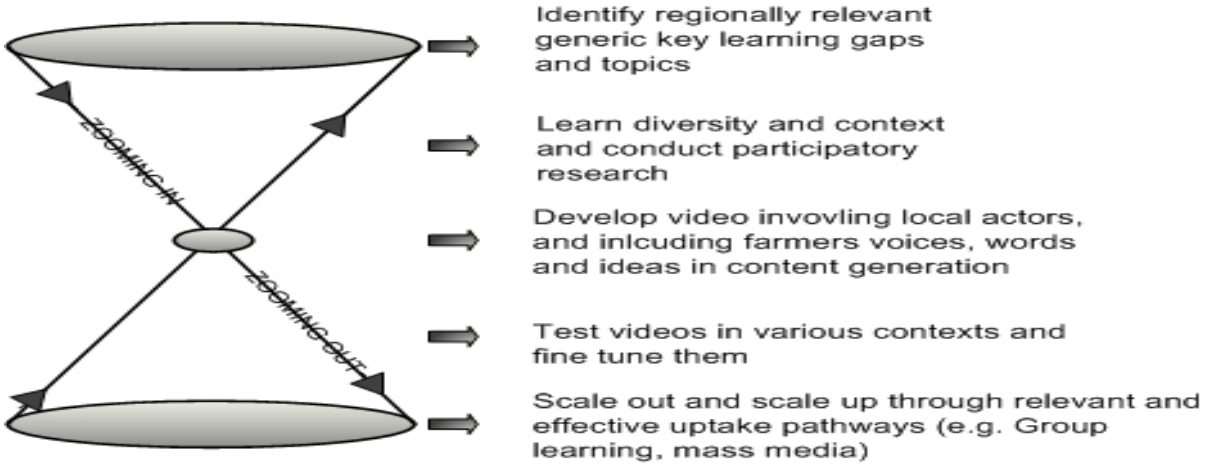


Fig. 1 Zooming in zooming out (ZIZO): a new approach for developing video and learning tools to scale out sustainable agricultural innovations

The project also trained up the PV team on preparation and use of vermin-compost. In later stage 02 participatory videos (preparation and use of botanical pesticides & preparation and use of vermin-compost) were prepared with the PV team and these videos were projected among 600 female farmers from 06 (six) different districts of northern and north-eastern part of Bangladesh for scaling out. Necessary data for the present study were collected from the records of the project as well as from Focus Group Discussion (FGD) with the PV members.

Results

Through participatory research PV members of Kamarpara, Bogra has developed vermin-compost and botanical pesticides. To promote this outcome of participatory research after getting participatory video development training PV members has developed two separate learning videos (preparation and use of vermin-compost and preparation and use of botanical pesticides) following ZIZO approach. They are also projecting these videos among the people of the farming communities of Bogra and neighboring Gaibandha and Rangpur districts. The main intention of video projections were to increase adoption of organic farming for improving sustainability of agricultural systems as well as curbing down environmental pollution and ensure supply of safe food.

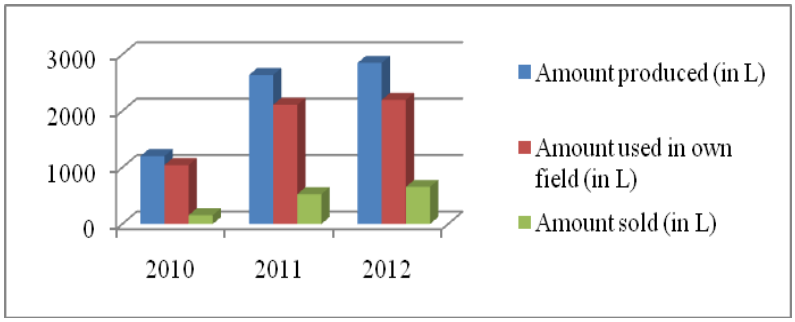


Fig. 2 Trends of production, consumption and sale of botanical pesticide by the PV members (2010-2012)

Like botanical pesticide PV members of Kamarpara are producing vermi-compost for using their crop fields to supplement chemical fertilizers. After using their crop fields PV members sale addition amount of vermin-compost to neighbors which is contributing to some extent in improving their income. As majority of the PV members are woman so with this addition income they are contributing in their household income which is ultimately empowering them in the society.

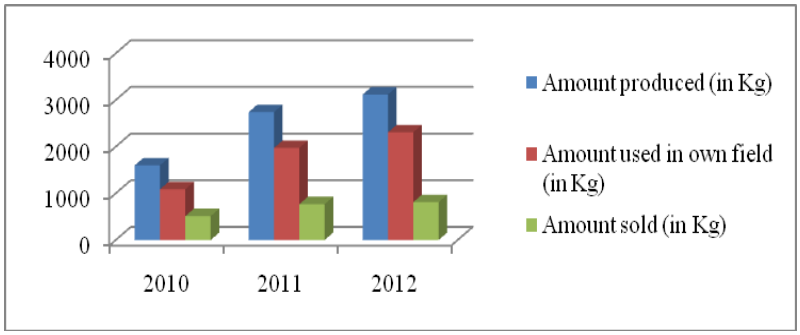


Fig. 3 Trends of production, consumption and sale of vermi-compost by the PV members (2010-12)

Discussion

Results of the study showed that PV team of Kamarpara, Bogra has produced 6,689 liter botanical pesticide in 03 (three) years (2010-12) among which PV members used around 80% in their own crop fields and rest 20% they sold to the community members. With this amount of botanical pesticide they have covered around 465 acre of vegetables crops (shown in Table 1).

Table 1: Calculation for pesticide (botanical & chemical) for 1 acre brinjal field

Item	Botanical	Chemical
Amount of l pesticide require	50 ml	5 g
Number of spray require in the entire season (@ 4 spray in each month)	16	16
Amount of pesticide require for 1 acre brinjal field in the entire season (@900 ml per spray)	14.4 liter/acre @900 ml/spray	960 g/acre @60 g/spray
Money required	720 BDT @50 BDT/Liter	8640 BDT @90 BDT/10g

On the other side, the scenario is quite different in case of using for cultivating the same crop in the same amount of land with chemical pesticide. From Table 1 it is clear that botanical pesticide can save 7920 BDT or 99 USD (1 USD=80BDT) from 1 acre brinjal field. Thus the PV centre of Kamarpara, Bogra has contributed in saving (99×465) 46035 USD chemical pesticide cost with their produced botanical pesticide. Similarly, PV members has saved huge amount chemical fertilizer's cost with their produced vermi-compsot. In the scaling out face PV members have a target to demonstrate their produced learning videos directly among 600 farmers of six districts of north-east and north-west regions of Bangladesh. This endeavor obviously motivated huge amount of farmers to produce and use more amount of botanical pesticide and vermi-compost in organic crop cultivation.

Suggestions to tackle with the future challenges of organic farming extension through video-mediated learning

It is evident from the study that participatory videos are significantly contributing in adoption of botanical pesticide and vermi-compost among the people of the farming community in the study area. Observing the success of the PV members neighbors, relatives and other community members of the study area have realized the importance of using botanical pesticide and vermi-compost in crop production and started to practice these environmentally friendly cultivation methods. In addition PV members are earning additional income from filming of various social programs like birthday, marriage ceremony etc. in their locality which is really contributing in adoption of organic farming as well as empowering the rural women in the study area. Hope this model will contribute to our journey towards rapid expansion of organic farming Bangladesh.

References

BBS. (2011). Statistical Pocket Book of Bangladesh. Bangladesh Bureau of Statistics. Ministry of Planning, Government of the People Republic of Bangladesh.

Salahuddin, A., Van Mele, P. & Magor, N. P. (2008). Pro-poor values in agricultural research management: PETRRA experiences in practice. *Development in Practice, 18*(4), pp. 619 - 626.

Van Mele, P. (2006). Zooming-in zooming-out: a novel method to scale up local innovations and sustainable technologies. *International Journal of Agricultural Sustainability, 4*(2), pp. 131-142.

Van Mele, P. & Braun, A. (2005). Methodological diversity and creativity in agricultural innovation systems. *PLA Notes, 53*, pp. 74-79.

The effect of tillage practices on a leek crop's nitrogen utilisation from a grass-clover sward

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Key words: grass-clover ley, leek, soil tillage, green manure, nitrogen availability, residual mineral nitrogen

Abstract

A grass-clover ley may serve to build soil fertility. However, destruction of the sward may result in a high mineral N content in the soil profile in autumn. We have therefore investigated if non-inversion tillage is feasible for destruction of a grass-clover sward. We also examined how mode and timing of destruction would affect the N availability as reflected by total N uptake of the subsequent main crop leek (Allium porrum) and the residual mineral N. Early destruction in March appeared to be the least favorable option due to the highest residual mineral N content at values of total plant biomass and N uptake not higher than those obtained after late destruction of a repetitively mulched grass-clover sward. Non-inversion tillage proved to be successful for destruction of a grass-clover sward. It did not lower total plant biomass and N uptake by leek when compared to mouldboard ploughing. Grass-clover management history and time of destruction were decisive for the N availability.

Introduction

Conservation agriculture practices in organic agriculture include reduced tillage and permanent soil cover with green manures. Destruction of green manure crops by non-inversion tillage presents some challenges in organic agriculture, such as a greater pressure from weeds (Peigne et al. 2007). A grass-clover ley may serve to build soil fertility. Biologically fixed N by clover will be recovered by the subsequent main crop. However, destruction of the sward may cause a high mineral N content in the soil profile in autumn. Our first research hypothesis was that mode and timing of sod destruction would affect N availability as reflected by total N uptake of the subsequent crop and residual mineral N. Our second hypothesis was that residual mineral N, total plant biomass and N uptake would be affected by the tillage method, either conventional (mouldboard ploughing) or reduced by non-inversion tillage using a chisel plough. Would non-inversion tillage be sufficient for sod destruction?

Materials and methods

The effect of green manure in a reduced tillage system was assessed in a multi-year field trial at the Institute for Agricultural and Fisheries Research (ILVO) located in Flanders, Belgium. A grass-clover ley (*Lolium perenne*, *Trifolium pratense* and *Trifolium repens*) was established in September 2010 after flax (*Linum usitatissimum*). It was either mown and harvested or mulched during the 2011 growing season. In 2012, the ley was destroyed either on March 19th (gm 1) or on May 18th (late destruction). In case of late destruction, two variants occurred: 1) cutting and removal of a full-grown grass-clover sward (gm 2) and 2) repeated mulching of a grass-clover sward (gm 3). The method of destruction for all three treatments was to cut above-ground plant parts from the root system using an Actisol equipped with goosefoot shovels in a shallow setting and then to use a rotary harrow. For preparatory soil tillage just before planting leek (*Allium porrum*) on June 20th, we used either conventional tillage with a mouldboard plough (CT) or reduced non-inversion tillage (RT) with the Actisol down to a depth comparable to mouldboard ploughing. Combining three green manure variants and two tillage methods resulted in six soil management treatments. These treatments were arranged in the field according to a split-plot design with four replicates and with tillage as the main plot factor and green manure as the subplot factor. Individual subplots were 7.5 m by 30 m. In 2012, the N release from the grass-clover green manure and utilisation by the leek crop was examined. No fertilisers were applied. The N input by the grass-clover green manure (below- and aboveground plant parts) was determined for the different green manure variants. With regard to gm 3, the plant shoot biomass and N content were determined just before mulching on March 14th, April 16th and May 8th. The N amount

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determined in plant shoots on March 14th was also representative for gm 1. The N yield of the full-grown grass-clover sward (gm 2) was determined just before mowing on May 8th. At every turn, grass-clover was mown and collected on 4 strips of 1.6 m by 4 m for each replicate. Stubble biomass and N content were determined on gm 2 plots of each replicate by collecting the stubble on four times 0.16 square meter after removal of the full grown cut on May 8th. Root biomass and N content were determined by digging out soil cores with an upper surface of 0.01 square meter in the 0-15 and 15-30 cm soil layers of gm 2 plots on April 3th. Four soil cores were taken per replicate. Roots were separated from soil particles by washing and sieving. The N input from stubble and root system was assumed to be equal for the different green manure treatments, although differences probably exist but would be rather small compared to differences in plant shoot biomass. Regrowth of the destructed grass-clover sod was assessed in a semi-quantitative manner. Just before main tillage operations, the degree of coverage by grass clumps (%) was estimated on June 15th. On August 1st, the number of grass clumps were counted under the leek crop.
At leek harvest on October 30th, total plant biomass, dry matter, N content and residual mineral N (i.e. NO_3^--N & NH_4^+-N) in the soil profile (0-90 cm) were determined. The ratio between the mineral N content of the 0-60 cm soil layer and that of the 0-90 cm soil layer was calculated (Nmin 0-60 : Nmin 0-90).
Mineral nitrogen content was extracted (1:5 w/v) in a 1 M KCl solution according to ISO 14256-2 and measured with a Skalar SAN++ continuous flow analyzer. Soil moisture content was determined as the weight loss at 105 °C. To determine plant parts dry matter content, crop subsamples were dried in a ventilated oven at 70°C during at least 48h. Their N content was determined on ground dried plant material according to the Kjeldahl method (ISO 5983-2).
Split-plot ANOVA was applied (Gomez and Gomez 1984). If a significant interaction was found between the tillage and green manure factor, data analysis was continued per variant of the tillage factor. The Scheffe method was applied for multiple comparison of the means of the green manure variants.

Results

The coverage by grass clumps just before main tillage operations was 2.3, 3.4 and 3.8% for gm1, gm 2 and gm 3, respectively. Coverage was significantly different between gm 1 and gm 3 ($P<0.05$). Grass clumps did not hinder plant bed preparations after RT nor after CT. The number of grass clumps on August 1st was low under CT (< 1 per 100 m^2). Under RT, 9, 30 and 28 grass clumps per 100 m^2 were counted for gm1, gm 2 and gm3 (mainly in the plant rows), respectively. A significant difference appeared between gm 1 and gm 2 ($P<0.05$). However, these numbers were manageable by mechanical weed control and some hand-weeding.
Rather high differences between fresh organic matter and N input were observed between the green manure variants (Figure 1). For gm 1, where a short canopy was cut and left as mulch on the field, the N input was 46 kg N ha^{-1} higher than the input for the gm 2 variant (where a full grown cut was removed)(Figure 1). The highest N input was obtained by gm 3 (three times repeated mulching). Differences in total plant biomass of leek and N uptake by leek were consistent with differences in the measured N input by grass-clover: a significantly lower N uptake was observed for gm 2 compared to gm 1 and gm 3, and a significantly lower total plant biomass for gm 2 than for gm 3 (Table 1). The soil organic N buildup by the grass-clover ley previous to the introduction of the green manure variants was assumed to be equal for the whole field or at least for the different replicates. It did not mask the differences in N availability caused by the more recently formed N, as Hansen et al. (2005) concluded in their study of residual N effects of grass-clover leys of different ages.

An interaction occurred between both factors affecting residual mineral N. In case of CT, early destruction (gm 1) showed a significantly higher residual mineral N than late destruction as in gm 2 and gm 3 (Table 1). In case of RT, residual mineral N for gm 2 was significantly lower than for both other green manure variants.
Both factors significantly affected mineral N distribution in the 0-90 cm soil profile at harvest, as expressed by the 'Nmin 0-60 : Nmin 0-90' ratio, which was 4% higher for RT compared to CT and 7% higher in case of late compared to early destruction.

The risk for N leaching losses at the end of the growing season was highest in the case of early destruction of the grass-clover ley (gm 1). This was due to both the highest residual mineral N and the location of mineral N lower in the soil profile. Obviously, under RT, the risk was lowest in the case of late destruction with removal of a full-grown grass-clover cut (gm 2). However, this green manure variant resulted in the lowest leek total plant biomass and N uptake. No significant effects from the tillage factor on leek total plant biomass and N uptake were observed.

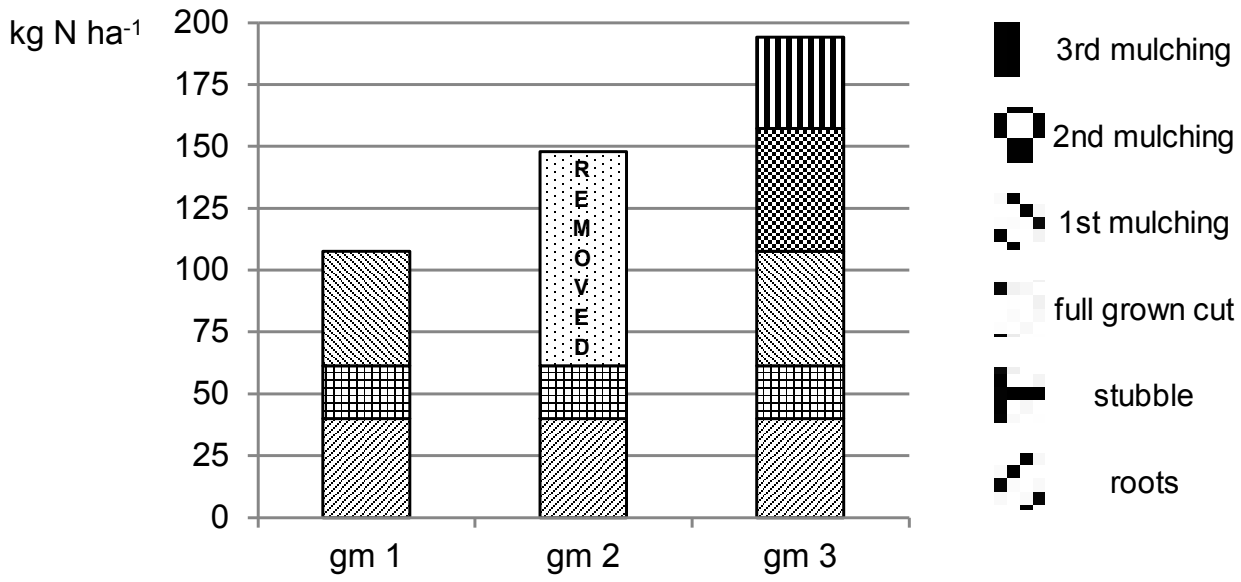


Figure 1. N input by below- and above-ground plant parts of the grass-clover green manure (full-grown cut represented no input because it was removed)

Table 1: Leek total plant biomass and N uptake and residual mineral N (Nres) for the different tillage and green manure variants

			CT	RT		gm 1	gm 2	gm 3	
total plant biomass		t ha^{-1}	49	50		50 ^{ab}	46 ^{a}	53 ^{b}	*
total N uptake		kg ha^{-1}	115	118		122 ^{b}	103 ^{a}	125 ^{b}	*
Nres 0-90	CT	kg ha^{-1}				107 ^{b}	91 ^{a}	94 ^{a}	*
	RT	kg ha^{-1}				133 ^{b}	75 ^{a}	122 ^{b}	*
Nmin 0-60 : Nmin 0-90		%	63	67	**	60 ^{a}	67 ^{b}	67 ^{b}	*

*significant at P<0.05 and ** significant at P<0.01; significant differences between green manure variants are indicated with different lower-case letters

Discussion

Our experiment has demonstrated that grass-clover destruction can be combined with a non-inversion tillage practice. The residual effect in our experiment in the first year is of the same order of magnitude than this reported by Eriksen (2001) following three years of grass-clover ley (i.e. 115 kg N ha^{-1}) whereas our ley was only half as old. This is in accordance with Hansen et al. (2005), who stated that the age of grassland at the time of ploughing has little effect on the residual N amount. N uptake and plant growth were proportional to the input of recently-formed organic N. Time of destruction, however, seemed to be decisive for its utilisation by the leek crop. Early destruction resulted in a high N availability but low degree of utilisation. Both the choice of time of green manure destruction and mowing regime are important factors in N availability and utilisation after destruction of a green manure crop. These findings deserve further attention in both research and practice.

Acknowledgments

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References

Eriksen, J., 2001. Nitrate leaching and growth of cereal crops following cultivation of contrasting temporary grasslands. Journal of Agricultural Science 136, 271-281.

Gomez, K.A. and Gomez, A.A. (Eds). 1984. Statistical Procedures For Agricultural Research, Second Edition . A Wiley-Interscience Publication, John Wiley & Sons, Inc., Chichester, UK, p. 680.

Hansen, J.P., Eriksen, J., Jensen, L.S., 2005. Residual nitrogen effect of a dairy crop rotation as influenced by grass-clover ley management, manure type and age. Soil Use and Management 21, 278-286.

Peigne, J., Ball, B.C., Roger-Estrade, J., David, C., 2007. Is conservation tillage suitable for organic farming? A review. Soil Use and Management 23, 129-144.

Country-specific analysis of competitiveness and resilience of organic and low input dairy farms across Europe

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Key words: Dairy farming, Organic, Low Input, Resilience

Abstract

Organic (ORG) and low-input (LI) dairy farms may have environmental advantages compared to high-input (HI) farms, but may also be less competitive in economic terms. This paper focuses on resilience in relative profitability of ORG and LI farms compared to HI farms in EU countries. Both a trend and a shock scenario were developed, based on milk and feed prices during 2007-2012. Although LI farms greatly vary among the EU countries, they tend to be more resilient than HI farms when assuming trend conditions. Moreover, they seem less affected by extremely low prices. ORG farms appear even more resilient in comparison with HI and LI farms but this can be explained by the higher revenues from subsidies.

Introduction

Although low-input (LI) and organic (ORG) dairy farms contribute more to environmental services compared to high-input (HI) farms, they often tend to be less competitive in economic terms. Explanations for this competiveness gap may be decreased productivity and lack of economies of scale, however, being less dependent on external inputs might also become an economic advantage. Indeed, recently milk, feed and energy prices have become more volatile and this is likely to continue in the future. In this paper, we focus on resilience in profitability given current and possible future prices. In this article, we further explore, more country-specifically, the results of a former EU-wide analysis of ORG and LI farms of Moakes *et al.* (2012).

Material and methods

Does the European low input dairy farm exist?

Based on literature on classification of farming systems, a definition of the European LI dairy farm was difficult to develop. Moakes *et al.* (2012) proposed a pragmatic LI definition, developed with a limited choice of variables available within the FADN data set, as a tool for further exploring the economic potential of ORG and LI farms in adopting new strategies. One of the main difficulties was the variety of farming systems in Europe. To fully elaborate competitiveness issues within and between the farming systems across Europe, LI farms were defined for each country as those farms with the lowest 25% expenditures on inputs for that country and HI farms were defined as farms with the highest 25% expenditures. The inputs taken into account to identify LI farming systems, were the costs for fertilizers, crop protection, purchased feed

and energy, expressed as € per grazing livestock unit. Exploration of the FADN database (2007-2008), revealed that LI farms were smaller, had fewer animals, a slightly higher family labor percentage and lower milk yields. Besides structural differences, LI farms were found to be less profitable than other holdings, but also receive lower support payments (Moakes *et al.* 2012).

Volatility of milk and feed prices

Based on historical observations in milk and feed prices and their relationship with the medians used in the study of Moakes *et al.* (2012), two sensitivity analyses were conducted to determine the resilience of the different farm types. First, the average milk price over a longer period (2007-2012) is lower compared to that over the period 2007-2008, though the recent price evolution is again upwards. Second, volatility was high, illustrated by the high milk price in 2008 and the pronounced decline in the following year 2009. Milk prices for 2007 – 2012 are about 5.5% lower and feed prices about 3% higher compared to 2007-2008. In 2009, milk prices were very low and declined by 30% while feed prices only declined by 13 %. Based on these figures, a trend and a shock scenario was developed, (based upon FADN data results from 2007-2008) to simulate the effect of both scenarios.

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Results

Country-specific differences in performance of dairy farms

With the pragmatic country-specific definition of low input dairy farms, farms were differentiated in each country into high versus low input farms. Figure 1 represents the median economic profit per annual working unit (AWU) for dairy farms across Europe for the years 2007-2008 (with direct input costs along the x-axis). The median profit for HI farms in EU (set to 100 in Figure 1) was 6168 euro/AWU. The relative economic profit of the farms in the different countries is compared to the economic profit of the EU 27 HI farm, e.g. the profit of a dairy farm in Denmark is more than 7 times greater than that of the EU median. In the figure, each country is represented by two dots, interconnected with a line. The left dot represents the median profit of the LI farms of that country while the right dot illustrates the median profit of the HI farm.

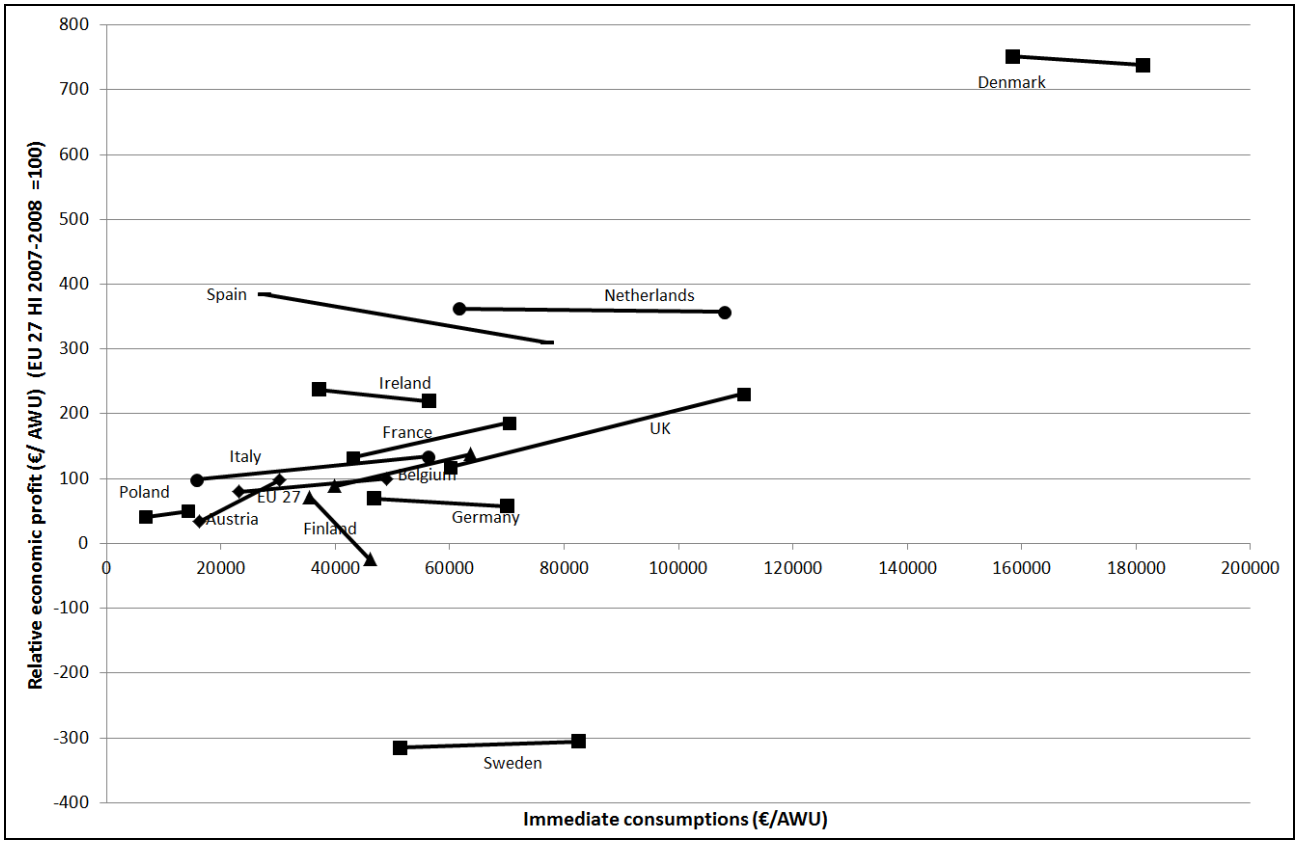


Figure 1: Relative economic profit per annual worker unit (AWU) of HI versus LI dairy farms in Europe (2007-2008)

The length of the line indicates the relative difference in input expenditure between HI and LI. The slope indicates the difference in profit: a downward slope indicating that LI holdings perform better than HI. This means that additional inputs have resulted in lower profitability. This is strongly pronounced in Finland, but also in Spain and Ireland. In several other countries, however, the line slopes upward; HI farms have higher economic profits compared to the LI farms. The position in the figure demonstrates very clearly the variety in farm size of the different farming systems within Europe. The immediate expenditures for a LI farm in Denmark, for example, are 10 times higher than those for an LI company in Italy. An LI farm in one country often corresponds with an HI country in another country. These data reveal further insights on the real behavior of LI farms: some belong indeed to another farming system, while other LI farms, such as in the Netherlands and Denmark, may be a similar production system but are more efficient than the HI companies in their country.

Table 1 summarizes the results of the relative economic profit in different countries for HI, LI and ORG farms. In most countries the ORG farms had a higher relative economic profit than the HI input and LI farms, with the exception of France, Italy, Poland and the Netherlands. In the Netherlands the relative economic profit of ORG farms is also lower than those of LI farms.

Table 1: Relative economic profit (€/AWU) per production system with EU 27 HI dairy farm = 100 and the immediate consumptions (inputs) per production system (€/AWU)

	Number of observations				Relative economic profit			Immediate consumptions		
	Total	HI	LI	ORG	HI	LI	ORG	HI	LI	ORG
EU 27	32,539	7,681	7,645	1,815	100	80	127	48,980	23,097	27,874
Austria	1,922	356	357	494	98	34	120	30,182	16,219	18,684
Belgium	752	181	181	26	138	89	372	63,590	39,873	44,907
Denmark	884	177	177	173	738	751	865	181,184	15,8422	175,033
Finland	760	173	173	65	-25	71	149	46,023	35,524	43,556
France	3,049	748	746	58	186	133	148	70,305	43,067	39,257
Germany	4,743	1,130	1,128	222	57	69	113	70,075	46,772	41,420
Ireland	740	182	181	10*	220	237	/	56,381	37,110	/
Italy	2,981	734	731	41	134	99	127	56,184	15,660	31,284
The Netherlands	699	162	161	49	357	362	259	108,045	61,588	70,968
Poland	6,117	1,501	1,494	115	50	41	5	14,291	68,21	3,683
Spain	2,249	565	561	5*	310	385	/	76,963	27,597	/
Sweden	790	154	153	174	-305	-315	-114	82,584	51,392	72,533
United Kingdom	1,108	259	257	74	231	118	334	111,357	60,147	89,282

* Calculations are not performed when there are less than 15 observations

Are LI and ORG farms more resistant to milk and feed price volatility compared to HI farms?

The absolute median economic performances of HI, LI and ORG dairy farms in EU27 in 2007-2008 are compared to the developed, trend and shock scenario (Table 2).

Table 2: Economic performance of HI versus LI and ORG dairy farms

Economic key figures (€/AWU)	2007-2008			Trend scenario			Shock scenario		
	HI	LI	ORG	HI	LI	ORG	HI	LI	ORG
Total output	71,141	43,541	49,401	67,250	41,160	46,699	50,610	30,975	35,144
Intermediate consumptions	48,980	23,097	27,874	50,401	23,767	28,683	42,726	20,148	24,315
Gross farm income	32,874	28,456	36,689	27,562	25,404	33,178	18,597	18,839	25,991
Farm net income	14,692	15,968	17,984	9,380	12,916	14,473	415	6,351	7,286
Economic profit	6,168	4,941	7,815	856	1,889	4,304	-8,109	-4,676	-2,883

The results show that ORG farms are more resilient towards price fluctuations than LI and HI farms. The ORG farms had the highest economic profit in 2007-2008 and this was also the case in both the trend and

shock scenario. This can be explained by the higher support level of the ORG farms compared to the other farm types (Moakes *et al.* 2012). LI farms are more resilient towards price fluctuations than HI farms. Where HI farms had a higher economic profit in 2007-2008, they have a lower income when assuming trend conditions and were more affected by extremely low prices as those observed in 2009. These results are confirmed by some country-specific data (Figure 3). In Figure 3 the original, trend and shock scenario are presented; HI and LI are interconnected, as in Figure 1 and the median profit of ORG farms is represented by a separate dot. When prices decline, either in the trend or shock scenario, the economic advantage of HI farms decreases in these countries where HI farms perform better; and in countries where LI farms perform better; this comparative advantage increases when prices decline. ORG farms perform better in the different scenarios than the other farm types and this is more pronounced in Sweden. For Poland the benefit of ORG farming is smaller or negative in comparison with HI and LI farms.

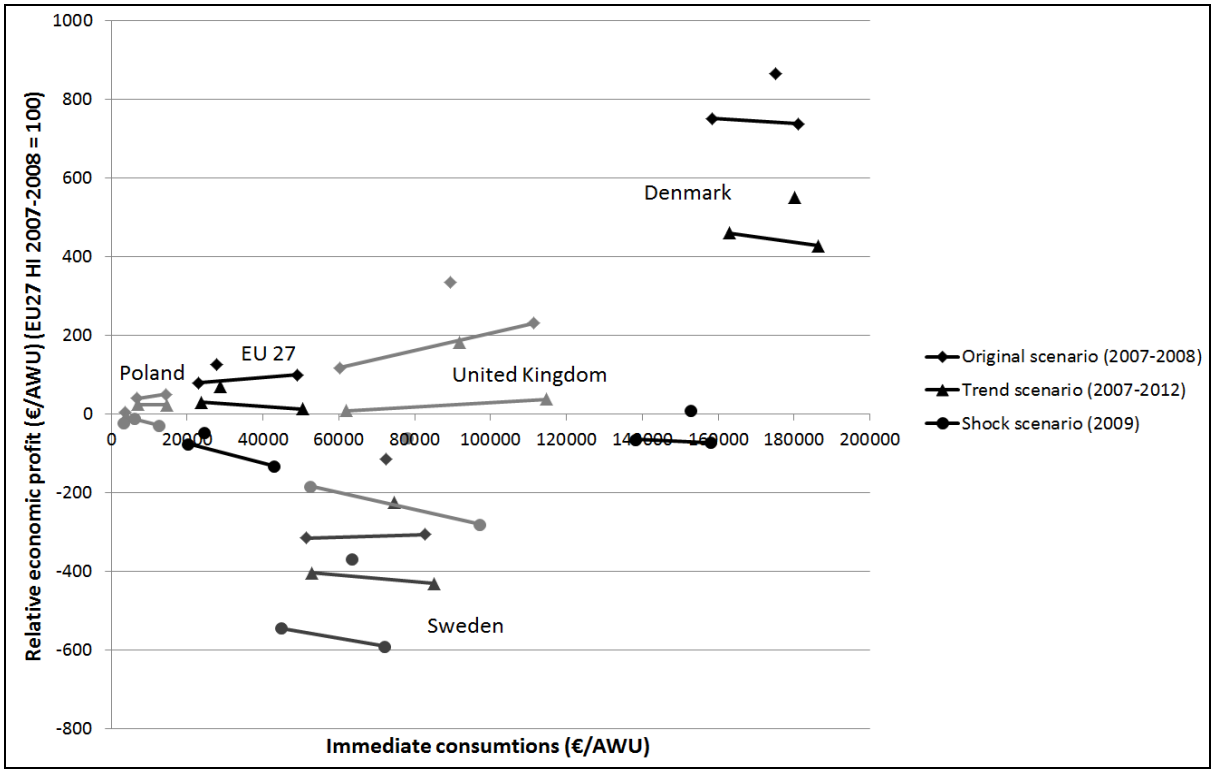


Figure 2: Median economic profit per annual worker unit (AWU) of HI, LI and ORG dairy farms in Europe during 2007-2008, and simulations of a trend and shock scenario

Discussion

Earlier analysis of LI farms across Europe revealed lower profitability of the LI farms compared to the high input ones. However, although this observation can be extended to several European countries, the opposite is true for some countries where LI farms perform better than HI farms. Although their lower use of inputs produces less output, lower inputs may result in increased efficiency in the use of fertilizer, crop protection, feed, and energy on these farms. Moreover, in all European countries, LI farms seem to be more resistant to price fluctuations, which may become more important in the post quota era, and may be of particular relevance to family farms where reduced income fluctuation can be as important as absolute profit.

Acknowledgements

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References

Moakes, S., Bijttebier, J. & Lauwers, L. (2012). Economic analysis of EU dairy systems. Deliverable 6.1. to the EU FP7 project SOLID (http://www.solidairy.eu/wp-content/uploads/summary-deliverable-6.1-SOLID.pdf)

FADN (2012). Farm Accountancy Data Network, Dataset for 2006/07 and 2007/08 - DG AGRI.

Soil quality and crop productivity as affected by different soil management systems in organic agriculture

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Key words: farmyard manure, plant residues, farm compost, reduced tillage

Abstract

Compost prepared on-farm based on plant residues may be an alternative for manure from extensive conventional livestock systems. In a multi-year field trial, we compared two soil management strategies: 1) farm compost application combined with reduced tillage and 2) animal manure incorporated by conventional mouldboard ploughing. Benefits for crop performance of both systems depended on the crop used in the rotation and the weather. A wet spring season caused the spring barley crop in the reduced tillage system to fail. The system showed a good potato yield due to a better youth growth, however. After one 4-year rotation, soil organic carbon content and pH of the upper 0-10 cm soil layer was ca 20% and 0.5 unit higher for farm compost compared to the farmyard manure treatment. The combination of compost application and reduced tillage proved to be a promising soil management strategy.

Introduction

The use of manure from conventional livestock systems is authorised in organic agriculture due to a lack of animal manure from organic livestock farms. On-farm prepared compost, which mainly consists of plant residues, may be an alternative for animal manure. Compost can be easily applied in a reduced tillage system. Reduced tillage systems are favourable for soil quality but are not always easy to apply in organic agriculture (Peigné et al. 2007). One of the constraints may be the incorporation of a straw-rich farmyard manure. We conducted a multi-year field trial to compare soil management strategies (tillage and fertilisation) with regard to their effect on crop performance and soil quality. Two soil management systems were assessed. Farm compost application was combined with reduced tillage by non-inversion tillage using a chisel plough. In contrast, animal manure was incorporated by conventional tillage with a mouldboard plough.

Materials and methods

This soil management trial took place on a sandy loam soil on two adjacent fields of the Institute for Agricultural and Fisheries Research (ILVO) located in Flanders, Belgium. On one field the trial started in 2005. On the other field the trial was repeated with a time delay of one year (2006 start). Prior to starting the trial, the fields underwent a 2-year conversion period to organic agriculture. During that time a grass-clover ley was installed as green manure crop and was regularly mulched. The crop rotation used was a 4-year cycle of maize (*Zea mays ssp mays*) - potatoes (*Solanum tuberosum*) - spring barley (*Hordeum vulgare*) - red clover (*Trifolium pratense*) (Table 1). Winter rye (*Secale cereale*) was sown as a green manure after maize; yellow mustard (*Sinapis alba*) was sown after potatoes. On the first field, red clover was sown in summer 2007 after spring barley. On the second field, red clover was sown in spring 2009. Five soil management treatments were compared, each of which was a specific combination of a tillage practice and a fertilisation type. The first combination was reduced tillage (RT) by non-inversion tillage with a chisel plough (Actisol) up to a depth comparable to the ploughing depth, together with farm compost application. Farm compost was applied in either a single dose (FC) or double dose (2xFC). Farm compost was produced at ILVO in a windrow composting system using an equilibrated, predominantly vegetative feedstock mix. Conventional tillage (CT) with a mouldboard plough was combined with three different types of fertilisation, which all included animal manure: farmyard manure (FYM), cattle slurry (S) and slurry plus municipal waste compost (S+MWC). Organic matter input by fertilisation was equalised for the RT-FC, CT-FYM and CT-S+MWC treatments. The treatments were arranged in strips of 15 by 50 or 100 m; the dimensions of the strip varied according to the treatment. In those strips, four plots (1 m^2) at a preset location were used for soil sampling (0-10 and 10-30 cm). The soil quality parameters total organic carbon content (TOC), total N content (Ntot), pH-KCl and plant available nutrients (extractable with ammonium-lactate) were measured. Crop yield was determined per treatment in

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four replicates on plots scattered over the respective strip. Differences between treatments with regard to yield were assessed by the Scheffe method for both growing seasons separately. 'Field' was considered as an additional factor in the data analysis with regard to the soil quality parameters. Differences between treatments for soil parameters were assessed by the Dunnett ($P<0.05$) method with CT-FYM as the reference treatment and for both soil layers separately.

TOC content was measured on oven-dried (70 °C) soil samples by dry combustion at 1050 °C with a Skalar Primacs SLC TOC-analyser according to ISO 10694. For soils with pH-KCl > 6.5, inorganic carbon was measured separately; none of the samples had inorganic carbon levels higher than the limit of quantification. pH was measured potentiometrically in a 1M KCl solution (1:5 v/v) according to ISO 10390. Ntot content was determined by dry combustion (Dumas principle) with a thermo flash 4000 according to ISO 13878. Plant available nutrients (P, Ca, Mg, K) were determined by shaking 5 g air-dried soil in 100 ml ammonium lactate for four hours (Egnèr et al., 1960) and were measured using a CCD simultaneous ICP-OES (VISTA-PRO, Varian, Palo Alto, CA).

Table 1: Arrangement of the crops in the rotation of the two adjacent fields

year	field 1	field 2
2005	maize	
2006	potatoes	maize
2007	spring barley	potatoes
2008	red clover	spring barley
2009		red clover

Results

Final soil quality assessment

Compost application (either farm compost or municipal waste compost) clearly positively affected TOC and pH-KCl in the 0-10 cm soil layer, irrespective of the tillage system (Table 2). Steel et al. (2012) reported that a pH increase is an important short-term effect of farm compost application, irrespective of the feedstock materials used in the compost. Increases of Ntot, plant available P and Ca in the 0-10 cm soil layer were only observed for farm compost application under RT. The deep incorporation of municipal waste compost by ploughing also resulted in a TOC increase in the 10-30 cm soil layer. A double compost dose (2xFC) led to K enrichment in the 10-30 cm soil layer. This increase is probably caused by leaching because of the superficial incorporation of the compost.

Crop results

In 2005, no yield differences between treatments were observed for maize. Averaged over the treatments, maize yielded 18.9 t dry matter ha^{-1}. In 2006 maize yield was lower for the RT-2xFC treatment (13.2 t dry matter ha^{-1}) compared to all other treatments (on average 16.7 t dry matter ha^{-1}) due to a lower plant density related to bird damage in the crop youth stage. The potato crop showed better youth growth in the RT system with farm compost than in the ploughed treatments with animal manure. In 2006, this resulted in a higher potato yield for both farm compost treatments (Willekens et al. 2008). Spring barley yield in 2007 was approximately 0.5 t ha^{-1} lower for the RT-FC treatment compared to the other treatments (3.5-3.6 t ha^{-1}) except the CT-S+MWC treatment. In 2008, a crop failure occurred for the RT practice. Due to a wet spring season, deep RT was omitted. This led to serious weed-related problems during the crop youth stage. The highest yield was registered in the CT-FYM treatment, approximately 4 t ha^{-1}. In 2008, the dry matter yield (4 successive cuts) in the RT-2xFC treatment exceeded the yield in some of the other treatments, whereas in 2009, the highest dry matter yield (2 successive cuts) was registered for CT practice with animal manure.

Table 2: Final soil quality parameter values for 5 soil management treatments

		0-10 cm soil layer				
SOIL		RT		CT		
MANAGEMENT		FC	2xFC	FYM	S	S+MWC
TOC	%	1.1 *	1.2 *	0.9	1.0	1.1 *
Ntot	%	0.10 *	0.11 *	0.09	0.09	0.09
pH-KCl		5.4 *	5.6 *	4.9	5.2	5.3 *
P	mg / 100 g	23.3 *	24.1 *	17.3	17.3	17.6
Ca	mg / 100 g	74.5 *	82.7 *	57.7	73.6	71.8
K	mg / 100 g	18.3	24.8	14.3	14.0	15.5
Mg	mg / 100 g	11.2	12.9	10.1	10.3	10.2
		10-30 cm soil layer				
SOIL		RT		CT		
MANAGEMENT		FC	2xFC	FYM	S	S+MWC
TOC	%	0.9	0.9	0.8	0.9	1.0 *
Ntot	%	0.08	0.08	0.08	0.08	0.09
pH-KCl		5.3	5.4	5.0	5.2	5.3
P	mg / 100 g	24.0	23.8	20.3	19.9	19.9
Ca	mg / 100 g	71.6	77.5	62.3	85.8 *	75.6
K	mg / 100 g	12.4	17.2 *	13.5	11.0 *	12.0
Mg	mg / 100 g	10.5	11.1	10.2	9.3	9.6

*significantly different from FYM value, Dunnett, P<0.05

Discussion

With regard to soil quality, a reduced tillage practice in combination with compost application seemed to be favourable for soil quality of the surface layer in the short term. With regard to crop productivity, an effect of soil management strategy was less clear and depended on seasonal variation of the field situation. More insight is needed about performing reduced or non-inversion tillage techniques in order to optimise seed-plant bed conditions. Vegetative compost may partly replace animal manure input in organic cropping systems. Compost is suitable for a reduced tillage system, as appeared in these experiments. Animal manure can also be composted before application (Berner et al. 2008). Reduced tillage systems lower the need for fuel and labour and compost fertilisation is important for closing nutrient cycles. To encourage the use of FC in combination with RT practices, more information is needed about how to prepare low-cost, high-quality compost on farm.

References

Berner, A., Hildermann, I., Fliessbach, A., Pfiffner, L., Niggli, U., Mader, P., 2008. Crop yield and soil fertility response to reduced tillage under organic management. Soil & Tillage Research 101, 89-96.

Egnèr, H., Riehm, H., Domingo, W.R., 1960. Untersuchungen über die chemische Bodenanalyse als Grundlage für die Beurteilung des Nährstoffzustandes der Böden. II. Chemische Extraktionsmethoden zur Phosphor- und Kaliumbestimmung. Annals of the Royal Agricultural College of Sweden 26, 199-215.

Peigné, J., Ball, B.C., Roger-Estrade, J., David, C., 2007. Is conservation tillage suitable for organic farming? A review. Soil Use and Management 23, 129-144.

Steel, H., Vandecasteele, B. , Willekens, K., Sabbe, K., Moens, T., Bert, W., 2012. Nematode communities and macronutrients in composts and compost-amended soils as affected by feedstock composition. Applied Soil Ecology 61, 100-112.

Willekens, K., De Vliegher, A., Vandecasteele, B., Carlier, L. 2008. Effect of compost versus animal manure fertilisation on crop development, yield and nitrogen residue in the organic cultivation of potatoes. Proceedings of 2th ISOFAR conference, Modena, Italy, 2008, 576-579.

Action plan for innovation and learning
Agroecology and organics in EU innovation policy

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Key words: agroecology, EU policy, innovation

Abstract

Putting ideas into practice has become the central goal of Horizon 2020, the EU's Framework Programme for Research & Innovation for 2014-2020. In comparison with earlier EU research policy, the focus has shifted from research for its own sake to innovation with tangible impact. This evolution also affects the EU's Common Agricultural Policy. By learning from experiences with agroecology and organics, policy makers can make these policies a success. TP Organics, the European Technology Platform for Organic Food & Farming, is preparing an Action Plan for Innovation and Learning with recommendations for this to happen. These include the demand to include a preparatory phase in multi-actor projects needed to build a solid basis of trust among the participants. In addition, the European Commission should develop means of rewarding the efforts made by practitioners and researchers to collaborate. Practitioners should be remunerated for the value they add and the knowledge they develop.

Introduction

The EU has put innovation at the heart of its strategy for achieving smart, sustainable and inclusive growth. Putting ideas into practice has become the central goal of Horizon 2020, the EU's Framework Programme for Research & Innovation for 2014-2020. This evolution also affects Europe's food and farming sector. Innovation support will be strengthened in the EU's Common Agricultural Policy (CAP). Among the different measures that are foreseen in the CAP for 2014-2020 is the creation of a European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) that should close the gap between research and practice.

Organic and agroecological farming has a long history of strong collaboration between researchers and practitioners and across disciplines. The objective of this contribution is to analyse:

- If EU innovation policy offers opportunities for organic and agroecological innovation and if so which.
- What lessons EU innovation policy could learn from experiences made with organic and agroecological innovation.

Innovation in the EIP-AGRI and Horizon 2020

According to the draft guidelines of the EIP-AGRI, the EIP-AGRI follows an "interactive approach" in which "building blocks for innovations are expected to come from science, but also from practice and intermediaries, including farmers, advisory services, NGOs, researchers, etc. as actors in a bottom-up process" (European Commission, 2013a). This "interactive innovation includes existing (sometimes tacit) knowledge which is not always purely scientific". The European Commission expects that innovation generated with such an interactive approach will "deliver solutions that are well adapted to circumstances and which are easier to implement" (European Commission, 2013a). This interactive innovation model will in the first place be implemented through operational groups, the support of which is foreseen in the CAP. Operational groups should bring innovation actors together on the initiative of the innovation actors themselves and should tackle a certain (practical) problem or opportunity that may lead to an innovative solution (European Commission, 2013a).

The interactive approach is also reflected in the Horizon 2020 regulation which asks for a "multi-actor

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approach" which "will ensure the necessary cross-fertilising interactions between researcher, businesses, farmers/producers, advisors and end-users" (COM(2011) 809 final). The first draft Work Programme of Horizon 2020 (2014-2015) for the so-called Societal Challenge "Food Security, Sustainable Agriculture and Forestry, Marine and Maritime and Inland Water Research and the Bioeconomy", contains 14 research calls demanding a multi-actor approach. The Work Programme stresses that this multi-actor approach is more than a strong dissemination requirement. It means involving stakeholders all along the project, with a clear role for the different actors. Projects should have sufficient quantity and quality of knowledge exchange activities. The objectives of the projects should be targeted towards the needs and problems of the end-users. The project consortium must be composed of key actors with complementary types of knowledge. The European Commission recommends projects to show openness and involve additional partners during the project.

Opportunities for agroecological innovation in the EIP-AGRI and Horizon 2020

EU thinking on agricultural innovation is based on the "systems of innovation" concept (Smits *et al.*, 2010). Smits *et al.* (2010) distinguish between two views on innovation policy: the systems of innovation approach versus the macro-economic approach. The macro-economic view tends to see innovation as a linear process from (basic) research via R&D to a commercial application. The systems perspective of innovation focuses on interaction between different stakeholders (European Commission, 2013b).

The "systems of innovation" concept corresponds in a way to the agroecological concept. According to this concept, science should not be disconnected from day to day life, but should directly engage with social realities. Therefore, agroecology is based on general principles, rather than unique, rigid and fixed recipes that are supposed to work always without taking local, climatic, cultural, economic specificities into account. Direct participation of practitioners is needed to adapt these general principles to a specific problem and context. Practitioners are not any longer considered as users of knowledge generated by others, but become experts themselves. They participate in setting the research agenda and during the whole research process. These two elements, tailored solutions and stakeholder participation, are the basis of agroecological innovation.

Agroecology as well as the systems perspective of innovation broaden the concept of innovation from technological to know-how and social innovation. New fields such as the organisation of food chains and innovation for the public good rather than commercial products are addressed. Both approaches ask for transdisciplinary collaboration between scientists (such as natural scientists, rural sociologists, economists) and between scientists, practitioners and agricultural advisers.

The new EU policy potentially offers many opportunities for more stakeholder and demand-driven research & innovation. However, a lot depends on practical implementation. Contradictions exist with other developments in EU policy, e.g. the tendency to fund fewer but larger projects. These may mainly benefit big research institutes and companies that have the capacity to manage the accordingly big budgets. This makes it difficult for individual farmers or SMEs to participate which could act against considering agroecological and organic approaches. There is also a need for learning among public servants who might not always be familiar with the new approach taken. This might for example be the case for authorities in the Member States, who are responsible for setting-up the operational groups, but were not necessarily involved in the design of the concept.

Conclusions and outlook

EU innovation policy has adopted a systems approach of interactive innovation which is a welcome shift away from the linear model. The success of this new thinking will depend on the political will and the services' capacity to implement it. By learning from experiences with agroecology and organic farming, policy makers and public servants can make Horizon 2020 and the EIP-AGRI a success. In order to provide guidance, TP Organics, the European Technology Platform for Organic Food & Farming, is preparing an Action Plan for Innovation and Learning. In short, this Action Plan will:

- Demonstrate the innovation potential of organic farming and agroecology
- Develop a vision on agroecological learning and innovation
- Analyse opportunities offered by EU policy instruments
- Provide policy recommendations for innovation and better learning in the EU

Among the first recommendations is the suggestion to include a preparatory phase in multi-actor projects. This is needed to build a solid basis of trust through communication among the participants, compared to

purely academic research where the researchers are more familiar with each other's worldview. This aspect of the work must be recognised and budgeted for accordingly. In addition, the European Commission should develop means of rewarding the efforts made by practitioners and researchers to collaborate. Practitioners should be remunerated for the value they add and the knowledge they develop. Finally, policy makers should provide long-term support to innovation projects. Following the close of a successful project, further financial support and follow-up promotion is often necessary to help disseminate the new ideas and change farming practices.

References

European Commission (2013a): Draft guidelines on programming for innovation and the implementation of the EIP for Agricultural Productivity and Sustainability, Brussels, 12p

European Commission (2013b): Agricultural Knowledge and Innovation Systems towards 2020 – an orientation paper on linking innovation and research, Luxembourg, 204p

Smits RE, Kuhlmann S & Shapira P (2010): The Theory and Practice of Innovation Policy – An International Research Handbook, Edward Elgar Publishing.

Opportunities and Challenges for organic producers to access to financial services in Bolivia

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Key words: organic production, small organic producers, enabling environment, financial services

Abstract

Organic agriculture is expanding rapidly in Bolivia due to the favourable legal framework that permits producers to expand their production through the access to technical and entrepreneurial services most of them provided by NGO and Foundations but there is a lack of suitable financial services offer for organic producers from the private sector. In spite of the rural insurance which is provided by the Rural Insurance Institute (INSA) since 2012 to the producers that were affected by natural phenomena. The principal problem is that there is not a wide range of suitable financial services for organic producers by public and private providers. There are only four financial services providers. Three out four are from the private sector and only one is from the public sector. This paper seeks to identify which are financial services providers available for organic producers in Bolivia?, What are the services they offer? , What are the requirements they demand to their clients? and How can we help to foster the access to financial services to producers form the organic subsector. In order to respond to these research questions a quantitative and qualitative framework was selected using the semi-structured interview, the survey to financial services providers and organic producers. The principal results of this research were that 96% of the surveyed organic producers did not have a suitable access to financial services, the potential financial services providers come from the private sector and the rural insurance service is provided by the public sector. One out four financial services providers in the Bolivian context offers the Green Ecologic Loan that helps organic innovators to make investments with the 20% interest rate. The others interest rates are still higher. Among the financial service providers, the INSA from the State offers insurance for natural disasters to all producers and no charges any fee for this service but the principal requisite is to be registered in the national data base. Both private and public financial services providers must offer their services according to an assessment of the real demand from organic producers. This task can be sustained by technical and entrepreneurial services providers which have been working in organic agriculture for more than fifteen years. Finally, policy makers must consider suitable public policies oriented to help organic producers at local levels.

Introduction

The organic agriculture in Bolivia is growing rapidly according to the last UC-CNAPE census made last 2012 at a rate of 20% a year (Vildoso 2008). The support for organic agriculture is a priority in the Bolivian context according to the favorable political framework such as the New Constitutional State Letter, the number 3525 Law on the Promotion of the Organic Agriculture, and the number 144 Law on Agro-productive Revolution and the Participatory Guarantee Systems National Normative. All these legal instruments state the ¨Right to Food¨ as the number one political priority in the New Plurinational State.

In spite of this favorable framework in the Bolivian legislation, small producers are still marginalized from the financial services access provided by private organizations. In other words, the available financial services such as ecologic credits are not suitable for small organic producers due to the highest taxes and rates imposed by private financial service providers that discourage small organic producers to access to these services.

In order to respond to the small organic producer´s expectations for suitable financial services such as the loans, public financial services must be developed to assist producers to increase their production, and develop organic local markets and keep them involved in organic farming avoiding the side-selling of products through the conventional channel (Bacon 2005).

This scientific paper will show how the financial enabling environment is working for small organic producers in the Bolivian context showing the opportunities and limitations for the access to these services. Furthermore, this paper shows which are the financial actors for the organic chains, their roles, what sort of services they provide and limitations that face organic producers in the access to these services.

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In sum, the principal objective was to create awareness for policy makers to develop a suitable financial framework for small organic producers in Bolivia which will be complementary to the National Insurance Policy for Small Producers (INSA).

The specific objectives were: a) To describe the available financial services for organic production and their requisites for clients, b) To sketch recommendations to policy makers to assists small organic producers with suitable financial services according to their demands and ability to paid for them

Material and methods

Both quantitative and qualitative research methods were used to collect data on the perceptions and attitudes of organic producers and service providers in order to collect primary information from the actors involved in the organic value chains (producers, processors, traders, consumers and service providers). To compare and evaluate the obtained results, the case study methodology was selected for this paper (Yin 2004). The study case provides an insight to the working structure of the financial service providers. For this paper, we selected four study cases. The Ecologic Credit, Green credit, Rural Credit and the Green Entrepreneur credit.

The research techniques that were used include the questionnaires, semi-structured interviews with key informants and secondary sources of data such as academic literature, official statistical information such as reports, government publications. Questions about the crops, area, access to credit and other socio-economic characteristics were directed to the organic producer's household heads through a questionnaire. Questions that inform the role and the financial services were conducted with key informants. The study was undertaken in La Paz, Oruro and Cochabamba Departments. The collection of primary information from organic producers came from three producer organizations such as Eco-feria, Bio-Achocalla and Bio-Caracollo. On the other hand, the collection of primary information from the financial services providers was taken from four providers from two groups: private (Bancredit, Promujer, CIDRE) and public (INSA) through semi-structured interviews.

Results

- 96% of the surveyed producers indicated that the limitation for increasing their production is the lack of suitable financial services
- The highest taxes from the private financial service providers are too high for small organic producers which limit their participation in these services
- Service providers such as NGOs and Producer Associations are reluctant to help provide financial services to their members endangering the organic agriculture movement in the country for lack of access to these services
- Policy makers do not often pay attention to the financial services offer for the Bolivian organic movement rather than the technical and entrepreneurial services

Discussion

Financial services in the organic Bolivian context are not suitable according to the real demands for these services by small organic producers. For example, the lack of a census of the financial services providers as well as the real demands for organic producers restrains the expansion of the Bolivian organic movement.

The 20% interest rate for green credits is an acute limitation for small organic producers to be involved in this movement in spite of the higher percentage of the number of producers in the transition phases.

If public services providers such as UC-CNAPE and the Ministry of Rural Affairs will not pay attention to the development of suitable financial services according to the real demand for small organic producers complementing with the INSA rural insurance, the expansion of organic hectares and the number of organic producers involved in the value chains will not increase further than the 5% annually.

On the other hand, private financial services providers such as the foundations, private banking operators (Bancredit, Promujer, CIDRE, and INSA) must be obligated to provide financial services for small organic producers with the collateral of the public agencies such as UC-CNAPE and the Ministry of Rural Affairs.

Policy makers should direct their efforts to design public policies to assist the organic sector in the access of a wide variety of services such as technical, entrepreneurial and financial services.

Suggestions to tackle with the future challenges of organic animal husbandry

The challenges of Organic Animal Husbandry must face are: 1) the use of medicines such as antibiotics, 2) the humane treatment in the management and slaughtering of animals and 3) the lobbying for public policies in order to norm these activities for organic animal husbandry at local, national and international levels. In order to tackle these challenges we must seek the adoption of Good Management Practices for organic animal husbandry that must be elaborated in a participative way at international level and being enhanced according to national and local levels. This must be done in order to not impose an internationalization of the standardization of norms that must be designed at national and local levels at first instances. I also suggest that the use of medicines must be regulated and to adopt much more responsible practices in their applications to animals such as vaccines and antibiotics. I mean that organic animal raisers must manage the correct administration of medicines to animals an await a period of time for milking and slaughtering according to the species, race, size and the sort of medicine and its dose for avoiding the contamination for direct consumption (e.g. eggs, milk and meat).

The humane treatment in the management and slaughtering of animals in the context of the organic husbandry is a difficult issue to be treated due to the economic, cultural conditions involved in these activities. I recommend taking into consideration the international legal frameworks such as the PETA and the Humane Society recommendations and adapting them to national and local levels taking into consideration cultural and traditional practices of small organic animal raisers.

Finally, these recommendations and suggestion to tackle these challenges for the organic animal husbandry must be lobbed into the political arena. In Bolivia, for example, we were invited to sign a book of acts in order to collect signs from the citizens interested in the emission of an Animal Well-being Law. In order to be considered in the legal area, some 150 thousand signatures must be collected. This activity is been fostered by national and local NGO and Animal Associations from Bolivia. This action has called the attention of some advocate members of the political arena and according to the actual trends it must be considered in the political arena soon.

References

Altieri, M and Nicholls, C. (2008). Scaling up agroecological approaches for food sovereignty in Latin America. Society for International Development 51 (4): 472-480.

Bacon, C. 2005. Confronting the Coffee Crisis: Can Fair Trade, Organic and Specialty Coffee Reduce Small-Scale Farmer Vulnerability in Northern Nicaragua? World Development 33(3): 497-511.

Berger, M. (2002). Microfinance: An emerging market within the emerging markets. Interamerican Development Bank. Social Sustainable Department. Micro, Small and Medium Enterprise Division.

DeLind, L. (2002). Place, Work and Civic Agriculture: Fields of Cultivation. Agriculture and Human Values. 19: 217-224.

Gonzalez-Vega, C. (1998). Microfinance: Broader Achievements and new challenges. Economics and Sociology Occasional Paper 2518. 10-12, 17-21p.

Vildoso, D. (2008). La agricultura orgánica en Bolivia. Tendencias de producción y crecimiento. Octavas jornadas de agricultura ecológica. Octubre 15 y 16. 2008. Cochabamba, Bolivia.

Vogel, R.C. 2004. Del crédito agrícola a las finanzas rurales: En búsqueda de un nuevo paradigma. Simposium Internacional Experiencias y Desafíos en Microfinanzas y Desarrollo Rural. Quito-Ecuador. 2-12p.

Yin, R.K. 2004. The Case Study Anthology. Thousand Oaks, CA. Sage Publications Inc.

Influence of moon rhythms on yield of carrot (*Daucus carota* L.*)*, under biodynamic management

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Key words: moon rhythms, cronobiology, biodynamic agriculture, lunar phases

Abstract

The purpose of this work was to evaluate the influence of moon rhythms on yield of carrot roots under biodynamic management sowed in different dates. The experiment was carried out over a two period on a biodynamic farm, in Botucatu, São Paulo State, Brazil. Rhythms were tested observing the effects of seeding at different planting dates. The experiment was performed with four randomized blocks and 31 treatments (different dates) in 2005, and fourteen treatments in 2006. The harvest was made 82 days after sowing. Effects associated with planting at a specific lunar position were measured by the deviations from the trend curve. The following characteristics had been evaluated: fresh mass of roots and leaves and dry mass of roots. Dry mass was the only one that in the contrast between averages showed significant results in the two periods of the experiment. Result was that the synodic new phase was superior to the first quarter, and full phases and in the ethno synodic rhythm, the full phase was inferior to the other.

Introduction

Nowadays most of the people live in cities, and few can even recognize any constellation in the sky. The story of the great civilizations of the past shows the importance of astronomical rhythms, not only in agriculture but in all daily activities. This knowledge is disappearing, but it still remains in small farmers practice, like using the phases of the moon in agriculture, forestry and animal management. Biodynamic agriculture values this popular knowledge and also expands it, incorporating the rhythms of the moon and other planets move related to agricultural activities in general. In international biodynamic movement, the best known Agricultural Astronomical Calendar currently is from MariaThun, which is translated into several languages. She has systematically researched these interactions through experiments for almost 50 years. In this line, there are few researchers who have worked with cultivated plants.

Material and methods

The experiment was conducted on the farm Santo Antonio, from the biodynamic gardener Geraldo Joaquim Baldini, where carrots are grown in rotation with other vegetables. The property is located in Botucatu / SP, with the following coordinates: latitude 22º44'00"S and longitude 48º34'00"W, altitude 800 m. The climate is classified as Cwa mesothermal, humid subtropical with dry during winter, as the international system of Köppen (Setzer, 1946). The soil is a Ferralsol, medium texture. The experiment was carried out in randomized block design with 31 treatments, four replicates in 2005 and 14 treatments, four replicates in 2006. Each plot had the following dimensions 1.5 x 1.0 m with four rows of plants spaced 0.25 x 0.05 m with 120 plants per plot. Each block was composed of a bed divided into 31 shares in 2005, and 14 shares in 2006. The cultivar used was Brasilia carrots. All plots managed in the same way, according to the biodynamic management adopted by the producer, ie, fertilizing with biodynamic compost (with livestock) and crop residues, crop rotation and spread with biodynamic preparations manure (500) and silica (501).
The treatments consisted of different sowing dates, ranging from 5 May to 04 June 2005 and 25 April to 25 May in 2006, always performed between 13 and 15hs. Carrots were sown in beds of 1.0 m wide and 0.20 m high. The irrigation system was spray (average of 20 mm / day), and liming was not necessary, as the pH was above 5.5 and percent base saturation above 60%. We used manual seeder and covered with biodynamic compost (7500 kg / ha). The weeds were eliminated of the plots before sowing carrot.
At 27 DAG (days after germination) made up thinning the plants, to obtain a population of 20 plants per linear meter. The weeds control was manual, it there was no use of fertilization coverage and no pest control. The harvest was done 82 DAS (Days After Seeding), equivalent to three cycles of sidereal light (three cycles of 27.3 days). For the experiment we used only the central portions of the beds and plots, discarding the sides. Some plots were considered lost. eg.:24/5/05 day was discarded due to a rain of 95 mm. Other 10 plots were eliminated due to the action of dogs. In 2006 only 3 plots were discarded.

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The astronomical data of lunar rhythms used for correlation with production were extracted from Agricultural Astronomical Calendar (Thun, 2005 and 2006). For this we considered the astronomical data concerning the dates of sowing in relation to following lunar rhythms: Synodic moon rhythm (phases of the moon). Also considered the ethno moon phases, which does not include the traditional concept "phase", but indicates that the impulse starts three days before the traditional phase, up to three days after this (Restrepo-Riviera, 2005). Also evaluated the Agricultural Astronomical Calendar based on astronomical (not astrological) ephemeris. One of the fundamental principles of this calendar is related to the movement of the Moon through the twelve regions of the Zodiac (Sideric Moon Rhythm). The Zodiac is the set of constellations in front of which the moon and all the planets move, as it is observed from Earth. In each of these days the plants receive stimuli which act on the development of its various constituent parts: root (constellations of Taurus, Virgo and Capricorn), stems and leaves (constellations of Pisces, Cancer and Scorpio), flowers (constellations Gemini, Libra and Aquarius) and fruits (constellations of Aries, Leo and Sagittarius), and exert beneficial effects on them. (Thun, 2000).

The following characteristics were evaluated: Weight of Roots and leaves fresh, percentage of dry weight. Production data were used to calculate a polynomial equation. This equation produced a line that describe the general trend of effects that were due to planting at different times. The data for individual plantings were then compared with the trend line for all of the replicates. The percent deviation from the trend line was calculated. These values were then analyzed with a analysis of variance using the SAS statistical analysis program. It was verified the following contrasts between treatments:
a) Comparing the Phase of the Moon each other: full with new, crescent and waxing, new with waxing and crescent, crescent with waxing (for ethno moon phases were made the same contrasts that traditional stages) b) Rhythm ascending to descending c) with Perigee peak d) Node with ascending descending e) Comparing Root Day to leaf day, flower and fruit day (when the root carrot was evaluated), f) Comparing Root Day to leaf day, flower and fruit day for fresh mass of leaves; 3 days before the full moon and three days before the New Moon in 2005, and 1 day before the full moon and two days before the New Moon in 2006.

Results

Weight of roots fresh: The following effects were observed: the fresh root weight decreased in the later sowings (Figure 1). This occurrence was due to the increase of the cold and decrease hours of light / day during the fall and winter. Figures 2 refer to the seasonal trend values of fresh weight of root in 2005.

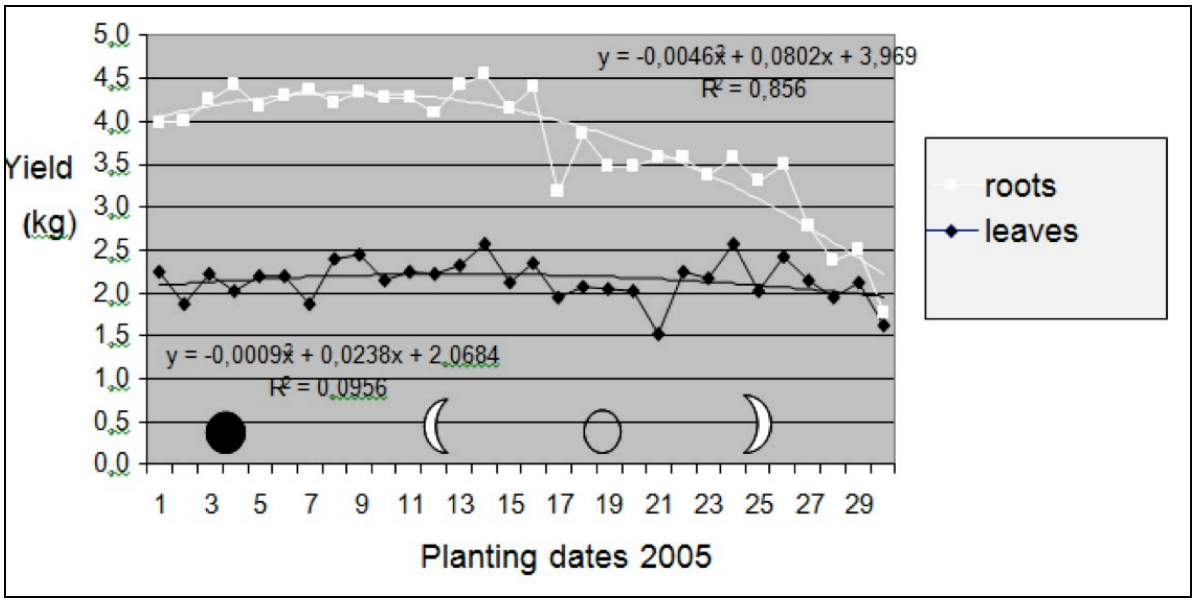


Figure 1. Weight of Roots and leaves fresh for different sowing dates seeding in 2005. Botucatu, UNESP, 2007.

Comparing the average fresh weight of roots, 2005, there was a significant difference (at 5% probability) at synodic ethno rhythm on the full moon with crescent and full with waxing. In 2006 data the average, there

was significant difference (significant at the 5% probability) between averages of fresh weight of roots only for the synodic ethno rhythm in new phase with waxing. In 2005, the full ethno phase was inferior than crescent and waxing. In 2006 these results did not happened again, and the new phase ethno was lower than waxing as can be seen in Table 1.

Other authors working with the carrot and using the seasonal trend values d different results. GOLDSTEIN (2000), in an experiment in the USA, found that sowing the day before the full moon had the most positive effect, resulting in a 15% increase in productivity (significant at p = 1%). The sowing during the waxing moon reduced the productivity in 17% (significant at p = 2%). According to SPIESS (1994) the highest productivity was achieved with the carrot sown three days before the full moon, and at Virgo constellation, reaching up to 22% more productivity. The Moon in Sagittarius was when were obtained the lowest yield for carrots, showing the influence of synodic and sidereal rhythms in carrot cultivation.
Figures 2 refer to data from the seasonal trend values of fresh weight of leaves in 2005. These data are related to astronomical rhythms in 2005. The contrast between 2005 medium showed no significant difference(at 5% probability) in synodic ethno rhythm at the full with crescent phase and full with waxing.

Table 1 - The seasonal trend values (%) fresh root weight (FRW) and leaves (FLW) and root dry matter (DM) of carrots, related to various lunar rhythms, in 2005 and 2006. Botucatu - UNESP, 2007.

Lunar Rhythms	FRW 2005	FRW 2006	FLW 2005	FLW 2006	DM 2005	DM 2006
Synodic						
New	100,51	99,64	100,29	101,50	105,03	104,33
First quarter	100,20	100,52	101,35	105,12	98,03	96,69
Full	99,46	95,91	97,85	90,75	97,31	97,25
Last quarter	99,62	103,09	98,93	100,12	99,26	100,81
Before Full Moon	95,84	105,37	97,05	110,55	96,06	89,85
Before New Moon	98,89	103,81	99,19	96,97	93,15	95,04
Synodic ethno						
New ethno	97,52	93,88	95,79	98,39	100,05	98,60
First quarter ethno	102,52	100,52	104,65	102,71	102,27	104,20
Full ethno	93,74	96,96	91,58	93,39	95,85	93,37
last quarter ethno	105,50	110,58	105,78	103,17	101,41	103,70
Sideric						
Root	101,43	97,95	102,56	101,58	100,77	100,57
Fruit	95,41	94,69	91,91	95,55	99,20	98,76
Flower	103,15	102,16	103,25	100,00	101,20	95,20
Leaf	99,89	105,28	100,42	101,79	99,39	105,01

The contrast between average of fresh weight of leaves in 2006 showed no significant difference at 5% probability. The 2005 results repeats what happened with the fresh weight of roots in synodic ethno rhythm, related to the smallest value of the seasonal trend values of ethno full phase regarding crescent and waxing (Table 1).

Percentage of dry mass of roots
The collected data were related to astronomical rhythms in 2005 (Figures 2) and 2006. The contrast between the averages of dry matter (%), 2005 showed a significant difference at 5% probability in the following rhythms: synodic traditional: new phase with the waxing phase, crescent and full; At synodic ethno Rhythm**:** full phase with the crescent phase, new and waxing. The contrast between the averages of dry matter of 2006 showed a significant difference at 5% probability in the following rhythms: Traditional synodic rhythm: new phase with the phases of crescent and full; ethno rhythm: new phase with the phases of crescent, full and waning, full phase with crescent and waxing phases; At sideric rhythm, in trine root versus leaf and root/ fruit. Evaluating the syderic rhythm in 2006, it was observed that the value of the seasonal trend value of

trine leaf was superior to the root, and this one was superior to the fruit and flower. According THUN (2000) the root trine should be higher than the leaf, fruit and flower. The results of SPIESS (1994), which worked with MS% carrot, showed that root trines were also superior to the others. In 2005 there were no significant results.
To the synodic traditional rhythm in 2005, new phase was superior to other phases. In 2006 the results for new phase was superior of full and crescent, and equal to waxing phase (Table 1). As for contrasts in Synodic ethno Rhythm in 2005, the full phase showed the lowest result, while the other phases results were equal. In 2006, the full phase also had the lowest result, followed by the new. The crescent and waxing phases were similar but superior to the others (Table 1). Similar Result were found for weight of roots and leaves in 2005.

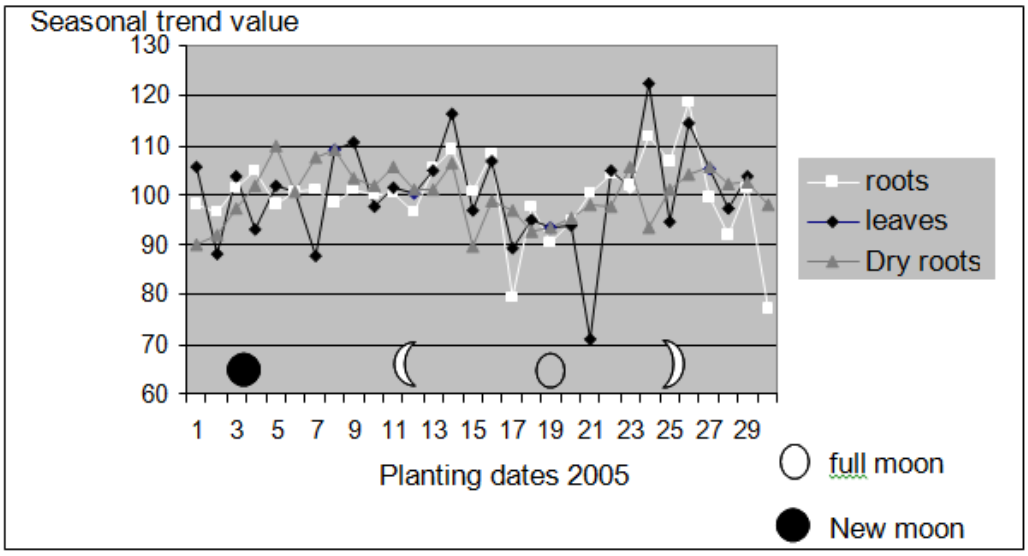


Figure 2. Weight of Roots and leaves fresh and dry weight of roots for different sowing dates in 2005 relative to the seasonal trend values. Botucatu, UNESP, 2007.

Discussion

The dry weight of roots was the only aspect that showed significant difference in the contrast between averages of the synodic traditional and synodic ethno rhythms in both periods of this study
In traditional synodic rhythm, the results on new phase of the moon was superior that on growing and full phases. In synodic ethno, the full phase was lower than the others. To sowing during the new moon period brings the best possible result to the producer. Precisely the rhythm of the moon phases is the most used by family farmers. The two-year research were not conclusive, but showed a tendency that demand more research. One of the aspects for future research is to increase the sowing period for at least three consecutive months.

References

Goldstein W (2000): The effects of planting dates and lunar positions on the yield of carrots. Biodynamics, EUA, July/August.
Restrepo-Riviera J (2004): La Luna: El Sol nocturno em los trópicos y sua influencia em la agricultura. Fundação Juquira Candiru, Manágua.
Setzer J (1946): Contribuição para o estudo do clima no Estado de São Paulo. Escolas Profissionais Salecianas, São Paulo, 48p.
Spiess H (1994): Chronobiologische Untersuchungen mit besonderer Berücksichtigung lunarer Rhythmen im biologisch-dynamischen Pflanzenbau. Darmstadt: Institut für Biologisch-Dynamische Forschung.
Thun M(2000): Sembrar, plantar y recolectar em armonía com el Cosmos. Editorial Rudolf Steiner, Madrid.
Thun M (2005): Calendário Astronômico-Agrícola 2005. Associação Brasileira de Agricultura Biodinâmica, Botucatu, 48p.
Thun M (2006): Calendário Astronômico-Agrícola 2006. Associação Brasileira de Agricultura Biodinâmica, Botucatu, 26p.

Potential use of medicinal plants in animal production: results in Brazil

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Key words: animals, phytotherapy, antibacterial, anti-parasitic, insecticide, maize

Abstract

The development of organic animal production systems combined with the problems of drug resistance, as well as the high input costs and the concern about toxic residues in foods have driven the use of plants or their extracts for both the prevention and maintenance of animal health as well for conservation of stored grains. This paper reports the results of the scientific evaluation of anti-parasitic, antibacterial and insecticide action of a group of plants or their extracts in popular use in southern Brazil. The results shown here refer to those plants that have proven a minimum of 70% efficiency in laboratory and / or in the farm. The study covered cattle, poultry, pigs, goats and buffaloes and also stored maize. The positive results lead to the conclusion that the use of plants or their extracts are a good choice for use in veterinary medicine and should continue to be studied.

Introduction

The development of organic livestock production systems combined with drug resistance, the high input costs and the concern about toxic residues in food have strongly driven the use of plants in the prevention and recovery of animal health as well for conservation of grains, in the past decade. Many countries, especially in Asia, Africa and Latin America, have a long tradition in the use of medicinal plants. Brazil has a significant genetic diversity, currently with 55,000 described species which highlights the enormous potential of this country. Popular knowledge about medicinal plants comes mostly from Native Brazilians, and this empirical knowledge is being scientifically confirmed and thereby gaining space and credibility.
In this paper we sum up some studies carried out in Brazil, focusing on several plants that have had their therapeutic efficiency scientifically demonstrated, ensuring their effectiveness.

Material and methods

We selected a group of plants that have had their therapeutic efficiency tested, with good results (minimum 70% effectiveness) on laboratory testing and/or in the farm dealing with some of the main current problems of animal breeding. The following tables show results grouped by the observed activity: antiparasitic and antibacterial effect.

Results

Table 1 shows the plants that have proven action against internal and external parasites of several species of animals. The administration of the plant or its extract in the animals was oral or dermal (baths) (7,11,12, 13,15) .

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Table 1 - Anti-Parasitic action (direct use in animals)

PLANT	USE	ACTION	ANIMALS
Musa sp.(Bananeira*)	Leaves (ingestion)	*Haemonchus , Cooperia, Trichostrongylus, Oesophagostomum*	Cattle and goat
Azadiractha indica (Nim)*	Powder or oil (ingestion or bath)	Ticks, botfly, hornfly	Cattle and buffalo
Cucurbita spp (Abóbora*)	Dry seeds or infusion (ingestion)	Internal parasites	Chicken
Chenopodiumam brosioides (erva-de-santa-maria*) *Allium sativum (*Alho*)*	Dry leaves (ingestion) Extract (ingestion)	*Haemonchus, Ostertagia, Cooperia, Strongyloide Trichostrongylus,*	Sheep

*Popular name in Brazil

Table 2 shows the action of extracts of plants to fight free living larvae of flies. The extracts were placed in the soil where the animals spent the night (5,6).

Table 2 – anti-parasitic action (use in the environment)

PLANT	POPULAR NAME IN BRAZIL	CONTROL OF LARVAE
Azadiractha indica	Nim indiano	94.4%
Nicotiana tabacum	Fumo	90.4%
Allium sativum	Alho	86%
Syzygium aromaticum	Cravo da índia	88.3%

Table 3 shows studies conducted by the Faculty of Veterinary and the Food Technology Institute of Federal University of Rio Grande do Sul - UFRGS, where hydric or alcoholic extracts from various plants have proven their efficacy against pathogenic microorganisms. The results have identified which plants may be used as disinfectants for wounds and udder of animals, as well as antiseptics for milking utensils and ambience collection, handling and processing of food (1,2,3,4,8,9, 14,16,17,18,19).

Table 3 – anti-microbial action

PLANT	POPULAR NAME IN BRAZIL	ACTION ON
Baccharistrimera	Carqueja	*Staphylococcus aureus* *Staphylococcus uberis*
Hypericum caprifoliatum	Escadinha	*Staphylococcus aureus*
Allium tuberosum	Alho nirrá	*Salmonella, Escherichia coli*
Achyrocline satureioides	Marcela	*Salmonella, Escherichia coli, Sataphilococcus aureus*
Llex paraguariensis	Erva-mate	*Salmonella, Escherichia coli*

Table 4 shows that plant extracts are also useful for the conservation of maize during storage to fight the weevil *Sitophilus zeamais* (10,16).

Table 4 - insecticide action in stored Maize

PLANT	POPULAR NAME IN BRAZIL	USE
Eucaliptus citriodora	*Eucalipto*	Layers interleaved
Caryophilus aromaticus	Cravo-da-índia	Layers interleaved
Azadirachta índica	Nim	Oils prayed

Discussion

The reported results show that some plants or their extracts have an efficient antiparasitic, antibacterial and insecticide action and may be used in animal production as well for conservation of stored grains. Although the use of herbal remedies for the prevention and treatment of a variety of illnesses in animals has increased tremendously in recent years, there is still a lot to study to bring about its full potential advantages.

For the results to be effective it is essential to understand and master all interwoven aspects, which include the identification, cultivation, collection, processing, storage, route of administration, dosage and recommended use for different species of animals as well as toxicology and safety use. Another major challenge is to pass on this knowledge to the breeders.

Suggestions

Herbal medicines have a great potential to be a good answer to treat animals, especially organic herds. However, further research, support and encouragement are required for this methodology to be correctly and safely used. Efforts should be made so that this methodology could be developed and disseminated.

The possibility of implementing a medicinal orchard, a true "living pharmacy", on farms or communities is feasible and of great importance because it also reduces the need to buy inputs from external sources, even herbal products. Needless to say, each region should preferably use its biome species.

References

Araujo, C.A et al. In vitro antibacterial activity of "Nira" garlic extracts (*Allium tuberosum* Rottler ex-Spreng.) Rev. Brasileira de Plantas Medicinais,vol.11 no.3, Botucatu,Brazil, 2009

Avancini, C. A.M. et al. Bacteriostatic and bactericidal activity of the *Baccharistrimera* (Less.) D.C., Composita e decocto, as disinfectant or antisseptic. Brazilian Jour. of vet and animal sciences. Belo Horizonte. Vol. 52, no. 3 (jun. 2000), p. 230-234

Avancini, C.A.M. et. al. Antimicrobial Activity of Plants used in the Prevention and Control of Bovine Mastitis in Southern Brazil. Latin American Journal of Pharmacy, 27 (6): 894-9 (2008)

Avancini, C.A.M et AL. Atividade desinfetante do decocto de *Hypericum caprifoliatum* Cham. e Schlecht. – *Guttiferae* (escadinha, sinapismo),frente diferentes doses infectantes de *Staphylococcus aureus* (agente infeccioso em mastite bovina). Revista Brasileira de Plantas Medicinais. v.10, p.64 - 69, 2008.

Deleito C. S. R; Borja G. E. M. Nim (*Azadirachta indica*): uma alternativa no controle de moscas na pecuária. Pesquisa Veterinária Brasileira, 28(6): 293-298 junho 2008.

Deleito, C.S.R. Alternative insecticides in the control of sinantropic flies. 2008. 123 p. Tesis (Doctor in Animal Biology). Universidade Federal Rural do Rio de janeiro, RJ, 2008.

Dias, A.V. – Uso do nim em bovinos e bubalinos de leite na Estação Experimental de Aramarí – Simpósio Produção Animal Orgânica,Curso Fitoterapia, UFRGS/IBEM, 2012.

Duarte, M.C. Atividade Antimicrobiana de Plantas Medicinais e Aromáticas Utilizadas no Brasil, UNICAMP, 2006.

Girolometto.G.; Wiest, J.M. (orient.) Avaliação da atividade antibacteriana de extratos de *Ilex paraguariensis* St.Hill. (erva mate) frente a bactérias zoonóticas em saúde e produção animal. 2005. Dissertação (Progr de Pós-grad em Ciências Veterinárias) – UFRGS

Lotuffo, D.C. Efeito do uso de folhas de eucalipto (*Eucaliptus citriodora*) na armazenagem de milho (*Zeamays*) em espiga, compalha, em pequenas propriedades rurais. Tese de mestrado apresentada a Faculdade de Eng. Agrícola da UNICAMP, 1998.

Lunardi, JJ - Produção de alimentos de origem animal isentos ou com menos biocidas Orientações Educativas e Informativas – MATER /RS Oliveira, D.B. et.al. Atividade anti-helmíntica da bananeira (*Musa sp*) em bovinos. Congresso Brasileiro de Med. Veterinária, Gramado, 1977.

Oliveira, D.B. et.al. Atividade anti-helmíntica da bananeira (*Musa sp*) em caprinos. Tese de doutorado. 63p - RJ, 1977.

Oliveira, E.A. Atividade antimicrobiana "in vitro" do decocto de *achyrocline satureioides* (lam.) dc (*asteraceae*) frente a cepa de Referência (*staphylococcus aureus* atcc 25.923) de interesse em medicina veterinária. Trabalho de conclusão de graduação, UFRGS, 2012.

Oliveira,R.G. Avaliação “in vivo” da ação anti-helmíntica de plantas Consideradas medicinais como recurso potencial no controle de endoparasitos gastrintestinais de ovinos. Dissertação de mestrado. FAVET, UFRGS, 2003.

Previero, C.A.et. al. Receita de plantas com propriedades inseticidas no controle de pragas – Palmas: CEULP/ULBRA, CNPQ, 2010.

Wiest, J.M.et.al Inibição e inativação in vitro de *Salmonella* spp. com extratos de plantas com indicativo etnográfico medicinal ou condimentar. Arquivos Brasileiros Medicina Veterinária e Zootecnia. v. 61, p.119 - 127, 2009.

Wiest, J.M.et al. Inibição e inativação de estafilococos por extratos de plantas com indicativo etnográfico medicinal ou condimentar. Rev. Brasileira de Plantas Medicinais. v.11, p.209 - 215, 2009.

Wiest, J.M.et al Inibição e inativação de *Escherichia coli* por extratos de plantas com indicativo etnográfico medicinal ou condimentar. Rev.Sociedade Brasileira de Ciência e Tecnologia de Alimentos . v. 29, n. 3, p 1 – 7, 2009.

The Campinas and Region Natural Agriculture Association's Participatory Guarantee System: a case study in Brazil

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Key words: Participatory Guarantee Systems, Participative Organic Quality Assurance Systems, Organic Seal

Abstract

The research aimed to review the context in which the Brazilian regulation of organic agriculture was conceived and to conduct a study of the first PGS (Participatory Guarantee System) registered in Brazil. Such PGS is part of the Campinas and Region Natural Agriculture, located in the state of San Paolo. The research sought to understand the farmers´ objectives and motivations for adopting the PGS and their experiences within this social control mechanism. The participants in this research identified as main advantages of the PGS: extended experience sharing, participatory decision-making and collective strategies for purchase and marketing. Those previously certified by third party systems unanimously declared that the PGS proved to be more stringent and reliable as an organic conformity assessment system. However, the farmers also highlighted that paperwork required by the government from PGSs has increased and that indirect costs continue to be the main challenges that they face.

Introduction

The Law 10.831 of 2003, pertaining to Brazilian regulation of organic agriculture was the result of an intense one decade debate including social movements, PGS supporters, third party certifiers, intellectuals, government members and other sectors of civil society. Consequently, Brazil was the first to include PGSs (Participatory Guarantee Systems) as an alternative to third party certification among the organic conformity assessment systems permitted to issue the official seal for marketing of organic products within the national territory. This work presents an historical overview of this law-conceiving process and a case study of an association that decided to convert its non-profit third party certification department to a PGS in 2010. The Campinas and Region Natural Agriculture Association´s PGS nowadays certifies sixty producers, corresponding to 435 hectares of organic farming in the states of San Paolo and Minas Gerais.

Material and methods

A comprehensive analysis of the context in which the Brazilian Law of Organic Agriculture was conceived has been possible through literature review and the analysis of reports from meetings of the Organic Agriculture Group (GAO by its acronym in Portuguese). GAO was responsible for the final version of the Law 10.831 and among its members there were social movements and PGS proponents, third party certifiers, intellectuals, government members and other sectors from civil society. In addition, a semi-structured interview with one of GAO's members was conducted.

For the ANC´s study, the methodology included six months field work based on the participatory observation methodology in one of the accredited farms, local organic markets, peers and verification visits and PGS´s meetings. Additionally, twenty semi-structured interviews were conducted with participant farmers.

The first phase of the field research occurred from June 2013 until December 2013. These six months field work took place in one of the properties certified by the PGS being studied. During this period the researcher took part in activities such as soil preparation, planting, cropping, processing, packing and labelling of the products. The researcher attended ten local organic open air markets organized by the SPG being studied where such products were marketed. In parallel and since the beginning of 2013 the researcher attended eight of the SPG monthly meetings, two peer visits and one verification visit.

Based on the qualitative criteria of social and economic diversity ten out of the sixty participant producers were selected for semi-structured interviews. The PGS is divided into fourteen regional groups and these first ten interviewed were each selected from a different group. However, as the interviews were carried on the need of ten other interviews emerged as the first block of interviews revealed fundamental differences among traditional and Neo-Rural (GIULIANI, 1990) farmers in terms of their comments on their PGS experiences. The script for the interviews was designed to identify family background, reasons for converting

to organic agriculture (if the case) and for adopting the PGS. Also farmers who had already been certified through third party systems were interviewed to draw a comparison between the two systems. The interviews also focused on the main advantages, disadvantages, challenges and demands pointed out by the farmers relative to the studied PGS.

Results

The Brazilian Law for Organic Agriculture

The literature review indicates that the international and especially the European debate on the regulation of organic agriculture had an important influence on the current Brazilian legislation. The main procedures required by both regulations are similar and based on the ISO 65 guide standards. However, as will be shown later, there was a remarkable openness in the Brazilian case in terms of discussion with the civil society arising from the Ministry of Agriculture, Livestock and Supply,

The demand for ecological products increased in Brazil after the United Nations, ECO -92, that was held in Rio de Janeiro, 1992 (Santos, 2005). The national media started then to emphasize expose`s concerning the use of agrochemicals and the consequent harm to nature and human health. However, a decade earlier many social networks of consumers, farmers, students, researches and other interested persons had been organized through local participatory systems to warrant the origin of its ecological products (Fonseca, 2005). Such guarantee was given more through the social strength of relationships than by specific control mechanisms (official norms, for instance) and the more the consumer was interested in the production process the higher their level of interaction with the farmer and understanding of the challenges involved in organic farming.

Therefore, in 1994 the Brazilian Ministry of Agriculture, Livestock and Supply started to mediate the debate about organic regulation. It was during this time that the first third party international organic certification bodies started to operate in Brazil. At the time, many large scale producers supported the need for a national regulation and defended exclusive third party certification as in Europe. Family farming and peasant movements also believed that an organic regulation would surely stimulate ecological production in the country, however criticized third party certification as the only alternative to assure organic quality.

As the negotiations were carried on, the main third party organizations started to push for exclusive third party certification and a proposal of normative practically identical to the ISO 65 was launched in 2002 by the Ministry of Agriculture, Livestock and Supply. Later in the same year, social movements gathered in the 1st National Meeting of Agroecology and the National Articulation of Agroecology (ANA by its acronym in Portuguese) organized a group called Organic Agriculture Group (GAO by its acronym in Portuguese) in order to present a counter version of the normative. GAO gathered representatives from PGSs and third party certifiers. The group, with the support of the Ministry of Agrarian Development, conducted an exhaustive research on the certification bodies operating in Brazil. At the time, three PGSs were already operating in Brazil: Rede Ecovida (in the south region of Brazil), Rede Xique-xique (in the northeast) and OAS Acre (in the Amazon Region). Such PGSs became the reference for the regulation concerning PGSs in Brazil.

The final version of the current Law 10.831/2003 for Organic Agriculture and the subsequent normative instruction from 2009 concerning control mechanisms for organic assurance were the first national regulations to include PGSs as alternatives to third party certification. Both PGSs and third party certifiers are audited, accredited and authorized by the Ministry of Agriculture, Livestock and Supply to perform inspections on the production units. The farmers certified by PGS or third party certifiers are allowed to use the organic seal and are included in the Brazilian System of Organic Conformity (SiSorg), which is a national record coordinated by the same Ministry. Another important innovation was the inclusion of Social Control Organizations (OCSs) as registered groups of organic farmers that are released from using the organic seal under the twin conditions that they are family farmers and sell only through direct sales at organic fairs. The OCS production units are not subjected to conformity inspections from the Ministry and the design of the control mechanism is let to the OCS' criteria, but are however submitted to the Ministry for later approval. One characteristic of SPGs and OCS in Brazil is that these models were developed to be locally based and promote civil participation by building bonds of trust and continuous knowledge exchange through a wide and growing agroecological network.

Another interesting fact is that due to GAO´s influence, the Brazilian organic law was written based on the wide concept of Agroecology and its final version highlights several elements such as the cultural integrity of rural communities, social equity, the economic value of family farming and respect for natural resources. It also recognizes different farming styles as organic: biodynamic, organic, natural agriculture, permaculture, agroforestry, regeneration systems and others. Such wideness resulted in a great variety of ecological farming systems all officially recognized as "organic" in terms of the current legislation. Therefore the law recognizes at the same time systems guided by the principles set out by Agroecology and those which are based exclusively on chemical inputs replacement. (Abreu et al, 2009).

The Campinas and Region Natural Agriculture Association's Participatory Guarantee System

ANC was founded in 1991 as a non-profit civil organization by producers who decided to address themselves to meet the growing demand for an ecological market in the region. Since 1994 ANC had a non-profit third party certification department but in 2010 its members decided to adopt the PGS instead.

However, only eight out of the total of sixty associates were accredited by ANC at the time. The others came from already existing international or national third party certifiers or then started their conversion processes as they intended to join the PGS.

All those interviewed were previously accredited by a third party certifier and have unanimously declared that the PGS has turned out to be more severe in terms of assessment and control. According to the farmers, the peer and verification visits to their properties happen more often under the PGS and that they are more closely examined about their procedures by other farmers than they were by technicians from external certifiers. They have also pointed out that the participants assume collective responsibility for the credibility of a member and if a failure to conform to standard occurs all the producers might lose their accreditations. Due to this solidarity of responsibility the farmers believe that they have become more committed to and engaged with organic procedures since they have joined the PGS.

The participants interviewed have all pointed to the experience sharing and the participatory decision-making processes as the main gains within this kind of system. They declared that constant visits and meetings allow them to share their difficulties and become aware of everyone's problems. In relation to fulfilling all the procedures required the national regulation they declared that the collective search for solutions is essential for the PGS and that they have the chance to learn and take advice from other farmers who have found means to overcome their own challenges related to production and marketing.

The adoption of the PGS also encouraged cooperation among the regional groups for whom direct sale at fairs was an important marketing strategy. In two of the fourteen groups the farmers started to organize common transport for fairs, common leasing of market spaces and also started to alternate their presence on fairs days. Such strategies play an important role in increasing income for these farmers.

As well, the research identified that communication is essential within the regional group and that at least one participant of each regional group should attend a PGS meeting or visit. And it is evident that the more dynamic the group is the more the producers show enthusiasm about the PGS' advantages and the less overloaded a specific member of the group is.

The PGS demands considerable personal time. The PGS´s activities proved to be profitable only for those who take advantage from such activities to exchange experiences and knowledge. On the other hand, producers who view the PGS exclusively as a cheaper alternative to third party certification tend to be discouraged in the long-term. Furthermore, in the PGS studied the financial cost can be considered to be higher than for third party certification because of money, time and work days spent on traveling for visits, meetings and filling out the required paper work. Also a monthly fee is charged by the Association.

The PGS studied also employed a technician specialized in organic agriculture and does not depend exclusively on volunteer work. This was fundamental to the success of the PGS and the following advantages must be highlighted: producers deal with less paperwork than in other PGSs, the employee coordinates the agendas of peers and verification visits and is responsible for advising, researching and answering questions related to technical issues concerning organic regulation. Furthermore, the Association provides public access to documents through an internet website which is updated by this employee weekly. On this website interviews and meeting reports, annual management plans of each property, the profile of

each producer and many other documents are available to the public. This is fundamental to guarantee the principles of transparency and traceability related to PGSs.

A significant difference concerning the producers' social backgrounds was revealed during the interviews and the PGS meetings. Two major social groups were identified: traditional producers and Neo-Rurals. One of the main challenges identified for the PGS perpetuation is related to conflicts that emerge from such diversity. Traditional farmers have always lived on their properties and have less formal educational background than Neo-Rural farmers that have left urban life and moved to the countryside. Traditional farmers believe technical procedures should be discussed in more straightforward language so they can feel more confident to share their ideas during the meetings. They also often insist that more gatherings should take place on the farms so they can point out and see for themselves the problems that the farmers have been facing on production and share even more experiences. Also traditional farmers have identified paperwork as a bigger challenge than did the Neo-Rurals. They also believe organic regulation is written in a too complex way and changes rapidly, consequently they said they are constantly worried about failing to comply with standards due to the lack of information.

The Brazilian System of Organic Conformity Assessment requires detailed registers of qualitative and quantitative information regarding the management of the properties and commercial transactions. However essential for control it is a challenge for farmers who have little time and are not used to bureaucratic paper work to keep such records constantly updated.

Discussion

Participatory Guarantee Systems empower local organic networks if they are not designed exclusively as control mechanisms. The study shows that the studied PGS was an important tool for strengthening ecological based family farming in the region and that it stimulates local sociability through the constant collective search for solutions. The studied PGS has also revealed a great diversity of producers' profiles. Farmers can share their practices while visiting other organic properties and discuss organic procedures at meetings. The participants consider such system more reliable than external accreditation due to its shared responsibility. Therefore, PGSs can be considered a resistance space for organic family farming in regions mainly occupied by agribusiness and conventional monoculture such as the countryside of Brazil in which the PGS studied is located.

References

ABREU, L. S. from; KLEDAL, P, Pettan, K. , RABELLO, F. , MENDES, S. C. . History and current status of ecologically-based agriculture in Brazil and in the state of São Paulo. Ca-dernos Science & Technology. Books on Science & Technology, vol. 26, p. 149-178, 2009.

FONSECA, M. F.A.C. The institutionalization of organic markets in the world and in Brazil: an interpretation. 2005. Thesis (Ph.D. in Development, Agriculture and Society) - Federal Rural University of Rio de Janeiro, Rio de Janeiro, 2005.

GIULIANI, Gian Mario. 1990. "Neo-rurality: the new style of the old models." RBCS / ANPOCS, n. 14, year 5.

SANTOS, L. C. Regulation of Organic Agriculture in Brazil: Paths, misdirection and their contribution in building the Fair Trade system. 2005. Florianópolis. Available at: http://followscience.com/content/367914/certificacao-de-produtos-organicos # sthash.8XGI20n8.dpuf.

TORREMOCHA, E.. The participatory systems of liability. Tools and definition of strategies, North America, 6, dec. In 2011. Available at: <http://revistas.um.es/agroecologia/article/view/160701>. Access Closes: Sep 26. In 2013.

Consumers' perceptions of organic foods in Bulgaria: evidence from semantic differentials application

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Key words: organic food, Bulgarian yoghurt, consumers' perceptions, Bulgaria

Abstract

The article aims to present consumers' perception of Bulgarian organic foods (Bulgarian yoghurt case) by applying the method of semantic differentials. The empirical study is framed by the focus-groups and semantic differential approaches. The first stage of the survey in 5 sessions was carried out in Sofia and Plovdiv. The second stage of the study tests the consumers' perception of quality and safety attributes of Bulgarian yoghurt by the semantic differential method. Principal component analysis with varimax rotations extracted six factors for these results and each of them groups around it specific descriptors of the bipolar scales used in the study. The interpretation of the importance of the factors is done by clarifying the semantic relations between the underlying descriptors.

Introduction

The main tendency for most countries in Central and Eastern Europe is their organic production to be developed mainly for the purpose of export. This leads to the impossibility for organic products to be adapted to the local market. The solution to this is the quick development and expansion of the domestic market for organic agricultural products and foods. Although the share of organic food products in the general food market in Bulgaria is relatively small - less than 5%, the organic market enlarged significantly in the last few years.

In order to promote marketing possibilities for organic foods, it is important to understand consumer motivations in the purchase of organic foods (Magnusson et al. 2003, Thogersen 2009, Zanoli and Naspetti 2002).

The article aims to present consumers' perception of Bulgarian organic foods (Bulgarian yoghurt case) by applying the method of semantic differential.

Material and methods

Choice of organic food product for the purpose of the study

The country is known around the world with Bulgarian yogurt. The presence of the bacterium *Lactobacillus Bulgaricum* guarantees its unique nutritional properties. Bulgarian consumer is familiar with yogurt from a very early age. This allows for a much better appreciation and completeness in describing this product typical for the country. It is important to note that the variety of organic food offered in the Bulgarian market is not great. Based on the above considerations, certified organic yogurt was selected as the object of the study.

Questionnaire

The survey was conducted using a preliminary prepared questionnaire. Focus group discussions preceding this study helped to formulate the main questions of the study (Vasileva et al. 2009). On this basis, a set of descriptors that characterize organic yogurt were determined, 24 of which were included in the bipolar scales of the semantic differential. Part of the questionnaire has the form of an interview with closed questions conducted by the interviewers. The rest, laid out on separate sheets for convenience, is completed by the respondents independently. The aim is to avoid discussing questions in the interview which could cause discomfort - personal information and such requiring concentration (e.g. semantic differential) from the respondents.

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The questions were grouped as follows: a) basic closed questions on the topic; b) questions of the semantic differential (24 bipolar descriptors for organic and conventional yogurt); c) questions describing participants.

Date collection

The empirical study is framed by the focus-groups and semantic differential approaches. The first stage of the survey (5 sessions) was carried out in the towns with the most developed markets of organic foods in the country - Sofia and Plovdiv They were conducted in the period May – June 2009. A total number of 46 people participated in the focus-groups. The second stage of the study tests the consumers' perception of Bulgarian yoghurt by the semantic differential method. Data was collected during April and May 2011 in Sofia. The target population of 84 Bulgarians included consumers who are knowledgeable about organic foods and regularly buy organic yogurt. All participants in the study were clients of the shop "Elemag - gourmet" who have bought organic yogurt. Later, when invited, they have expressed a desire to participate in the study.

Data analysis

To the answers of the participants in the focus groups was applied content analysis, which resulted in a series of descriptors characterizing organic yogurt. The research team limited them to 24 items which were included in the bipolar semantic differential scales. Descriptive statistical analysis is used in the study. Principal component analysis with varimax rotations was applied to the results obtained after using the semantic differential. The software used for the quantitative analyses was SPSS 21 for Windows.

Results

The largest percentage of consumers (29.8%) buys organic products because they hold the view that these products are associated with healthy lifestyle and good health status. Very often, curiosity (interest) in the new product (about 16.7% of the respondents) and recommendation from friends (about 8.3% of the respondents) are indicated as the reason for the purchase. The participants in the study appreciate highly the taste (4.8%), purity (6.0%), organic aspect (7.1%), quality (3.6%) and origin (3.6%) of the products.

The results of the application of the semantic differential for organic and conventional yogurt among Bulgarian consumers describe two separate graphs for the studied products. Principal component analysis with varimax rotations extracted six factors for these results and each of them groups around it specific descriptors of the bipolar scales used in the study. They are used to build the picture of the perceptions of the respondents regarding the quality and safety of the studied products. The interpretation of the importance of the factors is done by clarifying the semantic relations between the underlying descriptors.

The first factor contains the poles "necessary - excessive", "pleasure - displeasure," "happy - sad", "tangible - intangible", "attractive - unattractive" and "practical - impractical." Provisionally we can call this factor "Ability to derive pleasure without difficulty". The emphasis on the possible difficulties is placed because the descriptor "practical" was indicated in this group. In the perceptions of the respondents organic products bring joy and pleasure to the senses, without the need to apply complex preparations, difficult culinary treatments and so on.

The second factor is derived from the adjective "controlled - uncontrolled", "toxic – non-toxic", "polluted - unpolluted", "recyclable - non-recyclable" and "obsolete - contemporary". Putting control in the centre of this set of descriptors by the respondents indicates another of their key beliefs: in modern day conditions the certainty that a product is not dangerous and does not endanger the health of the consumer and others stems from adequate control measures. In the past, it might not be necessary, but in the modern ways of marketing it is required.

The third factor groups the adjectives "risk – trust", "light - heavy", "artificial - natural" and "delicious - tasteless". It cannot be distinguished from the first two factors, if interpreted out of their context. It reflects the confidence of consumers that they are able through their senses to experience artificial or untypical additives. The key features here are trust and perceptions of taste. Apparently respondents, as evidenced by the first factor, tend to rely on the experience gained from the use of these products. However the higher significance they give to the second factor, suggests that this happens only after ensured control (certification). Within this category of guaranteed controlled products the taste, the smell, the feeling of lightness, freshness, etc. will influence the final choice.

The fourth factor includes only three polar elements: "genuine – fake", "harmless - harmful" and "Bulgarian - foreign". The focus on identity is strongly manifested and should be placed in the centre. They connect the descriptors of that identity, that is, what they think is typical for Bulgarian products. Apparently, according to

the participants of the survey organic products are truly "Bulgarian and harmless". Respondents distinguish between non-toxic (proven to not contain poisons) and harmless, i.e. unable to cause harm in any way.

The fifth factor contains only the adjectives "homemade - industrial" and "rural - urban". The connections in this case are direct and obvious. Industrial and urban are related concepts to such an extent that in certain cases they can be used as synonyms. Organic products in the perception of the respondent are typically rural and far from their understanding of industry.

The sixth factor unites the adjectives "high tech - low-tech" and "prestigious - non-prestigious". At first glance, there is contradiction with the previous - organic product is not industrial but are highly technological. The explanation is in the meaning implied in the concepts. Industrial is associated not with the technologies but with the quantity (mass) of produced products. For the respondents high technologies are obviously information technologies, biotechnologies, nanotechnologies, etc. The relationship between high technologies and prestige is logical. Consumer expectations are organic products to be produced in small quantities in small businesses or farms following classical and traditional recipes or approaches but using high technologies. According to them, the process is that of the home made and rural product but in conditions of high hygiene and control, impossible without the use of high technologies.

Discussion

Bulgarian consumers purchase organic products because they differ from the conventional in taste, smell, texture, etc. When developing marketing strategies for launching organic yogurt on the market the fact that Bulgarians distinguish organic yogurt from its conventional counterparts by sensory characteristics (delicious and genuine) and with guaranteed control and safety (safe, non-toxic, controlled) should also be take into account. Interesting for the marketing of organic yogurt is the relationship between "experiencing pleasure" and "maintaining a healthy lifestyle". Probably a new group of consumers is formed which simultaneously combines the gourmet and the person who tries to eat healthily. Consumer expectations are organic products to be made following traditional recipes and traditional production processes, but by using high technologies which ensure hygiene and proper functioning of the processes.

References

Magnusson M, Arvola A, Hursti U, Aberg L & Sjoden P (2003): Choice of organic foods is related to perceived consequences for human health and to environmentally friendly behaviour. Appetite 40(2), 109–117.

Thogersen J (2009): Consumer decision-making with regard to organic food products. In: Teresa de Noronha Vaz et al. (eds): Traditional food production and rural sustainable development. A European challenge. London: Ashgate 173–194.

Vasileva E, Ivanova D, Tipova N & Stefanov S (2009): Quality and Safety Attributes of Organic Yoghurt: Consumers' Perceptions in Bulgaria. 3rd International Congress on Food and Nutrition. Book of Abstracts 190–91, Antalya, Turkey, April 22 – 25.

Zanoli R & Naspetti S (2002): Consumer motivations in the purchase of organic food. A means end approach. British Food Journal 104(8), 643–653.

Development of the Organic Sector in Post-Socialist Bulgaria 1990-2013

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Key words: organic agriculture, Bulgaria, institutional development, policy, community, market

Abstract

The paper presents a comprehensive analysis of the social, political and economic processes that influenced the development of the Bulgarian organic sector in a post-socialist context. The analysis identifies and challenges an important scientific gap showing that despite the unquestionable importance of the organic concept for achieving sustainable rural development, that phenomenon has not been subject to a lot of scientific research in Bulgaria. It discusses the influence of the socialist legacy on Bulgarian agriculture and identifies the driving forces that made possible the development of the concept and debates the relevance of the so-called organic sector "boom" in the country.

Introduction

Many researchers are certain that the post-socialist transformations and the legacy of the past strongly affect the structure of ownership, organization and production of the agricultural sectors. The aim of the paper is to question the problem of building up the organic concept in terms of national policies, farming practices and market forces in Bulgaria. That aim is fulfilled by answering three main questions: 1) how did the legacy of the socialist past affect the structure of the agriculture and influenced the emergence of the organic concept; 2) which are the driving forces that influence the development of the organic sector in Bulgaria and 3) are economic considerations important while building the organic concept. The relevance of the research findings is achieved through an interdisciplinary approach providing instruments to disclose the emergence of the organic concept and its embeddedness in social, economic and political actions. The paper is supported by the Swiss Enlargement Contribution in the framework of the Bulgarian-Swiss Research Programme through the Project "*Addressing socio-economic regional disparities: the potential of organic farming for strengthening rural areas in Bulgaria*".

Material and methods

The results are based on triangulation of qualitative and quantitative methods: 1) 22 semi-structures in-depth interviews with key informants working in the areas of organic farming research, organic farming associations, environmental and consumer organizations, retail, policy decision-makers, extension and administration; 2) Policy document analyses, desk-top analyses of relevant literature and other public resources; 3) network analysis of more than 20 interviews using a semi-structured questionnaire.

Results

In correspondence to the main research question the results of the analysis can be summarized in the following three dimensions.

- *Legacy of the past and post-socialist transformations*

Unlike other countries like the Czech Republic, Poland, Hungary, Serbia, etc. at the collapse of the socialist system Bulgaria finds itself without an established private ownership of agricultural land as the agriculture itself had developed predominantly in collectivist structures (cooperatives) (*Bezemer* 2002, *Sutherland* 2010). At the beginning of the 90s the cooperatives were rapidly destroyed but people professionally engaged with agriculture such as owners or tenants of land were predominantly absent. Thus the legacy of the socialist past affected the agriculture to an extent that hampered the emergence of the figure of the farmer who produces for the market and who is able to maintain subsistence farm. It was only at the beginning of the 90s when a process of land restitution started, following the model of "restitution in actual size", i.e. heirs of the owners of the land which was collectivized during the 1950s receive the same plots of land. This process finished in 2002. The restitution was accompanied by processes of de-professionalization and loss of professional identity as the land was returned to people occupied in other industry or already disconnected from their agricultural and rural roots. Currently the structure of agriculture in Bulgaria is

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characterized by few very largescale farms and a myriad of tiny family plots on the other.The absence of the so-called 'medium sized family farms', 83.2% of the utilized agricultural area in Bulgaria have less than 2 ha (*Ministry of Agriculture and Food 2011*).In addition very small amount of farm owners have formal education in agriculture and there is a tendency of decreasing of the number of farmers.

The land restitution encouraged the appearance of organic farms, not existing before. They are predominantly small in size as the biggest share of the producers possess and cultivate up to 2 or 3 ha and cannot ensure enough amount of production or assortment of products for the market. Most often the organic producers are coming from other industries and having no professional training in agriculture. The first certified organic farm was established in the mid 90s, even before the appearance of appropriate legislation regarding organic farming. The driving forces for development of organic farming involve a broad set of motivations, which might be environmental (nature protection), economic (economic survival), ethically driven (produce in conformity with nature) and even stimulated by opportunities for receiving EU subsidies and other national payments. Thus the appearance of the organic farms in Bulgaria can be further explained with the embeddedness of the organic concept in the cultural, economic and political specifics of the transformation and dependence on national policies-created opportunities, farmers' solidarity and access to markets.

- *Driving forces building up the organic concept*

Two main driving forces that influence the building up of the organic concept in Bulgaria could be distinguished: internal (academic circle, NGOs, agricultural policies) and external (foreign programs and organizations). On the one hand, despite the existence of policy instruments for supporting the organic concept, the policy-making itself is marked by lack of coherence between legislative (ordinances), financial (compensation payment measures), and strategic (national plan) instruments (*Stoeva, Slavova, Georgieva* 2013). On the other hand, although the organic farmers have established several professional organizations, the membership rate is rather low (about 5%) and most of them do not participate in the development of national policies and measures for supporting the sector. In this sense, the impetus for the development of the organic concept did not come from the state, neither from the farmers, but from academic and external factors having experience and interests in the development of organic farming. During the first years of the transformation these institutions managed to promote organic concept as a specific 'culture' of farming and even as a 'cause' based on value oriented practice. Later on the accession to the EU (2007) stimulated profit oriented practices for receiving EU subsidies for organic farming rather value oriented ones.

- *Economic considerations of the development of the organic concept*

While building the organic concept the economic considerations play an important role to the extent where the sector involves different type of actors: organic operators (producers, traders, and processors), occupied in different types of activities and pursuing different kind of economic interests. Their motivations for entering the organic sector vary from a strategy for subsistence of the household, full or part-time employment, receiving EU subsidies, etc. Even more: what is challenging to be explained is that in the Bulgarian case the development of national policies, introduction of financial instruments and organic organizations did not encourage effectively the building of organic market forces. We argue that there are different types of economic logic (values, actions, motivations, etc.) that the different types of operators are following. For example, despite the significant growth of the number of certified organic operators at the end of 2012 associated with a "boom" of the sector development, the leading motivation among operators (the biggest part are producers) is not to produce for the market but to receive EU subsidies. Furthermore, there are operators (producers and traders) who are simultaneously occupied in production, processing and trading in order to increase their gain, receiving profits from the State (EU subsidies) and from the market. We can also outline another group of operators (mainly traders) interesting only in market profit. Considering all of these economic interests in the field the so-called "boom" in the sector should be analyzed with more attention.

As the economic considerations are concerned we can observe a narrowness of the domestic market in Bulgaria. On one hand this is due to the structure of organic farms mentioned above and the different economic interest of the operators. Besides, the biggest part (90-95%) of the production is aimed for export and not for the local market. On the other hand, indeed, during the last three years we observe an increase of the number of specialized shops and stands for organic products as well as of consumers' interest in the biggest cities. However, the high prices of organic production combined with the low incomes in the country are serious obstacle that hinders the development of the domestic organic market. Concerning the export it should be mentioned that except for one or two producers there are no well-established Bulgarian brands on the international markets and the biggest part of organic production is exported as raw materials and not as products ready to be sold.

Discussion

The origins of the organic notion in Bulgaria can be traced back to the last years of the socialism when certain academic circles started to introduce the methods of organic farming. Later on these circles together with local and foreign NGOs became important internal factors for the building up of the organic concept in Bulgaria. The role of the State still remains questionable as despite the existence of policy instruments for supporting the organic concept, they are not flexible enough to solve newly appeared problems. In such a context the ownership of land could not explain the emergence of the "organic farmer" but rather the existence of a wide range of interests and motivations: produce for markets, produce for subsistence, receiving EU subsidies and other national payments. Others as shown above are interested in market profit. However, we find a significant group of actors (producers) motivated not by the idea for producing in conformity with nature, but it is rather the economic interest for receiving subsidies (a common strategy developed by farmers is to stay as long as possible in conversion because the EU subsidy for it is higher than the one for production).

Suggestions to tackle with the future challenges of organic animal husbandry

The subject of the paper makes possible suggestions relevant only in post-socialist context and in societies where the organic concept is still developing. In the Bulgarian case we may argue that despite some positive tendencies the organic animal husbandry represents one of the main weaknesses of the organic farming sector. Yet the organic farms in Bulgaria seams not to ebrace the orthododx organic concept for combining plant growing and animal breeding but rather to divide the two activities. As a result mixed organic farms in Bulgaria are actually missing. Currently in the country there are only 5 organic livestock breeding farms out of 1916 organic producers. This can be explained with the lack of financial support or compensation payments of organic animal husbandry. The farmers receive no subsidies for breeding or for certification. Another obstacle is the shortage of organic green crop (forage) production as well as of certified slaughterhouses. These facts give ground for suggesting an improvement of national and EU policies for 1) encouraging the organic husbandry, 2) the development of mixed organic farming and 3) creating opportunities for processing organic animal products which in Bulgaria seem to be quite limited.

References

Bezemer, D.J. (2002). Credit markets for agriculture in the Czech Republic. Europe-Asia Studies 54(8): 1301-1317

Sutherland, L. A. (2010). Differentiating farmers: opening the black box of private farming in post-Soviet states. Agriculture and Human Values 27: 257-276

Stoeva, S., Slavova, P., Georgieva, Z. (2013), Institutional development of organic farming in Bulgaria 1990-2013. Country report in the frame of the project Addressing socio-economic regional disparities: the potential of organic farming for strengthening rural areas in Bulgaria (Bulgaria Organic)"

Ministry of agriculture and food. (2011) Census of Agricultural Holdings in the Republic of Bulgaria in 2010. Agrostatistics. Bulletin 170

Swot analysis of organic market in Bulgaria

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Key words: organic market, swot analysis, Bulgaria

Abstract

In 2009, a big market research has been carried out by Vitosha research company, including 120 producers, retailers and wide number of consumers. Main conclusions from SWOT analysis made are: Bulgaria has sufficient objective conditions to become a serious player in bioproduction. Consumption of organic products in the country is still poorly developed.

Introduction

In order to evaluate development and characteristics of organic market, together with attitude towards organic products in Bulgaria, a big market research in 2009 has been carried out by Vitosha research company. Production, sale and consumption of organic goods had been inquired among 120 producers, retailers and wide number of consumers. This research contains a lot of analyses, the most important of which is SWOT analysis.

Results

Analysis of the strengths of organic market

As a strong market feature could outlined *appreciation of Bulgarian organic products from the representatives of the various stores (distributors, tourist sites)*.

The appreciation of Bulgarian organic products from the current consumers of organic food and non-food products.

Price advantages of Bulgarian organic products
Their price advantage, combined with their image of high quality products providing reasonable advantages in the realization of the market.

Presence of organic products in the most visited shopping sites of food (supermarkets, etc.) and in internet space.

Presence of a relatively high proportion regular users.
Almost half of consumers who buy organic produce in last year are regular customers (buying organic products are more than once a year). The relatively high share of regular users is important for the development of this market, but on the other hand it shows that the **Bulgarian market has is still at an early stage of development.**

Existence of a clear legal basis for the conditions of production, import and export
As a whole it could be stated that official legislative in the country is clearly regulated and complies with European requirements.

Availability of sufficient objective conditions for the development of organic production
As is clear from previous reports (Ivanova-Peneva, 2004) and the results of a desk research (Vitosha research, 2009), Bulgaria has good conditions for the development of both organic farming and organic livestock. Opportunities in this regard, however, are yet to come.

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Analysis of the weaknesses of the organic market

One of the problems the market is currently low share biological products in comparison with conventionally produced.
This means that the market is still at an initial stage of development, i.e. can be defined as the incipient.

Insufficient awareness of the population about organic product.
According to a consumer survey (Vitosha reserch, 2009), just over one-fifth of respondentsare absolutely not aware of the existence of organic products. On the other hand, informed ones are not sufficiently aware of the characteristics of the biologically produced products, and therefore it is very difficult to distinguish them, or would be distinguished from counterfeits ones and similar products of natural ingredients. Insufficient information is one of the main factors for reduced consumption market.

Insufficient popularity of organic products (through advertising and other marketing techniques)
On the other hand, as shown by the results of the desk research, the popularity of the topic in the media is extremely low. Although Bulgarians are well informed about biodiversity and ecology, the theme about health life and respectively organic products remain off the public interest.

Insufficient awareness of current users
An example is given about attitudes of consumers that organic products are sold at identical prices to conventional alternatives.

Relatively high proportion of users "outside the market"
This includes just over a quarter of the population. These users are not at all familiar with the concept of "biological product", so at this stage they can be assigned even to a group of potential users of the market of organic products.

Presence of counterfeits and imitations
Presence of imitations creates a sense of distrust to the market on the part of consumers and may become a prerequisite for refusal consumption.

Lack of distinctive marks for identification of organic products
Most consumers tend to seek universal logo, although this marking is not mandatory.

Lack of established brands and a variety of brands
A common option is a company that produces a particular type of product (say yogurt) to offer biovariant of products. On the other hand, most of the organic products are offered by small manufacturers who do not have enough advertising opportunities.

Complicated system of quality control on the market
Proof of this is the relatively low share of distributors, representatives, merchants and hotels, and a small share users who know where to pay in the event of a problem with the quality or imitation of a biological product. On the one hand, MAF is a body of last resort to which can turn both consumers and manufacturers or distributors. On the other hand, for specific problems such as detection and others, users should refer to the first type organizations Federal consumer protection organization or the appropriate State Commission consumer protection organization. Problems with product quality or distributors manufacturers must turn to the organization that has certified the products. An other problem in this regard is the lack of public information to what control authorities should refer consumers, producers or distributors in similar types of problems.

Insufficient supply in hotels and restaurants

Insufficient development of favorable conditions for organic farming in the country
Despite the best opportunities for the development of organic farming in Bulgaria, on amost of the farmland is still not practiced organic farming or livestock breeding. The capacity of production of wild organic products is still small, in comparison to the possibilities.

Insufficient subsidies to organic production
Although the figures of MAF show some progress, the real picture in subsidies that Bulgarian organic farmers receive, is different. The survey among manufacturers, shows that the most costly expenses in this type of production is soil preparation and purchase of manure, which are crucial to organic cultivation. Insufficient state funding creates a risk of increased costs of production and reduce competitiveness of manufactured products.

Analysis of market opportunities for organic products

Increasing the range of products available in trade chains.
Currently the most widely practiced in trade chains is the offer of food and above all dairy products, eggs, bread and vegetables of organic origin. Potential users, however, would also be interested in organic meat and fruit. Supply of organic cosmetics, spa products, herbs and herbal products could be extended in connection with the growing interest to green and eco-friendly way of life.

Offering of more organic products in other types of retail outlets (not sale), such as hotels and restaurants.
Spa tourism is just beginning to be offered as a service in Bulgaria. Given the fact that the country has imposed production of organic essential oils and similar of these products (second place in the production of Lavender oil after France), it would be a favorable niche for the development of this type of product. In similar guidance could be expanded the supply of organic cosmetics.

Diversification and expansion of distribution channels.

Stimulating demand by attracting new customers.
Except through expansion of the distribution channels, the need of organic products h could be induced by *promotion of organic products among large sections of the population*.

Stimulating of demand by raising awareness of current and potentialcustomers.

Increase the diversify of organic products.
On the one hand, a small percentage of existing farmland currently are used for organic production, on the other hand, the existing climate, soils, waters, etc. in Bulgaria are very suitable for extensive agriculture, including development of organic farming and livestock breeding.

Increase organic production through the possibilities for production of wild organic products.
In Bulgaria, there are favorable conditions for the collection of various wild products such as herbs and mushrooms. The yield of these products is related to the significantly less cost, therefore in this direction could be sought opportunities for development.

Encouraging producers through a package of measures.

Promotion of exports through a package of measures.
Given the results of desk research (Vitosha research, 2009), the demand for organic products in developed countries continues to increase. Suitable package of measures, including simplified export procedure could stimulate the implementation of local products outside Bulgaria.

Promotion of the "industrial" use of organic products by suitable package of measures.

Hazard Analysis of organic market

Contraction in demand due to high prices of products.

Contraction of consumption due to the presence of many fakes and imitations.

Collapse consumption due to poor popularization of bioproducts.
Promotion of organic products has several dimensions. First is related to *the degree of awareness of the consumers that manufacturers and traders determined as relatively low.*This creates a danger consumption

remains reduced to a size where it is today, unless steps are taken to increase the level of awareness of consumers. Another problem is *the lack of advertising of organic products.* This is one of the factors which the producers themselves determine as an obstacle to better realization of such goods.

Contraction of consumption due to poor availability of organic products.
A significant part of potential consumers argue that they do not know where to buy these products or that they have never seen them to sell in stores. Limited distribution channels are likely to cause the consumption to remain at a level which is at present

Collapse due to insufficient production subsidies.
Biological production requires relatively high investment costs for a preparation of the production (i.e . transition period) and activities covering the requirements for certification. In every EU country organic farming receives preferential subsidies, but in Bulgaria aid per hectare is still very low, which discourages some of manufacturers in the future to switch to this type of production.

Collapse of production for unfavorable external economic factors.
Deepening of economic crisis is one of the factors that could affect negatively Bulgarian organic products producers.

Conclusions

Bulgaria has sufficient objective conditions to become a serious player in the bioproduction. As a serious potential can be reported the presence of a suitable environment and agricultural soils that could be adapted to organic farming. Regulations of organic production, and import and export of such products are clearly regulated and aligned with European requirements. Problems facing the bioproduction are more of economic nature - still lower subsidies per hectare, which have Bulgarian producers.

The consumption of organic products is still poorly developed. The reason is low consumer awareness of the benefits of these products, as well as the ability to differentiate organic products from any imitations.

Obstacles to consumption could be still limited distribution of organic products - the lack of specialized stores (except big cities like Sofia, Varna, Plovdiv), and also the available information sources, as well as low social status of people.

Least popular products in Bulgaria are organic products that are not foods. Such products, with the exception of the essential oils are hardly produced in the country. The main part of organic production in Bulgaria remain foods, herbs, honey.

References

Ivanova-Peneva, S.G. 2004, Organic farming in Bulgaria: Early development and problems, In: Proceedings of the 3rd SAFO Workshop “Enhancing animal health and food safety in organic livestock production systems”, 16-19 September 2004, Falenty, Poland, 145-151.

Production, sale and consumption of organic products in Bulgaria (results from marketing research), 2009, Vitosha research, Sofia, 2009, 273 pp. [REPORT_BIOPRODUCTS_last.pdf].

Grazing Green Manures to Optimize Nitrogen Supply on the Canadian Prairies

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Key words: green manures, grazing, annual forages, forage utilization, soil nitrate.

Abstract

Returns from annual forages can be optimized when multiple benefits are drawn from them: soil fertility, weed competition and animal live weight gains from grazing forage biomass. An experiment was conducted in Manitoba, Canada between 2009 and 2011 to investigate the productivity, weed competitiveness and livestock utilization of seven green manure species and mixtures. We hypothesized that soil NO_3-N levels will be greater when green manures are grazed than when they are left ungrazed. Hairy vetch, pea/oat mix and oats produced the greatest forage biomass in two of three years. Soybean and lentil failed to compete with weeds; containing 30 to 73% weed biomass in all years. Utilization by sheep for all crops ranged from 28% to 86%. Total soil NO_3-N (0-120 cm) was significantly greater in grazed compared with ungrazed plots in the first year of all three experiments. Therefore, instead of single benefit of soil fertility, two benefits were reaped from green manures; potential livestock live weight gain and soil fertility.

Introduction

Grazing of green manures by ruminants has been suggested as a way to improve economic and soil fertility building value of green manures. Grazing accelerates N mineralization from plant material and may improve the N availability to following cash crops. Although forage potential of many annual forage species has been evaluated, very few studies used actual grazing as a management effect. Particularly in organic systems, where soil management history may produce different soil fertility and weed pressure than conventional systems, such information is critical. Therefore, selection criteria for annual forages in organic systems should include: i) sufficient dry matter biomass production for livestock, ii) nitrogen contribution to following cash crops, iii) weed competitiveness, and, iv) nutritional quality and palatability. The objectives of the present experiment were to investigate: i) productivity, weed competitiveness and livestock utilization of seven green manure types, and ii) effects of grazing on soil NO_3-N.

Material and methods

The trial was conducted at University of Manitoba Ian Morrison Research Station located at Carman, Manitoba, Canada (49° 49' N, 98° 00' W) on a Hochfeld fine sandy loam soil. Trial was started in 2009 and was repeated in 2010 and 2011. Green manure species were hairy vetch (*Vicia villosa* L.), lentil (*Lens culinaris* cv. Indianhead), oat (*Avena sativa* cv. Legget), soybean (*Glycine max* cv. Prudence), sweet clover (*Melilotus officinalis* cv. Norgold), and, the mixes were pea/oat mix (*Pisum sativum* cv. 40-10/ *Avena sativa* cv. legget) and cocktail mix of barley (*Hordeum vulgare* cv. Cowboy), field pea (*Pisum sativum* cv.40-10), red millet (*Pennisetum glaucum* L.), radish (*Raphanus sativus* cv. Groundhog), soybean (*Glycine max* cv. Prudence), purple top turnip (*Brassica rapa* L.), sunflower (*Helianthus annuus* L.*).* Green manure species were grazed by 3 ewes and 2 lambs for 24 hours (1667 sheep d/ha). The plot size was 2m in width and 9m long and was surrounded by metal fence for precision and protection. Both sides were tandem disked at the same time upon the completion of grazing.

For experiment 1, soil samples were only taken from pea/oat and oat plots. In experiment 2, mixture plots were also sampled. In experiment 3, hairy vetch plots were sampled as well. Soil samples were taken using Dutch auger at four 30cm increments up to 120cm depth and analyzed for NO_3-N using KCl extraction method. Above ground biomass of green manures and wheat was collected from 2x 0.4 m^2 areas within each plot. Samples were sorted and dried for 2 days at 60 °C and weighted for dry matter content. The ground dry matter samples were subsampled and analyzed for N concentration by combustion analysis using a LECO FP-528 (LECO, St. Joseph, MI). Percent forage utilization was determined by taking residual

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above ground biomass (2 x 0.4 m^2) from grazed plots. Residual biomass was washed and dried for 2 days at 60 ^oC and weighted for dry matter content. The experimental design was randomized complete block design in split plot arrangement with four replicates. The main plots were management type (i.e. grazed and soil incorporated) and the subplots were the species (Table 3). Differences were considered significant at $P < 0.05$. Means were separated using a Fisher protected LSD test.

Results and Discussions

The growing season precipitation (April to October) over three year was very sporadic and averaged 386 mm, 607 mm and 297 mm in 2009, 2010 and 2011, respectively. The 30-year average in this location is 386 mm (Environment Canada 2012). Hairy vetch, pea/oat mix and oats produced the greatest forage biomass in two out of three years. In 2010, sweet clover produced a similar amount (5813 kg ha^{-1} Table 1). Soybean and lentil failed to compete with weeds; containing 30 to 73% weed biomass in all years. Utilization by sheep for all crops ranged from 28% to 86% but the most common range was between 60% and 80% (Table 1), which are higher than managed pasture utilization rates of 30-45% (Bardgett, 2005). Lower utilization rates in 2009 can be attributed to the methodological omission, where post-grazing residual biomass were not washed before drying and weighing. Lower utilization of sweet clover in 2010 (33 %) may be result of high biomass production and consequent woody stem of sweet clover. In the present study, sheep completely rejected Canada fleabane (*Conyza canadensis*) but consumed other weed species present.

Soil NO_3-N was measured after green manure grazing (in autumn) to determine whether grazing increased the short-term N availability in the 0 to 120 cm soil profile. Greatest soil NO_3-N content (226 kg ha^{-1}) was observed in grazed pea/oat plots in experiment 1 and lowest (44 kg ha^{-1}) was in ungrazed mixture plots in experiment 3. Most of the soil NO_3-N content difference between grazed and ungrazed plots was at the top layer of soil (0-30 cm). Total soil NO_3-N (0-120 cm) was significantly greater in grazed compared with ungrazed plots in the first year of all three experiments (Figure 1). In experiment 1, total profile soil NO_3-N level in pea/oat plots was greater than in oat plots. In experiment 2, oat plots contained less NO_3-N than pea/oat and mixture plots. In experiment 3, there was significant species and management effect where soil in grazed hairy vetch plots contained the greatest amount of NO_3-N. This interaction indicated that increase in soil NO_3-N availability is greater when hairy vetch is grazed than grazing of other crops. Hairy vetch biomass is known to have low C:N ratio (Parr *et al*. 2011). Kyvsgaard *et al.,* (2000) showed that N concentration of faeces was highly correlated with C:N ratio and apparent digestibility of the feed.

Table 1: Green manure species biomass production, percent weed content and percent utilization for experiments 1, 2 and 3.

	Biomass†			Weeds			Utilization		
Species	Exp1	Exp2	Exp3	Exp1‡	Exp2	Exp3	Exp1	Exp2	Exp3
	----------kg ha^{-1} -------			----------%----------			----------%----------		
Hairy vetch	6202a§	4260bc	4645a	<10	36b	0d	28b	81a	71bc
Pea/oat	6157a	5589ab	3352bc	<10	9c	15cd	45b	68a	65c
Oat	4337b	5570ab	4916a	<10	9c	12cd	54b	67a	74ab
Lentil	3442b	3536cd	3789ab	-	73a	64a	82a	71a	84a
Soybean	3540b	2606d	3376bc	30	70a	62a	40b	73a	85a
Mixture	-¶	3869cd	3234bc	-	16c	39b	-	76a	80ab
Sweet clover	-	5813a	2316c	-	n/a	30bc	-	40b	86a
P>F	0.0004	0.0015	0.0143	-	<.0001	<.0001	0.0008	0.033	0.0055

† With weeds. ‡ Visual ratings.
§ Within columns of same main effect, numbers followed by the same letters are not significantly different according to Fisher LSD test ($p < 0.05$).
¶ Mixture and sweet clover were not seeded for experiment 1

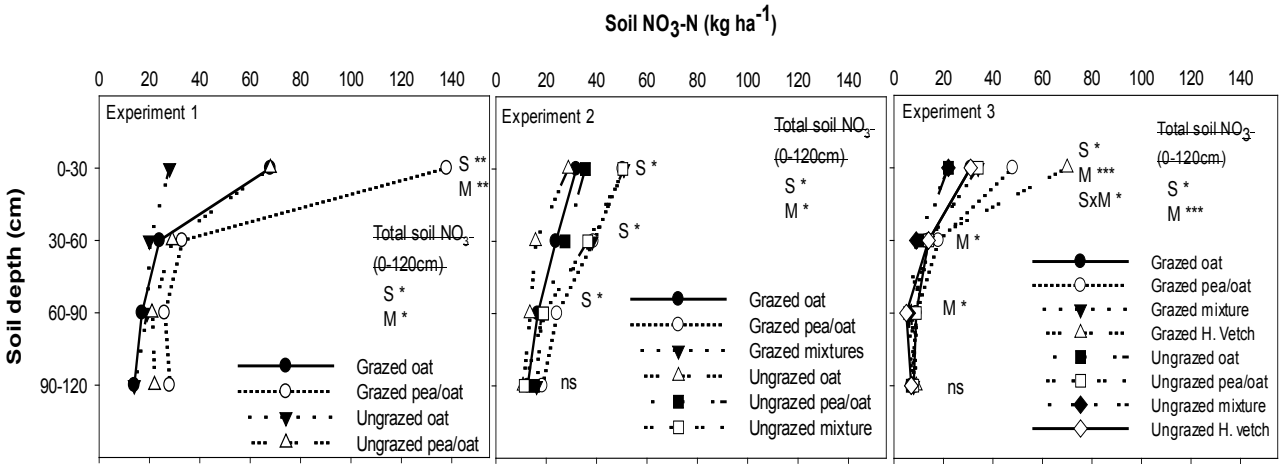


Figure 1: Soil nitrate as affected by green manure species (S) and green manure management ([M] grazing and incorporation) at depths of 0-30, 30-60, 60-90 and 90-120 cm for experiments 1, 2 and 3. *Significant at $p \leq 0.05$. ** Significant at $p \leq 0.01$. ns not significant.

Animal diet rich in N may increase the risk of N losses through leaching (Ryden *et al.,* 1984) and gaseous emissions (Oenema *et al.,* 1997). The size of a ruminant animal species can have a direct impact on N cycling. For instance N loading under urine patches for sheep is usually half that of cattle, which reduces the risk of N losses (Di and Cameron, 2002). In the absence of grazing rate of N release from green manures is mainly a function of residue placement. For instance, soil incorporated green manures released N faster than herbicide terminated (Mohr *et al*., 1998) or surface-mulched green manures (Vaisman *et al.,* 2011). Faster N mineralization from soil incorporated green manure biomass has been attributed to greater contact with soil microorganisms. An advantage of an integrated crop-livestock system is that additional processes (i.e., rumen function) can be brought to bear on decomposition of green manures.

Discussion

This study established the value of pea/oat and hairy vetch as annual forages for grazing. Pea/oat and hairy vetch produced high levels of biomass, competed with weeds, and were readily utilized by sheep. Lentil and soybean failed to compete with weeds, produced little biomass. Based on high utilization values, legumes and mixtures tested in the present study show promise as annual forages. Even though lentil and soybean forage biomass contained high proportion of weed biomass, palatability by sheep was not decreased relative to less weedy forages. Palatability and nutritional properties of some annual and perennial weeds have shown to be comparable to common forage species (Marten and Anderson 1975). It appeared that soil NO_3-N can be significantly increased with the selection of appropriate species with low C:N. In situations with low legume biomass productivity, grazing may be used to increase the N benefit from legume green manures to the following crops. Therefore, instead of single benefit of soil fertility, two benefits were reaped from green manures; potential livestock live weight gain and soil fertility.

Suggestions to tackle with the future challenges of organic animal husbandry

Arable and rangelands all around the world are under constant pressure from urbanization, climate change related stresses and human mismanagement. Feeding of animals has become a major challenge because of the conflict between food production for humans and forage for animals. These challenges instigated some to adopt new methods of faming where animals and crop productivity complement one another. Crop-livestock integrated systems have the potential to capitalize on the synergies of resulting from integration of production systems. Such integrated systems not only address critical issues in animal husbandry, but also in crop production.

References

Bardgett R., 2005. The Biology of Soil. *A community and ecosystem approach.* Oxford University Press, Oxford, UK. pp. 120-140

Di, H.J., Cameron, K.C., 2002. Nitrate leaching in temperate agroecosystems: sources, factors and mitigating strategies. Nutr. Cycling Agroecosyst. 64, 237-256.

Kyvsgaard, P., Sorensen, P., Moller, E., Magid, J., 2000. Nitrogen mineralization from sheep faeces can be predicted from the apparent digestibility of the feed. Nutr. Cycling Agroecosyst. 57, 207-214.
Marten, G. And R. Andersen. 1975. Forage nutritive-value and palatability of 12 common annual weeds. Crop Sci. 15:821-827.
Mohr, R.M., H.H. Janzen, E. Bremer and M.H. Entz. 1998. Fate of symbiotically-fixed N-15(2) as influenced by method of alfalfa termination. Soil Biology & Biochemistry 30:1359-1367.
Parr, M., Grossman, J.M., Reberg-Horton, S.C., Brinton, C., Crozier, C., 2011. Nitrogen Delivery from Legume Cover Crops in No-Till Organic Corn Production. Agron. J. 103, 1578-1590.
Oenema, O., Velthof, G., Yamulki, S., Jarvis, S., 1997. Nitrous oxide emissions from grazed grassland. Soil use Manage. 13, 288-295.
Ryden, J., Ball, P., Garwood, E., 1984. Nitrate Leaching from Grassland. Nature 311, 50-53.
Vaisman, I., M.H. Entz, D.N. Flaten and R.H. Gulden. 2011. Blade roller-green manure interactions on nitrogen dynamics, weeds, and organic wheat. Agron. J. 103:879-889.

Weeds promote the development of arbuscular mycorrhizal fungi in organic wheat fields

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Key words: arbuscular mycorrhizal fungi, phospholipid fatty acids, wheat, organic agriculture, weeds

Abstract

Understanding the effect of aboveground plants on arbuscular mycorrhizal fungi (AMF) in organic agriculture is of great importance in developing more efficient and sustainable agricultural systems. This study was conducted to evaluate the effect of weeds on AM and the effect of AMF on wheat (Triticum aestivum L.) grain quality in organically managed weed-free and weedy fields. The soil microbial profile was characterized using phospholipid fatty acids (PLFA) analysis. The presence of weeds increased the proportion of AMF; however, this increase did not alter the quality of wheat grain grown with sufficient soil phosphorus (P).

Introduction

Arbuscular mycorrhizal fungi (AMF) have attracted researchers' attention due to their ubiquitous distribution and beneficial effects on symbiotic host plants. Phosphorus (P) uptake enhancement is a well-known benefit of AMF (Smith and Read, 2008). Organic fields tend to have a larger AMF community than conventional fields (Oehl et al., 2004).

Although weed pressure has resulted in economic loss, some studies have emphasized the importance of aboveground species for maintaining soil mycorrhizal communities under conventional practices (Kabir and Koide, 2000). However, the relationship between weeds and AMF under organic management fields is still poorly understood.

The present study was conducted 1) to understand the role of weeds on the maintenance and promotion of AMF communities, and 2) to determine the effect of AMF on wheat grain quality in organically managed fields.

Material and methods

This study was conducted in 2010 and 2011 at the University of Alberta research farm, Edmonton, AB, Canada (55° 34' N, 113° 31' W). Fertility levels were adequate for wheat cultivation in both years, albeit with low N levels. The field has been organically managed since 1999. Plant residues from prior years were disc-harrowed in the field several weeks before seeding. A single tillage operation was also performed to control initial weed emergence prior to seeding. Thirteen Canadian spring wheat cultivars (*Triticum aestivum* L.) were seeded in a split-plot design with four replications. Weed treatment (weed-free and weedy) was the main plot effect and wheat cultivar was the subplot. Weed-free plots were maintained by daily hand-weeding throughout the wheat growing seasons to avoid soil surface disruption, while no weed control was applied in the weedy treatment.

Weed samples were collected from a quadrat in each plot when wheat vegetative growth was completed. Wheat yield samples were collected at their maturity. The samples were stored in a dryer at 40 °C for at least 48 h before measurement.

Soil samples for a microbial community analysis were collected twice during the wheat growing season (1st: May, 2nd: September). Soil samples were analyzed to characterize soil microbial communities using phospholipid fatty acid (PLFA) analysis (Hannam et al., 2006). Indicator PLFAs were used to calculate the relative contribution (as % of total microbial PLFA) of several soil microbial groups (i.e. gram-positive bacteria, gram-negative bacteria, actinomycetes, AMF).

Wheat grain nutrient contents were analyzed using a standard HNO_3 H_2O_2 method (Zn, Mn, Cu, K) and the Kjeldhal method (P). Grain protein content was recorded using near-infrared reflectance (NIR) spectroscopy.

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All collected data were tested to meet the assumptions of ANOVA prior to analysis. The data were analyzed using the PROC MIXED procedure (version 9.2, SAS® Institute, 2008) of SAS. They were analyzed as a randomized complete block design in a split-plot arrangement. For PLFA analyses, all PLFA data were transformed using arcsine square-root transformation prior to the analyses. Pearson's correlation coefficients were computed to examine correlations among grain nutrients, weed dry biomass (WDB), total biomass production (TBP: wheat grain + weed dry biomass) and soil microbial communities.

Results

The weedy treatment had a greater percentage of AMF (Weedy: 3.4 %, Weed-free: 3 %), wheat grain yield (Weedy: 3.94 t ha^{-1}, Weed-free 4.79 t ha^{-1}), weed dry biomass (Weedy: 2013 kg ha^{-1}, Weed-free: 7 kg ha^{-1}), total biomass production (Weedy: 5.86 t ha^{-1}, Weed-free: 4.8 t ha^{-1}) and manganese (Weedy: 34.1 ppm, Weed-free: 31.9 ppm) relative to the weed-free treatment at $p < 0.05$. However, levels of phosphate and protein were not affected by the weed treatment.

There was a moderate positive correlation between weed dry biomass and the percentage of AMF in the weed-free treatment; however, weed dry biomass did not correlate with AMF in the weedy treatments (Table 1). Zinc and potassium were negatively correlated with the proportion of AMF only in the weedy treatment (Table 1). However, there was no discernible difference in the levels of grain nutrients related to the presence of AMF.

Our study also observed an increase in AMF over the wheat growing season in both treatments (Figure 1). The increase of AMF was greater in the weedy treatment than in the weed-free treatment (Weedy: from 2.9 % to 3.9 %, Weed-free: from 2.8 % to 3.1 %), while gram-negative bacteria decreased over the growing season (Weedy: from 13 % to 12 %, Weed-free: from 12.8 % to 11.9 %).

Table 1: Pearson correlation coefficient of WDB, TBP and grain nutrition with soil microbial communities at the second soil sampling

				Weed-free				
	WDB	TBP	Zn	Mn	Cu	K	P	Pro
Gram+	-0.36**	-0.42**		-0.34*				-0.41**
Gram-	0.31*	0.34**		0.28*				0.36**
Actino		0.37**						
AMF	0.4**							
				Weedy				
	WDB	TBP	Zn	Mn	Cu	K	P	Pro
Gram+	-0.32*	-0.29*		-0.28*		0.49**	-0.32*	-0.57**
Gram-			-0.28*			-0.41**	0.36**	0.46**
Actino				-0.31*			-0.31*	
AMF			-0.38**			-0.43**		

*,**= significant at the 0.05, 0.01 probability levels.
Gram+: Gram-positive bacteria, Gram-: Gram-negative bacteria, Actino: Actinomycetes, WDB: Weed dry biomass, TBP: Total biomass production, Pro: Protein

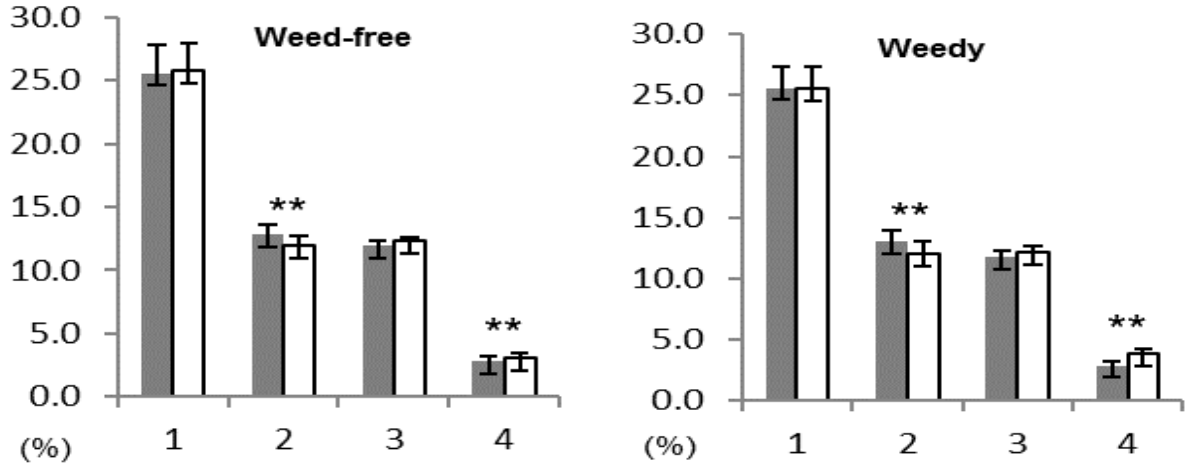


Figure 1: Mean proportion of soil microbial communities in the weed-free and the weedy treatments in two different samplings

Grey bars denote first sampling time (May) and white bars represent second sampling time (September). 1: Gram-positive, 2: Gram- negative, 3: Actinomycetes, 4: AMF.
**= significant at the 0.01 probability levels. Bars indicate standard errors of the means.

Discussion

These results indicated that the presence of weeds supported a substantial increase in AMF over the growing season. Interestingly, we observed a positive correlation between AMF and weed dry biomass only in the weed-free field. This indicated that the substantial increase in AMF did not occur continuously with the growth of aboveground vegetation. The increase may have reached a marginal point at which symbiotic nutritional exchange became imbalanced due to intensification of light and nutritional competitions among aboveground spices (Facelli et al., 1999).

As in a previous study (Liu et al., 2000), AMF did not alter wheat grain quality under sufficient soil P conditions (2010:134 kg ha^{-1}, 2011:63 kg ha^{-1}). The total aboveground biomass and soil P status are important factors in controlling AMF benefits for host plants. Further studies on the behavior of AMF at various aboveground crop and weed densities may contribute to the development of efficient organic agricultural practices.

References

Facelli E., Facelli J. M., Smith S. E. & McLaughlin M. (1999): Interactive effects of arbuscular mycorrhizal symbiosis, intraspecific competition and resource availability on *Trifolium subterraneum* cv. Mt. Barker. New Phytologist. 141, 535-547.

Hannam K. D., Quideau S. A. & Kishchuk E. B. (2006): Forest floor microbial communities in relation to stand composition and timber harvesting in northern Alberta. Soil Biology & Biochemistry. 38, 2565-2575.

Kabir Z. & Koide R.T. (2000): The effect of dandelion or a cover crop on mycorrhiza inoculums potential, soil aggregation and yield of maize. Agriculture, Ecosystems & Environment 78, 167-174.

Liu Y., Hamel C., Hamilton R. I., Ma B. L. & Smith D. L. (2000): Acquisition of Cu, Zn, Mn and Fe by mycorrhizal maize (*Zea mays* L.) grown in soil at different P and micronutrient levels. Mycorrhiza. 9, 331-336.

Oehl F., Sieverding E., Mäder P., Dubois D., Ineichen K., Boller T., & Wiemken A. (2004): Impact of long-term conventional and organic farming on the diversity of arbuscular mycorrhizal fungi. Oecologia. 238, 574-583.

Smith S.E. & Read D.J. (eds.) (2008): Mycorrhizal Symbiosis. 3rd ed. Elsevier Ltd. London. Middleton.

Beneficial and pest insects associated with ten flowering plant species grown in Québec, Canada

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Key words: conservation biological control, preventative pest management, Coccinellidae, *Lygus lineolaris*, flea beetles, insectary plants

Abstract

The attractiveness of ten flowering plant species (Achillea millefolium, Coriandrum sativum, Cosmos bipinnatus, Lobularia maritima, Medicago sativa, Petunia grandiflora, Phacelia tanacetifolia, Sinapis alba, Tagetes patula and Tropaeolum majus) to beneficial natural enemies, such as ladybeetles (Coccinellidae) was assessed. Observations were also recorded for the economically important insect pests Lygus lineolaris and flea beetles (Chrysomelidae: Alticinae). Coccinellids captures were highest in T. patula, T. majus, C. bipinnatus and A. millefolium plots. Numerous captures of insect pests, such as L. lineolaris in P. tanacetifolia and flea beetles in L. maritima, S. alba and T. majus, indicate that rigorous selection of flowering plant species has to be used in pest management strategies to reduce insect pest problems.

Introduction

Curative strategies to control insect pests are quite limited in organic production. Therefore, preventative approaches, such as cultural and conservation biological control, are of highest priority in organic cropping systems (Zehnder et al. 2007). Conservation biological control involves managing the agroecosystem to provide ecological resources for natural enemies of insect pests. The use of flowering strips which may provide food source (pollen and nectar) and shelter for beneficial insects may contribute to increase predator or parasitoids' fitness and make them more effective biological control agents (Gurr et al. 2004).

This 3-year study looked at the attractiveness of ten flowering plant species to natural enemies, focusing on beneficial predatory Coccinellids, as well as insect pests that could be harmful to adjacent crops.

Material and methods

This study was conducted at the Organic Agriculture Innovation Platform managed by the Research and Development Institute for the Agri-Environment (IRDA). The site is located in Saint-Bruno-de-Montarville, Québec, Canada. The experimental design consisted of a randomized complete block design with ten flowering plant species (*Achillea millefolium, Coriandrum sativum, Cosmos bipinnatus, Lobularia maritima, Medicago sativa, Petunia grandiflora, Phacelia tanacetifolia, Sinapis alba, Tagetes patula* and *Tropaeolum majus*) and 4 replicates. Plots were 2.4 m x 3 m, with 3 m between plots within a block and 10 m alley between blocks. In 2012, a vegetation- free treatment was added. Plots were regularly manually weeded. In 2011 and 2012, one replicate out of four was not sampled due to lack of plant uniformity for some species. Plant growth stages* were recorded weekly to determine the annual flowering period for each plant species.

Beneficial insects and their abundance were monitored weekly with sweep nets and yellow sticky traps. Counts included predatory insects such as Coccinellidae, Syrphidae*, and *Orius* spp.*, and other beneficial insects (Syrphidae and Hymenoptera)*. Insect pests were also recorded: tarnished plant bug (*Lygus lineolaris*), flea beetles (Chrysomelidae: Alticinae), aphids (Aphididae)*, leafhoppers (Cicadellidae)* and thrips (Thysanoptera)*.

The GLIMMIX procedure of SAS was used to fit a generalized Poisson mixed model for overdispersed count data. Treatment fixed effect and random effects of year and blocks were accounted for in the model. Tests of treatment effect were carried out using Wald tests.

* Data not presented

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Results

Yellow sticky traps captured a higher number of coccinellids than the sweep net as has been previously reported (Schmidt et al. 2008). In our study, for all treatments combined, the average number of ladybeetles per yellow sticky trap per week was 2.64, 2.53 and 2.89, whereas captures by sweep net were 0.13, 0.62 and 0.18 in 2010, 2011 and 2012 respectively.

The following six species constitute nearly 100 % of the Coccinellidae assemblage detected by the sampling techniques used: *Coleomegilla maculata*, *Coccinella septempunctata*, *Harmonia axyridis*, *Hippodamia variegata*, *H. convergens* and *Propylea quatuordecimpunctata*. The three dominant species on the experimental site were: *C. maculata, H. axyridis* and *P. quatuordecimpunctata*. Treatment effect was significant ($F=15.16$, $p<0.0001$). There were twice as many Coccinellidae captured in *T. patula, T. majus, C. bipinnatus* or *A. millefolium* compared to *S. alba* (for all contrasts, $p<0.0001$), and there were twice as many insects trapped in *T. patula* compared to *L. maritima* ($p<0.0001$) (Figure 1). As nectar is an important food source for many Coccinellidae (Hagen 1962), this likely reflects the high nectar loads and secretion rates associated with *T. patula* and *T. majus* as reported by Comba et al. (1999). Ambrosino et al. (2006) also observed higher number of Coccinellidae visits in *C. sativum* and *Fagopyrum esculentum* compared to *L. maritima* and *P. tanacetifolia*.

Coccinellid larvae were occasionally caught with the sweep net. Captures varied between years, in terms of number, date and associated plant species. Plant species in which larvae were consistently found were *C. sativum, M. sativa, T. patula* and *A. millefolium*. These larvae were also found in *S. alba, P. tanacetifolia* and *C. bipinnatus* plots. The presence of larvae indicates that adult coccinellid females oviposited in these plant species. Coccinellid larvae feed on aphids and adult females lay their eggs near aphid colonies. However, in this study, there is no apparent link between the number and timing of aphids captured with the sweep net or the yellow sticky traps and the occurrence of coccinellid larvae.

For insect pest species, use of the sweep net showed significant captures of *L. lineolaris* ($F=51.42$, $p<0.0001$) and flea beetles ($F=23.56$, $p<0.0001$). *L. lineolaris* had a clear preference for *P. tanacetifolia* (Figure 2). After this, the presence of this economically important pest species was highest on *S. alba, C. sativum. A. millefolium* and *C. bipinnatus* compared to *L. maritima, P. grandiflora, T. majus* and *T. patula* (for all contrasts, $p<0.0001$). Flea beetle captures were highest on *S. alba, T. majus* and *L. maritima*, two of these being Brassicaceae species which is an economically important family of flowering plants.

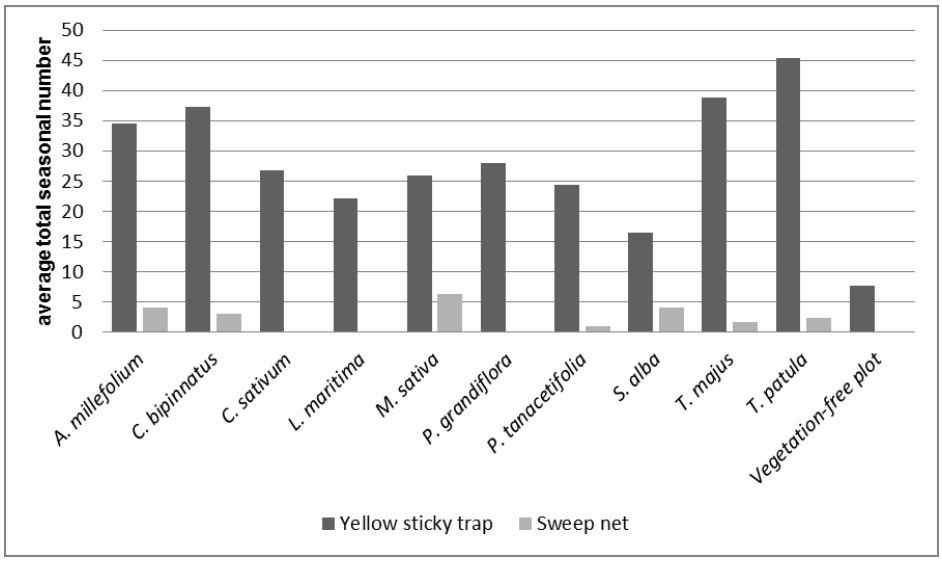


Figure 1. Average seasonal number of Coccinellidae captured with yellow sticky traps in ten plant species, 2010, 2011 and 2012 and in vegetation-free plots in 2012.[a,b,c]

[a] Captures in the vegetation-free plots with sweep net were negligible.
[b] For yellow sticky trap data, the relative standard errors of estimated means are 18 %, except for the vegetation-free plot treatment (28 %).
[c] For sweep net data, the relative standard errors of estimated means vary between 25 % and 30 %, except for *P. grandiflora* and *L. maritima*, for which abundance was negligible.

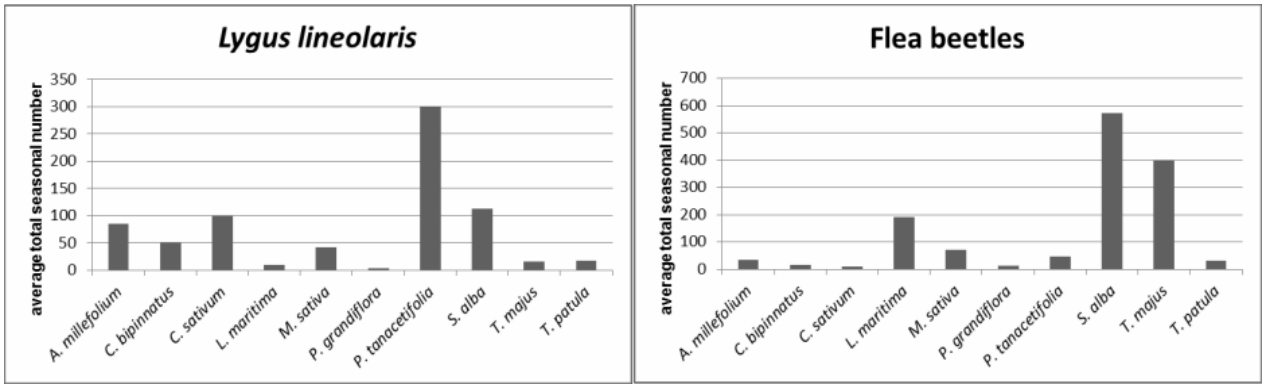


Figure 2. Average seasonal number of pest insects captured with sweep net in ten plant species in 2010, 2011 and 2012 and in vegetation-free plots in 2012.[a,b,c]

[a] Captures in the vegetation-free plots with sweep net were negligible.
[b] For *L. lineolaris*, the relative standard errors of estimated means are 30 %.
[c] For flea beetles, the relative standard errors of estimated means are 30%.

Discussion

These results show that Coccinellids are attracted to some flowering plant species and these plants could be used to provide a food source/habitat for these beneficial insects. This knowledge can be implemented in conservation biological control strategies. Further studies are needed to understand the resources that these plants provide to these beneficial insects as non-prey foods (floral nectar, pollen, honeydew, etc) are critical to the success of conservation biological programs (Lundgren 2009). As habitat manipulation is an important component of insect pest management in organic cropping systems, these results emphasize the importance of rigorous selection of plant species as suggested by Winkler (2005). It is essential to consider not only the attractiveness of a flowering species to beneficial insects but its potential to act as a reservoir for pest insects that can contribute to pest problems. Flowering strips, therefore, can serve to support beneficial insect populations and also serve as trap plants for insect pests and by both means contribute to crop pest control.

Suggestions to tackle with the future challenges of insect pest management in organic cropping systems

Future studies conducted at different spatial scales are necessary to fully understand the potential use of plant diversity around crops to achieve effective conservation biological control in organic cropping systems. Better understanding of landscape spatial scale effects will contribute to better integrate conservation biological control approach. Increased knowledge of specific natural enemies' requirements (floral and extra floral nectar, pollen, shelter, alternate hosts and preys, etc.) would greatly contribute to improve conservation biological control.

References

Ambrosino MD, Luna JM, Jepson PC & Wratten SD. (2006): Relative frequencies of visits to selected insectary plants by predatory hoverflies (Diptera: Syrphidae), other beneficial insects, and herbivores. Environmental Entomology 35, 394-400.

Comba L, Corbet SA, Barron A, Bird A, Collinge S, Miyazaki N & Powell M. (1999): Garden flowers: insect visits and the floral reward of horticulturally-modified variants. Annals of Botany 83, 73-86.

Gurr, GM, Scarratt SL, Wratten SD, L. Berndt L & Irvin N (2004): Ecological engineering, habitat manipulation and pest management. Chapter 1 In: Gurr GM, SD Wratten & MA Altieri (eds): Ecological engineering for pest management. Advances in habitat manipulation for arthropods. New York, Comstock Publishing Associates, pp. 1-12.

Hagen, JS. (1962): Biology and ecology of predaceous Coccinellidae. Annual Review of Entomology 7, 289-326.

Schmidt NP, O'Neal ME & Dixon PM. (2008): Aphidophagous predators in Iowa soybean: a community comparison across multiple years and sampling methods. Annals of the Entomological Society of America 101, 341-350.

Lundgren JG. (2009): Nutritional aspects of non-prey foods in the life histories of predaceous

Coccinellidae. Biological Control 51, 294-305.

Winkler K. (2005): Assessing the risk and benefits of flowering field edges. Strategic use of nectar sources to boost biological control. Ph.D. Thesis. Wageningen, Wageningen University, 118p.

Zedhner, G, Gurr GM, Kühne S, Wade MR & Wratten SD. (2007): Arthropod pest management in organic crops. Annual Review of Entomology 52, 57-80.

Transferring the Science of Organic Agriculture through Accessible Written and Oral Communication

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Key words: knowledge transfer, decision making, tacit knowledge, organic, organic farmers

Abstract

Stewardship of the land and respect for the environment can involve complex decision-making. Organic practitioners are compelled to follow stringent management practices, designed to optimize environmental benefits in relation to land, air, water and livestock. As self-identified stewards of the land, organic practitioners also create additional management systems designed to protect the environment. Decision-making in organic agriculture is a process in which the needs of the whole are considered, rather than the needs of one aspect of the business. The ability to effectively make these decisions is one which requires a new way of thinking and a critical mass of credible scientific research.

Objective: To discuss the purpose of and factors influencing effective knowledge translation (scientific to practical) and transfer for the organic sector to improve farm profitability and sustainability.

Introduction

One of the tenets of organic agriculture is that of land stewardship and respect for the environment. Long term sustainability goals of healthy soils, people and the environment require uninterrupted nurturance. Profitability for the sector must be stressed in order for this production system to thrive and have a positive ecological impact. Thus, the first step towards sustainable agriculture and business practices in organic require a focus on industry stability. This stability begins with economic stability, which revolves around profitability in business endeavors.

Decision-making in organic agriculture is a process in which the needs of the whole are considered, rather than the needs of one aspect of the business. The ability to effectively make these decisions is one which requires a new way of thinking and a critical mass of credible scientific research. Research has shown that organic practitioners prefer information that is developed specifically for the organic community rather than for the agricultural community as a whole (Padel 2001).

Review

Industry stability can be enhanced in two main streams, both requiring access to credible scientific knowledge.

1. Create an environment in which new entrants (either new to farming or new to organic agriculture) are attracted to produce, process or sell organic products. The average conventional Canadian farmer is approximately 55 years of age, and is male (Statistics Canada 2012a). There are concerns in agriculture regarding succession and maintaining consistent farming as this population begins to age. Organic agriculture, in juxtaposition, attracts new entrants, including women (Egri 1999). New entrants may be from rural areas, but may also be in proximity to cities in order to capitalize on innovative market opportunities.

   Between 2001 and 2011, the Census of Agriculture (Statistics Canada 2012b) shows that the number of Canadian organic operations increased by 66.5%. During the same time frame the number of certified organic processors and handlers increased by 194% (OVCRT 2013). Creating a new business or modifying operations in an existing business requires careful planning and research to mitigate risk. Readily available, credible scientific research results in accessible language are crucial to today's business person in order to make an important decision such as transitioning to a new production model or opening a novel operation. As decision makers, organic farmers tend to fall into one of two categories: 'innovators' or 'early adopters' (Padel 2001). Characteristics of each of these categories include a need for knowledge to make decisions (Padel 2001).

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2. Create an environment in which existing producers, processors and retailers have credible scientific research in order to increase their margins and/or sales receipts. On a daily basis, the organic stakeholder faces change, decisions and increasing pressure to develop innovative solutions to a host of challenges in production, marketing and distribution. To remain competitive and effective, time has become a precious commodity, yet problems are more varied and ever-present. These business people require credible scientific research delivered through multiple information channels and through relationships in which it is understood that the knowledge transferred is from a credible source.

Farm profitability is impacted by a variety of factors including farm size, type, yields and prices (Offerman and Nieberg 2000). “The influence of the farm manager’s abilities on economic performance .can be assumed to be one of the most important determinants ” (Offerman and Nieberg 2000). Thus, increasing knowledge translation (from scientific to practical language) and transferring to the farm manager to enhance their performance can be assumed to be an important determinant of economic performance. As stated by Lundvall and Johnson in 1994, “Knowledge is now the most important economic resource and learning the most important process”.

The needs of the organic sector are varied and diverse, encompassing field crops, horticultural crops, livestock, and markets while traditional sectors may focus on a single commodity group. While scientific research is vital, knowledge transfer is the action that allows it to have impact within the sector. Adoption of practices and processes, such as organic agriculture, occur more readily when knowledge reaches a critical mass of saturation (Padel 2001). In order to support the growth of this mass of information the scientific community must be supported in knowledge transfer.

In Canada, the Organic Value Chain Round Table (OVCRT) has identified knowledge transfer of scientific information to the sector as one of the key goals of the sector (OVCRT 2013). This transfer provides extension experts with the information for communications to the producers. In its strategic planning, the Regulatory Working Group (RWG) of the OVCRT has identified that ‘Organic agriculture is horizontal, in all parts of the supply and value chains.’ One of the ways to address this lack of vertical movement is through knowledge transfer. Along with the knowledge that is mobilized, this function also connects players within the industry, strengthening and stimulating the vertical value chain for future communication, sector mobility and the ability to react swiftly and decisively to profitable opportunities.

Traditionally, knowledge transfer plans developed as one way communication models. In agricultural research, industry and producers are key players in knowledge transfer. Therefore, the model needs to be interactive. Current research and best practices need to be transferred to these players, and feedback on these newly developed practices and additional ideas on research required to grow the sector require a means of communication. According to Padel 2001, for organic farmer knowledge transfer, ‘a broad vision of a knowledge network with the involvement of producers, advisors and researchers should be aimed for.’ Thus, a system of a continuous communication feedback loop must be developed and implemented.

The model of information flow and relationship development varies between conventional and organic agriculture. Research has shown that the organic practitioner can be considered a high user of software – or knowledge – rather than hardware, or traditional inputs (Padel 2001). Conventional farmers may tend to rely on and build trust relationships with input suppliers. Since the relationship is established, the input supplier becomes an important conduit for information (Morgan and Murdoch 2000). However, due to a decreased reliance on inputs, this informational relationship is not available to the organic farmer who has needed to become a ‘knowing agent’ (Morgan and Murdoch 2000, Padel 2001). As such, it is important to direct information to the organic farmer, using other available trust relationships. Cooperation among organic players has been an integral and unique part of the industry development (Aeberhard and Rist 2009). Research has shown that the rate at which knowledge is institutionalized (adoption rate) increases when the knowledge is delivered through a trust relationship (Morgan and Murdoch 2000, Santoro and Gopalakrishnan 2000).

Tacit knowledge is knowledge which is inherent to the practitioner. Organic practitioners rely heavily and often unknowingly on tacit knowledge. The practitioner may not realize that others are unaware of this knowledge. In a high trust relationship, tacit knowledge is easily transferred and adopted (Morgan and Murdoch 2000). This experiential knowledge is a preferred form of learning for many farmers (Aeberhard and Rist 2009), while talking through a challenge is a preferred form of information delivery (Carrascal et al. 1995). Scientists must build relationships with practitioners and be able to relate to their operations in order for this valuable form of knowledge exchange to occur. Ongoing communications in high trust relationships allow tacit knowledge to exchange naturally between practitioners or practitioners and scientists. This can be

a very effective means of impactful communication. This can be achieved when researchers conduct work on farms and when they include practitioners in the entire scientific process from research prioritization and conceptualization, design, interpretation and dissemination.

Discussion

Transferring the science of organic agriculture through accessible written and oral communication is integral to the growth of the Canadian organic industry. A critical mass of knowledge transfer can positively impact profitability and sustainability of the sector.

To satisfy this need a continuous communication feedback loop must be established between scientists and practitioners, with targeted pathways of knowledge transfer. Thus, knowledge transfer is a crucial function in the success of the business of organic agriculture. A key aspect of each of these activities should be an emphasis on feedback and adjustment of materials and delivery to satisfy the needs of stakeholders. These activity components, through a continuous communication feedback loop, link people, processes and knowledge in a diverse community. One of the key aspects of a knowledge transfer plan is the importance of the role of the stakeholder. Through a focus on continuous improvement, trust relationships within the value chain increase, as stakeholders see that their voice has impact.

References

Aeberhard A & Rist S (2009): Transdisciplinary co-production of knowledge in the development of organic agriculture in Switzerland. Ecological Economics 68, 1171-1181.

Carrascal M, Pau LF & Reiner L (1995): Knowledge and information transfer in agriculture using hypermedia: a system review. Computers and Electronics in Agriculture 12, 83-119.

Egri C (1999): Attitudes, Backgrounds and Information Preferences of Canadian Organic and Conventional Farmers: Implications for Organic Farming Advocacy and Extension. Journal of Sustainable Agriculture 13, 65.

Lundvall B & Johnson B (1994): The Learning Economy. Industry and Innovation. Journal of Industry Studies 1, 23-42.

Morgan K & Murdoch J (2000): Organic vs. conventional agriculture: knowledge, power and innovation in the food chain. Geoforum 31, 159-173.

Offerman F & Nieberg H (2000): Economic Performance of Organic Farms in Europe. In: Organic Farming in Europe: Economics and Policy. Volume 5. University of Hohenheim. Pp.10.

OVCRT (2013): Organic Value Chain Round Table Strategic Plan 2013-2018. http://oacc.info/DOCs/OVCRT/OVCRT_Strategic_Plan_Aug_2013_EN.pdf. Accessed: 30 September 2013.

Padel S (2001): Conversion to Organic Farming: A Typical Example of the Diffusion of an Innovation? Sociologia Ruralis 41, 40-61.

Santoro M & Gopalakrishnan S (2000): The institutionalization of knowledge transfer activities within industry–university collaborative ventures. Journal of Engineering and Technology Management 17, 299-319.

Statistics Canada. 2012a. Almost Half of Farm Managers 55 and Older. Snapshot of Canadian Agriculture. http://www.statcan.gc.ca/pub/95-640-x/2012002/02-eng.htm#IV. Accessed: 22 March 2013.

Statistics Canada. 2012b. Snapshot of Canadian agriculture. http://www.statcan.gc.ca/pub/95-640-x/2012002/05-eng.htm#XVI. Accessed September 30, 2013.

Canada's Organic Science Cluster: Science with Impact for Profitability, Sustainability and Competitiveness

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Key words: organic agriculture, science, research, national, science cluster

Abstract

Organic science must be a catalyst that explores opportunities and creates a platform for processors and producers to link, while promoting stability and creating an environment for growth in production to support processing and to capture domestic markets. In this paper we provide an overview of the goals and potential benefits of a national science program for organic agriculture in Canada from 2013-2018. The "Organic Science Cluster II (OSCII): Science With Impact for Profitability, Sustainability and Competitiveness" is linked with Canada's Organic Value Chain Roundtable, the think tank addressing priorities for increasing capacity and market development for organic. OSCII will increase competitiveness by addressing barriers that are constraining production and by capturing new market opportunities. OSCII will be coordinated and managed by the Organic Agriculture Centre of Canada at Dalhousie University's Faculty of Agriculture on behalf of the industry applicant, the Organic Federation of Canada.

Introduction

Organic agriculture is a model of food production that is guided by principles of sustainability in terms of environment, resources, economics and animal well-being. It is a regulated and inspected production system driven by consumer demand domestically and internationally. Canada has established regulated standards (CAN/CGSB 2008) and equivalency agreements with the U.S. and E.U., which account for over 90% of the global organic market. Consumers are willing to pay premium prices for raw products, suggesting that the production system in itself adds value in their view. The organic sector is like a premium brand spanning all commodity markets. It captures the willingness of consumers to pay more for practices that are grounded in environmental sustainability and hence lower social cost.

As the market for organic food continues to grow, the gap between Canadian supply and demand is widening. Approximately 80% of organic product consumed in Canada is imported (AAFC 2010). This presents a significant opportunity for Canadian producers to expand production. In order to thrive, organic agriculture and food production must have a stable and diverse base of production that supports the entire value chain.

Cluster Goals Match National Strategy

Canada's Organic Value Chain Roundtable (OVCRT) was launched in 2006 to build a shared understanding of its competitive position, create consensus on how to improve it, and put plans into action (AAFC 2011). OVCRT has recognized the need for science supporting organic production and market development in its strategic plan and the Research and Innovation Working Group (RIWG) was established as the Steering Committee for OSCII. The RIWG is responsible for identifying the broad-scope research priorities for organic agriculture. This has been supported by national surveys (OACC 2008) and consultations held at the Canadian Organic Science Conference (OACC 2012). The vision of the Cluster is that "Science and innovation enables organic agriculture to thrive in Canada" and it is supported by the following goals and objectives:

Goals:

A. Enable organic agriculture to thrive in Canada through science and innovation,
B. Increase profitability and competitiveness of Canadian producers and processors in organic markets by resolving barriers,
C. Capture growing organic market opportunities through development of innovative products, practices and processes,
D. Canada is a leading nation in organic agriculture guided by science and innovation,

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E. Support development of sustainable production systems that reduce business and environmental risk for all producers by using ecologically sound management,
F. Maintain Canada's reputation as a leader in organic standards development in compliance with international equivalency agreements,
G. Optimize the impact of investment in applied agricultural science by linking stakeholders with scientists and scientists with each other.

Objectives:

1. Intensify agricultural production in an ecological approach through improved understanding of interactions at the farm level and application of ecologically sound practices, inputs and technologies,
2. Identify innovative and ecologically sound solutions to pest problems by advancing and applying our understanding of pest life cycles and management practices,
3. Identify improved practices and alternative products for maintaining the health and welfare of livestock under organic management,
4. Increase the profitability and competitiveness of Canadian products in the marketplace by developing value-added options and technologies and studying marketing strategies,
5. Maximize impact of science in organic agriculture through knowledge transfer directed at both organic and non-organic stakeholders,
6. Ensure Canadian stakeholders are aware of the latest advances in organic science in order to maintain standards and increase competitiveness and profitability in the marketplace,
7. Increase and support Canada's scientific capacity in organic by working with scientists, linking with stakeholders, and training new highly qualified personnel.

Overview of Project

The organic sector is unique in the agricultural community in Canada in that it represents a regulated and inspected production system driven by consumer demand domestically and internationally rather than a single or small group of commodities. Organic agriculture is a model of food production that is guided by principles of sustainability in terms of environment, resources, economics and animal well-being. As such, the research and development priorities for organic agriculture may span all commodity groups and applies to the entire value chain, from production through to the consumer. This Cluster is very much industry-led research and development and its outcomes are centered on competitiveness, market growth, adaptability and sustainability. This will be accomplished by using innovation to drive 'ecological intensification' through the following Themes:

A. Field Crops: Optimizing productivity and competitiveness through adaptable systems for field crops,
B. Horticultural crops: Advancing the science of vegetable, fruit novel horticultural crop production
C. Crop pests: Innovation in sustainable pest management strategies,
D. Livestock: Optimizing animal health and welfare for productivity and quality,
E. Markets: Adding value to capture markets, understanding consumer demand and marketing structures, and
F. Knowledge Transfer: Creating impact through knowledge translation and transfer to organic stakeholders.

The Field Crop and Horticultural Crop themes will generate new knowledge and innovative practices with activities that include both station- and farm-based, medium and long-term research trials to maximize research relevance and impact for industry stakeholders. The Field Crop theme will examine new crops for Canada, advance the genetics of cereal cultivars through traditional and participatory breeding programs, and studying low-input and sustainable solutions for managing soil fertility. The Horticultural theme will explore season extension and energy efficiency strategies, soil management and compost utilization, flavour and quality improvement, enhancement of health promoting properties, and production of various organic ornamental crops. Weeds, insects and diseases are an on-going challenge for all producers. In organic agriculture adoption of cultural controls is favoured to reduce risks associated with pesticides. The theme of Crop Pests seeks innovative solutions that are suitable for dealing with pests under organic management. Solutions for diseases in horticultural and grain crops both in storage and in the field will be explored.

Practices for insect and weed management in both field and horticultural cropping systems need to continuously evolve. The standards for organic livestock production are unique in that they not only establish production guidelines but they also address animal welfare and potential risks outside of production. OSCII will explore feeding, housing and disease management in dairy, poultry and aquaculture.

Knowledge, Translation and Transfer

Organic science must be relevant and presented in an accessible form to stakeholders who can use it. A key strength of this Cluster is the linkages that have been strongly encouraged and established between stakeholders and scientists. Knowledge translation and transfer will occur through: a) the research Activities led by the researcher and their collaborators, and b) aggregated knowledge dissemination by the Organic Agriculture Centre of Canada by:

1. Awareness Building: increasing recognition of the credible, peer-reviewed applied science that is conducted in Canada,
2. Knowledge Translation: translation of knowledge both from academic to accessible as well as between Canada's two official languages (English and French).
3. Knowledge and Technology Transfer: dissemination of results targeted toward stakeholders that can use it through documents, conferences, videos, etc.

Discussion

Although a relatively small market for organic product in the world, Canada maintains a strong reputation for quality in export markets. Domestically, Canada is far from achieving its full capacity to satisfy domestic markets. Organic science is needed to support enhanced production and value adding through innovation, increased efficiency and addressing constraints to production and processing. Organic Science Cluster II links industry stakeholders with university, private and government researchers, making the science relevant and impactful. Results of the Cluster research program will be accessible through websites, conferences, videos and documents that are accessible to stakeholders.

References

AAFC (2010): Market Trends Organics. International Markets Bureau. http://www.ats-sea.agr.gc.ca/inter/pdf/5619-eng.pdf/. Accessed 21 March 2013.

AAFC (2011): Organic Value Chain Roundtable: A brief history. www.ats-sea.agr.gc.ca/rt-tr/org-bio-eng.htm. Accessed 21 March 2013.

CAN/CGSB (2008): Organic production systems general principles and management standards. Canadian General Standards Board. CAN/CGSB-32.310-2006 Amended October 2008.

OACC (2008): Final results of the first Canadian Organic Farmer Survey of Research Needs. Nova Scotia Agricultural College, Truro NS, Canada. http://oacc.info/Docs/Canadian%20Organic%20Farmer%20Survey%202008.pdf Accessed 21 March 2013. 34 pp.

OACC (2012): Strategic Planning for Organic Research Priorities. Canadian Organic Science Conference, Winnipeg MB Feb. 23, 2012. http://oacc.info/COSC/COSC_Strategic_Planning_Session.pdf Accessed 21 March 2013.

Potential of Cranberry Extracts as Immuno-Modulatory Agent in Organic Broiler Chicken Production

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Key words: cranberry, broiler, chicken, organic, immune-modulatory agent, bioactive

Abstract

*Cranberry (*Vaccinium macrocarpon *Ait.) has received considerable attention for its putative human health benefits. Most of the focus is on its phenolic compounds including phenolic acids, anthocyanins, flavonols, flavan 3 ols and the polymer classes of procyanidins and proanthocyanidins. Research in our laboratories has revealed that crude cranberry extracts can disrupt the cell envelope in Listeria, Escherichia coli, Salmonella, and S. aureus, activity which parallels that of antibiotics widely used as growth promoters in the poultry industry. The plant proanthocyanidins are well known to improve nitrogen nutrition in ruminant animals and as a powerful antioxidant with beneficial effects on human health and immunity. Limited laboratory research has examined the biological effect of cranberry extract using animal models. The purpose of the present work was to discuss progress being made in evaluating the potential for utilizing cranberry as an immune-modulatory agent in organic broiler chickens production.*

Introduction

Several antimicrobial agents are used in conventional broiler chicken feed for growth promotion and to prevent infectious diseases (Butaye et al. 2003). These antibiotics improve feed conversion and bodyweight gain presumably by altering the composition and activities of gut microflora, which may create a selective pressure in favor of resistant bacteria (Aarestrup 2006). Antibiotic use has long been forbidden in organic production. For organic poultry production to increase, suitable solutions must be available for disease prevention and control that meet organic standards.

Poultry utilized for commercial meat production are genetically very homogenous and their ability to build sufficient immune responses to bacteria during the rearing period is of concern (Koenen 2002). Nutritional methods including addition of probiotics or natural additives have been investigated to modulate chicken immunity (Rahmani and Speer 2005, Taheri et al. 2005). The impact of poultry production on food safety and environmental health is becoming an important public health issue. Methods that can improve chicken health and food safety under organic production will provide a good alternative to conventional antibiotic use.

Cranberry (*Vaccinium macrocarpon* Ait.) has received considerable attention for its putative human health benefits (Neto 2007, Wu et al. 2008). In past few years, we have made significant progress in the development of cranberry bioactives in animal production. The following is a review of this progress resulting from several studies.

Results

1) Non-dialyzable materials (NDMs) from cranberry fruit at 1 mg/ml increased phagocytosis and intracellular killing activity of chicken heterophils (which protect against bacterial infections). This has suggested that the infecting bacteria have become more susceptible to immuno-defense mechanisms against infections (Diarra and Rempel 2008).

2) Cranberry extracts induced growth inhibition and a decrease in viable cells of *Clostridium perfringens* isolates over 24 h of in vitro incubation, and significantly decreased expression of the necrotic enteritis causing toxin cpA gene of this bacterium, indicating that further examination of the antimicrobial potential of these compounds is warranted (Delaquis et al. 2010).

3) In vivo biological effects of cranberry extracts in a poultry feeding trial using a commercial whole cranberry fruit extract at 40 mg/kg of feed induced low early mortality rates (improvement by 40% compared to the control) in birds. Diet supplementation with such extracts caused a shift of the intestinal tract bacterial population while not altering any broiler meat properties (Leusink et al. 2010).

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4) The demonstration for the first time that a cranberry press cake (pomace) extract exerts vasodilatory effects (widening of blood vessels) by inducing 90-101% relaxation of rat aorta rings, which was similar to results achieved with aqueous *Prunus serotina* (Harrison et al., 2012).

5) Further studies on the effect of cranberry extracts against *E. coli*, a major cause of colibacillosis causing important economic losses to poultry industry worldwide, have been conducted using a DNA array-based approach in an attempt to correlate specific transcriptional signatures and bacterial cell damage. Treatment of *E. coli* with cranberry strongly down-regulated OmpF and overexpressed TolQ and Gad genes, all involved in membrane functions, maintenance of ionic balance and protection against high-proton-concentration environments, suggesting important membrane disturbances. In sum, the effects observed on the transcriptome of *E. coli* exposed to cranberry extracts correlated with known characteristics of cranberry constituents such as condensed tannins (flavonoids) and phenolics that could possibly act as iron chelators (González-Lamothe et al. 2009).

6) Demonstrated antimicrobial activity of cranberry fruit bioactives against several *Listeria* strains including *L. monocytogenes*, including clues about mode of action. Antimicrobial activity was related to disturbances in membrane integrity. To date, activity measured in vitro has exceeded that achieved in vivo (Block et al. 2012).

7) In *S. aureus*, the cranberry extracts were found to induce a transcriptional signature similar to that of peptidoglycan-acting antibiotics. We showed that pomace fractions induce membrane depolarization similar to daptomycin and are much better than vancomycin in interfering with bacterial cell-wall D-Ala-D-Ala synthesis (Diarra et al. 2013).

8) Recently, we demonstrated that cranberry extracts induce dose dependent bactericidal effect against *Salmonella* in broth and on cooked chicken meats as well as decreased the salt tolerance of this pathogen, indicating that that our cranberry extract could be developed for food preservation (Goubé et al. 2013).

9) In an exploratory study, we evaluated the high molecular weight NDMs of cranberry fruit extracts on the humoral response of broiler chicken. Our results showed no clear linear (dose dependence increase or decrease) effects on the immunoglobulin [IgA, IgG (IgY) or IgM] level. One of the explanations for this lack of effect could be the low concentration (0.5 to 2 mg of cranberry fruit extract per bird per day) and duration of treatments (1 wk at 7 to 14 days old). However, higher doses of cranberry extract might still be effective in promoting the antibodies levels in serum. This suggestion needs to be confirmed in a vaccination experiment using cranberry constituent as adjuvant. Further studies involving higher doses of cranberry extract administered for longer periods of time are warranted and are being conducted.

Discussion

Investigations on cranberry compounds could lead to the development of a feeding strategy for organic chicken production to improve bird health and immunity and on-farm food safety while reducing use of antibiotics (in conventional operations). Based on the above data, it is clear that additional research will unlock the full potential of cranberry and other fruits pomaces and how best to use them as feed ingredients for organic chicken producers.

References

Aarestrup FM (2006): Other pathogens. In: Aarestrup FM (ed): Antimicrobial resistance in bacteria of animal origin. ASM Press, 249-267.

Block GS, Harrison J, Delaquis P, Oomah BD & Diarra MS (2012): Antimicrobial activity of a cranberry pomace extract against Listeria spp. 62nd Annual Conference of the Canadian Society of Microbiologists, Vancouver, British Columbia, June 20 – 23. Abstract/Poster.

Butaye P, Devriese LA & Haesebrouck F (2003): Antimicrobial growth promoters used in animal feed: Effects of Less Well Known Antibiotics on Gram-Positive Bacteria. Clinical Microbiology Reviews 16,175-188.

Delaquis P, Diarra MS, Rempel H & Saeed D (2010): Antimicrobial effects of cranberry extract, vanillin and vanillic acid against *Clostridium perfringens*. 97th Annual Meeting of International Association for Food Protection. August 1-4th Anaheim, CA, USA. (Poster P1-32).

Diarra MS & Rempel H (2008). Antibacterial and immuno-stimulatory activities of cranberry extracts against *Staphylococcus aureus*. CIFST/AAFC Conference, Charlestown, PEI, May 25-28.

Diarra MS, Block G, Rempel H, Oomah BD, Harrison J, McCallum J, Boulanger S, Brouillette É, Gattuso M & Malouin F (2013): In vitro and in vivo antibacterial activities of cranberry press cake extracts alone or in combination with β-lactams against *Staphylococcus aureus*. BMC Complementary and Alternative Medicine. Under review.

González-Lamothe R, Mitchell G, Gattuso M, Diarra MS, Malouin F & Bouarab K (2009): Plant antimicrobial agents and their effects on plant and human pathogens. International Journal of Molecular Sciences 10, 3400-3419.

Goubé MA, Diarra MS & Fliss I (2013): Antimicrobial potential of cranberry extract against Salmonella. La 4e rencontre annuelle de l'Association québécoise pour l'innocuité alimentaire (AQIA): La gestion de la qualité, un défi récurrent. Lévis, Quebec, Canada. 19 septembre 2013.

Harrison JE, Oomah BD, Diarra MS & Ibarra-Alvarado C (2012): Bioactivities of pilot scale extracted cranberry juice and pomace. Journal of Food Processing and Preservation. 37, 356-365.

Koenen ME, Boonstra-Blom AG & Jeurissen SH (2002): Immunological differences between layer- and broiler-type chickens. Veterinary Immunolology and Immunopathology 89, 47-56.

Leusink G, Rempel H, Skura B, Berkyto M, White W, Yang Y, Rhee J-Y, Xuan SY, Chiu S, Silversides F, Fitzpatrick S & Diarra MS (2010): Growth performance, meat quality and gut microflora of broiler chickens fed with cranberry extract. Poultry Science 89, 1514-1523.

Neto CC (2007): Cranberry and its phytochemicals: a review of in vitro anticancer studies. Journal of Nutrition 137, 186S-193S.

Rahmani HR & Speer W (2005): Natural additives influence the performance and humoral immunity of broilers. International Journal of Poultry Science 4, 713-717.

Taheri HR, Rahmani HR & Pourreza J (2005): Humoral immunity of broilers is affected by oil extracted propolis (OEP) in the diet. Inter. Journal of Poultry Science 4, 414-417.

Van Loo EJ, Alali W & Ricke SC (2012): Food safety and organic meats. Annual Review of Food Science and Technology 3, 203-25.

Weinreb O, Amit T, Mandel S & Youdim MBH (2009): Neuroprotective molecular mechanisms of (−)-epigallocatechin-3-gallate: a reflective outcome of its antioxidant, iron chelating and neuritogenic properties. Genes & Nutrition 4, 283-296.

Wu, VC, Qiu X, Bushway A & Harper L (2008): Antibacterial effects of American cranberry (*Vaccinium macrocarpon*) concentrate on foodborne pathogens. Food Science and Technology 41, 1834-1841.

Simulation experiment of organic farming system: changes of soil organic carbon and microbial communities by organic fertilization

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Key words: organic farming system, organic fertilization, soil microbial community

Abstract

Soil beneficial microbe products were used in organic farming system as soil amendment. Effects of different organic fertilization on soil organic carbon (SOC) and microbes were analyzed in this study in order to improve fertilization technology. Culture experiment in the lab was designed to simulate organic farming system and exclude uncertain factors of environment and human operations. Results showed that beneficial microbe with organic fertilizer applied in soil accelerated decomposition of SOC significantly compared to single organic fertilizer treatment. Photosynthetic Bacterium (PSB) liquid applied in soil increased soil bacterial colonies and declined soil fungal colonies significantly compared to other treatments on the 40th day. Bio-fertilizer treatment increased soil fungal colonies, but this effect was not significant.

Introduction

Organic farming aims to develop fertile soil with sufficient organic matter and microbes. Soil microbe, which controls the key process of soil ecosystem, is the most active ingredient in soil. Bacteria, fungi and actinomycetes are three main categories of microbes influence the SOC cycle. Studies showed that organic fertilizer application in soil with beneficial bacterial, e.g. PSB, improved organic nutrient cycle in soil and increased chlorophyll content and yield of the crop (Zhang et al., 2008). In view of the irreplaceable effects of soil microbes on soil fertility, microbial products and their extracts are allowed to use in the organic farming system. In this study, we intend to improve fertilization technology by simulating organic farming system and analyzing changes of SOC and soil microbial communities in the culture experiment.

Material and methods

The soil of this study belonged to the *Fimic Anthrosol* developed from the *Haplic Luvisol* and was collected from Nanjing Planck Organic Farm in China. The farm has been treated by organic management since 2002. Soil physicochemical and microbial properties at the beginning of this study were shown in Table 1. The organic fertilizer of this study was commonly used in the organic farm (organic matter 190 g Kg^{-1}, total nitrogen 13.8 g Kg^{-1} and available nitrogen 612.5 mg Kg^{-1}). The bio-fertilizer was consisted by decomposed organic matter and beneficial microbes screened directionally from healthy soil (viable count ≥ 0.5×10^{8} CFU g^{-1}, organic matter 150 g Kg^{-1}, total nitrogen 5.8 g Kg^{-1} and available nitrogen 296.5 mg Kg^{-1}). PSB strain of study was *Rhodopseudomonas sphaeroids x3* (viable count ≥ 1.2×10^{9} CFU mL^{-1}).

Four treatments of different fertilization were designed and replicated 3 times: treatment OF (organic fertilizer 2.25g), OPF (organic fertilizer 2.25g + PSB liquid 3mL), OWF (organic fertilizer 2.25g + aseptic water 3mL, as the contrast of OPF), OBF (organic fertilizer 2.25g + Bio-fertilizer 0.12g). 400g sieved fresh soil sample was mixed well with different fertilizer into a tall glass beaker (500mL) for every treatment. Parafilm (breathable, waterproof and antipollution) was covered on top of the beaker. Above operation was completed as soon as possible to keep soil moisture after the soil was collected from the organic farm. Whole culture time was set for 60 days and all culture devices were kept in 25 °C. Periodically destructive sampling was set for once every 20 days. Dosage of different fertilizer was designed based on soil bulk density and farming conditions of the organic Farm. Colonies of soil bacteria, fungi and actinomycetes were calculated by dilution plate counting method (Lin, 2010). Soil properties were analyzed according to the standard methods. Data was expressed as mean ± S.E. Significant differences were calculated at $P<0.05$ and $P<0.01$ by ANOVA.

Results

As was shown in Fig.1A, no difference of SOC was analyzed among different treatment on the 20th and 40th days. SOC was significantly higher ($P<0.01$) in OF and OWF compared to OPF and OBF in the end. Soil microbial biomass carbon (MBC) was distinctly higher ($P<0.05$) in OPF and OBF compared to OF and OWF

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on the 20th and 40th days (Fig.1B). Soil mineralized carbon was significantly higher (P<0.01) in OPF compared to other groups in the end (Fig.1C). It was significantly higher in OWF compared to OF after 20 days. Soil microbial colonies of four groups were declined gradually during whole culture time (Fig.1D to Fig.1F). Soil bacterial colonies of OPF were more than that of OF and OWF, which was remarkable on the 40th day (Fig.1D). No statistic difference of soil fungal colonies were found between OF and OBF (Fig.1E). It was less in OPF compared to other groups on the 40th day, with significant difference (P<0.05). As was shown in Fig.1F, soil actinomycetes colonies of OPF was more than other treatments on the 60th day, with significant difference (P<0.01).

Table 1: Soil physicochemical properties and microbial properties at the beginning of this study

Soil physicochemical properties		Soil microbial properties	
Soil organic carbon (g Kg^{-1})	19.82±0.30	Microbial biomass carbon (mg Kg^{-1})	344.55±29.08
pH	6.41±0.08	Microbial biomass nitrogen (mg Kg^{-1})	62.70±2.40
Total nitrogen (g kg^{-1})	1.81±0.05	Bacterial colonies (×10^6 CFU g^{-1})	9.32±0.56
Available phosphorus (mg kg^{-1})	43.86±2.54	Fungal colonies (×10^4 CFU g^{-1})	7.24±0.97
Available potassium (mg kg^{-1})	216.31±20.13	Actinomycetes colonies (×10^5 CFU g^{-1})	14.06±0.37
Mineralized carbon (mg kg^{-1})	356.27±35.72		

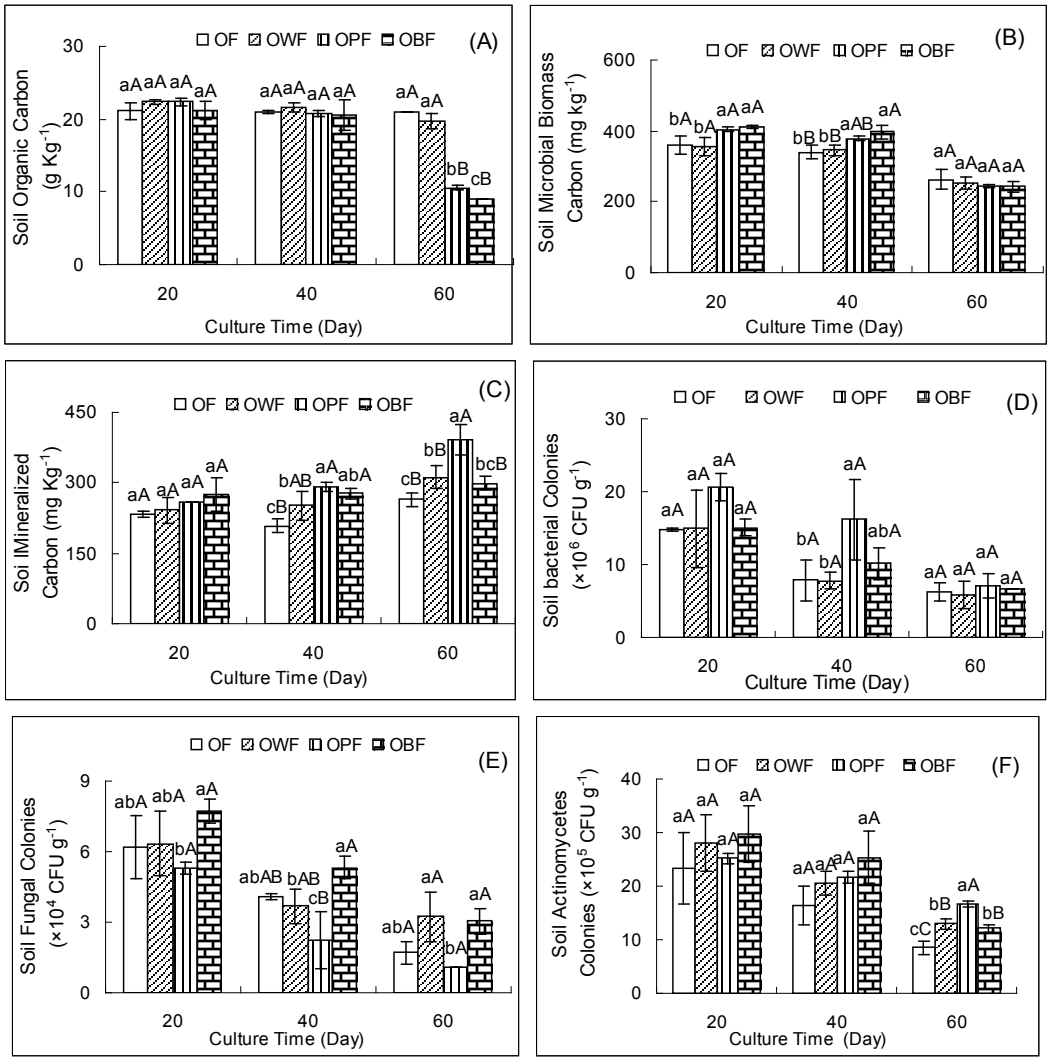


Fig. 1 Changes of soil organic carbon (A), soil microbial biomass carbon (B), soil mineralized carbon (C), soil bacterial colonies (D), soil fungal colonies (E) and soil actinomycetes colonies (F) by different fertilizatiton treatment

Different capital and small letters show significant differences at the levels of 0.01 and 0.05 under different management.

Discussion

Beneficial microbes with organic fertilizer applied in soil increased MBC and transformed soil microbial community structure. Soil mineralized carbon, which is CO_2 contents released by decomposition of SOC, can be interpreted as bio-degradable carbon in soil. As culture time went by, mineralization process continued and SOC contents declined gradually. It was noteworthy that beneficial microbe applied in soil accelerated decomposition and mineralization of SOC. No difference of soil MBC was found among different treatment in the end indicated that survival competition among microbes intensified and consumption of labile SOC increased. When microbial products were applied in soil with organic fertilizer, additional organic fertilizer should be supplemented into soil at the end of the cultivation.

References

Zhang XD, Cao H, Xu DQ, Jin YF & Chen YK (2008): Effects of photosynthetic bacteria and organic fertilizer on soil microorganisms and enzyme activities. Soils 40, 443-447.

Lin XG (2010): Principles and methods of soil microbiology research. High education press, Beijing.

Comparative study on runoff N, P from organic and conventional rice-wheat rotation field in the tai lake region in china

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Key words: Organic agriculture, Runoff N and P, Agricultural non-point pollution

Abstract

The runoff N, P from organic and conventional rice-wheat rotation field in terms of equal N input was studied through field plot test in Tai lake region. The results showed that in the rice-wheat rotation field the runoff TN from organic and conventional field was 56.15kg/hm^2 and 77.90kg/hm^2 respectively, 27.9% less from organic field; for the runoff N coefficient, in organic field, rice season it's 7.19% and wheat season 9.12%, in conventional field, rice season it's 9.74% and wheat season 16.75%; the runoff TP from organic and conventional field was 2.38 kg/hm^2 and 1.03 kg/hm^2, respectively, 131.06 % more from organic field; for the runoff P coefficient, in organic field, rice season it's 0.84 % and wheat season 0.14%, in conventional field, rice season it's 1.1 % and wheat season 0.05 %. In rice field, NH_4-N was the main form of runoff TN and in wheat field, NO_3-N was the main form of runoff TN. Analysis suggested that more runoff P from organic field was because of more P input from organic fertilizer in case of equal N input in organic and conventional field.

Introduction

Agricultural non-point pollution has long been a major concern among the environmental issues. The study about Tai lake exogenous pollutants showed that industrial pollution only took up a small proportion which was 10%~16%, and agricultural non-point pollution accounted for 59% of the total pollutants [1]. Thus, the local government implements a project of comprehensive management of Tai lake water environment. In this project, it declared the plans about construction of one kilometer organic agriculture ecological circle around Tai lake to reduce agricultural non-point pollution [2]. This paper compared the N, P runoff regular patterns in organic and conventional rice-wheat rotation fields to provide the scientific proof of how to reduce non-point source pollution in the Tai lake region through developing organic agriculture.

Material and methods

The experiment located in Wanshou village, Changzhou city, where is 5 km far away Tai lake. The climate in the region is the typical semitropical and warm temperate climate, characterized by the annual average temperature 15.8 ℃, the annual average precipitation 1091.6 mm, and the total annual sunshine 1940.2 h. Rice-wheat rotation is the main cropping model in this area.

Three treatments as organic, conventional and control were set from summer of 2011(rice season) to spring of 2012 (wheat season). Each treatment had three 30m^2 repeated plots. It applied the equal quantity of N input in the organic and conventional treatments. The total N input amount

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was 300kg per hectare in rice season and 185kg N per hectare in wheat season, which were the usual input amounts of local farmers. Runoff samples were collected from each sampling point when there was runoff resulting from heavy rain and water drainage during the growth season for nitrogen and phosphorus test. The Runoff Coefficient of N and P were accounted as following formula:

$$\text{Runoff Coefficient}(\%) = \frac{(\text{Runoff amount in test treatments} - \text{Runoff amount in CK})*100\%}{\text{Input N or P amount}}$$

Results and Analysis

Comparison of crop yield among three treatments

The results of wheat and rice average yield in three treatments were showed in Table 1. Compared to the conventional sites, organic rice yield was reduced by 3.1 %, and organic wheat yield was increased by 25.5 % which had the significant difference.

Table.1 Comparing crops' average yield during three treatments (Dry weight, kg/hm^2)

Treatments	Rice yield	Wheat yield
CK	9200.40 a	3579.84 a
CONV.	21178.80 b	7294.12 b
ORG.	20523.30 b	9154.07 c

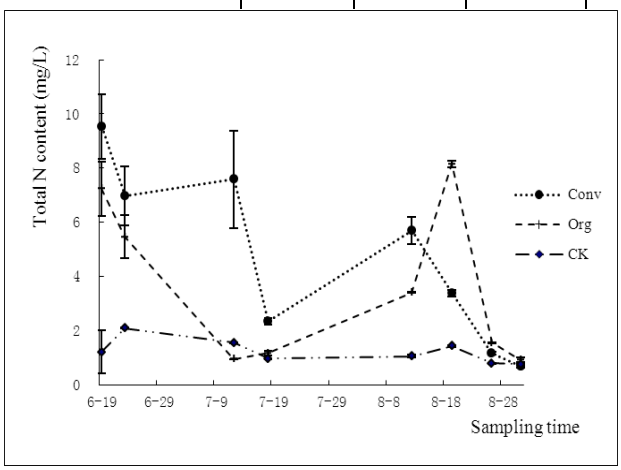
Note: No significance difference among the mean values with the same letter in the same column (P<0.05)

N and P runoff amount and coefficient in the rice growth season

During the rice growth season, total precipitation was 931.9 mm, thus it induced 8 times runoff, and the total volume of runoff was up to 21200 L per treatment plot. The runoff N content and loss amount during the growth season were continuous monitored and the results showed in Table2 and Figure1. In the study site, total runoff N loss amounts were 29.55kg·hm^{-2}, 37.20kg·hm^{-2}, 7.97kg·hm^{-2} in organic, conventional and control treatment respectively during the rice growth season, and NH_4-N took the main ratio. The runoff N coefficients were 7.19% and 9.74% respectively in organic and Conventional treatments. Compared to conventional treatment, organic rice runoff TN loss amount reduced 20.56%. In Figure2, the results of runoff TP loss showed that total runoff P loss amounts were 2.01 kg·hm^{-2}, 0.87kg·hm^{-2} and 0.43kg·hm^{-2} in organic, conventional and control treatment respectively during the rice growth season. In organic rice treatment, runoff TP loss amount was 131.03% more than that of the conventional one. The runoff P coefficients were 0.84% and 1.1% respectively in organic and Conventional treatments.

Table.2 Runoff N, P loss Amounts and Coefficient during the rice season

Treatment	Loss Amounts (kg/hm^2)						Loss Coefficient（%）	
	TN	TDN	NO_3-N	NH_4-N	TP	TDP	TN	TP
CK	7.97	5.34	2.36	2.50	0.43	0.37	-	-
CONV.	37.20	33.53	9.03	20.34	0.87	0.78	9.74	1.1
ORG.	29.55	27.65	2.93	22.43	2.01	1.90	7.19	0.84



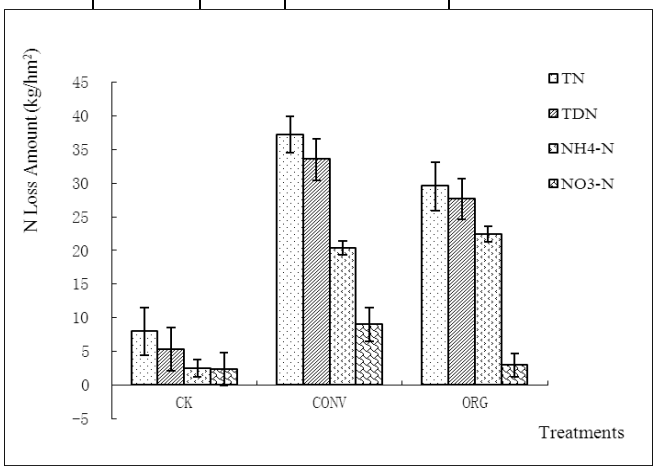


Figure.1 The N content and N loss amount in runoff water during rice growing season

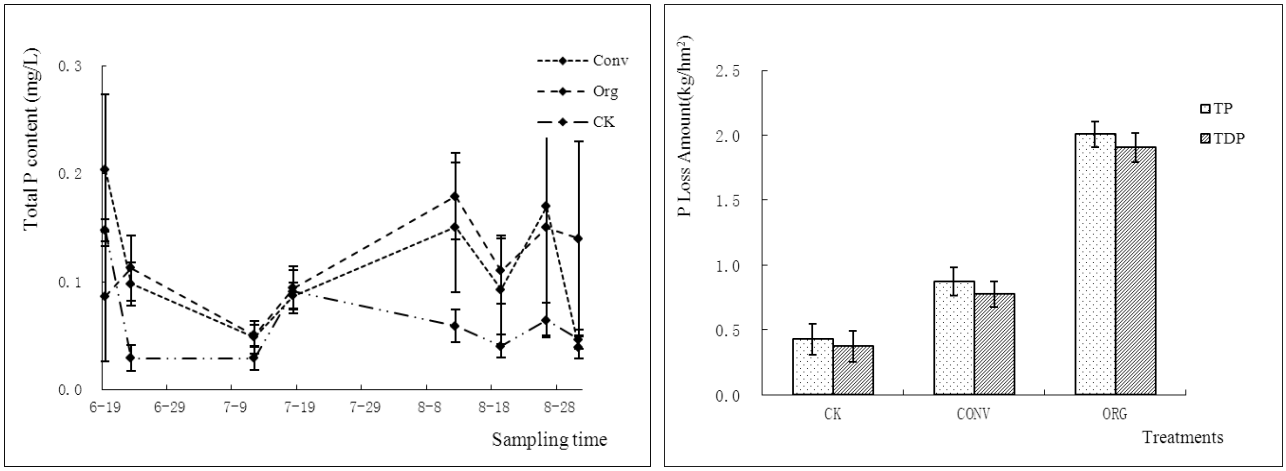


Figure.2 The P content and P loss amount in runoff water during rice growing season

N and P runoff amount and coefficient in wheat growth season

During the wheat growth season, the total precipitation was 343.4 mm, thus it induced 5 times runoff, and the total volume of runoff was around 6 800 L per plot. The results of runoff N content and loss amount during wheat growth season were showed in Table 3 and Figure 3. In the wheat growth season, total runoff N loss amounts were 26.6kg·hm^{-2}, 40.7kg·hm^{-2}, 9.72kg·hm^{-2} in organic, conventional and control treatment respectively during the wheat growth season, and the runoff N coefficients were 9.12% and 16.75% respectively in organic and Conventional treatments. Different from rice season, NO^3-N took the main ratio. Compared to conventional treatment, runoff TN loss amount in organic site decreased 34.64%, which the amount reduced 14.1 kg·hm^{-2}. In Figure 4, the results of runoff TP loss during the wheat growth season showed that total runoff P loss amounts were 0.37kg·hm^{-2}, 0.16kg·hm^{-2}, 0.15kg·hm^{-2} in organic, conventional and control treatment respectively, and the runoff P coefficients were 0.14% and 0.05% respectively in organic and Conventional treatments. Organic wheat runoff TP loss amount was 131.25 % more than conventional treatment.

Table.3 Runoff N, P loss Amounts and Coefficient during the wheat season

Treatment	Loss Amounts (Kg/hm^2)						Loss Coefficient（%）	
	TN	TDN	NO_3-N	NH_4-N	TP	TDP	TN	TP
CK	9.72	8.57	7.64	0.25	0.15	0.15	-	-
CON.	40.7	38.63	29	1.82	0.16	0.15	16.75	0.05
ORG.	26.6	25.41	20.8	0.46	0.37	0.36	9.12	0.14

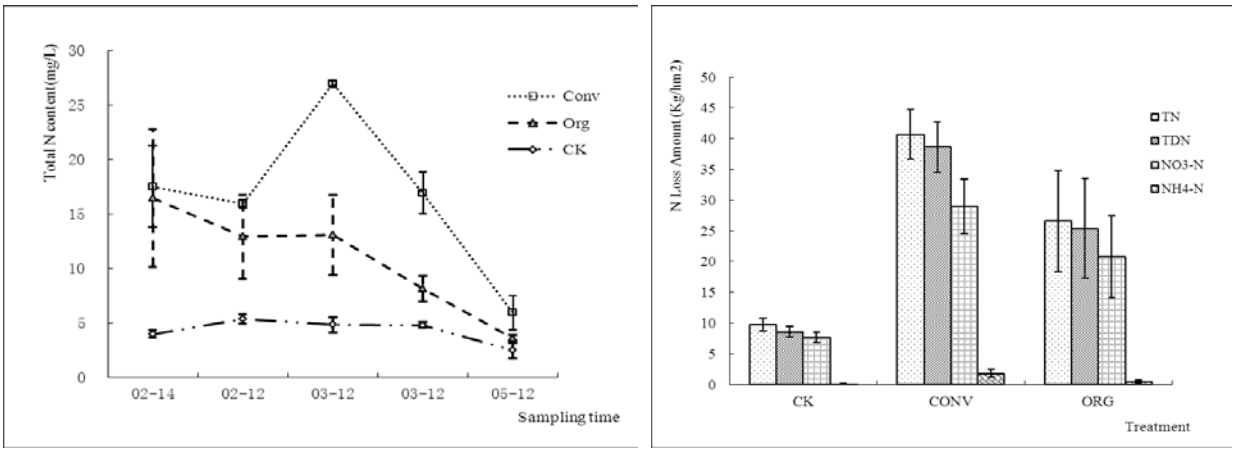


Figure.3 The N content and N loss amount in runoff water during wheat growing season

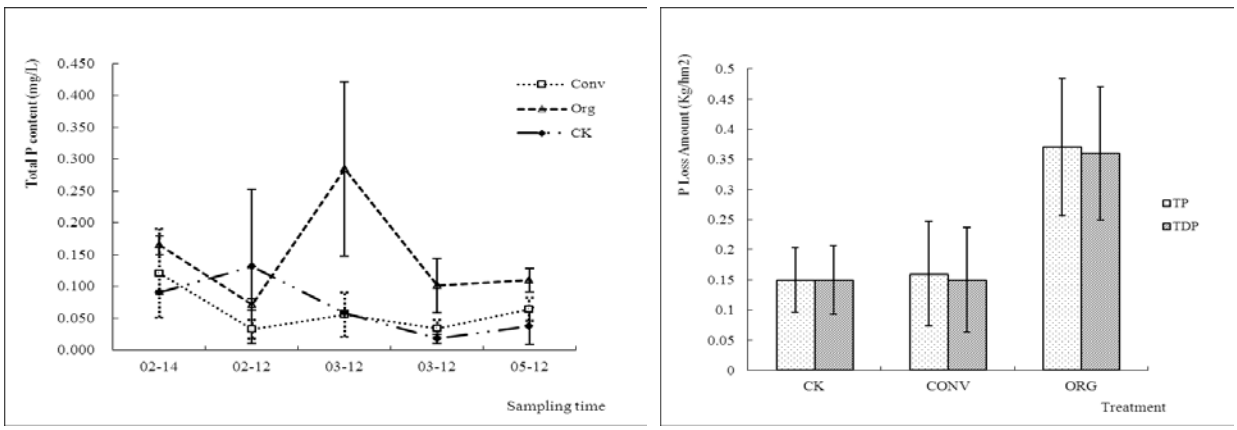


Figure.4 The P content and P loss amount in runoff water during wheat growing season

Conclusion and Discussion

In the Tai lake region, total runoff N loss amount was 77.90Kg·hm^{-2} in fertilized rice-wheat rotation cropland, and 56.15Kg·hm^{-2} in the organic treatment, which was 27.92 % less than conventional treatment. It proved that organic farming could reduce runoff N drainage. Total runoff P loss amount in fertilized rice-wheat rotation cropland was 1.03 kg·hm^{-2} and 2.38 Kg·hm^{-2} in the organic treatment, which was 131.06 % more than conventional one. The preliminary analysis indicated that organic fertilizer could take along overmuch P into cropland and induce higher output of runoff phosphorus. So, construction of organic agriculture ecological circle around Tai lake region should pay attention to the risk of more runoff P drainage through organic fertilizer application. It suggested that to meet crop's demand for N meanwhile avoiding heavy P input through planting leguminous green manure and choosing high N and low P content organic fertilizer is very important for organic agriculture development in the view of agricultural non-point pollution control.

Reference

[1] Tianwei Xu (2009): Organic agriculture development and agriculture non-point pollution control [J]. Environmental Protection and Circular Economy, 4(29): 45-47.
[2] Jiangsu Province Governmental Document (2009): The implementation plans for water environment comprehensive control of Tai Lake watershed.

Organic potato crops are improved by inoculating a microbial inoculum to the cut surface of seed tubers

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Key words: Antioxidant enzyme, chitinase, *β*-1,3-glucanase, microbial inoculum (EM), potato (Solanum tuberosum), *StLTPa1* gene, xerophytophysiology

Abstract

Potato seed tubers are usually cut into blocks to reduce seed cost, break dormancy and induce dominance. In chemical farming, the cut surface is usually treated with fungicides to avoid infection. In the present research, the cut surface of the seed tuber blocks was treated with a microbial inoculum (EM) mixed into bamboo charcoal powder and dried for hours. Inoculating and drying the cut trace of seed tuber blocks induced activation of the antioxidant enzymes SOD and POD. Properly drying the cut trace induced osmotic adjustment, leaf turgor improvement, disease resistance and yield increase in the potato crop. The inoculation also induced up-regulation expression of StLTPa1 gene and activation of chitinase and β-1,3-glucanase, which were all responsible for disease resistance. The treatments were more effective in the soil with compost applied onto the surface. The treatments with sterilized inoculum were more effective than that with the original inoculum in improving rooting. In conclusion, inoculating and properly drying cut trace of seed tuber blocks was feasible to improve organic potato crops.

Introduction

Potato seed tubers are usually cut into blocks to reduce seed cost, break dormancy and induce dominance. Usually, cutting into blocks is adopted but drying is usually intentionally avoided (Jenkins et al. 1993, Nielson et al. 1989). However, mildly drying the cut surface might harden the seed tuber and the young plant by inducing xerophytophysiological regulations (Su et al. 2014) and prevent pathogen infections by inducing formation of a cork cell layer (Priestley & Woffenden 1923). In practical, farmers used to paste ash onto the cut surface for prompt drying. Drying the cut trace of the seed tubers is also taken as hardening of the young plants and some positive xerophytophysiological regulation are expected (Xu et al. 2011). In chemical farming, the cut surface of potato seed tubers is also treated with fungicides to avoid infections (Keil et al. 2008). Instead, as one of the nature farming practices, in our experiments the cut surface was inoculated with a microbial material mixed into bamboo charcoal powder and dried mildly. It is reported that *β*-1,3-glucanase and chitinase as key enzymes are responsible for fungal cell and sclerotial wall degradation, as an important factor in biological control (EL-Katatny et al. 2000). It is also reported that *StLTPa1* gene is related with disease resistance in potato plants (Gao et al. 2008). Therefore, activation of these enzymes and expression of the gene were examined in Experiment 1 in this study. In addition, the effects of inoculation and drying the seed tubers were examined in separate experiments in terms of osmotic adjustment, plant growth, photosynthetic activities, disease resistance and the final tuber yield of the organic potato crops.

Material and methods

Experiment 1: Six plants of potato (*Solanum tuberosum* L. cv. Danshaku) were grown in a plastic planter (50 mm × 40 mm × 25 cm). Before planted, the seed tubers were cut each into two pieces and inoculated with either of the followings: 1) CK—bamboo powder only, 2) Original—inoculum (EM as the commercial name, EM Laboratory, Co. Ltd., Shizuoka, Japan) containing lactic bacteria and yeast, 300 time diluted, and 3) Sterilized—heat (120 °C) sterilized inoculum of 2). Activities of chitinase and *β*-1,3-glucanase were analyzed according to El-Katatny et al. (2000). Activities of SOD (superoxide dismutase) and POD (peroxidase) as well as the MDA (malondialdehyde) concentration were measured according to Kakkar et al. (1984). The expression of StLTPa1 gene was analyzed according to Gao et al. (2008).

Experiment 2: With the same potato cultivar as in Exp. 1, experiment was conducted in field conditions with plastic rainout shelters and compost application was taken as the main plot and the cut seed tuber drying as

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the sub-plot in a 2×2 factorial split design. The main plots were arranged in a 2×2 Latin square and one main plot included two sub-plots of 1) cut tubers dried properly, 2) cut tubers not dried. Each sub-plot was arranged in three 12 m × 0.75 m ridges. Space between plants was 0.2 m. Analyses of photosynthesis and osmotic adjustment and photosynthesis were made according to Xu et al. (2011). The data from both experiments were subjected to statistical analysis based on Tukey's multiple comparisons using the software of DPS Data Processing System (Tang and Feng, 2006).

Results

Experiment 1. Chitinase and *β*-1,3-glucanase were activated and as suggested defense mechanisms again pathogen were induced by both types of inoculating (Table 1). Moreover, up-regulation expression of the *StLTPa1* gene was also induced 1 day after inoculation with original inoculum, and as suggested, defense mechanisms against pathogens might be induced because *StLTPs* protein plays several biological roles including antimicrobial defense and signaling. SOD was activated but the inoculations were not stimulations strong enough to largely activate POD. MDA concentration was lower in treatment with both inoculations. It was suggested that the inoculations protected the seed tubers from damage by pathogens. Soluble sugars and protein were in higher concentration in the treatments, which might contribute to improvements in rooting, shooting, and the final tuber yield.

Experiment 2. Leaf turgor potential at full turgid status (P_{FT}) was higher in treatments of drying and also higher in treatment of compost than the controls (Table 2). At the point of incipient plasmolysis, both osmotic potential (π_{IP}) and relative water content (ζ_{IP}) were lower and, as suggested, the desiccation tolerance was higher in treatments of drying and in treatment of compost. The relative water fraction in symplast (ζ_{sym}) was higher in treatments of drying and in treatment of compost than the controls, suggesting that the cell water was recompartmented and part of the water in apoplast moved into the symplast where all biochemical metabolisms occurred. The active net increment of cell solute concentration at full turgid status (ΔC_{FT}) in comparison with the corresponding control was used to show the ability of osmotic adjustment. ΔC_{FT} was higher in treatment of drying. Synergistic interaction between drying the cut surface of seed tubers and applying compost to the soil surface was apparent in all abovementioned variables.

Table 1. Effects of drying cut trace of the seed tubers on tuber yield, disease incidence and photosynthetic activities (Experiment 2).

Inoculation	Chit	Gluc	Gene	SOD	POD	MDA	Proteins	Sugars	Emerg	Yield
Control	0.98_c	47.6_b	0.26B		5.6_C	11.7_b	251.3_a	4.68_b	2.57_b	76.7_b 1372_b
Original	1.28_a	56.6_a	4.93A		28.6_B	29.2_a	172.1_b	5.05_a	3.50_a	83.3_a 1523_a
Sterilized	1.14_b	53.6_a	1.15B		34.8_A	21.0_a	198.1_b	5.11_a	3.93_a	83.5_a 1520_a

Chit, Chitinase activity (Unit g^{-1}FW); Gluc, *β*-1,3-glucanase activity (Unit g^{-1}FW); Gene, relative expression of the non-specific lipid transfer protein gene (*StLTPa1*); SOD, the total activity of superoxide dismutase (Unit g^{-1}FW); POD, activity of peroxidase (Unit g^{-1}FW min^{-1}): MDA, malondialdehyde concentration (mmol kg^{-1}FW); Proteins, concentration of soluble proteins (g kg^{-1} FW); Sugars, concentration of soluble sugars (mmol kg^{-1}FW); Emerg, emergence rate (%); Yield, tuber yield (g pot^{-1}). Lowercase and uppercase letters show difference at p=0.05 and p=0.01.

Table 2. Effects of drying cut trace of the seed tubers on tuber yield, disease incidence and photosynthetic activities (Experiment 2).

Compost	Drying	Yield	DI	L color	P_C	P_{FT}	π_{IP}	ζ_{IP}	ζ_{sym}	ΔC_{FT}
No	No	2.87	21.5	57.4	22.6	0.66	-1.11	0.832	0.74	0.0
	Yes	3.26	14.6	61.7	24.5	0.71	-1.19	0.809	0.68	24.6
Yes	No	3.94	17.3	61.4	26.7	0.69	-1.17	0.831	0.72	8.2
	Yes	4.59	11.2	63.3	27.8	0.78	-1.26	0.819	0.66	49.2
Compost		**	*	**	**	*	*	*	*	**
Drying		**	**	**	*	**	*	**	**	**
Drying×Compost		**	*	*	*	*	*	*	ns	**

Tuber yield (kg m^{-2}); P_C, photosynthetic capacity (μmol m^{-2} s^{-1}); DI, disease index (%); L color. Leaf color (SPAD); P, π, ζ and C mean turgor potential (MPa), osmotic potential (MPa), leaf relative water content and osmotic concentration (osmol m^{-3}), respectively; Subscripts, FT, IP, and sym, mean those at full turgid status, incipient plasmolysis, symplastic water fraction, respectively. * and ** show significance at p=0.05 and p=0.01.

Discussion

Inoculation with the EM microbial materials activated the enzymes of chitinase and the *β*-1,3-glucanase. Chitin is a structural component in organisms including fungi, insects, various crustaceans, and nematode eggs (Cohen 1993). Chitinase hydrolyzes the chitin polymer and plays roles in a defence mechanism in higher plants against attacks by pathogens (Mauch et al. 1988). The *β*-1,3-glucanase is also an enzyme related with pathogenesis and involved in plant resistance against fungi (Boller1985). Non-specific lipid transfer proteins (nsLTPs) in higher plants are lipid binding proteins that play biological roles including antimicrobial signalling and defence against pathogens (Gao et al. 2008). Up-regulation expression of the *StLTPa1* gene was found in the germinating seed potato tubers inoculated with the EM inoculum. SOD were also activated without damages shown by low concentration of MDA by inoculating the microbial materials. The overall results from Experiment 1 in the present research suggested that inoculations to the cut surface of potato seed tubers with the microbial inoculum induced defence mechanisms against the pathogen infections. The objective of Experiment 2 was to confirm whether mildly drying the cut surface of potato seed tubers could induce positive xerophytophysiological regulations in addition to the pathogen defence mechanisms. As shown by the analyses, properly drying cut trace of the seed tuber induced osmotic adjustment and the consequent leaf turgor improvement. Leaf turgor potential is the drying force for cell enlargement in plant growth and for stomatal opening in photosynthesis processes. Another consequence of osmotic adjustment caused by drying seed tubers was cell water recompartmentation between symplast and apoplast, i.e. part of the apoplastic water moved into the symplast, where most biochemical metabolisms occurred (Patakas and Noitsakis 1997). Physiological activities are totally improved and consequently the final tuber yield was increased by the treatment of properly drying cut trace of the seed tubers. The effect in xerophytophysiological regulation was more apparent in potato plants applied with compost into the soil surface layer. In conclusion, organic potato crops could be improved in physiological activities, disease resistance and the final tuber yield by inoculating the EM microbial materials mixed with bamboo powder to the cut surface of the seed tubers that was then mildly dried.

References

Boller T (1985): Induction of hydrolases as a defence reaction against pathogens. Key JL, Kosuge T (eds) Cellular and Molecular Biology of Plant Stress. New York: Alan R. Liss, Inc. 247-262.

Cohen E (1993): Chitin synthesis and degradation as targets for pesticide action. Archives of Insect Biochemistry and Physiology 22:245-261.

El-Katatny MH, Somitsch W, Robra KH, El-Katatny MS & Gübitz GM (2000): Production of chitinase and β-1,3-glucanase by *Trichoderma harzianum* for control of the phytopathogenic fungus *Sclerotium rolfsii*. Food Technology and Biotechnology 38 (3):173-180.

Gao G, Ren CH, Jin LP, Xie KY & Qu DY (2008): Cloning, expression and characterization of a non-specific lipid transfer protein gene from potato. Acta Agronomica Sinica 34 (9):1510-1517.

Jenkins PD, Gillison TC & Al-saidi AD (1993): Temperature accumulation and physiological ageing of seed potato tubers. Annals of Applied Biology 122:345-356.

Kakkar P, Das B & Viswanathan PN (1984): A modified spectrophotometric assay of superoxide dismutase. Indian Journal of Biochemistry and Biophysics 21:130-132.

Keil S, Benker M & Zellner M (2008): The use of copper seed treatments to control potato late blight in organic farming. The 16th IFOAM Organic World Congress, Modena, Italy, June 16-20, 2008.

Mauch F, Mauch-Mani B & Boiler T (1988): Antifungal hydrolases in pea tissue. II. Inhibition of fungal growth by combinations of chitinase and β-1,3-glucanase. Plant Physiology 88:936-942.

Nielson M, Iritani WM & Weller LD (1989): Potato Seed Productivity: Factors influencing eye number per seed piece and subsequent performance. American Potato Journal 151-160.

Patakas A & Noitsakis B (1997): Cell wall elasticity as a mechanism to maintain favourable water relations during leaf ontogeny in grapevines. American Journal of Enology and Viticulture 48:352-356.

Priestley JH & Woffenden LM (1923):The healing of wounds in potato tubers and their propagation cut sets. Annals of Applied Biology 10:96-115.

Su FF, Xu HL, Li FL, Qin FF, Chen YL, Lü DQ , Hu LS, Li Y, Wang SP & Shi Y (2014): Applications of xerophytophysiology in plant production - Potato yield increase induced by drying the cut trace of seed tuber blocks. Journal of Food, Agriculture & Environment 11 (1): (in press).

Tang QY & Feng MG (2006): DPS Data Processing System – Experimental Design, Statistical Analysis and Data Mining. Science Press, Beijing.

Xu HL, Qin FF, Xu QC, Tan JY & Liu GM (2011) Applications of xerophytophysiology in plant production – The potato crop improved by partial root zone drying of early season but not whole season. Scientia Horticulturae 129:528–534.

Applications of signal transduction and xerophytophysiology by exposing hypocotyls in organic peanut production

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Key words: AnM cultivation, anthocyanin, *Gdi-15* gene, peanut (*Arachis hypogaea*), signal transduction, xerophytophysiology

Abstract

The AnM practices in peanut production included three steps. A, n and M, showed the section-cross of the ridge at different peanut growth stages. First, seeds were sown deeper than usual to induce extra-elongation of hypocotyl. Then the ridge cross-section looked like "A". The second, the hypocotyls elongated more than usual were exposed to light and dry air by removing the soil away around the young hypocotyls. At this time, the ridge cross-section looked like "n". The third, at the middle growth stages, soils on both sides of ridge were earthed up to welcome the late pegs. Then the ridge cross-section looked like "M". AnM induced osmotic adjustment and improved photosynthesis by a higher leaf turgor. Anthocyanin accumulation was apparent in hypocotyls soon after the exposure started, accompanied by active increase in osmolytes such as sugars. The up-regulation expression of Gdi-15 gene was found in hypocotyl. The AnM practice was more effective in the soil with compost applied to the surface layer and therefore it is feasible in organic peanut production.

Introduction

The AnM peanut cultivation method is adopted in China (Shen and An 1988). The three letters, A, n, and M, refer to the shapes of the ridge at different stages. The letter "A" shows shape of the cross-section of the ridge after the seeds are sown; the small letter "n" shows the ridge shape at the seedling stage, when the hypocotyls are exposed by removing away the soil around; and the letter "M" shows the ridge shape at the full blossom stage, when soil is earthed up from both sides of the ridge to welcome the pegs. Agronomic advantages showed a yield increase by the AnM method (Shen 1985; Shen and An 1988). However, the related physiological and molecular biological basis for the yield increase have not been well understood since almost thirty years ago. Here, a hypothesis was proposed that AnM method would be a practice of applications of xerophytophysiology in plant production. Exposing hypocotyls to light and dry air might be the key practice to stimulate the young plant to cause drought stress signalling and activate some responsive genes. As reported, *Gdi-15* is a groundnut desiccation-induced gene and would be activated by drought signalling (Gopalakrishna et al. 2001). Therefore, in the present study, one experiment was designed to confirm AnM method with not only the agronomic traits and photosynthetic activities but also the xerophytophysiological regulations such as osmotic adjustment and turgor maintenance. In addition, another experiment was designed to examine the Gdi 15 gene and the physiological regulations related with its expression.

Material and methods

Experiment 1: Peanut (*Arachis hypogaea* L. cv. Chibahandachi) was grown in organic field with an organic fertilizer (N-52, P-30 and K-20 g kg^{-1}) fermented using oil mill sludge, rice bran and fish meal was applied 200 g m^{-2}. As shown in Fig. 1, seeds were sown 8 cm deep, the shape of the ridge cross-section was like the letter "A". Two weeks later, the soil around the seedlings was removed away with the hypocotyl exposed to light and dry air and the shape of the cross-section of the ridge was like the letter "n". At full blossom, the soil from both sides of the ridge was earthed up to welcome the pegs and the shape of the cross-section of the ridge was like the letter "M". The ridge was 20 cm high and the space was 30 cm between two plants and 60 cm between two ridges. Compost application to the soil surface layer was taken as the main plot and the AnM cultivation as the sub-plot in a 2×2 factorial split design. Analyses of photosynthesis and osmotic adjustment were according to Xu et al. (2011). Experiment 2: The same cultivar and similar management as in Exp.1 was used. The hypocotyl exposure was started one week after seeds sown, and only "n" stage was involved. The light density to which hypocotyls were exposed was more than 1200 µmol m^{-2} s^{-1} at midday.

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Concentration of anthocyanins was measured by spectrometry. The analysis with real time PCR (Applied Biosystems, USA) for *Gdi-15* was done following the steps in manuals of RNeasy Mini Kit (Qiagen, Tokyo, Japan), PrimeScript® II 1st Strand cDNA Synthesis Kit and SYBR® Premix Ex TaqTM II (TaKaRa, Japan). Primer pairs for Gdi 15 gene was [forward, 5'-GGTGTTCCCATGATTGC-3'; reverse, 5'-GCCTTGGTAGAAGAGCC-3'].

Results

Experiment 1: The shell yield was higher in the AnM plots in both treatments with and without compost application with a positive synergistic interaction between AnM and compost application. Disease of leaf spot was less severe in plots with higher shell yield. Leaf color and photosynthetic capacity were proportional to shell yield. The leaf turgor at the fully turgid status (π_{FT}) was higher due to more active solute accumulation (ΔC_{FT}) in AnM plots. At incipient plasmolysis, both osmotic potential (π_{IP}) and leaf relative water content (ζ_{IP}) were lower in AnM plots, suggesting higher stress tolerance in plants of AnM plots. The symplastic water fraction (ζ_{sym}) was also higher in plants of AnM plots, which might contribute to higher physiological activities. AnM cultivation was more effective in plots with compost applied to the soil surface layer. Experiment 2: The increased expression of *Gdi-15* gene was found in the exposed hypocotyl of the peanut seedling (Table 2). The clear accumulation of anthocyanins also confirmed the enhanced expression of *Gdi-15* gene. In the present experiment, anthocyanin accumulation in response to the hypocotyl exposure is a protective strategy against drought stress. The increased expression of the drought-responsive gene, *Gdi-15*, was found only in the exposed hypocotyl but not in leaves and root, where the stimulation was not directly imposed.

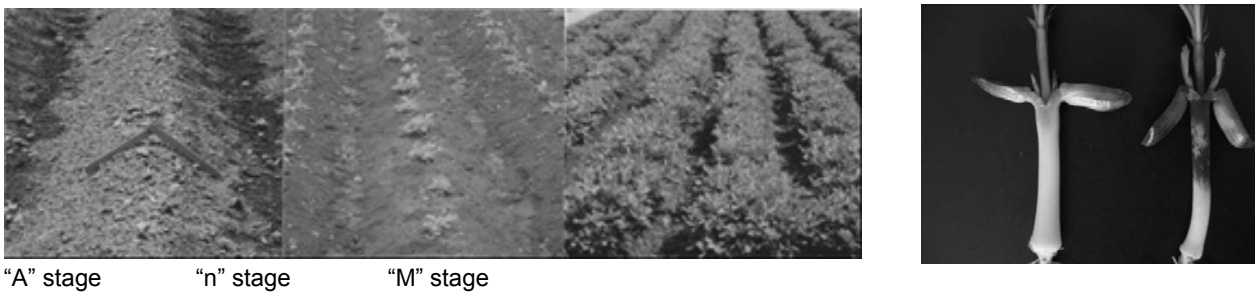
Table 1. Shell yield, disease index, photosynthetic activities and osmotic adjustment parameters under different cultivation practices (Experiment 1).

Compost	AnM	Yield	DI	L color	P_C	P_{FT}	π_{IP}	ζ_{IP}	ζ_{sym}	ΔC_{FT}
No	No	2.73	11.3	48.3	28.1	0.653	-0.984	0.858	0.71	0.0
	Yes	3.06	6.4	50.4	29.2	0.733	-1.161	0.829	0.75	37.1
Yes	No	3.24	8.2	50.2	30.3	0.748	-1.172	0.831	0.74	18.2
	Yes	3.76	4.2	52.1	31.9	0.802	-1.273	0.802	0.77	69.3
Compost		*	*	*	**	**	**	*	*	**
AnM		*	*	*	*	**	**	**	**	**
C×AnM		*	ns	ns	*	*	*	ns	*	**

Shell yield (kg m^{-2}); P_C, photosynthetic capacity (μmol m^{-2} s^{-1}); DI, disease index (%); L color. Leaf color (SPAD); P, π, ζ and C mean turgor potential (MPa), osmotic potential (MPa), leaf relative water content and osmotic concentration (osmol m^{-3}), respectively; Subscripts, FT, IP, and sym, mean those at full turgid status, incipient plasmolysis, symplastic water fraction, respectively. * and ** show significance at p≥0.05 and p≥0.01.

Table 2. Gdi 15 gene transcript levels, anthocyanins concentration (Experiment 2).

Plot	*Gdi 15* expression				----------In hypocotyls----------	
	Hypocotyl	Root	Cotyledon	Leaf	Anthocyanins (OD_{530} $g^{-1}FW$)	Sugars (g kg^{-1})
CK	3.2	2.62	0.76	11.2	0.14	9.5
AnM	117.3**	1.78 ns	0.63ns	10.4 ns	7.76**	11.4*



"A" stage "n" stage "M" stage

Fig. 1. The peanut AnM cultivation (left) and color changes (right) after hypocotyl exposing.

Discussion

The AnM cultivation has proved effective in China for many years. The agronomical advantages have been clarified (Shen and An 1988). The present study found that the fraction of the symplasmic water was larger; the osmotic concentration was higher and as a consequence the leaf turgor potential became higher in leaves of hypocotyl exposed peanut plants. The high leaf turgor maintenance is considered as the main one of the mechanisms for the yield increasing effect of the AnM treatment. The key point may be the stimulation by exposing the hypocotyl, whereby a signal can be sent to the internal gene system, where the stress-responsive genes are activated, transcripted and expressed to enhance the physiological activities for protection and stress resistance. *Gdi-15* is one of these drought responsive genes (Gopalakrishna et al. 2001) and related with anthocyanin biosynthesis and many abiotic stress adaptations (Chervin et al. 2009). In the present study, the increased expression of *Gdi-15* gene was found in the exposed hypocotyl of the peanut seedling. The clear accumulation of anthocyanins also confirmed the enhanced expression of *Gdi-15* gene. In plant physiology, foliar anthocyanins are synthesized in response to drought, cold or saline environment and serve as osmotically active solutes to decrease leaf osmotic potential, increase water uptake and maintain leaf turgor potential in addition to functions as UV screen and free-radicals scavenger. The color change, particularly the change in color from white to purple that the anthocyanins might be related, is a typical xerophytophysiological response (Xu 2007). Plant tissues containing anthocyanins are often resistant to drought stress although the drought resistance is not causatively linked to anthocyanin concentration. *Gdi-15* might be considered as the representative of the drought responsive genes (Gopalakrishna et al. 2001). In practice, the hypocotyl is exposed but the root anchors in the sufficiently moist soil without any soil water deficit. Actually, hypocotyl exposure is not a real stress and it is only a stimulus. The increased expression of the drought-responsive gene, *Gdi-15*, was found only in the exposed hypocotyl but not in leaves and root. Nevertheless, as a false stress it successfully induced the increased expression of drought-responsive gene and the consequent xerophytophysiological regulations that might be positive to the crop. This is the key point of practices of xerophytophysiology and signal transduction in plant production, which was proposed by Xu (2007) an also used in other crops, such as mesocotyl exposure for sorghum plants (Xu et al. 2009), clove exposure for garlic plants (Qin et al. 2008a), partial root-zone drying for potato (Xu et al. 2011) crops, and blue light irradiation in canopy for tomato crops (Xu et al. 2012). In most of the practices, the root of plants anchors in moist soils without real water deficit, as in case of the hypocotyl exposure of the peanut seedlings. Results of the present experiment confirmed that, as one of practices of stimulation based on the theory of xerophytophysiology, treatment of hypocotyl exposure in the AnM technique, was effective in inducing enhanced expression of drought responsive gene and the expected consequences of regulations in crop production.

References

Chervin C., Tira-Umphon A., Chatelet P., Jauneau A., Boss P.K. and Tesniere C. 2009. Ethylene and other stimuli affect expression of the UDP glucose-flavonoid 3-O-glucosyltransferase in a non-climacteric fruit. Vitis 48(1):11-16.

Sherwin H.W. and Farrant J.M. 1998. Protection mechanisms against excess light in the resurrection plants *Craterostigma wilmsii* and *Xerophyta viscosa*. Plant Growth Regulation 24:203-2b10.

Gopalakrishna R., Kumar G., Krishnaprasad B.T., Mathew M.K. and Udaya K.M. 2001. A stress-responsive gene from groundnut, Gdi-15, is homologous to flavonoid 3-O-glucosyltransferase involved in anthocyanin biosynthesis. Biochemical and Biophysical Research Communications 284:574-579.

Shen Y.J. and An K. 1988. Effect of controlling peg growth at the start of groundnut (*Arachis hypogaea* L.) flowering. Oleaginoeux 43:127-134.

Xu H.L. 2007. Xerophytophysiology in crop production. In: H.L. Xu (ed.) Dryland Crop Production -Technology Breakthroughs and Study Cases. Research Signpost, Kerala (India), p.37-54.

Xu H.L., Qin F.F., Xu R.Y., Wang F.H. and Li F.M. 2009. Applications of xerophytophysiology in plant production-Sorghum plants improved by exposing the mesocotyl as stimulus. Journal of Food, Agriculture and Environment 7:603-610.

Xu H.L., Qin F.F., Xu Q.C., Tan J.Y. and Liu G.M. 2011. Applications of xerophytophysiology in plant production - The potato crop improved by partial root zone drying of early season but not whole season. Scientia Horticulturae 129:528-534.

Xu H.L., Xu Q.C., Li F.L., Feng Y.Z., Qin F.F. and Fang W. 2012. Applications of xerophytophysiology in plant production- LED blue light as a stimulus improved the tomato crop. Scientia Horticulturae 148:190-196.

Analytical overview of the chinese organic sector with a focus on rural development

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Key words: Chinese organic sector, organic value chain, challenges for smallholders

Abstract

Like many others in China, the certified organic agriculture sector has grown rapidly, but with different characteristics than expected. Preliminary findings from this research show that there are inter-linking problems from farm to market in the whole value chain of organic production in China. For instance, lack of skills and knowledge at the farm level is leading to difficulties in adopting organic production practices. Traders are mainly interested in high-value single-crop marketing, and farmers are struggling to sell their other rotation crops. Access to information is difficult for farmers, as the resources for providing technical services and information on organic practices are limited. On the other hand, the application of Chinese organic standard has become increasingly stringent since the Chinese government updated the Chinese organic regulations and standards.

Introduction

China is one of the fastest-growing economies in the world, with a continuously rising demand for agricultural goods. This fast growth came at a cost, however – it stresses natural resources, pollutes the environment, and increases income inequality between the poor and the rich. Organic agriculture is widely regarded as a promising modern alternative to these issues. This research aims to analyze the competency of the organic sector and its challenges to rural populations in China. The overall objective is to gain a better understanding of the Chinese organic sector. This paper represents one part of a bigger ongoing research project implemented by International Federation of Organic Agriculture Movements (IFOAM) and International Network for Bamboo and Rattan (INBAR). Follow-up findings and results will be added once they are completed. The research applies a value-chain approach to study the different activities within the production chain in China.

Approach and methods

The data used in this research are sourced from expert interviews and a literature review. Qualitative data were collected through in-depth interviews with semi-structured questionnaires. In total, 5 groups of stakeholders related to the organic value chain were identified for interviews. These groups are producers and processors, traders and retailers, service and input providers, researchers, and other related stakeholders. Instead of sampling the interviewees at a particular time or place, stakeholders were selected according to their roles and functions in the organic value chain. The interviews were conducted in Beijing and Shanghai, China, and in Germany. Data were also collected at the Biofach Organic Fair, Nürnberg 2013; from Beijing farmers markets; and during the Shanghai Organic Certification Conference, 2013. The research adopts the Sustainable Rural Livelihoods (SRL) Framework (Scoones, 1998) to analyze the range of formal and informal organizational and institutional factors that influence sustainable livelihoods in the organic value chain.

Characteristics of the Chinese Organic Sector

For a few decades, Chinese authorities have sought alternatives to conventional agriculture to maintain high productivity without causing degradation of natural resources and the environment to fulfil the need for safe and sufficient nutrition for a still growing society. Certified ecological or organic agriculture has been suggested to be a modern and promising alternative that has a sound record of adapting food safety and natural harmony (Shi, 2002). Starting from the early 1990s, the Chinese government introduced different ecological certification schemes to the Chinese agro-food system including "Green Food," "Hazard-free

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Food," and "Organic Food," which are operated by different authorities of Ministry of Agriculture (MOA) and Ministry of Environmental Protection (MEP) such as the China Green Food Development Center (CGFDC), Organic Food Development Center (OFDC), and China Organic Food Certification Center (COFCC). However, none of these schemes have shown outstanding success (Scott et al., 2013). On the other hand, the organic agriculture movement in Europe and North America has grown rapidly, and the international demand for organic products has reached China. A rapid increase in various international certification schemes from different international organizations in China has led to the development of a new independent organic sector. As a result, China has become one of the leading countries in organic agriculture, with 1.4 million hectares of organic arable land by 2012 (FiBL, 2012). This enormous emergence and growth in such a short time is difficult to control, however, and the pricewise benefits have mostly remained with the international traders. The environmental benefits have not been seen directly or immediately by smallholders because they are mostly long-term results. The diagram below displays how a typical organic food chain in China functions. It should be noted that individual stakeholders are not detailed in this diagram.

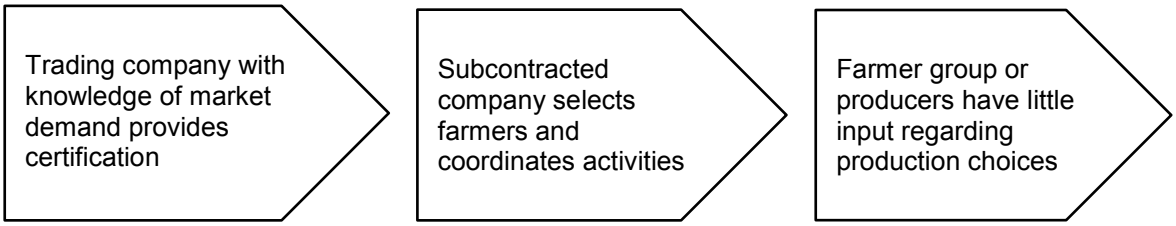


Figure 1: Function of a typical Chinese organic food chain

The major drivers behind organic production in China are international trading companies working directly with subcontracted local companies. These trading companies provide inputs technical advice, and marketing channels to poor farmers with small plots, e.g., less than 0.5 hectares per household – especially in southern China (Ye et al., 2001). The preliminary findings indicate that the Chinese organic agriculture sector has followed a different development pattern than those of other countries due to its trade-oriented roots and top-to-bottom approach, which is driven by commercial traders.

Results and Challenges

According to the SRL framework, starting from the farm level, our findings show that farmers' knowledge of organic farming fundamentals is lacking in China. With a thousand years of agricultural history and experience, Chinese farmers are traditionally good practitioners of ecological agriculture, from compost application to biological pest control, and their traditional knowledge centers around practices that keep the material flows cycle sustainable on farms. Our data show that many farmers complained about the difficulty of crop rotation. Others were not sure about application of pest-control strategies. The interviews revealed that information sourcing was more on a discussion basis rather than through structured and transparent systems between farmers. Therefore, know-how and information transfer, as well as access to updated information, represent a critical bottleneck at the farm level.

Technical services are provided by the Chinese government and sub-contracted companies, as mentioned in the above diagram. The government provides knowledge on organic farming through rural extension services; however, resources for advisory services on organic practices are limited. Another issue at the technical level is the lack of organic testing laboratories. All samples are first sent to Europe for testing, which is a very time-consuming and expensive process. Even though good laboratories with new and modern equipment exist in China, none of them are yet accredited.

The certification business is at the center of the organic food chain, and certification companies are abundant in China. In 2004 the number of organic certification bodies was 4; by 2006 the number had already reached 30 (Kledal et al., 2007). Most of these companies are international with branch offices in China. Thus, frequent communication with the head offices is required, which can impact information exchange. Difficulties related to reporting non-compliances were observed to be due to cultural hierarchical relations and other reasons.

Interestingly, organic agriculture is mostly understood as a food-safety instrument in China. Among 17 interviewed inspectors, 10 of them studied food sciences, and their technical knowledge of farming was limited, which caused them difficulties understanding the application of organic farming practices. Still, local inspectors seem to have the most information in the sector as well as the most accurate information. On the

other hand, it was mentioned during interviews that some inspectors are also involved in commercial relations with traders, which raises concerns linked to independence.
Due to the increasing number of general food scandals and occurrences of residue in organic raw materials in China (Xue and Zhang, 2012), in 2012 the Chinese National Certification and Accreditation authority updated the existing Chinese organic standard with many additional requirements. The new Chinese organic standard became one of the world's most difficult to achieve certification for, and the prospects of the new Chinese organic standard for the overall organic food chain as well as its challenges have not yet been discussed or assessed. Moreover, the new regulations mostly favor large producers, so the potential benefits of organic agriculture to rural development will be gradually reduced. On the other hand, the existing constitutional laws do not always favor organic producers. Unclear land ownership issues are often a problem for inspectors and for the scope of the certification. Marketing organic products is another challenge for producers. The domestic market demand is limited, and international markets are difficult to access. Traders have little interest in rotation crops, so the financial benefits to farmers are marginalized. Some farmers complained about the need to sell organic products to conventional markets (with resulting decreased financial returns). The consumer awareness on organic products is weak because many other products on the local market are sold under the labels of "healthy," "natural," or "ecological," confusing the end consumer.

Discussion and Suggestions for the Challenges in the Chinese Organic Sector

The organic sector in China shows different characteristics than its counterparts in Europe in terms of supporting concepts such as small producers, locality, and fairness. A strong top-to-bottom system is observed and predominant in the Chinese organic agricultural sector, which makes it hard for small producers to be involved in decision-making processes. On the other hand, entering the organic sector seems be a challenge for Chinese small farmers because of technical and economic difficulties.
With our preliminary findings we suggest that if the organic farming extension services are strengthened, the farmers knowledge can be increased; if the domestic market will be better promoted, the farmers can have better and direct access to these markets; and if the benefits can be shared better, the challenges of the Chinese organic food chain can be tackled in order to ensure sustainable livelihoods in the value chain. An effective institutional instrument for ensuring fair benefit share between large trade companies and small producers should be established by the government through consultation with different stakeholders. Consequently, it is recommended to increase support to farmers and to increase consumer awareness of organic food.

References

Kledal, P.R., Hui, Q.Y., Egelyng, H., Yunguan, X., Halberg, N. & Xianjun, L., (2007): Country report: Organic food and farming in China. In http://orgprints.org/11246/1/Fibl_article_07_org_food_&_farming_in_China.PDF.

Research Institute of Organic Agriculture (2012): Willer, H., and Kilcher, L. The World of Organic Agriculture - Statistics and Emerging Trends 2012. In cooperation with International Federation of Organic Agriculture Movements (IFOAM), Bonn V 2.0 10/02/2012

Scoones, I., (1998): Sustainable Rural Livelihoods: A Framework for Analysis. In:Institute of Development Studies Working Paper 72-201570.

Scott, S., Si, Z., Schumilas, T. & Chen, A., (2013). Contradictions in state- and çivil society-drivern developments in China's ecological agriculture sector. Journal of Food Policy. In: http://dx.doi/10.1016/j.poodpol.2013.08.002.

Shi, T., (2002): Ecological agriculture in China: bridging the gap between rhetoric and practice of sustainability. Journal of Ecological Economics 42, 359 – 368.

Xue, J. & Zhang, W., (2012): Understanding China's food safety problem: An analysis of 2387 incidents of acute foodborne illness. Journal of Food Control 30 (2013) 311e317

Ye, X.J., Wang, Z.Q. & Li, Q.S., (2002): The ecological agriculture movement in modern China. Journal of Agriculture, Ecosystems and Environment 92, 261 – 281.

The three-dimensional structure of lignite humic acid fermentation temperature based on matlab

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Key words: organic fertilizer, lignite, fermentation, temperature, three-dimensional

Abstract

The temperature is one of the most important factors in the traditional fermentation. Wireless temperature monitoring system is used for real-time monitoring on the three lignite fermentation heap temperature of YUNNAN GREENTECH CO.,LTD. in this experiment, lignite humic acid content, organic matter content and pH are tracked and detected. It reflect directly internal temperature changes of the fermentation heap through three-dimensional structure of the fermentation heap temperature mapping, especially of every lignite layers at certain point. More fermentation heap monitoring points, other indicators of organic fertilizer assessment besides humic acid content, organic matter content and pH can be selected to be monitored in further study. A more scientific and comprehensive lignite fermentation law can be explored to guide production practices better, and improve production quality and yield.

Introduction

Fertilizer is one of the most important factors to promote the development of agricultural production, and also an important material foundation for the establishment of sustainable agriculture. With China's large-scale cultivation of field crops, fertilizer pollution has been worsening in the past two decades, and the urban and rural people's concerning for environmental quality, people are on increasing desires for the commercialization of organic fertilizer. The domestic fertilizer industry and some related companies began to invest in the commercialization of organic fertilizer since the late 1980s. The wireless temperature monitoring system is used to monitor the three lignite fermentation heap in YUNNAN GREENTECH CO.,LTD. in this experiment. MATLAB software is used to draw the measured data for three-dimensional mapping at a certain time, analyze the internal fermentation reaction from the view of the three-dimensional structure, and obtain the internal regulation of the product temperature variation[1-2].

Materials and methods

1 Test Materials

Three lignite humic acid fermentation heap in YUNNAN GREENTECH CO.,LTD.(Fig.1)

2 Apparatus and equipment

Wireless temperature monitoring system (Mechanical Organization Chart is shown in Fig.2) and typical chemical laboratory equipments.

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Fig.1 Lignite fermentation heap

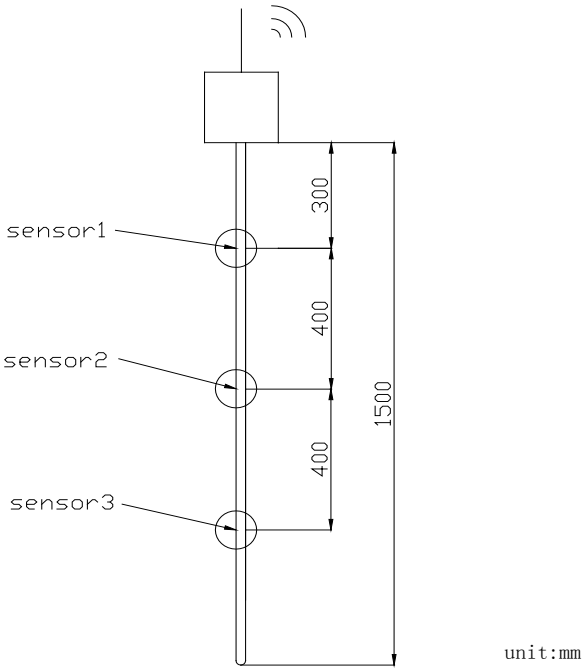


Fig.2 Mechanical organization Chart of wireless temperature monitoring system

3 Methods

3.1 Temperature measurement method: Select three lignite fermentation heap (Natural heap of fermentation, 1 day at interval). The temperature probe is used to measure the upper layer (40cm from the top of the fermentation heap), middle layer (80cm from the top of the fermentation heap) and lower layer (120cm from the top of the fermentation heap) of the central region and surrounding areas (About 20cm away from the fermentation heap wall) of the fermentation heap from the first day to the time when put the heap into production to end detection[3].

3.2 Detection of humic acid: Detection process complies with the Ministry of Agriculture standard (NY525-2002).

3.3 Detection of organic matter: Detection process complies with the Ministry of Agriculture standard (NY525-2002).

3.4 Detection of pH: (GB188877-2009)

Weigh the sample 10.0g in 100ml beaker, add 50ml of carbon dioxide-free water, shake 1 min and stand for 30min, detect it with pH acidimeter.

Data Processing

Matlab software is used for Three-dimensional mapping. This paper only list fermentation temperature of three-dimensional map analysis of the 1st fermentation heap due to the paper length limitations.

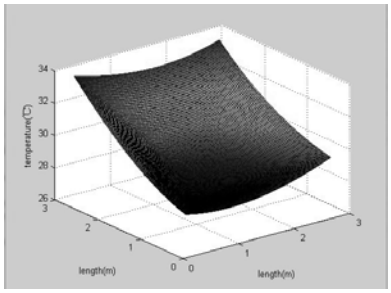


Fig.3 Temperature of the upper layer on the 1st day

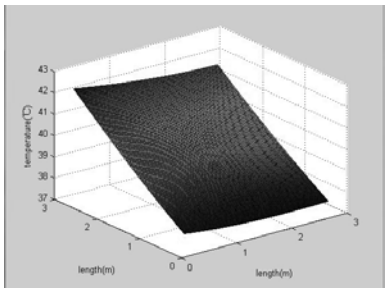


Fig.4 Temperature of the upper layer on the 5th day

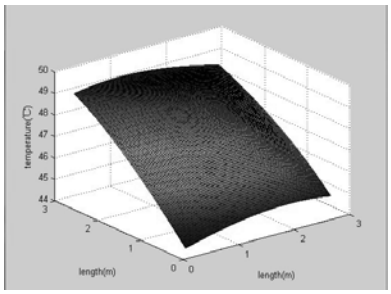


Fig.5 Temperature of the upper layer on the 10th day

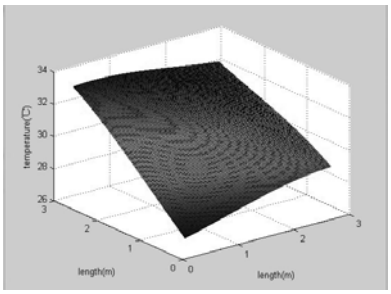


Fig.6 Temperature of the middle layer on the 1st day

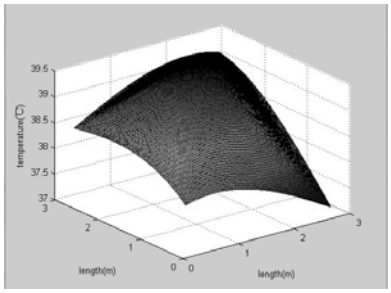


Fig.7 Temperature of the middle layer on the 5th day

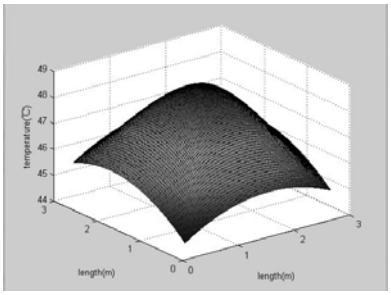


Fig.8 Temperature of the middle layer on the 10th day

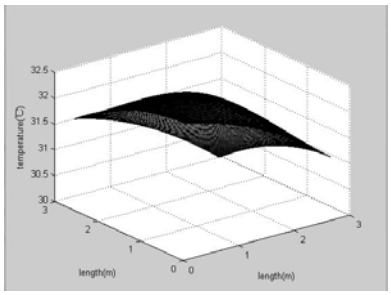


Fig.9 Temperature of the lower layer on the 1st day

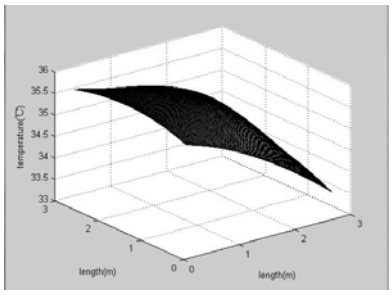


Fig.10 Temperature of the lower layer on the 5th day

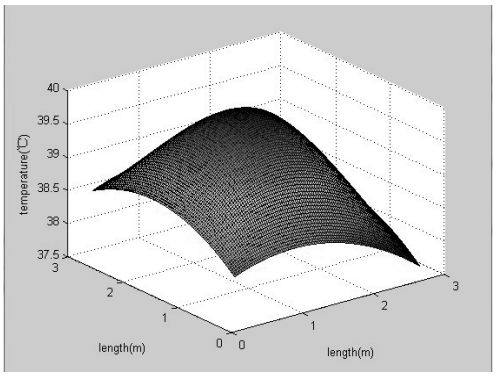


Fig.11 Temperature of the lower layer on the 10th day

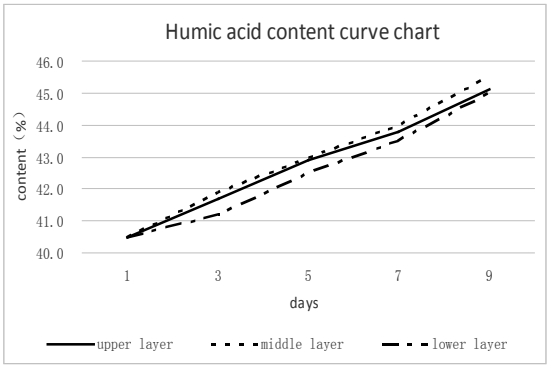


Fig.12 Humic acid content change

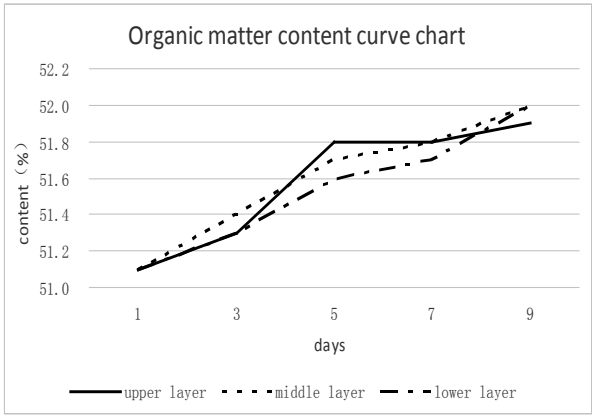


Fig.13 Organic matter content change

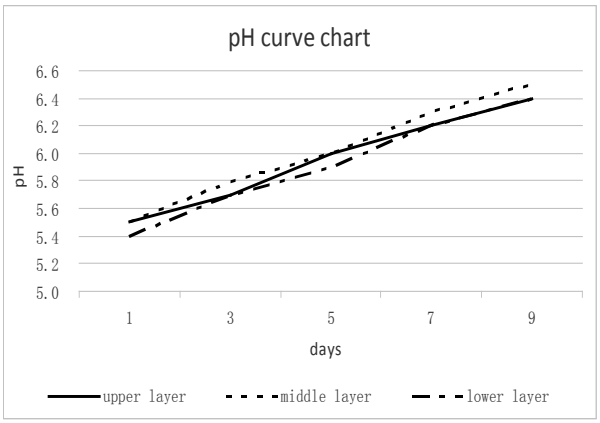


Fig.14 pH change

Fig.3~Fig.11 show temperature three-dimensional map of upper, middle and lower layer on the first day, the fifth day and the tenth day of the fermentation heap. The X-axis, Y-axis length and width at the bottom of three-dimensional map are both equate to 3m of the fermentation tank. Enumerate the 1st fermentation reactor center position, middle and lower layer of humic acid content, organic matter content and pH analysis.

Test results and analysis

1 Discussion

Fig.3, Fig.6, Fig.9 show the internal temperature of the fermentation heap on the first day. As is the way of outdoor natural accumulation of fermentation, half of the fermentation heap exposed to direct sunlight. As it can be seen, the temperature of the fermentation heap is significantly higher than on the upper and middle layer in the other side.Fig.3~Fig.5 show temperature three-dimensional map of upper layer on the first day, the fifth day and the tenth day of the fermentation heap. The three-dimensional map shape essentially unchanged, temperature rise steadily with the passage of time, parts exposed to sunlight the temperature was higher than other parts of the heap significantly. Fig.6~Fig.8 show temperature three-dimensional map of middle layer on the first day, the fifth day and the tenth day of the fermentation heap. Middle layer temperature raise significantly, and the temperature increase in the central areas is more apparent. The central temperature of the fermentation heap reaches the highest on the tenth day.Fig.9~Fig.11 show temperature three-dimensional map of lower layer on the first day, the fifth day and the tenth day of the fermentation heap. The temperature of lower layer increases steadily and the central temperature is higher than surrounding areas.Fig.12~Fig.14 show that lignite humic acid content as the temperature increases gradually improving, while organic matter content is relatively stable with slight changes. In the accumulation of fermentation process, lignite develops from the acidic to neutral, suitable for most crops which usually grow well in such neutral or slightly acidic soil.

2 The reasons for different temperatures in different regions during the fermentation. Initially, the upper and middle layer temperatures of one side of fermentation heap are significantly higher than the other side due to direct sunlight. The temperature on both sides increase steadily based on the temperature of the first day. It

produces a lot of heat accumulation in the central region during fermentation process, then the central area and its adjacent areas gradually reach equilibrium due to the heat transfer. The temperature of lower layer of fermentation heap is relatively low, since the ground reduces the temperature of the area around the fermentation[4-5].

3 Research Problems

3.1 Because the selected test points are less, it is not comprehensive, detailed and true picture of the internal temperature situation throughout the fermentation heap. More detection points should be selected for test in further studies. Since natural outdoor stacking mode is used in the production of fermentation in YUNNAN GREENTECH CO.,LTD., there is greater impact on the outside world, for example, solar radiation causes fermentation heap at temperatures significantly higher than other locations. In addition, the test did not consider season, outside temperature, humidity and other factors influencing the fermentation process due to limitations.

3.2 Chemical tests detect only the humic acid content, organic matter content and pH. The lignite, the basic structural units of humic acid and oxygen-containing functional group content changes in the relationship among the changes in temperature can be explored in further study.

Conclusion

Real-time monitoring for temperature changes of lignite heap fermentation process can be able to guide the production practices better, help enterprises improve production technology, improve product quality and yield. We can design more sophisticated chemical testing programs, select more monitoring points, establish a complete internal temperature of the dynamic three-dimensional map. The lignite, the basic structural units of humic acid and oxygen-containing functional group content and Ascaris mortality and humic acid properties of E. coli and other important indicators can be explored in further studies.

References

[1] ZHENG Ping, Production and Application of Coal Humic Acid. BeiJing, ON: Chemical Industry Press.

[2] Zeng Xiancheng. Humic Acid Returning Where It Comes. Humic Acid ,2012(4): 1-10 (30).

[3] LI Ming-chun, CHENG Tie-yuan, HUANG Zhi-guo, Three-dimensional Image of Temperature in the Fermented Grains. Food Research And Development, 2012(2):21-24.

[4] HUANG ZHi-guo, LUO Hui-bo, CHNEG Tie-yuan and LI Guang-hui. Real-time Detection & Establishment of Mathematical Model of Temperature Change Curve of Fermented Grains in Fermentation Process. LIQUOR-MAKING SCIENCE & TECHNOLOGY. 2008, No.10(Tol.172).

[5] ZHANG Liang, MENG Zhao-qing, LI Ling-yan and Huo Dan-qun. Investigation on Function Relation between Temperature and Liquor-making. LIQUOR-MAKING SCIENCE&TECHNOLOGY. 2008, No.3(Tol.165).

Organic tea has more health benefit and environmental adaptability than conventional tea

WEN-YAN HAN[1], MING-ZHEN YANG[2]

Key words: organic tea, quality, tea polyphenols, catechin, proline, health benefit

Abstract

Organic tea is booming in China since it is regarded as a high quality and healthy food. To confirm this believing, six pairs of organic and conventional teas from eastern China have been studied. The results show that organic tea had significantly higher polyphenols, including epigallocatechin gallate (EGCG), epicatechin gallate(ECG) and epigallocatechin(EGC), and water extracts, compared to the conventional tea. The concentrations of proline and γ-aminobutyric acid were also significantly higher in organic tea. It could conclude that organic tea has more health benefit and environmental adaptability than conventional tea. However, the amino acids, particular theanine were generally lower in organic tea, suggesting sufficient or/and N rich organic fertilizer should be applied in organic tea fields.

Introduction

Tea (*Camellia sinensis* (L.) O. Kuntze), next to water, is the most popular beverage consumed worldwide. In vitro and animal studies provide strong evidence that tea polyphenols may possess the bioactivity to affect the pathogenesis of several chronic diseases (Khan & Mukhtar 2007). Organic farming is booming in China, since it is regarded as a farming system that could contribute to climate mitigation and sustainable agriculture, but produce high quality and safety products as well. Many comparison studies reveal that the contents of minerals, vitamins, proteins and carbohydrates in organic food are not much different with conventional food, but the contents of defence-related secondary metabolites may be more in organic food (Brand & Mølgaard 2001). Tea is a product that the secondary metabolites such as polyphenols are quality parameters. Is organic tea more healthful? Such information is urgently needed for further promotion of organic tea production and consumption.

Material and methods

The selected tea farms are located in Zhejiang and Fujian provinces, eastern China. This region has a subtropical monsoon climate with a clear division of four seasons and abundant sunshine. All the farms have both organic and conventional tea gardens. The organic tea gardens were converted from conventional ones for more than 10 years. The five farms in Zhejiang province have been described previously in great detail (Han et al. 2013). The farm, Zhangzhou Tea Farm in Fujian province, has mean annual temperature of 21.0 °C, and mean annual precipitation of 1500 mm.

Three independent tea samples were taken from each site under organic and conventional management, respectively in spring 2011. Tea samples consisting of one bud and two leaves were made into Maofeng, a kind of green tea in each farm. The samples were then taken to the laboratory, oven dried and grounded into powder by a stainless steel grounder before analysis. Total tea polyphenols, caffeine, free amino acids and water extracts in all 36 samples were analyzed according to China National Standards. Tea samples from Jinhua site were analyzed for different kinds of catechins and free amino acids. The analysis of catechin was described in great detail by Wei et al. (2011). The amino acids were determined by Hitachi L-8900 automatic amino acid analyzer.

A one-way analysis of variance (ANOVA) was used to compute means and the least significant differences (LSD) with different management systems as a factor by SPSS 13 for Windows. The significance level was set at $p < 0.05$. The values in the Table and Figures are mean values and standard deviation (SD) of three replicates.

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[2]Same as above.

Results

1. Main tea quality components

The main quality components including tea polyphenols, free amino acids, caffeine and water extracts in organic and conventional tea products are listed in Table 1. The results show that organic tea was significantly higher tea polyphenols than conventional tea in all six farms. On the contrary, the total free amino acids were remarkably or significantly lower in organic tea. There were no different in caffeine concentrations. The water extracts of organic tea were also higher than that of conventional one.

Table 1: Concentrations of main tea quality components in organic and conventional teas from six pairs of farm in Zhejiang and Fujian provinces, eastern China (%)

Site	Manage-ment	Tea polyphenols	Total free amino acids	Caffeine	Water extracts
Jin-hua	Organic	31.6±1.1 a	4.25±0.17 a	2.76±0.16	43.6±0.9 a
	Conventional	27.1±1.0 b	4.81±0.22 b	2.99±0.07	39.8±1.0 b
Yiwu	Organic	22.7±0.7 a	3.46±0.28 a	2.68±0.16	35.8±1.9
	Conventional	20.5±1.0 b	5.30±0.03 b	2.99±0.37	33.8±0.7
Wuyi	Organic	22.6±1.0 a	4.33±0.25	3.27±0.34	37.5±1.3 a
	Conventional	18.1±0.5 b	4.72±0.24	3.19±0.17	34.7±1.7 b
Yuyao	Organic	28.8±0.4 a	2.78±0.10 a	2.64±0.32	39.6±1.2
	Conventional	25.5±0.7 b	3.15±0.16 b	2.50±0.14	38.8±1.9
Lishui	Organic	31.8±1.1 a	6.97±0.21 a	3.77±0.19	47.8±1.1 a
	Conventional	29.1±0.6 b	7.78±0.03 b	3.75±0.24	43.9±1.7 b
Zhang-zhou	Organic	23.6±0.7 a	2.40±0.24	2.72±0.23	35.1±1.2
	Conventional	19.5±0.8 b	3.28±0.68	2.61±0.19	32.8±2.1

Means ± SD are presented. The following different letters within a column in the same farm denote significant difference ($p < 0.05$) between organic and conventional teas

2. Constituents of catechins

Catechins are main components of tea polyphenols. The concentration of total catechins on average was 132.2 g kg^{-1} in organic tea, significantly higher than 115.7 g kg^{-1} in conventional tea. The main constituents of catechin were also significantly different between organic and conventional teas (Fig. 1). The epigallocatechin gallate (EGCG), epicatechin gallate (ECG) and epigallocatechin (EGC) were significantly higher in organic tea than its conventional counterpart. The concentrations of other catechin components were all relative higher in organic tea except for catechin (C).

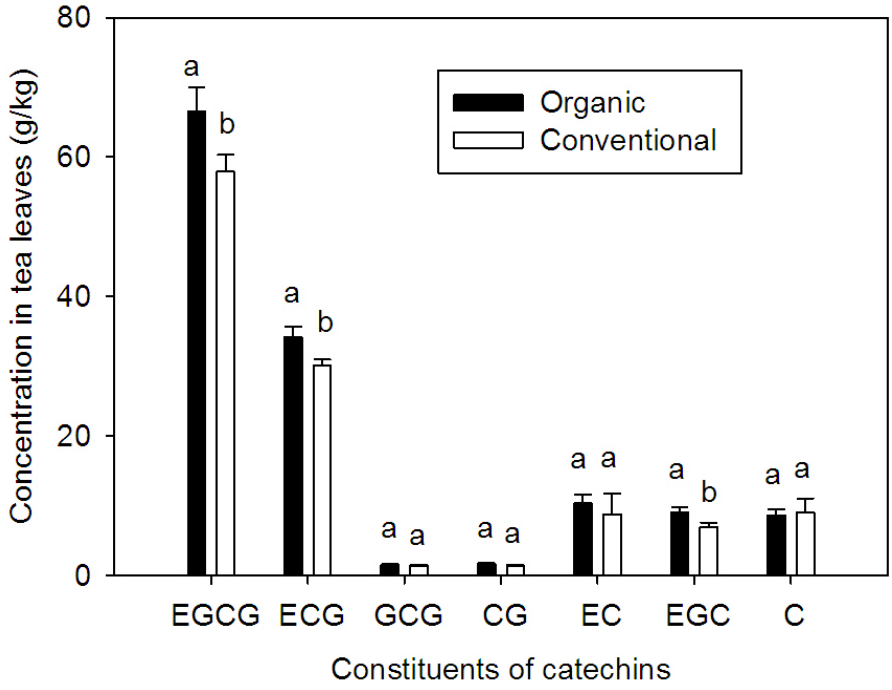


Figure 1. Concentrations of catechin components in organic and conventional teas from Jinghua farm. Vertical bars are standard deviations (SD). Different letters denote significant difference ($p < 0.05$) between organic and conventional teas in the same catechin.

3. Constituents of amino acids

The concentrations of different free amino acids in organic and conventional teas from Jinhua farm are presented in Fig. 2. The results show that aspartic acid (Asp), theanine (Thea) and arginine (Arg) were significant higher in the conventional tea. However, the proline (Pro) and γ -aminobutyric acid (GABA) were significantly higher in the organic tea. The other amino acids were not much different.

Discussion

Tea polyphenols, caffeine, free amino acids are main tea quality parameters. The higher is the better to some extent. These secondary metabolites not only have defence effect for tea plants, but health benefit to tea consumers. Tea polyphenols, particularly catechins are antioxidant and has anticarcinogenic effect, can prevent or cure cancers, cardiovascular diseases, diabetes, obesity and other bacterial and viral diseases; Thea and GABA can improve brain functioning (Khan & Mukhtar 2007). Pro could prevent plant damage from environmental stresses (Ashraf & Foolad, 2007). The present study show that organic tea was significantly higher in tea polyphenols, EGCG, ECG, EGC, Pro and GABA compared to conventional tea. Therefore, organic farming is beneficial to improve tea quality and its health properties, and also helps to adapt the adverse environment. Other organic products e.g. strawberry and orange also had more phenolic compound and antioxidant properties than their counterpart (Fernandes et al. 2012; Roussos 2011). The low concentrations of free amino acids, especially Thea in organic tea is probably due to the lower mineral N contents in soils under organic management, which could be improved by higher or/and N rich organic fertilizer application (Han et al. 2013).

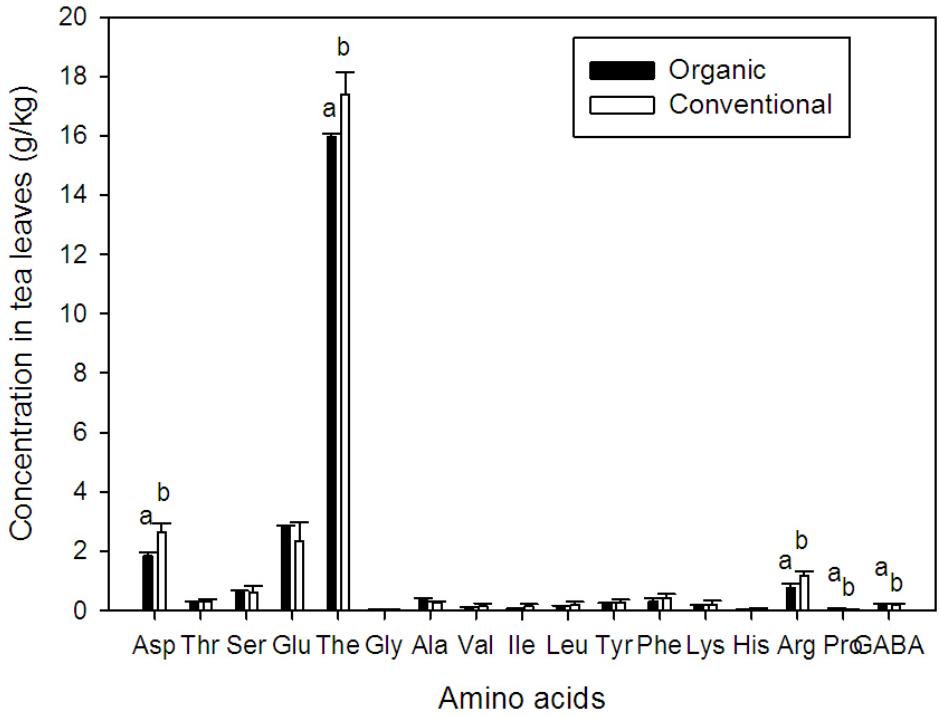


Figure 2. Concentrations of free amino acid constituents in organic and conventional teas from Jinghua farm. Vertical bars are SD. Different letters denote significant differences ($p < 0.05$) between organic and conventional teas in same amino acid.

References

Ashraf M & Foolad MR (2007): Roles of glycine betaine and proline in improving plant abiotic stress resistance. Environmental and Experimental Botany 59, 206-216.

Brandt K & Mølgaard JP (2001): Organic agriculture: does it enhance or reduce the nutritional value of plant foods? Journal of the Science and Food Agriculture 81, 924-931.

Fernandes VC, Domingues VF, Freitas VD, Delerue-Matos C & Mateus N (2012): Strawberries from integrated pest management and organic farming: Phenolic composition and antioxidant properties. Food Chemistry 134, 1926-1931.

Han WY, Xu JM, Wei K, Shi, RZ & Ma LF (2013): Soil carbon sequestration, plant nutrients and biological activities affected by organic farming system in tea fields. Soil Science and Plant Nutrition 59, 727-739.

Khan N & Mukhtar H (2007): Tea polyphenols for health promotion. Life Science 81, 519-533.

Roussos PA (2011): Phytochemicals and antioxidant capacity of orange (Citrus sinensis (l.) Osbeck cv. Salustiana) juice produced under organic and integrated farming system in Greece. Scientia Horticulturae 129: 253-258.

Wei K, Wang L, Zhou J, He W, Zeng J, Jiang Y & Cheng H (2011): Catechin contents in tea (Camellia sinensis) as affected by cultivar and environment and their relation to chlorophyll contents. Food Chemistry 125, 44-48.

Study on Nitrogen Surplus in Organic, Low-Input and Conventional Cropping Systems in Greenhouse

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Key words: long-term, cropping system, nitrogen balance, eggplant production

Abstract:

This study was based on a long-term field trials of three different vegetable cropping systems (organic (ORG), low-input (LOW) and conventional (CON)) in greenhouse initiated in 2002. The apparent nitrogen (N) surplus which equals to N input (N of fertilizer, manure, transplants and irrigation) minus N output (N of the eggplants) was compared to provide the reference for the development of high-yielding and sustainable cropping system. The main conclusions were as follows: The net N surplus in ORG, LOW and CON systems was 971 kg ha^{-2}, 1046 kg ha^{-2} and 1317 kg ha^{-2}, respectively, and ORG system was 7.2% and 26.3% lower than LOW and CON systems, respectively. The eggplant production in ORG system was 0.1% higher than LOW system and 3.6% higher than CON system. These data showed that ORG system tends to be higher yield and lower net N surplus, leading to higher N use efficiency when compared with LOW and CON systems.

Introduction

Since the 1970s, many ecological problems have been caused by excessive N application in China. Thus some alternative agriculture has been put forward and organic agriculture is one of them. Recently, China's production of greenhouse vegetable has become the biggest in the world (Duan et al. 2010). In the major areas of China, N fertilizer application rates are about 1100-1500 kg ha^{-1} in the north (Ju et al. 2009), and 900-1300 kg ha^{-1} in the south (Shi et al. 2009).

The objective of the study was to compare the N surplus in three systems in order to provide references for the development of high-yielding and sustainable cropping system.

A formula of N surplus which equals to N input minus N output was used in this paper. The N input includes N of fertilizer, transplants and irrigation while the N output comes from N of vegetable. And the leaching, denitrification, NH_3 volatilization and different forms of N in the soil were included in N surplus.

Material and methods

Experimental site and design

The long-term experiment was initiated in June 2002 on a salinized cinnamon soil at Quzhou Agricultural Experimental Station (36º52´N, 115º01´E) in Quzhou, Hebei province, North China. Precipitation averages 604 mm year^{-1}.

This experiment was conducted in three side-by-side greenhouses with three cropping systems: 1) conventional system (CON): use a small amount of animal dung (water content was 33.40 %) and chemical fertilizer; 2) low-input system (LOW): animal dung (water content was 33.40 %) and lower amount of chemical fertilizer; 3) organic system (ORG): only use animal dung (water content was 33.40 %). The total irrigation rate during this periods was 5275 m^3 ha^{-1} in each system.
At each greenhouse there were 3 subplots and all data were taken from individual subplot separately. During this research, seedlings of eggplant were transplanted into each greenhouse on March 12, 2011 and harvested on July 15, 2011.

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Sampling and data collection

Three transplants were taken before transplanting and one plant sample was taken from each plot of each greenhouse on April 30, May 12, May 23, June 1, June 11 and July 15. Two lines of eggplants were chosen in each plot of each greenhouse for biomass weighting. Samples of irrigation water were collected from a well near the greenhouses.

The selected plants were separated into stems, leaves and fruits (without consideration of residues below the ground), oven-dried at 80 ℃ for about 24 h and ground to a 0.5-mm powder.

Total N in plants and manure samples was analysed by the Kjeldahl method (Bao 2000) and total N in irrigation water was measured by Alkaline potassium persulfate digestion - UV spectrophotometric method.

Soil nitrogen balance was calculated by following formula (van Eerdt and Fong 1998, Oenema et al. 2003):

N surplus = input components (fertilizer + manure + N from transplant + N from irrigation) - output components (N removed by aboveground plant parts).

The N surplus represented N that was lost by ammonia volatilization, denitrification or leaching, or stored in various soil fractions.

Results

Nitrogen input

Total N content of animal dung and irrigation water was 11.92 g kg^{-1} and 7.77 mg L^{-1}, respectively. Fig.1 showed the accumulated total N input in different periods. And total N input of ORG, LOW and CON systems averaged 1150 kg ha^{-1}, 1182 kg ha^{-1} and 1433 kg ha^{-1}, respectively. Fertilizer and manure was the main source of N nutrient, contributing 96.32 %, 96.42 %, 97.05 %, respectively.

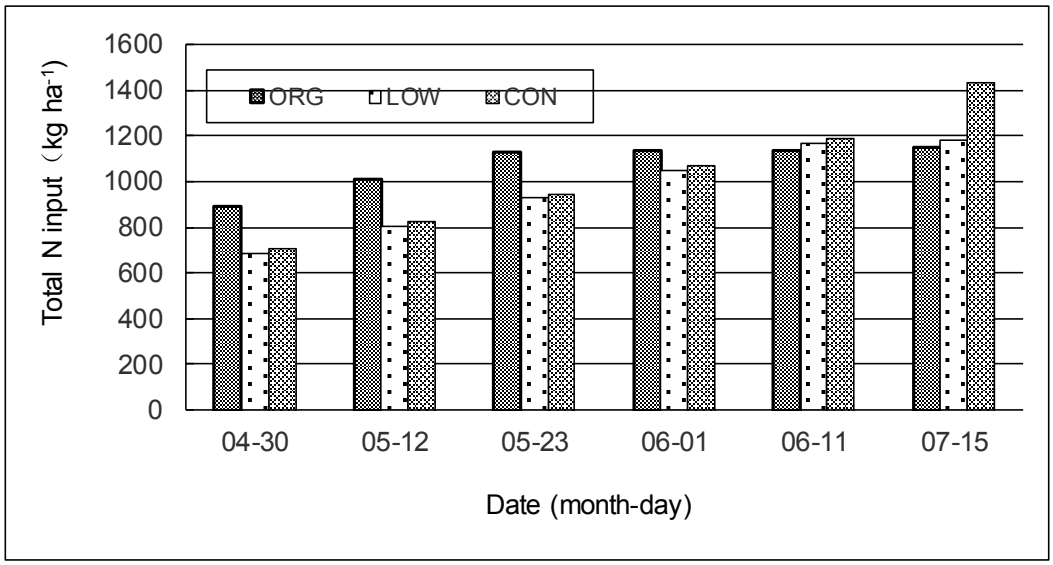


Figure 1. Changes of accumulated total N input in different periods under three cropping systems

Nitrogen output

Fig.2 summarized the N output of different growing periods of eggplant. It showed the N uptake and utilization of eggplant was lower during the vegetative stage and became higher during the reproductive stage, especially after the fruitage. The total N output of ORG, LOW and CON systems was 178 kg ha^{-1}, 135 kg ha^{-1} and 116 kg ha^{-1}, respectively, and the yield of them was 93458 kg ha^{-1}, 93320 kg ha^{-1} and 90209 kg ha^{-1}, but no significant differences were found.

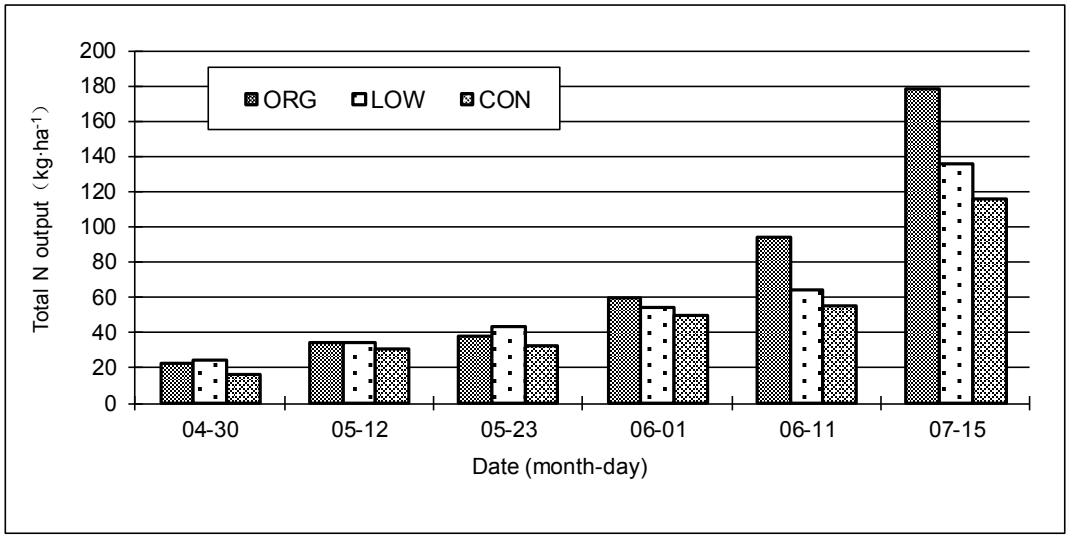


Figure 2. Changes of total N output in different periods under three cropping systems

Nitrogen balance

The net N surplus in ORG, LOW systems increased at beginning stages, and then decreased, but it increased at all stages in CON system (Fig.3). This may be led by two reasons: on the one hand, fertilizer application frequency under ORG, LOW and CON systems was four, six and eight, respectively and the amount of fertilizer in CON system was the most. On the other hand, the N uptake of eggplant increased greatly at fruitage, which leaded to decline of N surplus in ORG and LOW systems. The net N surplus in ORG, LOW and CON systems was 971 kg ha^{-2}, 1046 kg ha^{-2} and 1317 kg ha^{-2}, respectively. ORG system showed the least total N input and net N surplus.

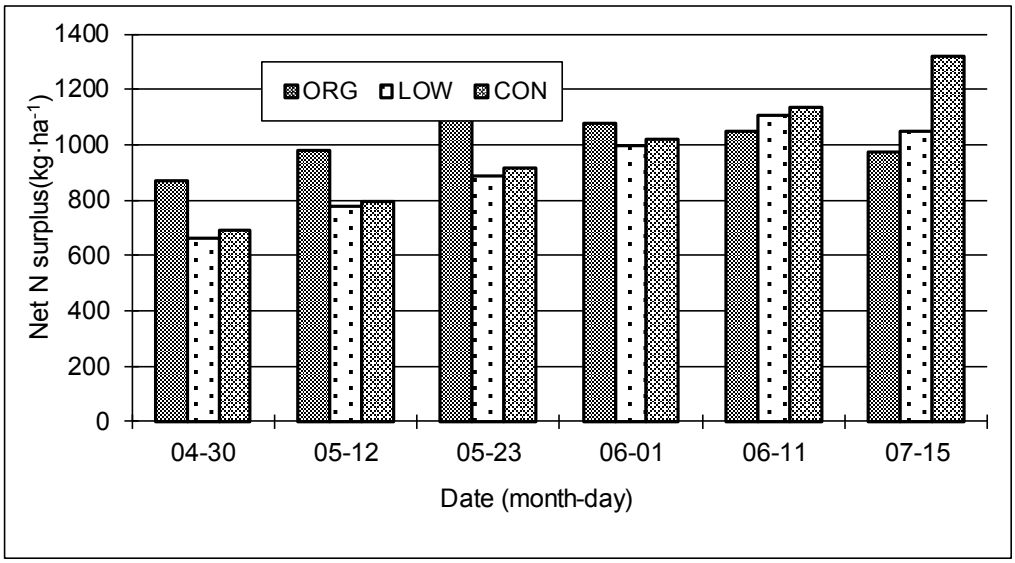


Figure 3. Changes of net N surplus in different periods under three cropping systems

Discussion

The total N input of ORG, LOW and CON systems averaged 1150 kg ha^{-1}, 1182 kg ha^{-1} and 1433 kg ha^{-1}, respectively. Total N output of ORG, LOW and CON systems was 178 kg ha^{-1}, 135 kg ha^{-1} and 116 kg ha^{-1}, respectively, and the yield of them was 93458 kg ha^{-1}, 93320 kg ha^{-1} and 90209 kg ha^{-1}. The net N surplus in ORG, LOW and CON systems was 971 kg ha^{-2}, 1046 kg ha^{-2} and 1317 kg ha^{-2}, respectively. Beside having very competent yield , ORG showed the lowest N input, highest N output and lowest N surplus compared with LOW and CON systems.

This result indicated that containing almost the same nitrogen content, manure had much more effects on decreasing N surplus than chemical fertilizers. This may be related to the higher organic nitrogen content, lower mineralization rate and lower proportion of leaching nitrate nitrogen in manure than chemical fertilizer. This research finding revealed the benifit of ORG in terms of reducing nitrogen loss over LOW and CON systems.

References

Duan Z J, Ma J K, Liu J Q, et al (2010): The trends of vegetable industry in China-A visit to Zhibin Zhang, the director of Chinese Academy of Vegetable and Flower Cultivation and Postpartum Room Process. Adviser of Peasant Families 4, 4–6.

Ju, X. T., Xing, G. X., Chen, X. P., Zhang, S. L., Zhang, L. J., Liu, X. J., Cui, Z. L., Yin, B., Christie, P., Zhu, Z. L. and Zhang, F. S (2009): Reducing environmental risk by improving N management in intensive Chinese agricultural systems. Proc. Natl. Acad. Sci. USA 9, 3041-3046.

Shi W. M., Yao, J. and Yan, F (2009): Vegetable cultivation under greenhouse conditions leads to rapid accumulation of nutrients, acidification and salinity of soils and groundwater contamination in South-Eastern China. Nutr. Cycl. Agroecosys 83, 73-84.

Bao S D (2000): Soil and Agricultural Chemistry Analysis. Beijing: China Agriculture Press.

van Eerdt, M.M., Fong, P.K.N (1998): The monitoring of nitrogen surpluses from agriculture. Environmental Pollution 102 (s1), 227-233.

Oenema, O., Kros, H., de Vries, W (2003): Approaches and uncertainties in nutrient budgets: implications for nutrient management and environmental policies. European Journal of Agronomy 20, 3-16.

Approach to the assessment of sustainability in organic livestock farms in a Colombian Andean region

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Key words: Organic, livestock, sustainability, production system.

Abstract

This study aimed to compare conventional livestock production systems in relation to organic production, evaluating environmental, productive and economic variables in 6 farms of Guayabal de Síquima (Colombia). The work established significant differences on water quality between the affluent and effluent water for variables such as pH, nitrate and phosphorus. The microbiological analysis of soil found significant difference in bacterial counts made for organic systems compared with the conventional. The botanical composition of grasslands showed a significant difference in the amount of grass on organic farms. The organic management stimulated the arthropod species diversity and its density per m^2 in the prairies in relation to conventional systems. Fertilization costs were lower and effective control of ecto and endoparasite burden was higher under the organic management system. An evaluation of 12 indicators related with sustainability evidenced the best results in organic systems.

Introduction

The intensified agricultural systems have suffered recently, by the high use of fertilizers, synthetic pesticides, antibiotics, hormones and fossil fuels, with effects on the environment (Pimentel et al. 2005). As result, agroecology has emerged to contribute to the solution of these problems (Sarandon and Labrador 2001). Organic agriculture, as application of agroecology, seeks the improvement and maintenance of soil fertility and productivity, satisfaction of human needs, economic viability, social acceptability, ecological adaptation and development systems by long-term (IFOAM 2009, Gómez-Limón 2010).

Methodological schemes that assess the sustainability of animal production systems continue to evolve based on the measurement of them (Masera 1999), using economic, social and environmental indicators, including agricultural practices, evaluation of soil, water, energy use, waste generated by the system, animal welfare and conservation of biodiversity (Nahed et al 2007).

Material and methods

This study aimed to compare conventional livestock production systems in relation to other forms that implement organic production, evaluating environmental variables (in water: nitrite, nitrate, phosphate, pH and availability of oxygen using photometric methods and Winkler modified method. In soils: counts of bacteria and fungi using MPN method, and physicochemical properties. In meadows: Prairie composition, quantity and density of arthropods), productive variables (in forages: biomass estimation using the methodology by Campbell and Arnold, nutritional quality using bromatology methods, in animals: milk production, and carrying capacity), and economic variables (Fertilization cost and control ecto-endo parasites cost) in 6 farms Township Guayabal de Síquima (Colombia). Three of them were classified as conventional while other three farms were classified as organic (2 certified following Colombian organic regulation and 1 in conversion process) in relation with management. Samples were taken periodically during 12 months for the components soil, water, plants and animals involved in the production process. The variables were compared statistically using T-test.

Results

The work established effects of conventional systems on water quality, significant differences were found between the affluent and effluent water for variables such as pH ($P = 0.046$) from 7.1 to 6.9, nitrate NO_3-N ($P = 0.027$) by the increasing from 10.0 to 20.8 mg L^{-1}, and phosphorus as PO_4^{3-} ($P < 0.001$) when going from 10.3 to 12.0 mg L^{-1} respectively. In the organic management systems, the values associated with nitrate as NO_3^-N and phosphorus in the effluent water decreased (15.0 to 11.7 mg L^{-1}; 11.0 to 10.3 mg L^{-1} respectively) and increased available oxygen (4.8 to 5.2 mg L^{-1}) but there was no significant difference between them. Regarding the microbiological analysis of soil (Table 1) found in most bacteria counts made for organic

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systems (average 1.58 x 10^7 cfu gDS^{-1}) being found significant difference compared to the conventional system (average 5.22 x 10^6 cfu gDS^{-1}), as well as many fungi (Conventional 1.30 x 10^4 and Organic 2.13 x 10^4 spores gDS^{-1}) although there was no statistical difference between the two systems.

Table 1. Counts of bacteria and fungi in soils from conventional and organic handling farms.

	Bacterias		Fungi	
	Conventional farms	Organic farms	Conventional farms	Organic farms
Dry season	3,85E+06	8,25E+06	7,65E+03	1,43E+04
Rainy season	6,59E+06	2,34E+07	1,84E+04	2,83E+04
Average	5,22E+06*	1,58E+07*	1,30E+04**	2,13E+04**

*Bacterias: Highly significant difference. T test (P=0,003)
**Fungi: No significant difference. T test (P>0,05)

The botanical composition of grasslands showed a significant difference (P<0.001) in the amount of grass of organic farms (80.1%) than in conventional (62.2%) and the amount of weed (P<0.001) being higher on conventional farms (32.1% versus 11.5%). Forage production per year was higher in conventional farms (112.1 tons ha^{-1} against 81.66 tons ha^{-1}), enabling higher carrying capacity on them (1,768 kg BW ha^{-1} in Conventional to 957 kg LW ha^{-1} in Organic) but not significant difference (P>0,05) between the systems (Figure 1).

The development of silvopastoral systems in the organic farms, allowed the incorporation of various species in the animal feed, and may have influenced the diversity of arthropods in the meadow, along with other practices that additionally favored an integrated pest management. Around 23.5% of the fodder in organic farms comes from the trees and shrubs established in the silvopastoral system (*Trichantera gigantea, Erythrina edulis, Thitonia diversifolia and Bohemeria nivea)*.

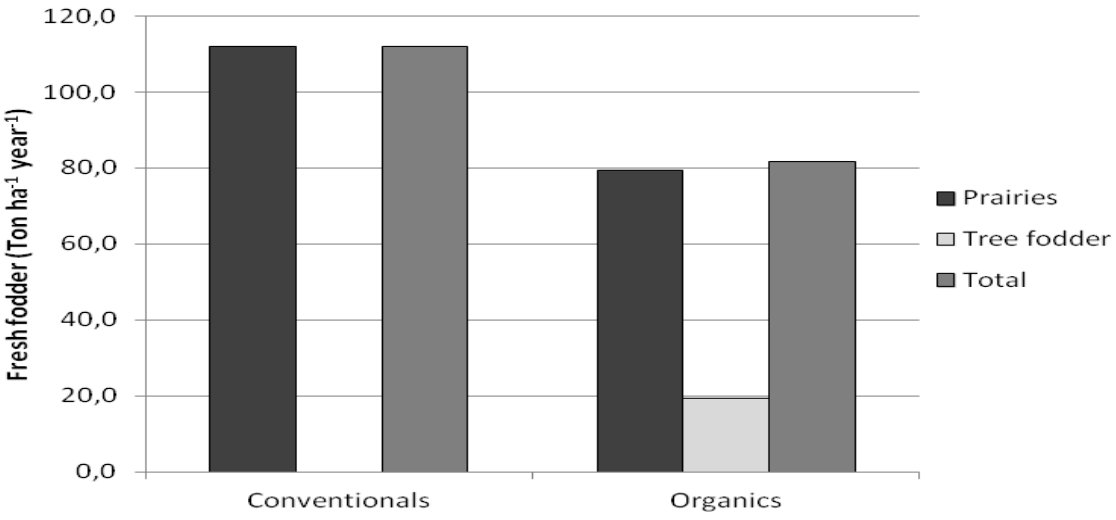


Figure 1. Forage production in organic and conventional farms

There was no significant difference in relation with the nutritional quality of fodder for variables evaluated in conventional and organic farms, as protein (12.2% vs. 12.7%), NDF (64.5% vs. 65.0%), ADF (30.3% vs 29.1%), lignine (3.5% vs. 2.8%), cellulose (26.8% vs. 26.4%), hemicellulose (34.2% vs. 35.8%), calcium (0.46% vs. 0.49%) and phosphorus (0.2% vs. 0.2%) respectively. The Organic management stimulated the arthropod species diversity (7.67) and its density per m^2 in the prairies (0.331 arthropods) in relation to conventional systems (6.67 and 0.190 arthropods), although there was no significant difference between them.

The comparison in fertilization costs and control of ecto and endoparasites was lower in organic management systems than in conventional agriculture based on the use of compost and enthomopatogenic fungi. Overall management of composting and soil microbial broths of organic systems favored more soil microbiology, and generate less pollution effects of nitrogen and phosphorus products in effluent waters. The

conventional farms used Ivermectin, Triazine, Cypermethrine for ticks and insects control, and urea and chemical composed fertilizers for soils during the crops process.

Finally, the cattle were crosses between Cebu x European breeds (Holstein, Normande, Jersey o Brown Swiss), or crosses between European breeds with a day milking by hand. The milk production registered during 9 months of evaluation were 4,5 L cow^{-1} day^{-1} for conventional farms, and 6,7 L cow^{-1} day^{-1} for organic farms. The cows of organic farms received a food supplementation at milking time, composed of fodder from trees and shrubs arranged in plots. An evaluation of 12 indicators related with sustainability evidenced the best results in organic systems (Figure 2).

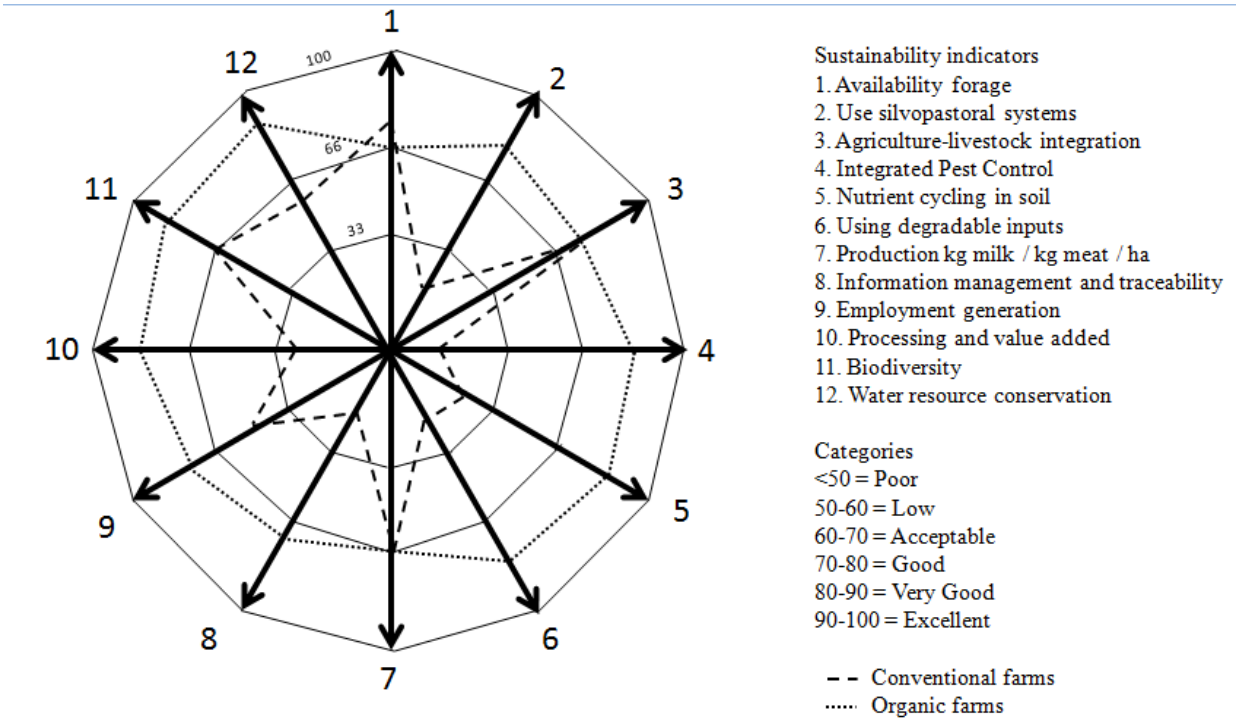


Figure 2 . Assessing the sustainability of conventional and organic farms monitored

Discussion

The sustainability assessment of conventional farms and organic farms management led to the discovery that the conventional were far less sustainable compared to a set of variables identified as key in this process. Organic farms remained higher microbiological activity of soils, greater diversity of arthropods in grassland, less use of chemical products, the farmers have better conceptualization and integration between animals and plants production system, which enabled most successful approaches such as integrated pest management.

Suggestions to tackle with the future challenges of organic animal husbandry

The systemic evaluation of social, economic and environmental components of organic farms, should allow identification of problems which let the development of particular production systems, making use of local resources, conserving and promoting biodiversity, emulating ecological cycles, and avoiding fall into the trap of setting producing certified systems under conventional schemes.

References

Gómez-Limón J A (2010): Evaluación de la sostenibilidad del olivar en Andalucía: Una propuesta metodológica. Cuaderno interdisciplinar de desarrollo sostenible 5, 95-140.

Ifoam (2009): The principles of organic agriculturea. Retrieved January 13, 2011, from http://www.ifoam.org/about_ifoam/priciples/index.html

Masera O, Astier M & López-Ridaura S (1999): Sustentabilidad y manejo de los recursos naturales. El marco de evaluación MESMIS (Sustainability and natural resource management. The MESMIS evaluation framework). Mundi-Prensa S.A., Gira, IE-UNAM. México, 109 p.

Nahed J, Mena Y, Ruiz F, Castel J & Placencia V (2007): Proposal of indicators of sustainability for small ruminant pastoral husbandry. In: VI International Seminar FAO-CIHEAM Network on Sheep and Goats – Sub Network on production systems. Changes in sheep and goat farming systems at the beginning of the 21th, Ponte de Lima (Portugal).

Information flows in organic value chain research – experiences from the project 'Productivity and Growth in Organic Value Chains (ProGrOV)'

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Key words: Value-chain approach, communication, participation, capacity building

Abstract

In the research and capacity building project ProGrOV 9 PhD and 6 MSc studies - at Makerere University in Uganda, University of Nairobi in Kenya and Sokoine University of Agriculture in Tanzania - are addressing farm level production and market integration. The overall aim of ProGrOV is to strengthen research based knowledge for supporting increased productivity and sustainable growth in organic production and value chains, and building capacity for future development of the OA based value chains. The project has developed a participatory value chains approach that the individual studies are implementing. This provides challenges of balancing the requirements of discipline oriented research with a cross-cutting implementation framework.

The objective of the paper is to illustrate and discuss the development of a value chain research approach and the related challenges for its implementation in PhD and MSc studies.

Introduction

The project 'Productivity and Growth in Organic Value Chains (ProGrOV)' is a combined research, development and capacity building project aiming at strengthening research based knowledge for supporting increased productivity and sustainable growth in organic production and value chains, and building capacity for future development of the OA based value chains in Kenya, Uganda, and Tanzania. Research is implemented via 9 PhD and 6 MSc studies with focus on value chains for local high-value markets as well as export chains.

A value-chain approach implemented in a participatory manner is envisioned for ProGrOV. The PhD and MSc students that are undertaking the research are, therefore, having a challenge in thinking participation into their research and framing it in a value-chain perspective this being in addition to the scientific requirements of their studies.

In this paper the value-chains approach developed by the project is explained and its challenge and lessons learned to date discussed.

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Development of a value-chain approach

Project concepts and ideas

Overall, the project address the need for an integrated research into - on the one hand - how to organise organic high value chains to improve chain management and livelihood benefits for the farmers and - on the other hand - further develop agro-ecological methods for farming systems intensification based on sustainable natural resource management. The overall hypothesis of the project is that 'Improved organic value chains may serve a dual purpose for:

- developing and demonstrating innovating partnership models for chain based economic and social growth; and at the same time
- improving productivity potential and sustainable natural resource management'.

While some research has focused on improving productivity and Natural Resource Management of smallholder farmers in Eastern Africa this has most often not been linked with studies of how to link improved production to market access and quality demands. NGO's have demonstrated the synergy of supporting ecological intensification through improved marketing and innovation capacity of groups of smallholder farmers but only very few research projects have studied this potential synergy (Pali et al., 2007; Hawkins et al., 2009; Høgh-Jensen et al., 2010).

The 9 PhD and 6 MSc studies are enrolled at at Makerere University in Uganda, University of Nairobi in Kenya and Sokoine University of Agriculture in Tanzania. All studies are interlinked either through the chain being addressed or the produce itself (pineapple, vegetables, livestock), thus the students work with their individual research projects as well as they work in national teams and learn from exchange of knowledge between countries (Figure 1).

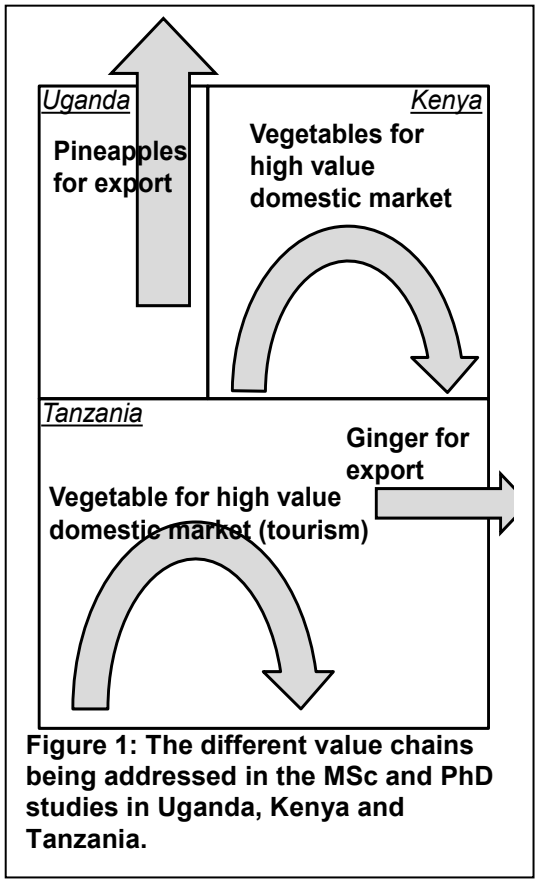


Figure 1: The different value chains being addressed in the MSc and PhD studies in Uganda, Kenya and Tanzania.

The value-chain approach

The project is applying participatory approaches to the degree possible that the individual MSc and PhD research projects can entail. The flow of information within and between the different links in the value chains is an important tool for participation. Therefore, the project is developing a value-chains approach that is based on information feed-back through the chain as illustrated in Figure 2. This research approaches is a further development of general concepts described in the academic literature (Kline and Rosenberg, 1986).

Value-chain research can be said to provide a tool for an interdisciplinary research approach in its own right to help researchers, entrepreneurs, and stakeholders at each step of the value chains, and from multiple disciplines, to identify relevant research questions that can contribute to the whole chain.

Vehicles for information flow are meetings, workshops and the interactions between researchers and stakeholders. While the initial contact and information exchange was related mainly to identification of research questions and immediate feed-back from stakeholders, a continued information flow is being attempted by the project participants in parallel with the experimental work, thereby ensuring that the research is both context-driven and problem focused.

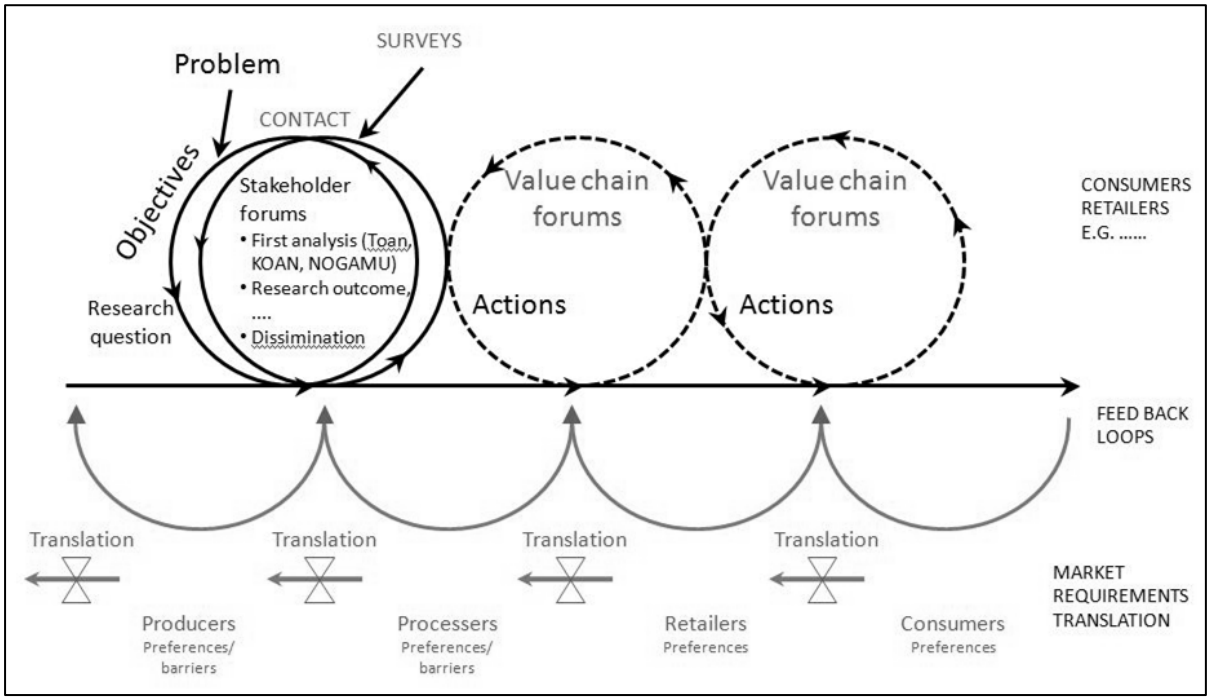


Figure 2: Illustration of information flows in participatory value chains research through feed-back loops, translations and stakeholder forums.

Discussion

Taking a participatory approach in MSc and PhD research projects and finding a balance between the academic requirements of the universities, scientific relevance, contextual complexities and the many facets of real-situation problems is a challenge for both students and supervisors. Some of the initial lessons learned are in brief:

- Value-chains based research is a challenge in the discipline oriented university environments as the problems investigated cuts across discipline boundaries.
- The perception of a participatory value-chains approach must be kept in mind through regular reminding exercises - researchers tend to be absorbed by their research questions and may forget to cross-check their temporary findings with stakeholder forums.
- The paradigms that most agricultural research institutions follow are still dominantly the productivity narrative, which makes it difficult to legitimize research that takes value chains aspects as quality attributes, consumer preferences, and chain governance into account.
- Academia has a long tradition for ways to merit research but how to merit research in value-chains development is yet to be established.

References

Bolwig, S., Ponte, S., du Toit, A., Riisgaard, L. and Halberg, N. (2010). Integrating Poverty and Environmental Concerns into Value Chain Analysis: A Conceptual Framework .Development Policy Review. 28 (2): 173-194.

Bolwig, S., Gibbon, P. and Jones, S. (2009). The Economics of Smallholder Organic Contract Farming in Tropical Africa. World Development 37 (6): 1094-1104.

Halberg, Niels, Sulser, Timothy B., Høgh-Jensen, Henning, Rosegrant, Mark W. and Knudsen, Marie Trydemann (2006a). The impact of organic farming on food security in a regional and global perspective, in Halberg, Niels, Alrøe, Hugo Fjeldsted, Knudsen, Marie Trydeman and Kristensen, Erik Steen, Eds. Global Development of Organic Agriculture: Challenges and Prospects. CABI Publishing

Halberg, Niels, Alrøe, Hugo Fjeldsted, Knudsen, Marie Trydeman and Kristensen, Erik Steen, Eds. (2006b) Global Development of Organic Agriculture: Challenges and Prospects. CABI Publishing.

Kline, S.J., and Rosenberg, N. (1986). An overview of innovation. In: The Positive Sum Stretegy (eds.: R. Landau and N. Rosenberg). National Academy Press, Washington DC. 275-205.

Pali, P.N., Freyer, B., Kaaria, S.K. and Delve, R.J. (2007). Human Capacity Development for Income Generation and Organic Market Linkages in Uganda. 9. Wissenschaftstagung Ökologischer Landbau. http://orgprints.org/9431/

Sultan, T., Mursal, A., Alem, S.G., Liu, Y., Oelofse, M., Knudsen, M.T., El-Araby, A., Delve, R.J., Yuhiu, Q., Hauser, M., Kledal, P., Egelyng, H., Halberg, N. and Høgh-Jensen, H. (2008). Market Integration Shape Organic Farmers Organisation. In: Cultivating the Future based on Science. Proceedings of the Second Scientific Conference of the International Society of Organic Agriculture Research (ISOFAR). 18-20 June 2008, Modena, Italy. 454-457.

Do living mulch based vegetable cropping systems yield similarly to the sole ones?

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Key words: organic farming, cauliflower, intercropping, yield quality, competition

Abstract

Ecological services may be exploited by use of living mulches in intercropping systems for production of vegetable crops. But may high yields be attained in intercropping systems for production of resource demanding crops such as cauliflower? In the frame of the InterVeg (Core Organic II) project, four field experiments were carried out in IT, SLO, DE and DK in order to study the effect of the living mulch introduction in cauliflower based cropping systems on crop yield and yield quality. The preliminary results, obtained after the first year project, showed yield and produces quality equal to those obtained in the sole cropping system if the system is properly managed (i.e. LM is late sown or its growth is controlled by root pruning).

Introduction

In living mulch (LM) systems a yielding crop is intercropped with one (or more) cover crop(s), introduced with the main aim to provide ecological services to the agro-ecosystem (Willey, 1990; Masiunas, 1998). While cover crop management is optimized to provide ecological services at field/farm level (i.e. weed, pest and diseases management contribution, pest control, nutrients leaching reduction, biodiversity conservation, etc.), competition between the yielding and the cover crop(s) should be managed in order to avoid yield losses (Hartwig and Ammon, 2002). Moreover, especially in cropping systems for vegetable production, yield quality detriment is also an issue. The *InterVeg* research project is studying the introduction of LM in vegetable crops in European environments. This paper reports the preliminary results obtained for cauliflower in four field experiments carried out during the first project year in IT, DK, SLO and DE. Yield and some selected yield quality parameters measured in living mulch and sole systems were compared to verify the hypothesis that the introduction and the proper management of living mulch do not reduce cauliflower yield and yield quality.

Material and methods

Experiment 1- Italy: the Experiment 1 was carried out at the Vegetable Research Unit of the Consiglio per la Ricerca e la Sperimentazione in Agricoltura (CRA-ORA) in Monsampolo del Tronto (AP), (latitude 42° 53' N, longitude 13° 48' E), along the coastal area of the Marche Region, Central Italy. In a strip plot experimental design with two factors (i.e. LM sowing time and crop cultivar) and three replicates, cauliflower (*Brassica oleracea* L. var. *botrytis*) was grown within August 2011 and January 2012 with Burr medic (*Medicago polimorpha* L. var *anglona*) used as living mulch. In this paper the effect of the first factor (LM sowing time) is discussed. Three treatments were compared: (i) control (no LM), (ii) living mulch early sowing (at cauliflower transplanting – es LM) and (iii) living mulch late sowing (three weeks delayed after cauliflower transplanting – ls LM).
Experiment 2 – Slovenia: the Experiment 2 was carried out at the University Agricultural Centre of the University of Maribor located in Pivola near Hoče (latitude 46°28′N, longitude 15°38′E), in Slovenia. In a randomized block experimental design with two factors (i.e. LM sowing time and crop cultivar) and three replicates, cauliflower was grown within June and October 2012 with white clover (*Trifolium repens* L.) as living mulch. In this paper the effect of the first factor (LM sowing time) is discussed. Three treatments were compared: (i) control (no LM), (ii) living mulch early sowing (at cauliflower transplanting – es LM) and (iii) living mulch late sowing (three weeks delayed after cauliflower transplanting - ls LM).
Experiment 3 – Denmark: the Experiment 3 was carried out at the Research Centre Aarslev, located at mid Funen (latitude 55°18´N, longitude 10°27´E) in Denmark. In a randomized block experimental design with three factors (i.e. LM presence, crop cultivar and N fertilization dose) and three replicates, cauliflower was

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grown within 31 May until harvest during the period 3-20 August 2012, and alternated with LM permanent strips according to a substitutive design (su LM), entailing a reduction of 1/3 of crop density. LM strips were root pruned at cauliflower transplanting. LM consisted of a overwintering mix of grass and legumes (*Trifolium repens* L., *Medicago lupulina* L. *Lolium perenne* L.). In this paper the effect of the first factor (LM presence) is discussed. Two treatments were compared, namely: (i) control (no LM) and (ii) living mulch (su LM).
Experiment 4 – Germany: the Experiment 4 was carried out at the Hessian State Estate Frankenhausen, located in Grebenstein (latitude 51°4'N, longitude 9°4'E), in Germany. In a randomized block experimental design with two factors (i.e. LM introduction strategy and crop cultivar) and three replicates, Cauliflower was grown within June and September 2012 intercropped with white clover (*Trifolium repens* L.). In this paper the effect of the first factor (LM introduction strategy) is discussed. Three treatments were compared, namely: (i) control (no LM), and (ii) living mulch introduced according to the additive approach (ad LM) and (iii) living mulch introduced according to the substitute approach (so LM), entailing a reduction of 1/3 of cauliflower density.
In all countries the no LM treatment was managed and weeded in accordance to the standard agronomic practices, commonly used by organic farmers in the area. In all the experiments, at cauliflower harvest total yield, marketable yield and size (diameter and weight of the cauliflower heads) were measured in accordance to local market standards.

Results

In the tables 1 to 4 the average values of cauliflower total yield, marketable yield, head diameter and weight are reported for the four experiments.
In the experiment 1 (IT, Table 1), the es LM treatment showed a significant reduction of all parameters compared to the control (no LM). This was due to the competition between the crop and the Burr medic since the beginning of the cauliflower cropping cycle. Also the presence of weeds (results not shown), which were not mechanically controlled and not suppressed by the LM, contributed to the reduction of crop yield and quality. On the other hand, the ls LM performed similarly to the no LM with regard to the marketable yield and head diameter. These findings were probably due to the reduced period of direct competition between cauliflower and LM.

Table 1 – Experiment 1 (IT)

Treatment	Total yield (Mkg ha^{-1})		Marketable yield (Mkg ha^{-1})		Head diameter (m)		Head weight (kg)	
no LM	21.2	a	19.4	A	0.135	a	0.62	a
es LM	6.1	c	4.0	B	0.054	b	0.21	c
ls LM	17.2	b	17.2	A	0.136	a	0.55	b

Note: no LM = sole crop system (control); es LM = LM additive system, sowing at cauliflower transplanting; ls LM = LM additive system, sowing delayed after cauliflower transplanting. The mean values in each column followed by a different letter are significantly different according to Duncan Multiple Range Test at the P≤0.05 probability level.

In the experiment 2 (SLO, Table 2), the cauliflower plants in the es LM strongly suffered from the competition by the LM and the weeds (not mechanically controlled, results not showed) and could not be harvested. As in the Italian experiment, the ls LM treatment yielded similarly to the control (no LM). Also the quality parameters measured showed lower but not statistically different values compared to the control.

Table 2 – Experiment 2 (SLO)

Treatment	Total yield (Mkg ha^{-1})	Marketable yield (Mkg ha^{-1})	Head diameter (m)	Head weight (kg)
no LM	28.8	11.9	0.126	0.74
es LM	-	-	-	-
ls LM	24.4	10.4	0.107	0.55

Note: no LM = sole crop system (control); es LM = LM additive system, sowing at cauliflower transplanting; ls LM = LM additive system, sowing delayed after cauliflower transplanting. The mean values in each column followed by a different letter are significantly different according to Duncan Multiple Range Test at the P≤0.05 probability level.

No significant differences for all the measured quality and quantity production parameters were observed between the two tested treatments in the Danish trial (Table 3). This was done after correction of the total yield and marketable yield values to take into account the reduced crop plant density in the substitutive system. These findings demonstrated that the introduction of opportunely managed permanent LM strips could be a valuable and feasible option for vegetable cropping system design and management.

Table 3 – Experiment 3 (DK)

Treatment	Total yield (Mkg ha^{-1})	Marketable yield (Mkg ha^{-1})	Head diameter (m)	Head weight (kg)
no LM	18.9	16.9	0.110	0.52
su LM	18.9*	17.0*	0.120	0.51

Note: * = results corrected to take into account the crop density difference between the compared systems; no LM = sole crop system (control); su LM = LM substitutive system; the mean values in each column followed by a different letter are significantly different according to LSD at the P≤0.05 probability level.

Table 4 – Experiment 4 (DE)

Treatment	Total yield (Mkg ha^{-1})		Marketable yield (Mkg ha^{-1})		Head diameter (m)	Head weight (kg)	
no LM	31.2	b	27.4		0.180	1.05	b
ad LM	33.6	b	26.5		0.190	1.14	b
su LM	38.3*	a	22.6*		0.190	1.29	a

Note: * = results corrected to take into account the crop density difference between the compared systems; no LM = sole crop system (control); ad LM = LM additive system; su LM = LM substitutive system; the mean values in each column followed by a different letter are significantly different according to Duncan Multiple Range Test at the P≤0.05 probability level.

No significant differences were found between the control (sole crop, no LM) and the additive LM treatment in experiment 4 (DE) (table 4). The substitutive LM system showed higher values for the total yield (if corrected to take into account the density difference to the control) and the head weight. The advantage of the substitutive system was probably determined by the lower number of cauliflower plants per area and the consequent lower intra species competition, which was apparently not made up by the inter species competition between the crop and the LM.
The bars in Fig. 1A represent the marketable yield percentage difference between the treatment (crop + LM) and its own control (sole crop, no LM system), measured in each experiment. Similarly, Fig. 1B shows the same for the head weight parameter. As far as marketable yield is concerned, not significant differences were observed in five cases out of seven, being the two cases with significant differences the es LM treatment in the Italian and the Slovenian experiments. In the same two treatments, head weight was

significantly lower. Conversely, the parameter showed a higher significant value in one case (experiment 4, DE, substitutive approach).

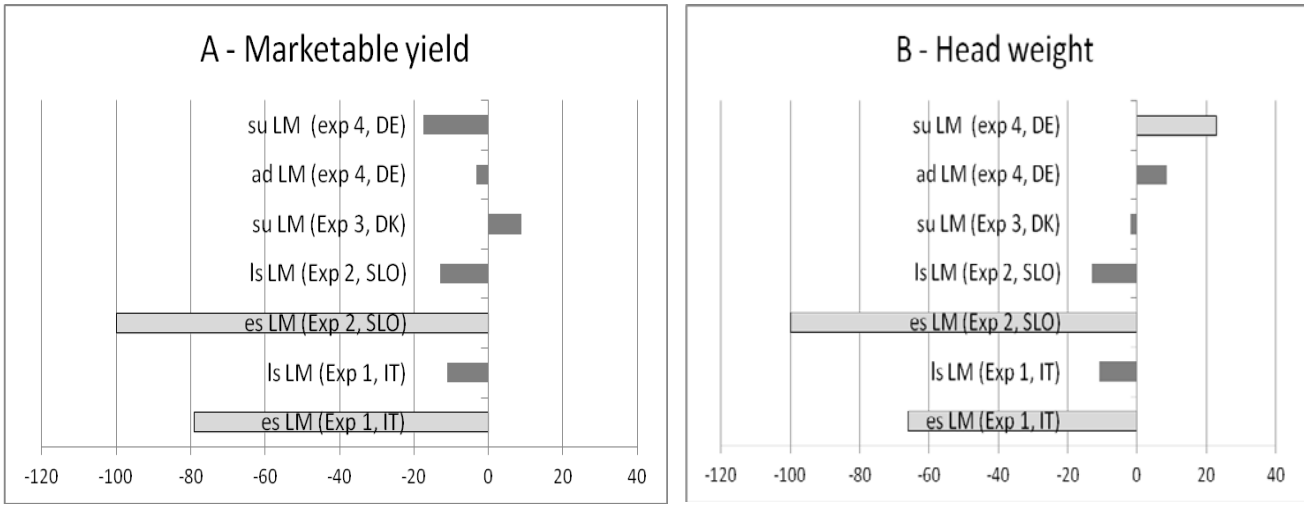


Figure 1. Marketable yield (A) and head weight (B) percentage difference between the treatment (crop + LM) and its own control (sole crop, no LM system). Note: light grey means significant differences between the treatment and its own control ($P \leq 0.05$); dark grey means no significant differences.

Conclusions

The results obtained indicated that the introduction of early sown LM (i.e. at crop transplanting) in cauliflower cropping systems reduces the yield and the yield quality. Conversely, if the LM was late sowed (i.e. 2 to 4 weeks after cauliflower transplanting, according to local conditions) no significant differences in yield and yield quality were observed. Moreover, our findings also indicated that the substitutive approach could be a valid agro-ecological approach if land area is not the main limiting factor in farming activities. The Danish experiment demonstrated that the introduction of opportunely managed permanent LM strips could be a feasible option for the design and management of vegetable intercropping systems. These results must be considered as preliminary, as they were obtained from a single year of field experiments.

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References

Hartwig, N.L., Ammon, H.L., 2002. Cover crops and living mulch. Weed Science 50, 688-699.
Masiunas, J.B., 1998. Production of vegetables using cover crop and living mulches - a review. Journal of Vegetable Crop Production 4, 11–31.
Willey, R.W., 1990. Resource use in intercropping system. Agric. Water Manage. 17, 215-231.

Extended lactation may improve cow health, productivity and reduce greenhouse gas emission from organic dairy cows

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Key words: extended lactation, dairy production, high-yielding, greenhouse gasses

Abstract

The concept of extended lactation should improve cow health and productivity while reducing greenhouse gas emissions per kg milk produced in high-yield organic dairy herds. This is achieved through fewer calvings per year and hence production of fewer replacement heifers. Combined with fewer days dry per cow per year, this will reduce the annual herd requirement for feed while maintaining milk production. This means average milk yield per feeding day (i.e. days lactating plus days dry) should remain the same. Cows will produce milk for the same number of lactations, and thus cows will have longer and more productive lives. Additionally, cow health may be improved as the majority of diseases occur around calving. An on-going project at Aarhus University aims at characterising those cows that can produce milk for an extended period of time, and those cows that cannot. Finally, the project will estimate the overall herd effect of this concept on farm economy and greenhouse gas emissions.

Introduction

Extended lactation is a break with the tradition of getting one calf per cow per year, which may improve cow health, productivity and reduce greenhouse gas emission per kg milk from high-yielding organic dairy production.

Extending the time between calvings will lead to fewer calvings per cow per year and thereby reduce the number of dry days per cow per year. Fewer calvings result in fewer replacement heifers, and thus feed use for young stock is reduced. Altogether, extended lactation leads to reduced feed use without reducing milk production per cow per year. Herd level feed use is a major determinant for greenhouse gas emission per kg milk (Kristensen et al., 2011).

Furthermore, 65% of all disease incidences occur around calving (Erb et al., 1984), and hence fewer calvings per cow per year should improve animal health, which may improve longevity.

The objective of this paper is to introduce the concept of extended lactation and show preliminary results of an on-going investigation.

Material and methods

Extended lactation has been practiced by a dozen private farmers in Denmark for several years, and a number of these are certified organic. Six of these have previously been described by van Vliet (2012), and four of them have been selected to be a part of an on-going investigation – the "Reprolac" project (http://agro.au.dk/en/ research/projects/reprolac/) – at Aarhus University in Denmark.

Three of these four private dairy farms are certified organic, and they all serve as case herds for the investigation of extended lactation as a management practice. Selected farm descriptive statistics are shown in Table 1.

Data used for analysing the effect of extended lactation were derived for each herd from the Danish cattle database. This study includes lactations where the cow had calved during 2009. Only lactations that had been completed by May 1st 2012, which means that the cow had had another calf, were included. Individual milk yields were determined over 24 hours six (herd 3, 4) and 11 (herd 1, 2) times per year, respectively.

Furthermore, the four Danish farmers practicing extended lactation were interviewed (van Vliet, 2012) about their experience with extended lactation, advantages and disadvantages,

In the on-going project, 'Reprolac', we will investigate the characteristics of cows that are able to produce milk for an extended period of time and those cows that are not along with the level of milk yield that these

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two groups of cows can produce. Furthermore, the project aims at investigating effects on herd dynamics, farm economics and greenhouse gas emissions from the farm.

Table 1: Herd descriptive statistics of involved, private dairy farms, 2009

Herd	1	2	3	4
System	Convent.	Organic	Organic	Organic
No of annual cows[a]	162	158	112	93
Breed[b]	Holstein	Cross	Jersey	Holstein
Kg ECM / annual cow[c]	11,274	7,669	7,090	10,099
Replacement rate, %	40	42	23	25
4th parity or older cows, %	12	19	22	13

[a]Annual cow - a cow fed for 365 days, which includes both lactation and dry period.
[b]The cross is between Jersey, Holstein and Red Danish.
[c]Average yield in kg energy corrected milk (ECM) per annual cow.

Results

Preliminary results of the Reprolac-project for calving interval (CI) and milk yield in the four herds are shown in Table 2. Mean CI varied from 14.2-17.0 months with a standard deviation of 1.5-3.5 months (43-109 days). Cows were able to produce 10,099-15,191 kg energy corrected milk (ECM) per lactation, which was equivalent to 20.8-31.3 kg ECM per feeding day. Total feeding days includes both days lactating and days dry. Milk yield at the last recording before drying off varied from 17.0-27.3 kg ECM with a standard deviation varying from 4.4-7.3 kg ECM.

Table 2: CI[a] and milk yield of completed lactations in the four herds

Herd	1	2	3	4
No of completed lactations	95	94	56	37
Mean CI, months	14.2	15.4	15.9	17.0
SD[b] of CI, days	84	43	109	95
Days milking / lactation	374	422	444	466
Days dry / lactation	60	48	42	52
Kg ECM[c] / lactation	13,579	10,387	10,099	15,191
Kg ECM / feeding day[d]	31.3	22.1	20.8	29.4
Kg ECM / lactation day	36.3	24.6	22.7	32.6
Yield at drying off[e], mean	27.3	17.0	19.5	22.0
Yield at drying off, SD	7.3	5.1	4.4	5.9

[a]Calving interval
[b]Standard deviation
[c]Energy corrected milk
[d]Feeding day = lactation + dry period
[e]Last milk recording before drying off day

In the interviews by (van Vliet (2012) one farmer noted (translated from Danish): “There is a greater chance that we will see a cow in heat, because the cow has multiple oestrus before it is inseminated”. Another believes that “to start inseminating 40 days calving is way too early” and stated that: “those cows that can, will get to wait with being inseminated”. Van Vliet (2012) states that “all the interviewed farmers believe that extended lactation gives several advantages, and therefore they will continue to practice it”.

Discussion

Results from the Reprolac-project indicate that it is possible to extend the calving interval, which is the same trend in recent extended lactation experiments in New Zealand (Kolver et al., 2007) and Australia (Grainger et al., 2009) where the calving interval was extended as much as two years. However, not all the cows were

able to produce milk for such long periods of time. One major aim of our project is therefore to characterise those cows, which can produce milk for an extended period of time and those that cannot as this is an important aspect of extended lactation.

This concept utilises the potential of each animal to reduce feed use for unproductive animals, and thus extended lactation could play a significant role in improving resource efficiency and reducing negative impacts on the climate and environment.

Furthermore, fewer calvings per cow per year and hence fewer risk periods could improve animal health, and thus potentially increase length of a cow's life.

Suggestions to tackle with the future challenges of organic animal husbandry

A holistic approach to organic animal husbandry research is necessary for improving the sustainability of animal production. A system with extended lactation will contribute to the aim of organic farming by improving animal welfare and health, improving resource efficiency and reducing negative impacts on the climate and environment.

Our results will provide a strong decision basis for farmers to adopt this concept and adapt it to their own farm.

References

Erb H N, Smith R D, Hillman R B, Powers P A, Smith M C, White M E, and Pearson E G (1984): Rates of diagnosis of six diseases of Holstein cows during 15-day and 21-day intervals. American Journal of Veterinary Research 45 (2), 333-335.

Grainger C, Auldist M J, O'Brien G, Macmillan K L, and Culley C (2009): Effect of type of diet and energy intake on milk production of Holstein-Friesian cows with extended lactations. Journal of Dairy Science 92(4), 1479-1492.

Kolver E S, Roche J R, Burke C R, Kay J K, and Aspin P W (2007): Extending Lactation in Pasture-Based Dairy Cows: I. Genotype and Diet Effect on Milk and Reproduction. Journal of Dairy Science 90(12), 5518-5530.

Kristensen T, Mogensen L, Knudsen M T, and Hermansen J E (2011): Effect of production system and farming strategy on greenhouse gas emissions from commercial dairy farms in a life cycle approach. Livestock Science 140 (1-3), 136-148.

van Vliet S (2012): Forlænget laktation hos malkekvæg. Effekt på ydelse, reproduktion og sundhed. Bachelor thesis. Aarhus University, Aarhus, Denmark, 40p.

Income and price as a barrier to organic food choice

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Key words: price, income, perception, barrier, review, children

Abstract

From the barriers said to potentially hamper the further development of the sector, the consumer demand side and herein the high prices are handled as crucial. We reviewed the literature since 2000 regarding the role of perceived price and income. We find that self-report based studies nearly unequivocally find price is the primary barrier to choice, deviations from this appear to occur when researching organic consumers and developed organic markets. There are mixed findings regarding income, but representative studies tend to indicate a significant influence. Number and age of children and income level are found to impact the influence of income on intention to or purchase of organic food.

Introduction

Despite considerable growth rates, organic farming is still practiced on only less than 1% of the world's agricultural land (Willer et al., 2013). Many national governments have defined goals for increasing the organic share in farming. In order to reach these goals, demand has to increase as well. The high price is often discussed as the crucial barrier (Padel, 2005; Jensen et al., 2011). Price, however, serves a double role, given that it is also used as a cue to quality (Völckner & Hoffmann 2007). Findings about the influence of income, assumed to be impacting the relevance of price, have been found to be mixed (Hughner et al. 2007). We aim to explore consumer behaviour research findings regarding organic food prices by reviewing the state of research. The following contribution focuses on the question of price as a barrier to purchase and the extent of the influence of income on organic food choice.

Material and methods

We searched databases such as organic e prints, Science Direct, Business Source Complete and Web of Science. The search terms used were 'organic', 'price' and 'consumer', in both title and abstract. We applied the following criteria for inclusion in the review: 1) research published between 2000 and 2013, given that roughly around that date, the market changed to a structure similar to the current (Aschemann et al., 2007; Hamm et al., 2002; Wier et al., 2008) so that results are relevant for today's situation, 2) studies conducted either in Europe or North America, given that these continuously represent advanced and comparable markets during the time frame (Willer et al., 2013), and 3) research included in English with the exception of German, given the sizable research on the specific issue at hand available only in German language.

Five research questions were phrased to be posed to the current state of knowledge, of which we focus on the following two: 1) How important is price as a perceived barrier to organic food choice? and 2) Which role plays income as an explanatory factor for purchase of organic food?

This approach resulted in 69 articles considered. Among these are reviews addressing the question of how organic consumers are characterised (Aertsens et al., 2009; Hughner et al., 2007), how consumers perceive or whether consumers prefer organic versus conventional food (Yiridoe et al., 2005) or which research has been done on organic consumer behaviour (Hamm et al., 2012), the remaining are research articles or reports.

Results

2.1 How important is price as a perceived barrier to organic food choice?

Arguing that perceived importance must be seen in relation to other factors, we focused on findings on a) self-reported importance of price in comparison to other barriers, or consumer elaborations that allow inferring on this comparison, and b) assessment of the influence of self-reported price perception of organic on self-reported or actual organic purchase behaviour in comparison to other factors.

With regard to a), most studies allow the conclusion that consumers express price to be the major barrier to purchase of organic food. However, some results appear to contradict. They indicate that availability

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(Fotopoulos & Krystallis, 2002), lack of information or identification (Zakowska-Biemans, 2011), taste and appearance (Hamm & Buder, 2011) and poor assortment (Jensen et al., 2011) can be overriding price as major barrier.

With regard to b), five studies find that expressing price to be a major barrier (Soil Association, 2004), the perception of organic food prices being high or expensive (Verhoef, 2005; Briz & Ward, 2009), price orientation (Zagata, 2012) or perceived importance of price for food shopping (Padilla Bravo et al., 2013) negatively influence frequency or self-reported or actual purchase.

2.2 Which role plays income as an explanatory factor for purchase of organic food?

We included findings on a) influence of income level on stated preference surveyed as self-reported intentions, purchase or willingness-to-pay, and b) influence of income on revealed preferences (panel or scanner data) observed as organic purchase, frequency and budget share.

With regard to a), nine studies indicate that income is positively explaining stated preference for organic. However, equally many are counted that do not find significant results for the income variable. Six studies report mixed findings or find income significant in one, but not in the other country. With regard to b), five studies find a significant effect and five do not, with two reporting mixed results.

We explored possible patterns between the studies. Contrary to conclusions from Aertsens et al (2009), no differences are observed for the US versus Europe. Also, no clear results can be found for income relevance being dependent on the product category studied (e.g. milk). A further possible explanation is the methodology applied. It appears that studies with (fairly) representative data tend to find a significant influence of income (e.g. Fotopoulos & Krystallis, 2002; Padilla Bravo et al., 2013; van Loo et al., 2011; Bartels & Reinders, 2010).

Furthermore, number and age of children in the household are of relevance – believed to be grounded in income constraints. It is found that the likelihood of organic purchase is lower for households with children (van Loo et al., 2011; Zepeda & Li, 2007; Loureiro & Hine, 2002; Jonas & Roosen, 2008), especially, though, with older and a higher number children (Schröck, 2011; Wier et al., 2008).

Quite a number of studies highlight that sociodemographics lack in explanatory power (Bartels & Reinders, 2010; Zakowska-Biemans, 2011; Michels & Hamm, 2010; Gracia & Magistris, 2008) and that they fall behind psychographics such as attitudes and lifestyle (Aertsens et al., 2009; Padilla Bravo et al., 2013; Tranter et al., 2009). Lastly, studies report interesting findings on how income level influences organic purchase behaviour, e.g. that income exerts an influence only unto a certain level (Yridoe et al. 2005), for the lowest income group (Buder, 2011) or only in terms of trying organic, but not considerably buying (Dettmann & Dimitri, 2009).

Discussion

Based on the literature described above, we conclude that price clearly is a major perceived barrier to organic purchase. This does, however, not show in an equally unequivocal significance of income, where findings are mixed, although tending to show a positive influence. Factors such as children, income level and psychographics are major variables influencing the relation.

The findings imply that marketing efforts should focus on decreasing the high price perception, while pricing and price-value communication strategies might target the low income groups and families with children differently.

References

Aertsens, J., Verbeke, W., Mondelaers, K., & van Huylenbroeck, G. (2009). Personal determinants of organic food consumption: a review. British Food Journal, 111(10), 1140–1167.

Aschemann, J., Hamm, U., Naspetti, S., & Zanoli, R. (2007). The organic market. In W. Lockeretz (Ed.), Organic Farming - An international history. Wallingford: CABI.

Bartels, J., & Reinders, M. J. (2010). Social identification, social representations, and consumer innovativeness in an organic food context: A cross-national comparison. Food Quality and Preference, 21(4), 347–352.

Briz, T., & Ward, R. W. (2009). Consumer awareness of organic products in Spain: An application of multinominal logit models. Food Policy, 34(3), 295–304.

Buder, F. (2011). Das Kaufverhalten bei Öko-Lebensmitteln. Kausalanalytische Untersuchung der Determinanten der Nachfrage nach ökologisch erzeugten Lebensmitteln. Hamburg: Dr. Kovac.

Dettmann, R. L., & Dimitri, C. (2009). Who's Buying Organic Vegetables? Demographic Characteristics of U.S. Consumers. Journal of Food Products Marketing, 16(1), 79–91.

Fotopoulos, C., & Krystallis A. (2002). Organic product avoidance: reasons for rejection and potential buyers identification in a countrywide survey. British Food Journal, 104(9), 233–260.

Gracia, A., & Magistris, T. de (2008). The demand for organic foods in the South of Italy: A discrete choice model. Food Policy, 33(5), 386–396.

Hamm, U., & Buder, F. (2011). Dynamik des Kaufverhaltens im Bio-Sortiment. Witzenhausen, http://orgprints.org/15931/.

Hamm, U., Gronefeld, F., & Halpin, D. (2002). Analysis of the european market for organic food. University of Wales, Aberystwyth.

Hamm, U., Hemmerling, Sarah, Schleenbecker, Rosa, Spiller, A., Wägeli, S., Cordts, A., Hermann, I., et al. (2012). Consumer purchase and consumption behaviour regarding organic food. Analysis of the state of the art. http://www.orgprints.org/20055/.

Hughner, R. S., McDonagh, P., Prothero, A., Shultz, C. J., & Stanton, J. (2007). Who are organic food consumers? A compilation and review of why people purchase organic food. Journal of Consumer Behaviour, 6(2-3), 94-110.

Jensen, K. O., Denver, S., & Zanoli, R. (2011). Actual and potential development of consumer demand on the organic food market in Europe. NJAS - Wageningen Journal of Life Sciences, 58(3-4), 79–84.

Jonas, A., & Roosen, J. (2008). Demand for milk labels in Germany: organic milk, conventional brands, and retail labels. Agribusiness, 24(2), 192–206.

Loureiro, M., & Hine, S. (2002). A comparison of consumer willingness to pay for a local (Colorado-grown), organic, and GMO-free product. Journal of Agricultural & Applied Economics, 34(3), 477–487.

Michels, P., & Hamm, U. (2010). Dynamik des Kaufverhaltens im Bio-Sortiment. ZMP GmbH and University of Kassel, http://orgprints.org/16983/.

Padel, S. a. M. P. (2005). The development of the European market for organic products: insights from a Delphi study. British Food Journal, 107(8), 636.

Padilla Bravo, C., Cordts, A., Schulze, B., & Spiller, A. (2013). Assessing determinants of organic food consumption using data from the German National Nutrition Survey II. Food Quality and Preference, 28(1), 60–70.

Schröck, R. (2011). A demand system analysis of organic and conventional fresh milk in Germany segmented by consumer groups. EAAE congress, 2011, Zurich.

Soil Association (2004). Organic Food: Understanding the consumer and increasing sales. http://orgprints.org/10858/.

Tranter, R., Bennett, R., Costa, L., Cowan, C., Holt, G., Jones, P., et al. (2009). Consumers' willingness-to-pay for organic conversion-grade food: Evidence from five EU countries. Food Policy, 34(3), 287–294.

van Loo, E. J., Caputo, V., Nayga, R. M., Meullenet, J.-F., & Ricke, S. C. (2011). Consumers' willingness to pay for organic chicken breast: Evidence from choice experiment. Food Quality and Preference, 22(7), 603–613.

Verhoef, P. (2005). Explaining purchases of organic meat by Dutch consumers. European Review of Agricultural Economics, 32, 245–267.

Völckner, F., & Hofmann, J. (2007). The price-perceived quality relationship: A meta-analytic review and assessment of its determinants. Marketing Letters, 18(3), 181–196.

Wier, M., O´Doherty Jensen, K., Andersen, L. M., & Millock, K. (2008). The character of demand in mature organic food markets: Great Britain and Denmark compared. Food Policy, 33(5), 406–421.

Willer, H., Lernoud, J., & Kilcher, L. (2013). The World of Organic Agriculture, Statistics and Emerging Trends 2013. Frick, Bonn.

Yiridoe, E. K., Bonti-Ankomah, S., & Martin, R. C. (2005). Comparison of consumer perceptions and preference toward organic versus conventionally produced foods. Renewable Agriculture and Food Systems, 20(04), 193–205.

Zagata, L. (2012). Consumers' beliefs and behavioural intentions towards organic food. Evidence from the Czech Republic. Appetite, 59(1), 81–89.

Zakowska-Biemans, S. (2011). Polish consumer food choices and beliefs about organic food. British Food Journal, 113(1), 122–137.

Zepeda, L., & Li, J. (2007). Characteristics of organic food shoppers. Journal of Agricultural Applied Economics, 39(1), 17–28

Cost and energy evaluation of organic cauliflower in sole crop and living mulch systems

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Key words: energy consumption, human labor, agroecological technique, environmental assessment.

Abstract

This paper presents the findings of an assessment aimed to evaluate, in term of cost and energy consumption, the introduction of living mulch in different organic vegetable systems producing cauliflower. The study was carried out in three European countries (IT, SLO and DK) in the frame of the InterVeg project (Core Organic II). The achievements demonstrated that, in economic terms, farmers' choice of a specific technique, like living mulch instead of sole cropping, can be influenced by two key elements: human labor and fossil fuel consumption. Different organic systems have a different proportion in using the two inputs depending on the specific farm strategy.

Introduction

Cost and energy consumption have important roles when assessing an agro-ecological technique. Their increase or decrease can strongly influence the farmers' decision in choosing a specific technique for both economic and environmental reasons. The literature already provides evidence on the ability of living mulch (LM) to reduce the use of pesticides and fertilizers contributing in the reduction of pest population, soil erosion and weed pressure, and the increase of soil organic matter and nitrogen conservation (Hartwig and Ammon, 2002). These features make LM an interesting tool in organic farming systems. However, the application at farm level is often constrained because farmers perceive the living mulch as a costly technique. This paper presents the findings of an assessment aimed to evaluate, in terms of cost and energy consumption, three different organic vegetable systems located in three European countries.

Material and methods

Within the InterVeg research project, in the season 2011-2012, three different organic cropping systems were set up to produce organic cauliflowers in Italy, Slovenia and Denmark. For details about the experimental sites and layouts see Canali et al. (in this book of proceedings). The 3 locations were different for climate, soil characteristics, management practices and socio economic conditions. Data about energy consumption and costs were collected in each experimental site following a similar standardized procedure. In detail, during the cauliflower cropping cycle, all the field operations were recorded and the consumption of energy (fossil fuel and human power) calculated in each site. In order to emphasize similarities and differences among the sites, the list of field operations was assessed and a common operation list was set up. Moreover, since the main aim of the study was to look at the elements that can influence the decision makers in the application of the LM technique, neither the energy embedded in the machinery, which represents a fixed cost, or the differences in the type of human labor, depending on the worker gender and on the type of work done were not taken into account (Giampietro and Pimentel, 1990). Many conversion factors to MJ are available for both fuel and human power. The energy equivalent of human power used was 2.3 MJ unit-1 (Ozkan et al.2004) and of 47.8 MJ kg-1 for diesel (Ortiz-Cañavate and Hernanz 1999). The unitary cost of fuel in the different Countries was used in order to calculate the cost. They were: 1.36/1.38/1.46 € l-1 for Slovenia, Italy and Denmark, respectively. Higher differences were observed for labor cost, which were: 5.2/11.9/22.0 € h-1 for Slovenia, Italy and Denmark, respectively.

Results

The energy consumption resulted for around 80% due to the fossil fuel and for a minor part to human power, in each system. This can easily be explained by the higher cost of work in developed countries compared to more traditional societies where the human power is part of the family and the investments for machineries

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are less available (Giampietro and Pimentel, 1990). In the Italian system the fossil fuel reached 90% of the total energy consumption, while in Slovenia and Denmark it was 85%. However, looking in absolute terms, the total fuel consumption in Denmark was twice that in Italy and Slovenia. This should be explained considering that the Danish system had the higher labor cost of the three systems. Slovenia had a lower consumption of fossil fuel energy than Italy, because of the larger consumption of human power. Results reported in Table 1 show an increase in the use of human power in the LM treatment with compared to the sole crop one in both the Italian and Danish systems, while an opposite trend occurred in Slovenia.

Table 1: Human power employed for organic cauliflower cultivation (MJ ha^{-1}).

Field Operations	IT				SLO				DK			
	Sole Crop		LM		Sole Crop		LM		Sole Crop		LM	
	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%
Soil tillage	18	2	18	2	11	1	11	1	121	5	121	4
Sowing at/after trans	0	0	253	24	0	0	2	0	0	0	2	0
Root cutting	0	0	0	0	0	0	0	0	0	0	46	2
Transplanting	232	29	232	22	173	13	173	13	299	11	299	11
Hoeing	30	4	15	1	221	16	106	8	414	15	414	15
Spray irrigation	92	11	92	9	25	2	25	2	86	3	86	3
Fertilizer application	33	4	33	3	6	0	6	0	46	2	46	2
Spraying/insect net	55	7	55	5	7	1	7	1	69	3	69	3
Harvesting-threshing	334	41	334	32	874	65	955	73	1553	58	1553	57
Transportation	12	1	12	1	21	2	22	2	35	1	35	1
Chopping residues	7	1	7	1	5	0	5	0	58	2	58	2
Total	813		1051		1341		1310		2680		2728	

In fact, the Slovenian sole crop system used hand hoeing instead of mechanical weeding and, consequently, the introduction of LM allowed reducing about 50% of work. The Italian system made the opposite choice: the shift from sole crop to LM system reduced mechanical weeding introducing LM, which was sown manually (Table 1). In the Danish experiment the larger difference between the sole crop and the LM systems occurred because of the introduction of two additional mechanical operations (i.e. LM sowing and root cutting) without any other change. On the other hand, the Slovenian LM system increased the use of machinery in the mechanical sowing (Table 2).

Table 2. Fuel energy consumption for organic cauliflower cultivation (MJ ha^{-1}).

Field Operations	IT				SLO				DK			
	Sole Crop		LM		Sole Crop		LM		Sole Crop		LM	
	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%
Soil tillage	2803	43	2803	44	1741	27	1741	28	5891	46	5891	39
Sowing at/after trans	0	0	0	0	0	0	89	1	0	0	406	3
Root cutting	0	0	0	0	0	0	0	0	0	0	2032	13
Transplanting	130	2	130	2	2032	31	2032	33	1016	8	1016	7
Hoeing	266	4	133	2	488	7	81	1	894	7	894	6
Spray irrigation	0	0	0	0	358	5	349	6	203	2	203	1
Fertilizer application	329	5	329	5	203	3	203	3	813	6	813	5
Spraying/insect net	1495	23	1495	24	244	4	244	4	0	0	0	0
Harvesting-threshing	0	0	0	0	0	0	0	0	406	3	406	3
Transportation	650	10	650	10	731	11	772	12	1097	9	1097	7
Chopping residues	781	12	781	12	731	11	733	12	2438	19	2438	16
Total	6454		6321		6527		6244		12758		15196	

Field operations contributed differently to the energy consumption in the three systems (Table 3). The field

operation, which required the largest amount of fuel energy, was the soil tillage and the transplanting bed preparation. However, in the case of Slovenia, the transplanting had the highest energy consumption, close to 30% of the total. Therefore, a study focused to reduce the consumption of this specific operation would relevantly contribute to increase to overall energy use efficiency of the system.
The Danish system had the best distribution of energy consumption among different field operations and, excluding the soil tillage; the other operations were never contributing for more than 15% to the total amount of energy. This indicates that further improvement of energy efficiency of a specific operation is not required.

Table 3. Total energy consumption for organic cauliflower cultivation (MJ ha^{-1}).

Field Operations	IT				SLO				DK			
	Sole Crop		LM		Sole Crop		LM		Sole Crop		LM	
	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%	MJ	%
Soil tillage	2821	39	2821	38	1752	22	1752	23	6012	39	6012	34
Sowing at/after trans	0	0	253	3	0	0	92	1	0	0	409	2
Root cutting	0	0	0	0	0	0	0	0	0	0	2078	12
Transplanting	362	5	362	5	2204	28	2204	29	1315	9	1315	7
Hoeing	296	4	148	2	708	9	187	2	1308	8	1308	7
Spray irrigation	92	1	92	1	382	5	374	5	289	2	289	2
Fertilizer application	363	5	363	5	874	11	955	13	1959	13	1959	11
Spraying/insect net	1550	21	1550	21	251	3	251	3	69	0	69	0
Harvesting-threshing	334	5	334	5	874	11	955	13	1959	13	1959	11
Transportation	662	9	662	9	752	10	794	11	1132	7	1132	6
Chopping residues	788	11	788	11	736	9	737	10	2495	16	2495	14
Total	7267		7372		7868		7554		15437		17923	

Hoeing had the higher fossil fuel consumption in Denmark than the other two systems, however the use of pesticides, allowed in organic farming, is the second field operation in term of fossil fuel consumption for the Italian system. The use of insect net instead of spraying in the Danish system, allows a significant reduction of energy consumption in this operation, with a little increase of human power for net management. This could represent an interesting result for the Italian system. However, as far as the costs are concerned (Table 4), the higher difference in total cost was obtained in the Italian system. In this case the human labor, which represents the highest cost input, is increased in the LM system, with a decrease of the fossil energy used.

Table 4. Total cost for organic cauliflower cultivation (€ ha^{-1}).

Field Operations	IT				SLO				DK			
	Sole Crop		LM		Sole Crop		LM		Sole Crop		LM	
	€	%	€	%	€	%	€	%	€	%	€	%
Soil tillage	188	4	188	3	82	3	82	3	1367	5	1367	5
Sowing at/after trans	0	0	1309	23	0	0	5	0	0	0	37	0
Root cutting	0	0	0	0	0	0	0	0	0	0	513	2
Transplanting	1206	27	1206	21	455	14	455	14	2897	11	2897	11
Hoeing	165	4	89	2	512	16	257	8	3992	15	3992	15
Spray irrigation	474	11	474	8	68	2	70	2	832	3	832	3
Fertilizer application	184	4	184	3	20	1	20	1	469	2	469	2
Spraying/insect net	336	8	336	6	24	1	24	1	660	3	6660	2
Harvesting-threshing	1726	39	1726	31	1961	61	2141	68	14865	57	14865	56
Transportation	82	2	82	1	71	2	78	2	369	1	369	1
Chopping residues	63	1	63	1	35	1	39	1	638	2	638	2
Total Costs	4423		5656		3226		3171		26088		26638	

The substitution of fossil fuel with human power has a positive effect for social welfare both for environmental concerns and employment levels. The Slovenian system reduced the use of labor even if resulting in a small difference in total costs due to the low cost of labor in the country. On the other hand Denmark had an increase in costs due to the cost of root-cutting included in the LM system.

Conclusions

This study highlighted different effects on cost and energy consumption, depending on socio economic conditions and agricultural systems in which the LM system substituted the sole crop one. In the three studied systems, the introduction of LM determined a difference in total energy consumption ranging from +14 to -4% and a cost difference ranging between +22 and -2%. Moreover, the use of LM determined the change in proportion between human power and fossil fuel energy consumption. These findings have to be considered together with the yield results and in a social perspective in the specific local context where the LM is introduced.

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References

Ozkan, B. Kurklu, A. Akcaoz, H. (2004). An input–output energy analysis in greenhouse vegetable production: a case study for Antalya region of Turkey. in Biomass and Bioenergy, 26 (1), 89–95.

Ortiz-Cañavate, J.,Hernanz, J.L. (1999). Energy analysis and saving. CIGR Handbook of agricultural engineering 5, 13–42.

Giampietro, M., Pimentel, D., (1990). Assessment of the energetics of human labor. Agriculture, Ecosystems & Environment 32, 257–272.

Hartwig, N.L., H.U. Ammon. (2002). Cover crops and living mulches. Weed Science. 50, 688–699.

Facilitating grazing for organic dairy farms with expanding herd size

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Key words: Grazing, Dairy farming, gates, sensors, logistics.

Abstract

Maximized grazing, in time and amount, must be the primary aim for organic animal management. Herd sizes have been expanding the last years, and automatic milking is being used in around 10% of the organic herds in Denmark. Limited acreage for grazing and desire for optimum feeding, makes the desire for the farm manager to control grass offer in the field and grass intake of the herd even more acute. Research with controlled logistics, intelligent gates, and sensors for estimation of grazing time, have shown promising results.

Introduction

Organic dairy farming is inseparably connected with grazing. One of the key objectives and core indicators for sustainability is to respect the animals' natural behaviour (SAFA 2013), and on this issue there is no doubt that the dairy cow is a grazing animal. Of course organic dairy farmers have to answer to the call for increasing production volume and continuity of delivery; therefore seasonal calving is mostly omitted, and barn feeding with supplements and concentrates is required in countries with no winter growth. However, maximized grazing, in time and amount, together with loose housing using straw or biomass matrasses for the winter periods, must be the primary aim for organic animal management. Farm and herd sizes have been expanding the last years due to increase of automation and mechanization, and rising labour costs. In Denmark the average herd size for organic herds has increased dramatically. (Tab. 1)

Table 1. Organic dairy farms statistics in Denmark

	2003	2009	2010	2011	2012	2013
Amount of org. dairy farms in DK	636	399	422	417	409	392
Milk delivery (1000 t)	434	453	478	490	499	505
Average delivery pr. farm (t)	682	1135	1133	1175	1220	1288
Average herd size (nr.)	85	126	126	131	136	143

Often the farm structure (fields surrounding the farm buildings and milking parlour), was destroyed by expanding farm size. Remote fields are not usable for grazing dairy cows, but used for cut and carry regimes or grazed by heifers and dry cows. The fields that are in reach of the milking herd are limited, and lack of land in the proximity is sometimes reason for the organic dairy farm to strive for further expansion. If all fields were ideally distributed in the near surroundings of the barns and 50% of the fields could be used for grazing (with 0.5 ha per cow), an average farm in 2013 would need about 150 ha adjacent to the farm. If herds should expand further, the distance from barn to fields would exceed one km. For normal batch milking in milking parlours or carousels this is not an insuperable problem, but for farms with automatic milking (AMS), this is problematic. The gregarious character of the cattle and the distance to the AMS hampers cows to visit the AMS voluntarily on individual basis (Ketelaar-De Lauwere, 2000). In addition, limited acreage makes the desire for the farm manager to control grass offer in the field and grass intake of the herd even more acute.

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Material and methods

During the last five years (2008-2013) Danish researchers together with the extension services and organic dairy farmers, have investigated the possibilities to facilitate the farms with innovative technology and design, with the aim of improving grazing and grazing management (technology for grazing). The projects have been financed by the Danish agricultural department and Danish Dairy. In the following article we describe some of the results.

Results

Logistics and walkway stabilizers

By actively involving farmers and their experiences, some interesting best practice suggestions came forward. One of the comments obtained, was that cows have the habit of remembering unpleasant experiences associated with logistics. Permanent and robust cow tracks, attractive openings and gates to fields, open water troughs and easily accessible entrances to the barn, greatly improved cow traffic. Cow tracks can be a source of nuisance if they become muddy, slippery or impassable; hoof sours and starting inflammatory and contagious diseases can occur.
Different kinds of coverage materials were tried out in experiments, permanent concrete or asphalt, removable plastic grids, and recycled rubber mining belts have been implemented. All materials greatly improved the walkability but needed a good foundation of sand and gravel, as well as drainage. Removable material was cheaper per square meter and can be used in other fields, when field rotation is practiced. Rubber belts could be slippery in wet weather, and should be kept sand-covered

Intelligent gates

Gates to the fields and gates from barn to field can easily be made intelligent. One-way gates to secure traffic in the desired direction, timer connected one-way gates to open automatically (Fig 1), and gates in the field that can direct the herd two or three ways as preferred (Fig 2), have been tested. In combination with RFID tags the latter two or three way gate could direct the cows individually.



Figure 1. Timer connected gate.



Figure 2. Selection gate.

RFID to register cows' behaviour
Cows in Denmark are being equipped with RFID tags in the left ear. Antennas to register the RFID tags can be programmed to register time of contact, and store the information or send it real-time to the herd manager.
The information can be used to register time spent outside when the antennas are installed close to the entrance (Fig 3), and from this information grazing time can be controlled. Especially in situations where herd managers were in doubt if the herd or specific animals had been outside long enough, the information was found to be valuable.



Figure 3. Gates with RFID scanner

Sensors for measuring cow behaviour
Different sensors can be used for measuring cow behaviour. Most of them are utilized with accelerometers. They register movement and can, by use of developed algorithms, translate these movements to key indicators (e.g. standing, walking, or grazing, Fig 4). The algorithms should be calibrated for different races and grass heights and can, although crudely, give information on grass intake. By increasing the measuring frequency of the accelerometers, grass intake can be estimated more accurately (Oudshoorn et al., 2013). More efficient supplement feeding and concentrates supply can be the result.

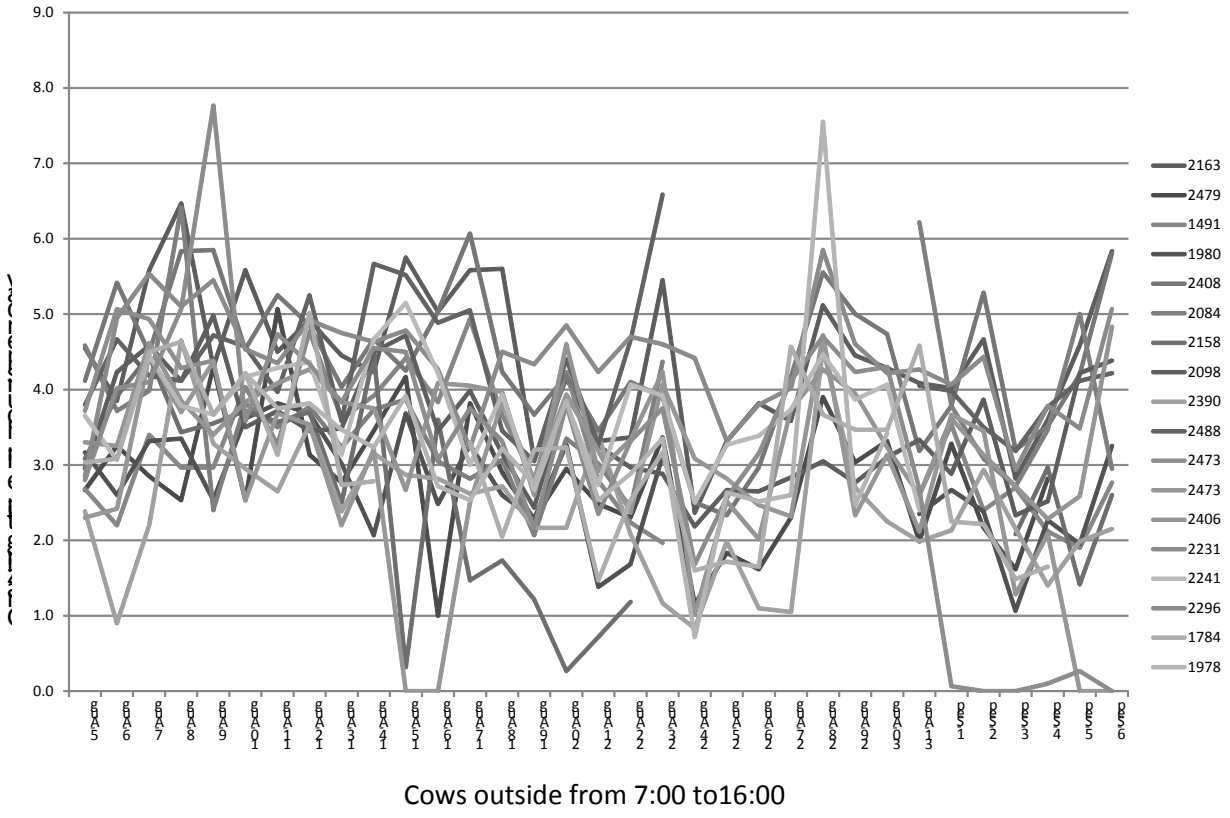


Figure 4. Information on individual grazing time per day for 18 cows.

Conclusions

Organic dairy farming can and is interested in using innovative technology. Best practice management experiences for improving grazing results in larger herds and herds with AMS should be extended by farm schools. Wireless contact to gates and sensors attached individually to cows' halters could save labour and increase feeding efficiency.

References

Ketelaar-de Lauwere, C.C. Ipema, A.H., Lokhorst, C. ,Metz, J.H.M., Noordhuizen, J.P.T.M., Schouten, W.G.P. , Smits, A.C. 2000. Effect of sward height and distance between pasture and barn on cows' visits to an automatic milking system and other behaviour. Livestock Production Science , 65 131–142.

Oudshoorn, F.W., Cornou, C., Helwing, A.L.F., Hansen, H.H., Munksgaard, L., Lund, P., Kristensen, T. 2013. Estimation of grass intake on pasture for dairy cows using tightly and loosely mounted di- and tri-axial accelerometers combined with bite count. Computers and Electronics in Agriculture 99 (2013) 227–235.

SAFA , Sustainability Assessment of Food and Agricultural Systems, version 2.0. July 2013. Visited 08-01-2014 on http://www.fao.org/ .

How to improve end-users' use of research results

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Key words: dissemination, organic farming, research results

Abstract

There is a gap between the provision of agricultural research results and the application of innovative approaches in practical farming. Based on a questionnaire investigation in 18 European countries this study aims to contribute to identification of appropriate ways for disseminating research results to end-users and stakeholders, and to give better guidance to researchers on how best to plan and disseminate their results in relation to the needs of the end-users and stakeholders.

Introduction

There is a gap between the provision of agricultural research results and the application of innovative approaches in practical farming. New research based knowledge does not, or takes too long time to reach the farmers, and the needs of farmers and the food industry are not sufficiently communicated to the scientific community. Therefore, there is an increasing need to fill this gap.

The overall objective of this study, carried out under the FP7 ERA-net project, *CORE Organic II* in 2013, is to contribute to the identification of appropriate ways for disseminating organic research results to stakeholders and end users on a national and transnational level across Europe in order to increase the use of the results in practice. Another objective is to give better guidance to researchers on how best to plan and disseminate their research in relation to the needs of relevant stakeholders and end-users.

Material and methods

A questionnaire interview study was carried out in 18 partner countries of the CORE Organic II project, i.e. Austria, Belgium (Flandern region), Denmark, Estonia, Finland, France, Germany, Italy, Latvia, Lithuania, the Netherlands, Norway, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. A list with contact details on the most important stakeholder organisations and key contact persons was drawn up with the assistance of the CORE Organic partners and key persons in each country.

A questionnaire of 17 questions was elaborated to identify: 1) Present use of tools for searching of research results; 2) Most important obstacles for dissemination and practical implementation of research results; 3) Most used tools and ways of disseminating research results to end-users; 4) Good examples of dissemination of research results; 5) Studies on implementation of organic research results by end-users; 6) Recommendations for planning of research; 7) Recommendations for improvement of research dissemination to end-users; and 8) Recommendations on tools and ways for dissemination of research results on a transnational level.

The comments collected from each country were compiled in an excel workbook and analysed country by country in relation to the 8 above mentioned subjects.

Results

The number of relevant organisations in each country varied considerably and so did the number of respondents per country (from 1 up to 10). Below are presented the most important results.

1. Present use of tools for searching of research results

The most used tool is the Internet, and the international databases mentioned most often are Google (incl. Google Scholar) and Organic Eprints. Other international websites used are the Web of Science/Web of Knowledge, IFOAM and ISOFAR. National magazines and farmer newspapers were also considered important sources.

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2. Most important obstacles for dissemination and practical implementation of research results

Main obstacles mentioned by the respondents are:

- Scientific papers are not suited for implementation in practice because researchers don't see the results in the context of the users. Besides, they often deal with isolated problems and they are not very concrete due to scientific precaution.
- Language is a barrier in two ways: The scientific language is difficult to understand for non-scientists, and the results may only be available in a foreign language.
- Universities and researchers are not rewarded for popularization of research results, and researchers may not have the communication skills needed, while advisors do not have time and money for searching and 'translating' research results into ready to use information for farmers.
- There are too many different channels, through which knowledge is transmitted.
- Researchers are not enough aware of the needs of end-users, when they plan their research projects, and farmers are not always good to take up new research results.

3. Most used tools and ways for dissemination of research results to end-users

Written communication is most used, and most used tools are webpages, databases and electronic newsletters. Oral communication is used for dissemination in training courses, field demonstrations and conferences etc. In some countries new ICT tools like videos, smartphone apps and e-learning are being developed, which may give end-users much easier access to the information they need at the time they need it.

4. Good examples for dissemination of research results

Most of the good dissemination examples mentioned were projects carried out at the regional/national level, where there is no language barrier. They fell in four categories:

- Research projects with close cooperation between end-users, advisors and researchers, e.g. on-farm research, participatory research and farm schools.
- Meetings/seminars, workshops etc. with direct communication between researchers, advisors and end-users.
- Research results that are highly needed and directly applicable, e.g. plant variety testing, guidelines / handbooks on various issues, e.g. animal welfare.
- Demonstrations, e.g. field testing of different machinery for weeding, long term rotation experiments comparing yields in relation to different rotations, treatments, applications and catch crops etc.

5. Studies on implementation of organic research results by end-users

Only few systematic studies on the uptake of organic research results by end-users were mentioned. More comprehensive national studies have been or are in the process of being carried out in Denmark, France, Germany, Norway and Sweden.[3]

6. Recommendations for planning of research

The respondents generally found it of utmost importance that the relevant user groups are involved right from the formulation of research project needs (research programmes) to the planning, conducting and dissemination of the research, in order to ensure proximity to practice. It was also suggested that representatives from the target groups should be involved in the evaluation of research projects, which is usually not the case, because the main evaluation criterion is the scientific quality of the research. More participatory and on-farm research with a system approach, closer collaboration between advisors and researchers and obligatory inclusion of a plan for transformation of research results into 'ready to use' information already in the research project proposal were also recommended. As regards which type of users to include, the general response was that it depends on the subject of the project, but it also depends on how the farmers' learning is organised in the country. It was also mentioned that support to end-users' engagement in research projects throughout the lifetime of such projects is necessary for their proper involvement.

[3] Denmark: http://www.icrofs.org/Pages/Publications/knowledge_syntheses.html
France: VALOMIEUX: http://www.itab.asso.fr/programmes/valomieux.php
Germany: http://orgprints.org/21871/1/BOEL_food%20quality%20and%20processing_2012.pdf
Norway: http://www.forskningsradet.no/no/Artikkel/Evaluering_av_norsk_okologisk_landbruks- landbruks forskning/%201253952178268
Sweden: http://www.slu.se/Documents/externwebben/centrumbildningar-projekt/ekoforsk/-Startsida/Evalutation%20of%20Research%202006.pdf

7. Recommendations for improvement of research dissemination to end-users

There was general agreement that presentation of results to end-users should be made short and concise, in a popular language, illustrated with practical examples for application and adjusted to the type of end-users addressed. Popular articles from research projects should be presented more often during the project period instead of waiting until the final results are ready after several years. Valuable grey zone information obtained during a project should be published somehow, as such information may have high practical relevance for end-users, while it is not suited for scientific publication. It was advised to use communication experts for popularisation and putting the research results into the context of the end-users. The target groups should be integrated in the dissemination activities or researchers should cooperate with organisations specialised in organic farming advice and knowledge transfer. It was advised to use already existing communication channels for farmers, e.g. newspapers, magazines, field days and farmer networks etc. instead of inventing new ones. Some also emphasised the use of modern ICT tools like videos, smartphone apps and e-learning.

8. Recommendations on tools and ways for dissemination of research results at the transnational level

There was wide agreement among respondents that a common European wide platform/ website/database for all national and transnational organic research results would be an excellent idea, as the information sources on organic research results currently are very scattered. Such a database should not only include scientific literature but also a section on practice oriented "ready to use" information and relevant "grey" literature. It was suggested that it could build on Organic Eprints, but at the same time it was advised that the search tools should be improved and more practice oriented. As regards the language problem the experts suggested that until a satisfactory electronic translation tool is developed, short and precise practice oriented summaries should be made in the main European languages. Some suggested to supplement the database with a weekly or monthly newsletter in several languages with short information on new practice oriented results, which may be downloaded in full on computer, tablet or smartphone according to a defined interest profile of the subscribers. It was recommended to use already established relevant international networks for dissemination, and if such networks do not exist, to create networks involving farmers, researchers and advisors at the European level. Other suggestions were international seminars/workshops, study tours, staff exchange and increased use of new ICT tools.

Recommendations

Based on the study the following recommendations should be highlighted:

- It is important that representatives from the user groups and relevant stakeholders are involved in research from the planning of research programmes to the dissemination of research results to secure the complex needs of end-users and an increased utilisation of the results.
- An international communication team or national teams should be established and funded for taking care of the translation of research results into practice oriented information and for translation into the language of the end-users.
- Use of new ICT tools for dissemination of research results in a way and time suitable to the need of different types of end-user groups should be investigated and developed more thoroughly.
- Funding bodies should work together at the European/World level to develop a ranking system that also rewards universities and researchers for popularisation of their research results.
- Development of a common European database and newsletter on organic research results, containing scientific as well as grey literature and practice oriented information, e.g. by building on the Organic Eprints archive, which is well known by most organic researchers and many agricultural advisors.
- Events, where researchers, advisors and farmers either work together or come together to discuss (e.g. field demonstrations, workshops etc.) should be used more often in organic research projects, though they may be more costly than written dissemination.
- Transnational and inter-regional cooperation on organic research programmes and projects should be strengthened to increase harmonisation of research methods, funding efficiency and increased applicability of research results that may be used in several countries or regions with comparable problems, geographic and climatic conditions.
- Much can be learned from a systematic analysis of the impact of national and transnational organic research programmes, and it is therefore proposed that a common methodology is developed and used for impact assessment of national and transnational research programmes.

How can we know if organics becomes better? A perspectivist view on multicriteria assessment

HUGO F. ALRØE[1], EGON NOE[2]

Key words: overall assessments, practice, communication, perspectives, values

Abstract

Methods to do overall sustainability assessment are very different, they produce different assessments, and none of them can claim to have the 'right' answer. This paper aims to show some of the deeper challenges of making and communicating overall assessments of organic food systems, by investigating the role of scientific and stakeholder perspectives. Some results are that (1) sustainability is a paradoxical perspective, which relies on a multitude of specialised scientific perspectives; (2) assessments are based on built-in, but mostly hidden and sometimes incompatible values; and (3) the key to successful overall assessments is to make perspectives and values explicit in order to enable assessment of assessments in a participatory process. We conclude that there is a need to develop new participatory methods to handle perspectives and values in the preparation and communication of assessments of organic food systems.

Introduction

Consumers buy organic goods, and citizens and politician support organics, to some degree, because they believe it is a better alternative with regard to global challenges and societal goals for environment, health and welfare. Much credibility and trust rests on whether organic agriculture can continue to improve in relation to its stated principles.[3] But there is also a need to show citizens, politicians and consumers that the organic alternative actually makes a positive difference. Organic systems are monitored and certified with regard to the organic standards, and not with regard to the principles, and the standards are directed at practices rather than (expected or possible) effects and impacts. This is an appropriate choice, since practices are much easier to evaluate than effects. But it leaves us with the questions of whether organic is a better alternative, overall, and whether the on-going developments make organic food systems better, overall. How can we know this?

In order to develop better and more sustainable organic food systems, there is a need to make overall assessments of their effects and to bring those assessments into practice. In the last decades, many methods to do overall sustainability assessment have been developed, including 'integrated', 'holistic' or multicriteria tools (Alrøe et al. 2014). But the methods are very different, they produce different assessments, and none of them can claim to have the 'right' answer.

One common problem with making overall assessments is indexation. An index 'machine' transforms indicator measurements into performance-based scores by way of 'scoring functions' that determine the value (in terms of desirable or not) over the expected range of the indicator (e.g. Andrews et al. 2002). Indexes are in other words very effective machines to remove information, which turn a range of value-based assessments into a number (typically) between 0 and 100. Overall indexes, like sustainability indexes, sum up assessments from very different research perspectives, which may be based on very different values, and effectively hides those perspectives and those values. (Even multicriteria methods are based on building separate indexes within a limited number of thematic areas.) Such indexation is problematic when the assessments are to be used in relation to specific values such as the organic principles, which may not be in accordance with the built-in and hidden values.

Another common problem is how to assess food system sustainability in such a way that stakeholders can use it in changing their practices (Alrøe et al. 2014). One approach is to categorize different assessment tools and provide guidance on how to choose the most appropriate tool for each situation. The choice of method is based on built-in methodological differences and trade-offs between different objectives. For instance there may be a trade-off between the scope in terms of area, level and comprehensiveness, and the precision and validity of the results (Schader et al. 2014); between complex expert-based full assessments and participatory rapid assessments (Marchand et al. 2014); and between measures of sustainability

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[3] See http://www.ifoam.org/en/organic-landmarks/principles-organic-agriculture.

performance and the management and development of agricultural enterprises (Trieste et al. 2014). These differences and trade-offs means that one-size-fits-all solutions are rarely feasible.

However, the problem is deeper than choosing the right tool for the job; it concerns the question of how we are at all able to do sustainability assessments, and what role assessment plays in relation to reflexivity and communication (Freyer and Bingen 2014, Alrøe et al. 2014). This paper aims to show some of the deeper challenges of making and communicating overall assessments of organic food systems.

Methods

This paper is the result of work carried out in the research and development project MultiTrust.[4] The twofold goal of the MultiTrust project is (1) to make the organic producers better able to develop organics in accordance with the organic principles and in synergy with societal objectives, thereby consolidating the long term growth of organic food systems, and (2) to make it easier for consumers, citizens and politicians to observe and evaluate the different contributions that organic food systems offer. To reach these goals the project develops methods for multicriteria assessment and communication that can effectively support an integrated and trustworthy development of organic agriculture. The project methodology is interdisciplinary and participatory. It applies a perspectivist methodology that investigates the role of different scientific and stakeholder perspectives in organic food systems and multicriteria assessment methods (cf. Alrøe and Noe 2011).

Results

The MultiTrust project has identified three pivotal challenges in developing overall assessments of organic food systems (Figure 1). The first challenge is how to balance different types of knowledge, and to avoid that what is most well-known, precise or easiest to measure gets the most weight. The second challenge is how to expose values such as the built-in values in assessment tools (cf. Gasparatos 2010), and relate them to the ethical principles of organic agriculture, societal goals, and other interests. The third challenge is how to reduce the complexity of overall assessments to enable communication in such a way that the assessments can effectively contribute to the development of better organic food systems.

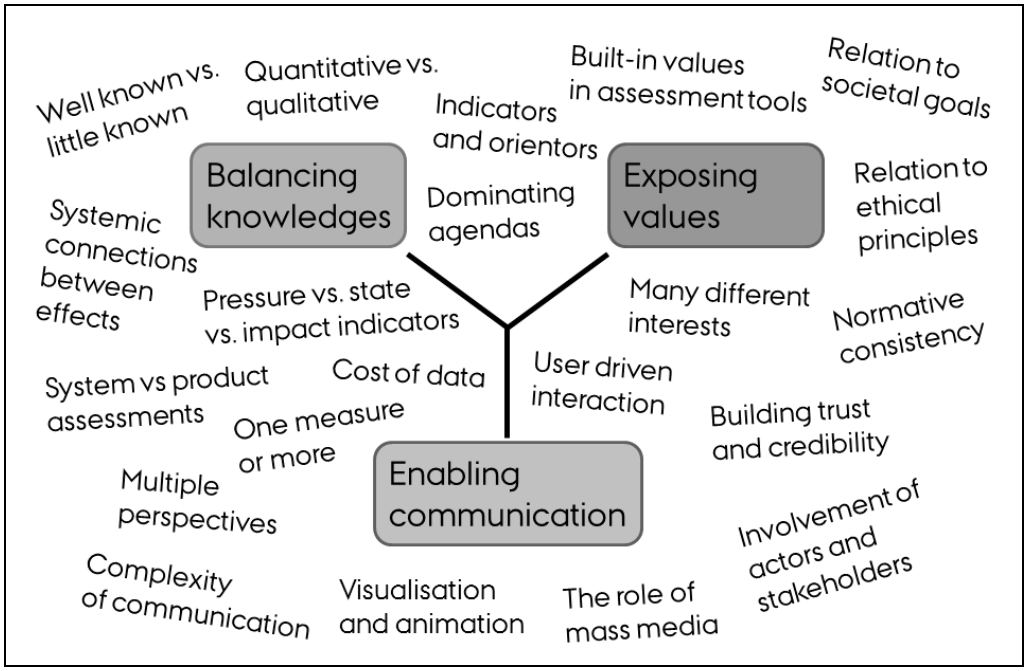


Figure 1. Three key challenges in the development of overall assessments of organic food systems, with some more specific aspects of the problematic.

[4] The MultiTrust project is part of the Organic RDD programme, which is coordinated by International Centre for Research in Organic Food Systems (ICROFS) and funded by the Danish Ministry of Food. We thank all the other partners in the MultiTrust project for their contributions.

To meet these challenges, we claim, it is necessary to explicitly and exhaustively address the question of what perspectives the assessments are made from. This is a complex problem in several dimensions. Firstly, sustainability is a paradoxical perspective in the sense that it wishes to comprise the whole, but must rely on a multitude of specialised scientific perspectives. Therefore, there is no one fixed idea of sustainability; new concerns arise continuously in society and new perspectives emerge in science, which must be included, and the assessment can never be exhausted. The same may be said of organics. Specifically, organic agriculture does not have its own 'holistic' perspective, from which to observe the development of organic food systems compared to the vision and goals laid down in the principles of organic agriculture; it always depends on other perspectives.

Secondly, the learning and knowledge that enters into an assessment is constricted by its discursive, practical and cognitive context. Scientific perspectives are based on built-in but mostly hidden values, which are embedded in the knowledges they produce (Thorsøe et al. 2014). Moreover, these values may be incompatible, and the scientific perspectives may be incommensurable or complementary (in Niels Bohr's sense). Each perspective can observe some aspects, but will be blind to others. For instance, we find two different values, care and naturalness, in animal welfare in organic agriculture, which are complementary in the sense that we cannot honour both values at the same time.

Thirdly, there are multiple kinds of stakeholders in food systems with very different values and goals, and these values do not necessarily match the values embedded in the scientific perspectives and assessments. Even when the same value terms are used, such as 'sustainability', 'nature quality' or 'animal welfare', they are often used in very different meanings by different stakeholders and scientists. This problem is aggravated by the fact that the existing sustainability assessment tools are generally inept in handling values.

Discussion

The answer to the question of how we can know if organic becomes better, calls for more than just making indexes or choosing the right assessment tool for the job. Science in itself cannot say whether organic agriculture is a better alternative, or whether any specific development of organic food system is toward the better, overall. There is no assessment without values, and the determination of what values to base overall assessments of organic food systems on, is not only up to science; it is something that has to be determined in cooperation between science, organic actors and other stakeholders. And this is where the attention to perspectives becomes essential. There is not one science but a range of relevant scientific perspectives which are needed to make overall assessments. The built-in values in perspectives and assessments may be incompatible with each other and with stakeholder values. A key to successful implementation of sustainability assessments is therefore to make values and perspectives explicit to allow for assessments of assessments in a participatory process. Values should not be hidden in indexes, but exposed so that stakeholders can assess as well the values behind the assessment. And methods should be developed that are able to handle perspectives and values in the preparation and communication of overall assessments of organic food systems.

References

Alrøe, H.F., H. Moller, J. Læssøe, E. Noe (2014), Multicriteria assessment and communication of food systems: challenges and perspectives. Guest Editorial for the Special Feature "Multicriteria assessment of food system sustainability." Ecology & Society (forthcoming).

Alrøe, H.F. and E. Noe (2011), The paradox of scientific expertise: A perspectivist approach to knowledge asymmetries. Fachsprache - International Journal of Specialized Communication vol. XXXIV, 3–4/2011:152–167.

Andrews, S.S., J.P. Mitchell, R. Mancinelli, D.L. Karlen, T.K. Hartz, W.R. Horwath, G.S. Pettygrove, K.M. Scow, D.S. Munk (2002), On-farm assessment of soil quality in California's Central Valley. Agronomy Journal 94: 12–23.

Freyer, B. and J. Bingen (2014), Reflexivity or Assessment? The Role of Self-Reflexivity in the Assessment Process. Ecology & Society (forthcoming).

Gasparatos, A. (2010), Embedded value systems in sustainability assessment tools and their implications. Journal of Environmental Management 91: 1613-1622.

Marchand, F., L. Debruyne, L. Triste, C. Gerrard, S. Padel, L. Lauwers (2014), Comparing full and rapid sustainability assessment on a dairy farming case. Ecology & Society (forthcoming).

Thorsøe, M.H., H.F. Alrøe and E. Noe (2014), Observing the observers – uncovering the role of values in research assessments of organic food systems. Ecology & Society (forthcoming).

Triste, L., F. Marchand, L. Debruyne, M. Meul and L. Lauwers (2014), Reflection on the development process of a Flemish sustainability assessment tool: contribution to the debate on tool development. Ecology & Society (forthcoming).

Schader, C., M. Meier, J. Grenz and M. Stolze (2014), Scope and precision of sustainability assessment approaches of food systems. Ecology & Society (forthcoming).

A prototype tool for participatory multicriteria assessment to develop organic food chains

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Key words: sustainability assessment, stakeholder involvement, participatory tool

Abstract

Research and experience suggest that stakeholder involvement is crucial to the successful development and implementation of methods of sustainability assessment – but it is far from clear how to do this. In this paper we investigate how stakeholders may be involved in making and using overall assessments of organic food systems, and propose a prototype tool that can help do this. Based on consultations and workshops with organic stakeholders, we conclude that: 1) assessments should be driven by user needs, 2) assessments must be used in food chains, and 3) assessments should focus on tangible initiatives. A prototype of a participatory tool for multicriteria assessment and communication in organic food chains has been developed and described in form of an animation film, a diagrammatic representation and an explanatory report.

Introduction

In order to develop better and more sustainable organic food systems, there is a need to make overall assessments of their effects, and to bring those assessments into practice. Experiences from a wide range of approaches suggest that in order to successfully develop and implement methods of sustainability assessment, it is necessary to involve stakeholders (e.g. Videira et al. 2010). The last decades have thus seen the development of a range of participatory assessment techniques and practices aimed at promoting sustainability. However, in many cases the results have been disappointing, and disillusionment has grown amongst practitioners and stakeholders who have felt let down when the many benefits that have been claimed for participation, are not realized (e.g. Reed 2008). It is therefore far from clear how to involve stakeholders in making and using overall assessments of organic food systems. In the present paper we investigate this problem and propose a prototype tool that can help do this.

This paper is the result of work carried out in the research and development project MultiTrust.[3] The twofold goal of the MultiTrust project is (1) to make the organic producers better able to develop organics in accordance with the organic principles and in synergy with societal objectives, thereby consolidating the long term growth of organic food systems, and (2) to make it easier for consumers, citizens and politicians to observe and evaluate the different contributions that organic food systems offer. To reach these goals the project has developed a prototype of a tool for multicriteria assessment and communication that can effectively support an integrated and trustworthy development of organic food chains.

Methods

Generally, the MultiTrust project methodology is interdisciplinary and participatory. It applies a perspectivist methodology that works deliberately and openly with the different scientific and stakeholder perspectives in organic food systems and multicriteria assessment methods, and what aspects of organics these different perspectives are able to observe (cf. Alrøe and Noe 2011). Specifically, the investigation here builds, firstly, on theoretical analyses of multicriteria assessment methods from different scientific perspectives represented in the project: philosophy and ethics, economics, psychology, management theory, communication theory, and media theory. Secondly, it builds on consultations and workshops with organic stakeholders. And thirdly, it builds on tool development and design processes in cooperation with stakeholders and professionals in animation and systems design. While the focus here is thus on assessments of organic food systems, we also draw on experiences from sustainability assessments more generally.

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Results

There are a range of potential barriers for successful stakeholder involvement in sustainability assessment and adoption of sustainability measures in food systems. Food systems are complex; they comprise many different systems, chains, networks, actors and practices. Transitions towards better and more sustainable food systems must therefore be based on coordinated decisions and synchronized changes of practices. Moreover, stakeholders' lifeworlds and relations are complex and varied, and different stakeholders have different understandings of sustainability, and of organic agriculture, and different ideas about what constitutes better food systems. On the scientific side, there is no one 'holistic' scientific perspective of organic agriculture from which developments can be observed and compared to visions and goals. Sustainability assessments rely on a multitude of different scientific perspectives, which are based on their own built-in, but mostly hidden, values. Furthermore, assessments are inherently value-based, they are always judgments of better and worse in some sense. A key to successful implementation of sustainability assessments is therefore to make values and perspectives explicit in a participatory process (Gasparatos 2010).

Based on this realisation, the MultiTrust project carried out a multi-stakeholder workshop focused on the question of how to communicate values as a basis for using overall assessments in the development of organic food systems. The workshop included representatives from production, processing, retail and consumers, who discussed the question first in homogeneous groups and then in mixed groups. The main conclusions from the workshop were that: 1) assessments should be driven by user needs, 2) assessments must be used in chains, and 3) assessments should focus on tangible initiatives.

These fairly simple conclusions have quite far-reaching consequences for the development of participatory assessment tools:

1. In order for assessments to be user driven, there has to be an option for discussing the criteria that the assessment is based on (criteria are values used for assessing). But often criteria are determined by expert ideas about what is important. And generally the existing sustainability assessment tools are quite inept in handling values. This is a problem if organic food systems are assessed using general sustainability tools, which are based on criteria that are not necessarily in accordance with organic values as formulated in the organic principles. But it is also a problem for a dedicated organic assessment tool, because there are many differences in values both within and between the links in the food chain.

2. Most tools have been focused on single entities like farms, businesses, sectors or countries, or single products, and not on the interaction between entities in product chains or food networks. But transitions towards better and more sustainable food systems happens through synchronized changes in practices across food chains and networks. Complex assessments don't communicate well, they are only manageable by experts. And when they are transformed into something that is easy to communicate, such as "footprints", sustainability indexes, etc., this involves processes of indexation that effectively hide the assessment values and prevents any interaction with stakeholder values (Gasparatos et al. 2009).

3. The focus on tangible initiatives (or 'good examples'), such as a farm biogas plant or a retail packaging reduction plan, points in another direction than the typical assessment tool, which is focused on entities or products. Tangible initiatives are easier to communicate across different actors and stakeholders, since they provide concrete and palpable objects that are amenable to common understanding. Tangible initiatives also make the concept of multicriteria assessment more concrete than when the assessment is done on an enterprise that may have many initiatives which point in different directions.

Based on the theoretical work and stakeholder workshops, the MultiTrust project has developed a prototype for a participatory tool for multicriteria assessment and communication that aims to effectively support the development of organic food chains (Figure 1). The tool is described in form of an animation film, a diagrammatic representation and an explanatory report.

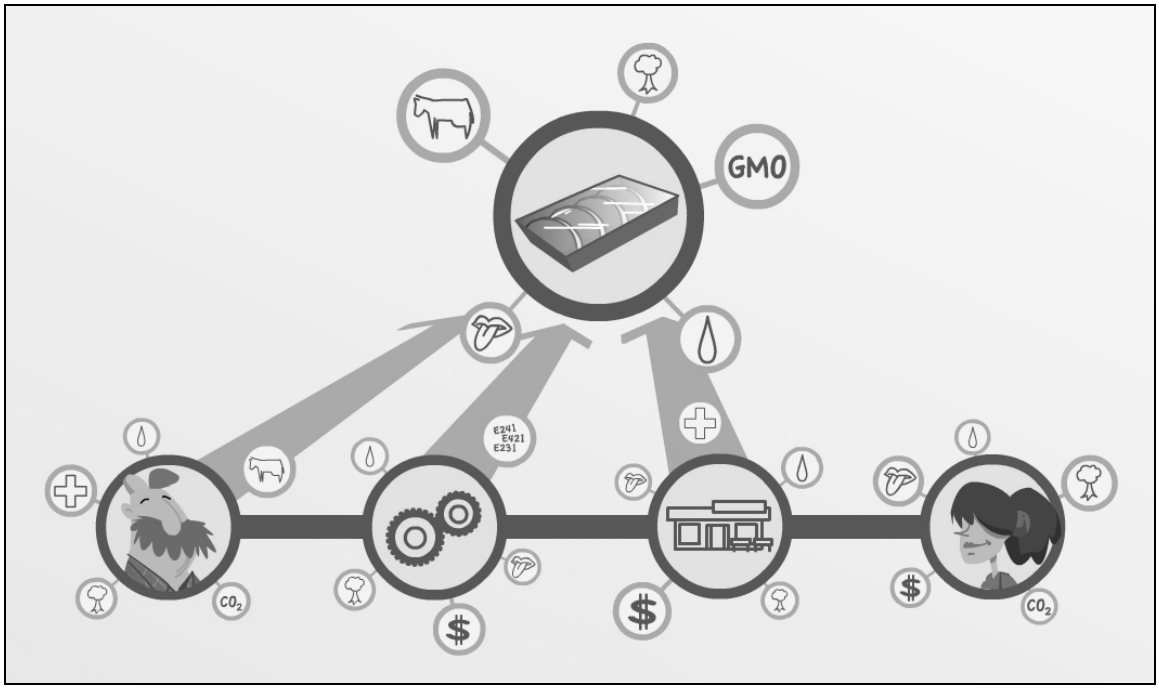


Figure 1. Snapshot from an animation film presenting the proposed participatory chain assessment tool, showing the criteria employed by different links in the chain for a specific product. © Tumblehead and MultiTrust

The tool is planned to be an online tool driven by users. It is directed at organic actors that want more transparency and deeper understanding and who wish to influence the development of organic agriculture, including producers, processors, retailers and consumers. Consumers, for instance, can use the tool for choosing products based on multiple criteria. They enter a product code and are provided with an overview of the complete production chain with links to the producers, processors and retailers that have (or may have, e.g. when there are more than one producer) been involved in the production. The given product shows a 'summing up' of the criteria that have been imprinted in the product through the production process, and there is detailed information on the criteria employed in the different links in the chain. Processors and retailers can use the tool to choose relevant suppliers. Producers, processors and retailers can get an overview of what criteria the next links in the chain weigh highly in their practices and use this in their strategic choices on development and sale.

The information is provided by the users. Each actor makes a user profile in the system which indicates what criteria they pursue in their actions. The selection and the stated importance of the criteria indicate the efforts made or planned, and not attitudes. For instance, a consumer selects the criteria she bases her consumer choices on, and a producer selects the criteria they use for making strategic decisions on their farm. Their efforts can be documented in the user profile in form of descriptions of tangible initiatives, observations (measures, pictures, videos) and assessments. Users can also comment on the profiles of other users, ask questions or make suggestions.

Discussion

The proposed prototype is an example of a tool that enables stakeholders to make and use overall multicriteria assessments in their daily practices; a tool that comprises the whole food chain and thereby makes it possible for stakeholders to work together in changing their patterns of production and consumption. The tool allows stakeholders to communicate what they desire and strive for in a way that works both ways in the chain. Consumers can learn from each other and establish connections with producers; retailers can gain insights in consumer needs; processers can make strategic decisions based on what the other actors in the chain want, etc. This proposal presents a new way of doing participatory multicriteria assessments, which provides deeper understanding and wider influence on the development of organic food systems.

References

Alrøe, H.F. and E. Noe, (2011), The paradox of scientific expertise: A perspectivist approach to knowledge asymmetries. Fachsprache - International Journal of Specialized Communication vol. XXXIV, 3–4/2011:152–167.

Gasparatos, A., M. El-Haram, M. Horner (2009), The argument against a reductionist approach for measuring sustainable development performance and the need for methodological pluralism. Accounting Forum 33: 245-256.

Gasparatos, A. (2010), Embedded value systems in sustainability assessment tools and their implications. Journal of Environmental Management 91: 1613-1622.

Reed, M.S. (2008), Stakeholder participation for environmental management - A literature review. Biological Conservation 141: 2417-2431.

Videira, N., P. Antunes, R. Santos, R. Lopes (2010) A participatory modelling approach to support integrated sustainability assessment processes. Syst. Res. 27: 446-460.

Effect of an in-season living mulch on leaching of inorganic nitrogen in cauliflower (*Brassica oleracea* L. var. *botrytis*) cropping in Slovenia, Germany and Denmark

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Key words: cauliflower, intercropping, nitrate leaching, vegetables

Abstract

Vegetables with a high nitrogen demand such as cauliflower may cause intensive leaching of nitrate to the environment in conventional as well as in organic production. In organic cropping systems, the use of an in-season living mulch may decrease the risk of nitrate leaching after harvest when left growing in the field to the end of the leaching season. The aim of this study was to investigate the effect of growing an in-season living mulch including legumes on the risk of leaching of inorganic nitrogen over winter, and soil nitrogen availability the following spring. Three field experiments were carried out in Slovenia, Germany and Denmark in the frame of the Interveg project (CORE organic II). Evaluation of soil inorganic nitrogen content was done at planting, at harvest, in late autumn and in spring to a depth of 0.6, 0.9 or 1.5 m as well as nitrogen uptake by the biomass. This study reports preliminary results of the first year of experiments on soil inorganic nitrogen. They indicate that living mulches may have a potential to decrease the nitrate leaching risk depending on the design of the cropping system.

Introduction

Production of organic vegetables is thought to be less harmful to the environment compared to conventional cropping. However, leaching losses of nitrate may be high in organic production depending on the composition of the crop rotation and use of catch crops (Thorup-Kristensen et al., 2012). In order to reduce nitrate leaching to the environment, new organic cropping systems have been developed where the main crop is intercropped with an in-season living mulch. The idea is to better exploit ecosystem services by use of the living mulch for example by attracting beneficial insects, suppressing weeds, increasing biodiversity and decreasing nitrate losses (Kremen and Miles, 2012). However, the question is if nitrate losses can be reduced while maintaining crop yields of, for example, a short-seasoned and high nitrogen (N) demanding crop such as cauliflower (*Brassica oleracea* L. var. *botrytis*) and if N fertilizer levels may be reduced when employing a living mulch including legumes. The aim of this study was to investigate the effect of growing an in-season living mulch including legumes on leaching of inorganic N in new intercropping systems for organic cauliflower production in Slovenia, Germany and Denmark. The study represents the first year preliminary results of the experiments carried out in the frame of the Interveg (Core Organic II Era-Net) project (Canali, 2013).

Material and methods

Experiment Slovenia was carried out at the University Agricultural Centre of the University of Maribor located in Pivola near Hoče (latitude 46°28'N, longitude 15°38'E) in Slovenia. In a randomized block design with two factors (i.e. LM sowing time and crop cultivar) and three replicates, cauliflower was grown within June and October 2012 with white clover (*Trifolium repens* L.) as living mulch, which was sown directly after planting of the cauliflower. Results are reported for the Snow ball cultivar.
Experiment Germany was carried out at the research farm Hessian State Estate Frankenhausen, located at Grebenstein (latitude 51°9'N, longitude 9°4'E) in Germany. In a randomized block design with two factors (i.e. LM introduction strategy comparing the addition and the substitution design, and crop cultivar, comparing the performances of the Chambord and the White ball ones) and three replicates, cauliflower was grown on a Parabrown earth with loess cover between June and September 2012 intercropped with white clover (*Trifolium repens* L.), which was sown 28 days after planting of the cauliflower.
Experiment Denmark was carried out at the Research Centre Aarslev, located at mid Funen (latitude 55°18'N, longitude 10°27'E) in Denmark. In a strip plot design with three factors (i.e. LM presence, crop cultivar and N fertilization dose) and three replicates, cauliflower was grown on a sandy loam soil from the

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31st May until harvest during the period 3-20 August 2012. The design was a substitution design where the rows of living mulch replaced every third row of cauliflower which reduced the crop density by one third. The living mulch was an overwintering grass-clover of *Trifolium repens* L. and *Lolium multiflorum* Lam. that was incorporated in strips or fully incorporated in December 2012 in both systems. The rows of living mulch were cut aboveground and root pruned below ground (0.2 m depth) before planting the cauliflower in May 2013 to control interspecies competition. The plots were fertilized with two levels of dried chicken manure. The amount was adjusted based on the inorganic N in the soil to a total of 240 and 290 kg N ha^{-1}. Results are reported for the Chambord cultivar.
In all three countries, after harvest, the living mulch was left to grow until early spring the following year. Soil samples were taken (to 0.6, 0.9 or 1.5 m depth) to evaluate the inorganic N content at planting, harvest, late autumn, and the following spring depending on the crop rotation of each country. The field experiment was conducted according to standard agronomic practices used by local farmers and to the rules of organic management which exclude the use of inorganic fertilizers or pesticides. Preliminary statistical analysis included analyses of variance (F-test) and multiple comparisons based on the least significant differences (GLM procedure).

Results and conclusions

Overall the levels of soil inorganic N at harvest were in the range of 34-106 kg N ha^{-1} when comparing the top soils (0-0.9, 0-0.6 and 0-1 m soil layer) for Slovenia (Table 1), Germany (Table 2) and Denmark (results not shown). At the end of the leaching season the following spring the amounts were in the range of 38-82 kg N ha^{-1}. Cauliflower is known to cause leaching levels of up to 300 kg N ha^{-1} or more due to a high amount of soil inorganic N and crop residue N left in the field at harvest. Compared to such levels, the leaching potential was low in the three organic systems in Slovenia, Germany and Denmark. This was confirmed by the measurements of soil inorganic N in late autumn (results not shown). However, the potential N leaching was still of a significant size in all three organic systems (Table 1-3), which was confirmed by the amount of 35-50 kg N ha^{-1} present in the 1-1.5 m soil layer, which may be considered as the bottom of the root zone of cauliflower, in the Danish experiment at the end of the leaching season (data not shown).
In Slovenia (Table 1), at harvest, the living mulch tended to decrease soil inorganic N in the 0-0.9 m soil layer from 91 to 53 kg N ha^{-1}, but at the end of the leaching season the following spring, this difference had disappeared. In Germany (Table 2), at the end of the leaching season, the addition design tended to have a 8-9 kg N ha^{-1} lower content of soil inorganic N, whereas the substitution design had a 7-12 kg N ha^{-1} higher content compared to the sole cropping system for the two cultivars. At the end of the leaching season in Denmark (Table 3), the soil inorganic nitrogen content tended to be 7-14 kg N ha^{-1} lower in the intercropped system compared to the sole cropped system for the two fertilizer levels.

Table 1: The soil inorganic N content in the 0-0.9 m soil layer under cauliflower without or with living mulch (addition design) in Slovenia.

Treatment	Harvest 0-0.9 m ($kg\ N_{inorg}\ ha^{-1}$)	End of leaching season 0-0.9 m ($kg\ N_{inorg}\ ha^{-1}$)
No LM	91	77
LM	53	82
	n.s	n.s.

Note: No LM = sole crop system; LM = crop+living mulch system; n.s. = not significant.

Table 2: The soil inorganic N content in the 0-0.6 or 0-0.9 m soil layer under two cultivars of cauliflower without (control) or with living mulch (addition and substitution design) in Germany.

Cultivar	Treatment	Design	Harvest 0-0.6 m ($kg\ N_{inorg}\ ha^{-1}$)	End of leaching season 0-0.9 m ($kg\ N_{inorg}\ ha^{-1}$)
Chambord	No LM	Control	51	48
	LM	Addition	45	40
	LM	Substitution	34	60
White ball	No LM	Control	41	47
	LM	Addition	50	38
	LM	Substitution	79	54
			n.s.	n.s.

Note: No LM = sole crop system; LM = crop+living mulch system; n.s. = not significant.

Table 3: The soil inorganic N content in the 0-1.5 m soil layer under cauliflower without or with living mulch (substitution design) grown at two fertilizer levels in Denmark.

Treatment	Harvest 0-1.5 m soil layer ($kg\ N_{inorg}\ ha^{-1}$)	End of leaching season 0-1.5 m soil layer ($kg\ N_{inorg}\ ha^{-1}$)
No LM, 240	95	116
No LM, 290	94	126
LM, 240	106	102
LM, 290	94	119
	n.s.	n.s.

Note: No LM = sole crop system; LM = crop+living mulch system; 240 = fertilized by 240 kg N ha^{-1}; 290 = fertilized by 290 kg N ha^{-1}; n.s. = not significant.

Discussion

Overall, the results indicate that the continued presence of the living mulch in the field over winter compared to bare soil after the sole crop may reduce the soil mineral N content during the leaching season and, consequently, contribute to lower the nitrate leaching risk from the cauliflower systems. However, the German results indicate that the effect depends on the design chosen for the introduction of the living mulch into the cropping system. In Germany, the substitution design, where a row of living mulch replaced a row of crop (lower crop plant density), tended to increase leaching. This may be due to a lower N uptake ability of the living mulch compared to the cauliflower that was replaced. In contrast, the addition design, where the living mulch was introduced in-between the rows of cauliflower (same crop plant density), tended to reduce leaching. This was probably due to an overall increase of the uptake capacity for N of the entire plant stand of crops and living mulch.

Further analyses of the results of this study are needed. Still, they point to new perspectives of the importance of the cropping system design for the introduction of living mulches into organic production of high N demanding crops.

Acknowledgments

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References

Kremen, C. and Miles, A. (2012). Ecosystem services in biologically diversified versus conventional farming systems: benefits, externalities and trade-offs. *Ecology and Society* 17: 40.

Thorup-Kristensen, K., Dresbøl, D.B., Kristensen, H.L. (2012). Crop yield, root growth, and nutrient dynamics in a conventional and three organic cropping systems with different levels of external inputs and N re-cycling through fertility building crops. *European Journal of Agronomy* 37: 66-82.

Canali, S. (2013). The Interveg project: Enhancing multifunctional benefits of cover crops – vegetables intercropping (CORE organic II program, ICROFS). The Interveg project homepage, 20. Sept. 2013, http://www.coreorganic2.org/ under Research projects and Interveg.

15 years of research in organic food systems in Denmark – effect on the sector and society

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Key words: research, impact, alignment, dissemination, relevance, publications

Abstract

The Danish government has funded research in organic agriculture and food systematically since the establishment in 1996 of the Danish Research Centre for Organic Farming (DARCOF, now ICROFS, International Centre for Research in Organic Food Systems). A recent analysis of the effects of the first 3 organic research programs (DARCOF I-III, 1996-2000) (Halberg et al. 2012) was carried out with the objective to determine not only the impact of the research on the sector from farmers and advisors to industry and retail but also on society from government and regulation to NGO's. The analysis showed that it has had a high impact on the development of the sector. Our results underpin and exemplify the general recommendations in recent international discussions on the need to improve the relationships between research, extension and agricultural production from a linear to a more complex knowledge interaction.

Introduction

It is generally thought to be quite difficult to evaluate a research program's effect on a sector of society, especially distinguishing the contribution from research from those of other development forces. There are many important factors behind the positive development of the organic sector in Denmark, including public support for market and product development, the regulatory framework from public and private sectors and the establishment of strong institutions in organic farming. A large group of entrepreneurs and pioneers in the organic farming, processing and retailing sectors have also shouldered a good deal of the burden. The results of research need to be channelled through these agents to be used for innovations. Farmers need new knowledge about nutrient balancing, weed control and animal husbandry to ensure an effective and economically viable production which is also robust and adheres to the organic principles and regulations but they are indifferent to whether new methods are the result of research or not, and many learn new methods from colleagues or consultants. The generally good connection in Denmark between research and development, the advisory service and farmers means that the people delivering the new knowledge to farmers tend to be the consultants, often as a result of discussions with scientists, who in turn are affected and inspired in their design of solutions to problems via this process. Results of research and development (R&D) do not always have farming as the primary target. Other users of the research results are businesses, organisations and the political system where knowledge of the effects of organic farming on, for example, animal welfare, climate and biodiversity form part of decision-making and political processes.

An analysis of the effect of 15 years of research in organic food systems in Denmark showed that it has had a high impact on the development of the sector. There are three main reasons: the content of research programs and the funded projects have been closely aligned with the needs of the industry as expressed by farmers, advisors and organizations. Many of the projects have had close contact to advisors and farmers securing continuous dissemination resulting in rapid application of results. Due to the close contact between researchers and users the research design has been adapted to ensure that treatments to be tested are as relevant and practical as possible, without compromising the scientific standards. Besides the practical applications the number of scientific products has been above average. Our results underpin and exemplify the general recommendations in recent international discussions on the need to improve the relationships between research, extension and agricultural production from a linear to a more complex knowledge interaction.

Material and methods

ICROFS (International Centre for Research in Organic Food Systems) has produced an analysis of the effects of organic research in the period 1996-2010 on the organic sector and on society in general. In the 15 years from 1996 and until 2010 there have been four research programmes in organic food and farming in Denmark financed via special government grants that amounted to just over 500 million DKK equal to roughly 67 million €. The allocation of funds between thematics areas can be seen in figure 1.

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The analysis itself was carried out as a collation of information from three viewpoints that each has been independently documented: 1) Interviews with (representatives of) end-users of R&D results and their assessment of the challenges for the sector in the period 1996-2010. 2) Assessment of the R&D endeavours in different thematic areas (Dairy/milk, Pigs, Crops, etc.) as they related to expected end-users. 3) Documentation of the dissemination of R&D results in relation to themes and challenges in the sector.

The recommendations in action plans for organic agriculture have furthermore been compared with the challenges in the sector identified by the end-users and with the corresponding R&D projects addressing these. Please see the more thorough description in Halberg et al. (2011).

An evaluation of the research results based on the general point scoring method used to evaluate other research programs (Pedersen et al. 2011) was also carried out. The results of this evaluation can be seen for two programmes in figure 2.

Results

The analysis shows that the research under the DARCOF programmes and CORE Organic overall has been very applied and directed at the barriers in the sector in order to support the general market and growth conditions for the organic sector. Having in this way laid a solid foundation, the private sector has been able to grasp the commercial opportunities when demand grew while adhering to the policy objectives of a market-driven growth in the organic sector.

The analysis documents and highlights three important reasons for a high impact on the development of the sector: First of all, the thematic focus of research programs and the funded projects have been closely aligned with the needs of the industry as expressed

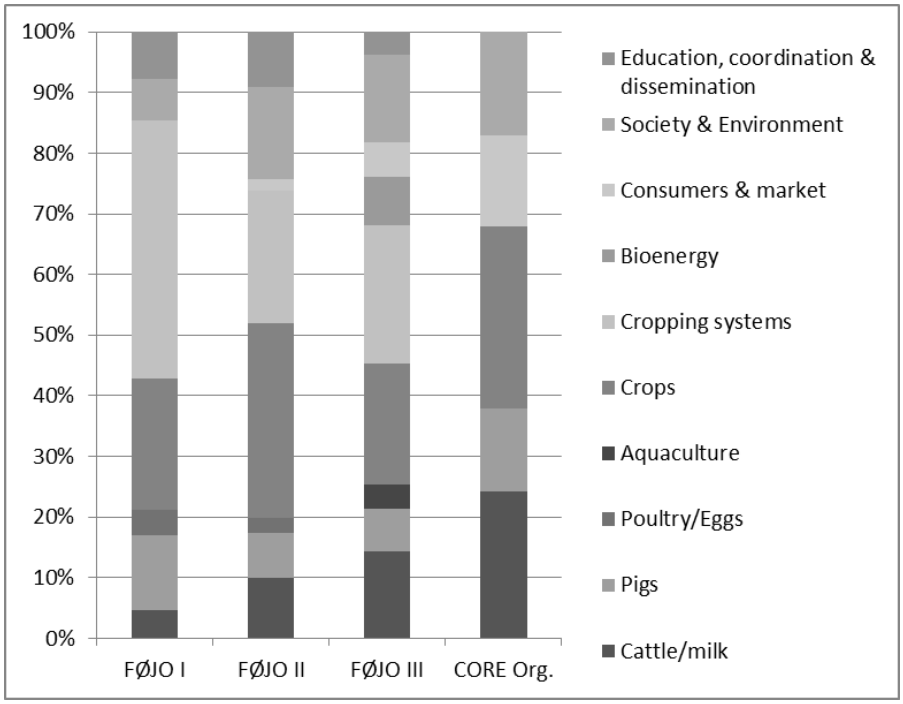


Figure 1. Allocation of funds between thematic areas in each of the four research programmes. From Halberg *et al.* (2011)

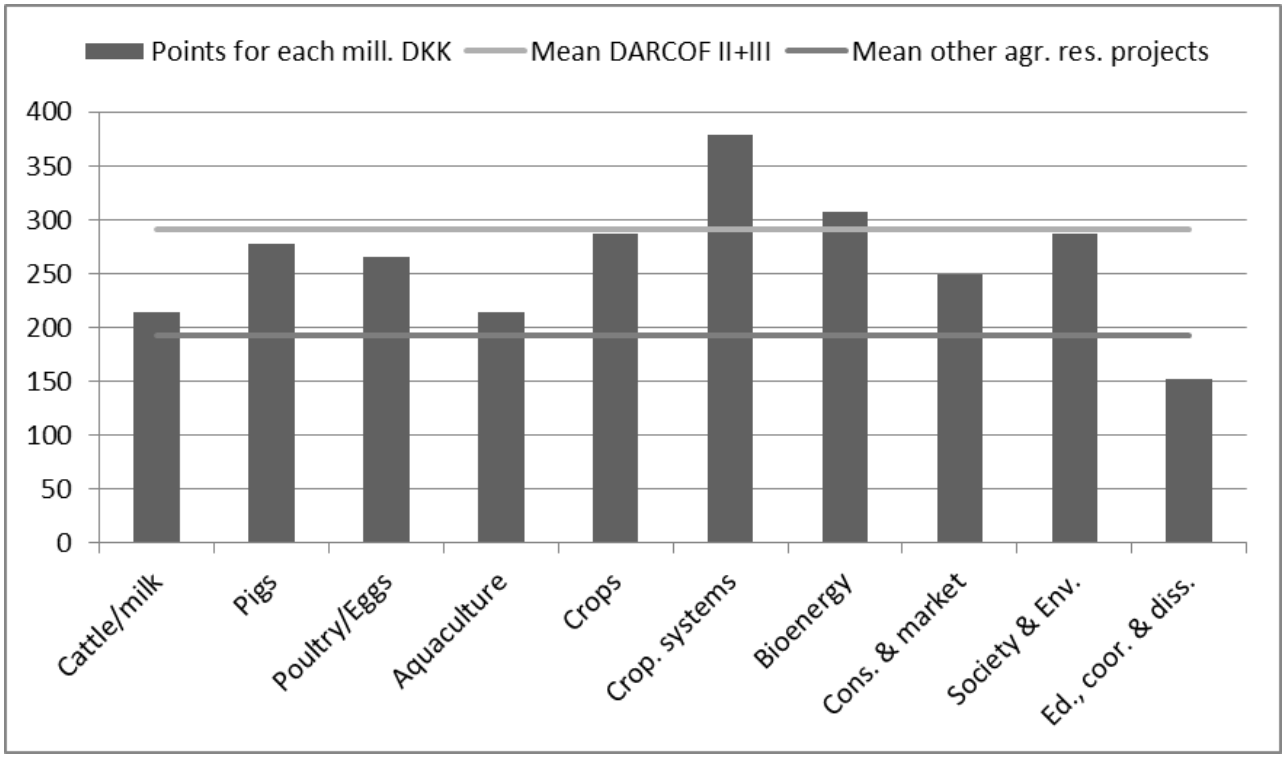


Figure 2. Points awarded for output calculated on the basis of Pedersen et.al. (2011) for each million Danish Crowns (DKK) funding for the thematic areas of the programs DARCOF II and III. From Halberg et al. (2011)

by farmers, advisors and organisations through various stakeholder committees and action plans. Second, many of the projects have had close contact to advisors and farmers securing continuous dissemination resulting in rapid application of results. Third, due to the close contact between researchers and users the research design has been adapted to ensure that treatments to be tested are as relevant and practical as possible, without compromising the scientific standards. Thus, the dialogues between the scientists and the users within projects improve the understanding of how research and the results can be adapted to the specific practical situations. This is a two-way process, and not just a question of improving dissemination of scientific results. There is a more complex interaction between research, development and the application of knowledge in agriculture than the traditional linear communication of scientific results via consultants to producers (EU SCAR, 2012).

There are clear indications that the project structure and organisation in DARCOF has supported this complexity in knowledge generation and exchange which is a prerequisite for high impact on research in terms of overcoming the farmers' main barriers. This underpins the general recommendations in recent international discussions on the need to improve the relationships between research, extension and agricultural production. In the "International Assessment of Agricultural Knowledge, Science and Technology for Development" (IAASTD 2008), the conclusions stress that it is necessary with a clean break with the linear relationship of research – extension – uptake. There is a need for the farmers' situation to have a stronger voice when prioritizing and designing research projects and to integrate their local knowledge and experience.

Measured on the number of research publications and other output, the output of the programs was satisfactory. However, this method alone does not give a satisfactory picture of the effect of the research in terms of the practical application of project results. This is because the point scoring method principally analyses research results (output) and only to a lesser degree research application (outcome).

Discussion

The result shows good correspondence between the perception of the challenges in the sector by the end-users, the R&D initiated in the four research programmes, and the publication of research results and other forms of knowledge transfer. The analysis documents direct effects of the research initiatives directed at the challenges in the sector in this period. This applies to higher yields, weed and pest control, animal health and

welfare, the potential for phasing out the use of antibiotics in Danish dairy herds as well as to the use of fungicidal seed treatment in primary production. In contrast, the analysis shows that the effects of the research in the processing industry are of a more indirect character. Research has helped stabilise the supply and quality of raw materials at a time of growing demand and sales. For the governmental and non-governmental organisations involved in policy development, the response also indicated a more indirect effect.

References

EU SCAR (2012), Agricultural knowledge and innovation systems in Transition – a reflection paper. Brussels (accessed at http://ec.europa.eu/research/bioeconomy/pdf/ki3211999enc_002.pdf on 30th Sept. 2013).

Halberg N, Kledal PR, Rasmussen IA, Mathiesen C, Sørensen LS Jespersen LM and Madsen KH (eds.) 2012. Organic research and development 1996 – 2010 – effects on industry and society. International Centre for Research in Organic Food Systems (ICROFS), Tjele, Denmark. (http://orgprints.org/22534/)

IAASTD (2008): http://www.unep.org/dewa/Assessments/Ecosystems/IAASTD/tabid/105853/Default. aspx/ (accessed on 30th Sept. 2013).

Pedersen SM, Boesen MV, Baker D, Larsen A, Pedersen JL (2011): Evaluation of research projects – perspectives for applied research in food and agriculture. Food Economics – Acta Agriculturae Scandinavica, Section C, 8:3, 127-141.

Organic Eprints – Helping research results go to work

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Key words: Open Access, publications, dissemination, archive, repository,

Abstract

Research results regarding organic food and farming from Europe have become easily accessible – and so can results from the rest of the world. The Open Access archive Organic Eprints (www.orgprints.org) has developed since the start in 2002 so that it now includes more than 14,000 items, has 27,000 registered users and more than 200,000 visits per month. The archive is open for all to use and registered users can deposit their research publications from refereed journals as well as non-refereed sources. Organisations, research facilities, research programmes and projects are also presented in the archive. Organic Eprints is the largest database in the world with publications about Organic Agriculture & Food Systems research. It can be utilized for entering papers for conferences as seen for the Organic World Congress 2014 and 2008.

Introduction

Organic Eprints is an Open Access digital archive with publications about research in organic agriculture and food systems. The publications are entered by the authors, who have carried out the research or participated in dissemination information about it. The authors aim for more users – other researchers, stakeholders, end-users, politicians *etc*. – to get easier access to their publications in order to disseminate the knowledge created from the research. In turn, this can help the farmers knowing more about their farming systems, advisers to be able to give better advice to farmers, teachers to supply better and more updated teaching, politicians to make better and more informed decisions – and other researchers to be informed about current research that might supplement theirs.

Background

The archive is a repository for all types of deposits concerning research in organic food and farming: journal articles that have been peer-reviewed, books or chapters from books, popular articles from farmers magazines or newspapers, papers, posters or presentations from conferences, reports, theses, teaching resources such as power-point presentations, web products. In addition descriptions of organisations, research facilities, research programmes and projects can be deposited. Once deposited, any item is referred to as an eprint.

The aim is that users can find information about research in organic food and farming. To aid the user in the search process, there is both the possibility to browse by subject area (or other browse views) and to search via a powerful search tool with many refinements. Additionally, registered users have the possibility to subscribe to an email alert system to receive emails on new entries in the subject area they are interested in.

National editors from 25 countries check the bibliographic information of the documents that users enter into Organic Eprints, before they allow them to enter into the live archive. In that way, it is ensured that there are only entries related to organic agriculture and food systems – including agro-ecological systems – and that the information is correct. The national editors do not review the entries – the quality of the eprints is the responsibility of the user depositing it. In addition, national editors promote the use of Organic Eprints and act as the helpdesk for the users in their country.

Open Access is free-of-charge internet access to research papers, including peer-reviewed journal articles. There are mainly two open access strategies: either to publish articles in an open access journal (golden road) or to publish articles in a paid-access journal and then self-archive in an open access eprints archive (green road). Open Access journals are often only available on the internet, and not in a printed version, but they are peer-reviewed just like printed journals. In the Directory of Open Access Journals (http://www.doaj.org/) there were in September 2013 more than 200 journals in the subject area Agriculture and Food Sciences, including some about or with focus on Organic Agriculture. Some printed, well-established journals also allow Open Access if the author of the article pays a fee, *e.g.* Organic Agriculture, the official journal of the International Society of Organic Agriculture Research (ISOFAR).

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Open Access repositories, like Organic Eprints, receive digital duplicates of published articles by depositing by the authors (self-archiving). The repository makes the articles publicly available. In order to address the copyright issues, Organic Eprints allows the author to restrict access to the paper either to the registered users or to only the author and archive administrators. In this way, users interested in the paper can still see the abstract and bibliographic data and send an email to the authors to receive a reprint. This is done very easily, since the system has a "Request-a-copy"-button, so that the interested user can send a request for a copy without even knowing the email address of the author. If the author agrees to let the user get a copy, it is automatically sent to the user.

Results

By September 2013, there were 3614 eprints from Germany, 3212 from Denmark and 2149 from Switzerland. In addition, there were more than 5500 eprints from other countries. The main part of these originated from other European countries (table 1), especially the countries of the European CORE Organic ERA-NET, but there were also entries from all other continents, with Brazil and Australia being especially well represented countries. Also the nationality of the over 27,000 registered users is mainly European (table 1). Many more than those, that are registered users benefit from the archive, which throughout 2013 had an average of more than 6600 daily visits.

Organic Eprints contains more than 14,000 items as of September 2013 (fig. 1). It is the largest – and maybe only – archive with publications about organic agriculture and food systems research. On OpenDOAR (http://www.opendoar.org), there are 107 repositories which are about agriculture, food and veterinary issues, however, many of those only has agriculture as one of many subjects. When looking only at those archives that focus on agriculture, food and veterinary subjects, and maybe one or two further subjects which are related, *e.g.* ecology and environment, there are only 5 that have more items than Organic Eprints: FAOBIB from FAO, UN; WaY from Wageningen University, the Netherlands; NALDR from USDA, USA; Infoteca-e from EMBRAPA, Brazil and ProdINRA from INRA, France. So Organic Eprints is the 6th largest agricultural archive in the world. In a world-wide ranking of 1650 repositories about all subjects based on size of the archive and number of documents attached (Aguillo et al., 2010), Organic Eprins is number 45 (http://repositories.webometrics.info/en/world).

Organic Eprints can be used for entering papers for conferences. This was done for the Organic World Congress in 2008 and again in 2014. As a result, 412 papers from the OWC 2008 can now be found in Organic Eprints. It was not used for the OWC 2011, and only 18 papers from that conference can be found there. It is used every odd year for the Scientific Conference on Organic Agriculture for the German-speaking countries, resulting in more than 200 papers from each conference. In this way, papers which may otherwise be difficult to find are available to many users.

Organic Eprints is based on the open-source software Eprints (http://www.eprints.org/ software/), which is continually updated. In addition to these updates, Organic Eprints is developed according to user input and ideas from the Organic Eprints team of national editors. Recent changes are:

AGROVOC (http://aims.fao.org/standards/agrovoc/about) keywords – a controlled vocabulary covering all areas of interest to FAO, including food, nutrition, agriculture, fisheries, forestry, environment *etc*. Each word may have a translation into up to 22 languages. This means that although Organic Eprints has a user interface in English and German, users that are not so familiar with these languages can find keywords in their own language in AGROVOC, e.g. organic agriculture can be found in many languages at http://aims.fao.org/aos/agrovoc/c_15911. Users can then find the English term and use that to search in Organic Eprints. It is at present possible to enter AGRVOC keywords in English, German and Spanish, but we plan to expand this to more languages gradually as users show an interest for this.

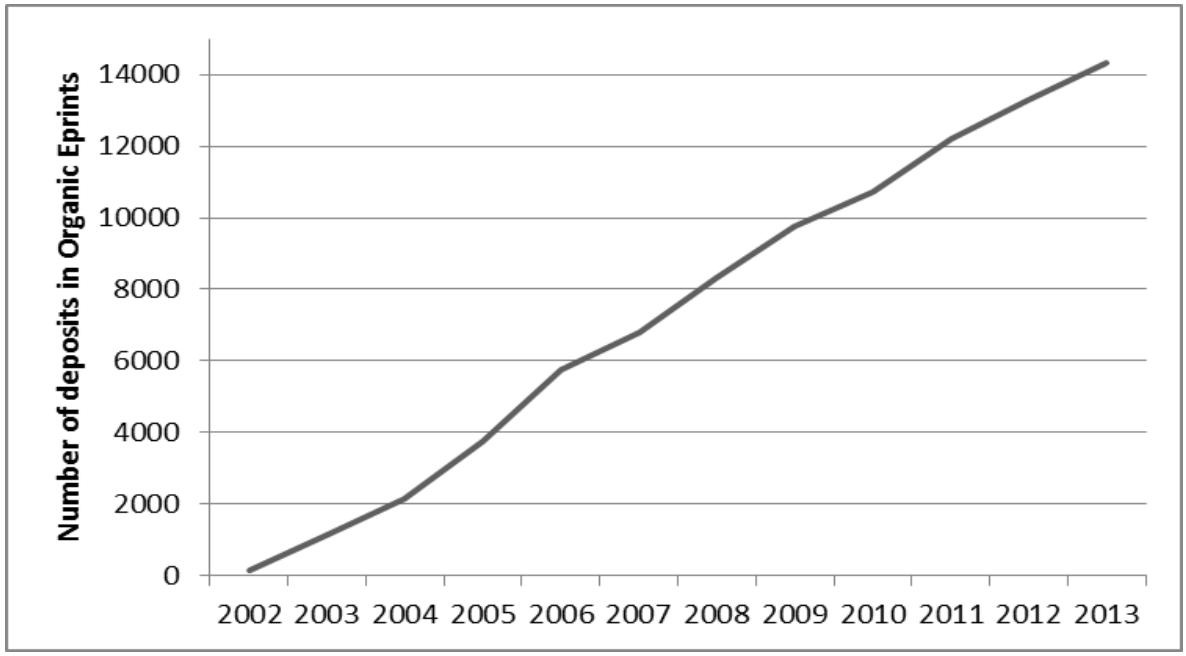


Figure 1. Number of deposits in Organic Eprints over time

Table 1: Number of eprints and registered users compared to continent of origin. Note that the sum does not add up to the totals mentioned in the text, as some eprints are not connected to a country and less than half of the users have given information about their country

Continent	Number of eprints	Number of registered users
Africa	27	242
Asia, Near & Middle East	123	1068
Europe	12392	5186
North America	61	782
Oceania	94	195
South and Central America	263	360

In order to expand the number of Spanish speaking users, we have in collaboration with IFOAM Latin America and others developed a screenshot users manual in Spanish, which can be found here: http://www.icrofs.org/Pages/Publications/orgprints.html

Discussion

Organic Eprints is the largest repository on organic agriculture and food systems – and possibly the only. By depositing documents in Organic Eprints, authors make their work more visible and users get access to more papers. The use of Organic Eprints should be encouraged all over the world, and this could in part be done by recruiting national editors from countries in continents, where Organic Eprints is not so well established.

Acknowledgments

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References

Aguillo IF, Ortega JL, Fernández M & Utrilla AM (2010): Indicators for a webometric ranking of open access repositories. Scientometrics 82:477-486.

Collaborative partnerships between organic farmers

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Key words: farmer collaboration, manure, nutrients

Abstract

A survey of Danish dairy farmers show that around 70% of all organic dairy farmers collaborate around manure, and that the main factors for success in collaboration are trust, reliabilty and timely communication. Organic exporting farmers are less concerned with distance because the organic network is more dispersed. Development of well-functioning collaborative partnerships may increase farm robustness to changing conditions.

Introduction

Organic farms are faced with the same external conditions as conventional farms in terms of environmental regulations, market uncertainties and increased quality standards. This has led to the specialization of organic farms and the decoupling of crop and animal systems resulting in deficits of manure on many arable farms and a nutrient surplus on livestock farms (Darnhofer et al., 2010). One solution to this problem is to establish collaborative partnerships between independent farms (Asai et al., *in review*). In 2009 76% of Danish organic arable farms had agreements with livestock farms to receive their manure, whilst about 70% of organic dairy farms were involved in partnerships and exported their manure (Asai et al., 2012). These agreements can be seen as examples of strategic partnerships that organic farms establish as a way to increase the robustness of their farm enterprise. For farmers, advisors and policy makers, to be able to include collaboration as a potential future strategy, there is a need to know more about the character of existing partnerships: what are farmers collaborating on, and how do they perceive successful partnerships? Therefore we aim to investigate partnerships among organic dairy and arable farmers: what forms of collaborations are established among partners, how are the collaborations organized and maintained and how stable are they? As an example we use a frequently established type of partnerships among organic farmers, manure agreements between dairy and arable farms.

Material and methods

We investigated manure partnerships between organic dairy and crop farmers and between conventional dairy and crop farmers in two regions of Eastern Denmark (Jutland) where organic dairy farming is mostly concentrated. The collaborative partnerships were investigated through a survey. Dairy farms exporting manure to other farms were identified from the Central Husbandry Register (CHR) and the Danish Fertilizer Account reports 2009-2011. Among 256 organic and 1,250 conventional dairy farms which had exported manure, 200 organic and 410 conventional farms were randomly selected. A total of 95 organic dairy farmers and 144 conventional dairy farmers completed the questionnaire. Farmers were asked to evaluate the importance of factors related to the function of the existing partnership: quality and frequency of communication, flexibility of manure reception and the stability of the partnership. They were also asked about their preferences if they were to choose a new partner: how important was the location of the partner's fields for them, the social relations and the partner's skills in farm management. In addition, the questionnaire included a question if they had any other collaborative activities with the partner. In order to understand the diversity of strategies among organic farmers, Multiple Correspondence Analysis and Hierarchal Cluster Analysis were used to establish typologies of organic partnerships.

Results

Dairy farmer found reliability of and timely communication with the partner to be the most important characteristics of their partnership (Table 1). Also flexibility as to when manure was delivered, how much and whether agreements could be adjusted was important. These characteristics were more important than previous knowledge of the partner or his/her professionalism. Only in the case of spatial characteristics

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(distance to and accessibility of the fields receiving the manure) the organic and conventional dairy farmers differed in their preferences. In all other questions there were no differences.

Table 1. Mean rankings for perception of statements on successful collaborative arrangement by manure exporters.

Rank	When selecting a new partner, how important is it that:	Org.	Conv.
1	The partner fulfils our agreements	4.5	
2	The partner informs me well in advance of changes which may affect our agreement	4.2	
3	The partner runs a solid business, so the arrangement can be extended	3.7	
4	The partner conducts organic farming	3.3***	1.1
5	The partner is flexible as to when he receives the manure	3.3	
6	The partner is a person from the local area	3.2	
7	Fields of partner are located close to my animal houses	3.1***	3.4
8	The partner is easy to get in touch with	3.0	
9	The partner is flexible in relation to the amount of manure	2.9	
10	Fields of partner are easy to access	2.7***	3.3
11	The partner will accept manure outside the agreed period	2.7	
12	The partner is a person I already know	2.7	
13	The partner is well informed about environmental regulations and subsidies	2.5	
14	Fields of partner are aggregated and not dispersed	2.5***	3.0
15	The partner is a competent farmer in his/her specialist area	2.3	
16	The partner runs a professional farming enterprise	2.4	
17	We can have frequent contact	2.3	
18	The partner is known by my advisor	2.0	
19	The partner is a person known by someone from my network	1.8	

Mann-Whitney U test: ***P<0.001. Scale ranging from 1 (not important) to 5 (very important)

About 80% of the organic and 70% of the conventional farmers had established at least one additional collaborative activity with their partner besides the manure arrangement. Partnerships between organic dairy and arable farmers comprised significantly more collaborative activities (2.3) than between conventional partners (1.6). Organic partnerships more frequently, in addition to manure, also encompassed grazing agreements, joint nature protection, joint sales and marketing and joint crop management (Figure 1).

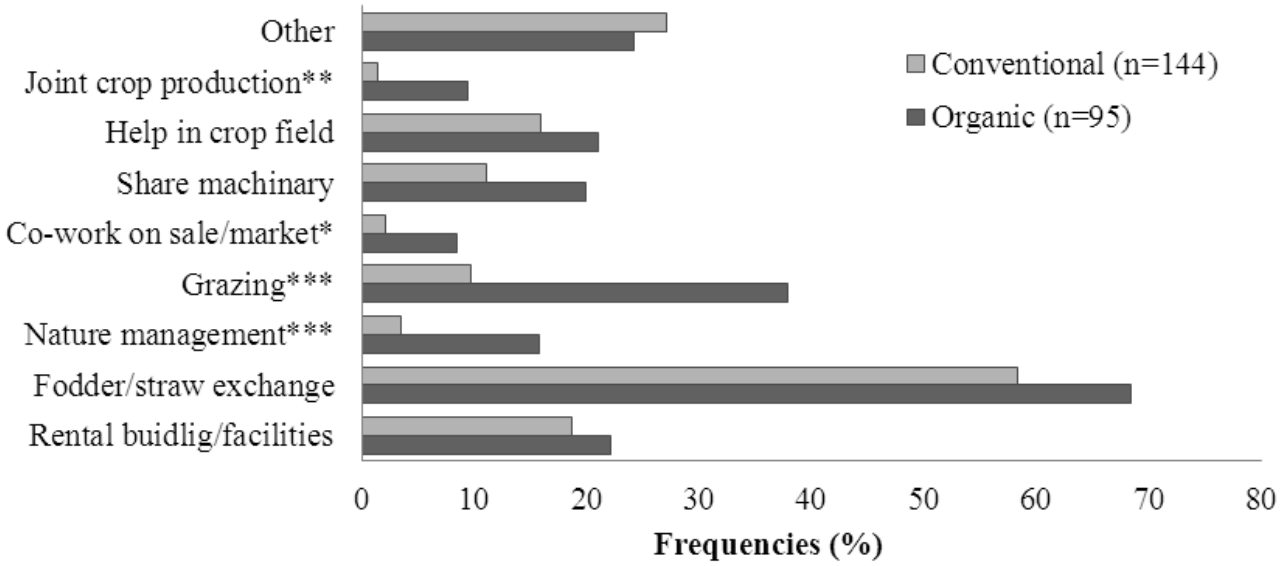


Figure 1. Frequencies of other types of collaborative activities

Frequencies between organic and conventional groups were checked by chi-square test: *P<0.05, **P<0.01 and ***P<0.001. No marks mean not significant.

Our exploration of the diversity of organic partnerships showed that they differ in social and spatial settings and in their degree of mutual obligations, expressed in the duration, communication frequency, economic burden sharing, and form of other collaborative activities (Table 2).

Table 2. Characteristics of partnership types between organic dairy and arable farms

	Group 1 Manure-driven (n=9)	Group 2 Socially-integrated (n=16)	Group 3 Local (n=33)	Group 4 Professional (n=21)	Group 5 Business-like (n=16)
Social relationship	Introduced by other people	Family, local network	Neighbour, local network	Professional network (e.g. farm group)	Neighbour, local network
Communication	Inactive	High frequency: weekly-daily	Infrequent: ~5 times/year	Infrequent: ~5 times/year	Relatively high: monthly
Duration	<5 years	>15 years	5-10 years	Around 10 years	10-15 years
Distance	Mainly >10km	5km~10km	~5km	Mainly >5km, partly >10km	~5km
Price of manure	70% free	Free	Free	50% paid	70% paid
Number of other collaborations	0.4	5.1	2.1	1.6	1.9

Discussion

Farmers perceived collaborative arrangements as successful if the partner could be trusted and reliable, fulfilling the agreements and with the prospect of sustaining a long term partnership. Also the physical and social accessibility of the partner were appreciated as well as the flexibility of the arrangement. Although the demand for organically certified manure by organic arable farms results in more organic partnerships being established without prior knowledge of the partner, many organic dairy-arable partners have strong social connections in spite of being spatially distant. Exploration of the diversity of organic partnerships shows that partnerships among organic farmers are defined mainly by social linkages and spatial settings. As organic farmers are continuously faced with global market conditions and tightening regulations, the development of

collaborative partnerships is necessary as a way of social innovation to strengthen farmers' adaptive capacities to the external changes.

References

Asai, M., Langer, V., Frederiksen, P., 2012. The importance of cooperative farm-based networks for sustainable development of agriculture - A study of manure management networks in Denmark The Vth World Congress of Agronomist and Agrologist, Quebec, Canada.

Asai, M., Langer, V., Frederiksen, P., (In revision). Responding to environmental regulations through collaborative arrangements: The case of Danish manure partnerships. Livestock Science.

Darnhofer, I., Lindenthal, T., Bartel-Kratochvil, R., Zollitsch, W., 2010. Conventionalisation of organic farming practices: from structural criteria towards an assessment based on organic principles. A review. Agronomy for Sustainable Development 30, 67-81.

Resource use in a low-input organic vegetable food supply system in UK - a case study

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Key words: vegetables, emergy, box scheme, supermarket, food supply

Abstract

The sustainability of a small-scale low-input organic vegetable farm in United Kingdom with high crop diversity and a related box scheme food supply system was assessed by emergy evaluation, an environmental accounting method based on the direct and indirect use of solar equivalent joules. The main questions for this study were how much the considered system contributes to society by taking advantage of local renewable flows, and how much it depends on input from society. By understanding the dynamics of this system we contribute to bridging the gap between practice and scientific knowledge. Our study is an example of how systems today need to take advantage of current cheap energy to avoid getting out-competed, while at the same time maintaining autonomy and freedom of action should any of the large scale systems supplying transport, money, energy or labour fail.

Introduction

Contemporary food production and distribution systems are due to their fossil fuel dependency inherently unsustainable. It has for instance been shown that more than four joules of fossil energy is used to produce and transport one joule of food energy in the Danish food production system (Markussen et al. 2013). In a fossil fuel deprived future, sustainable systems need to adapt to reduced availability of high quality energy input by relying more on local and renewable resources. In this study we assess the resource use of a vegetable production and distribution system which represents a fundamentally different way of producing and distributing vegetables than the dominating supermarket-driven mass distribution systems. The resource use in the system is evaluated based on emergy assessment (Odum 1996). A benchmarking of this system against two modelled organic farming systems which distribute vegetables via supermarkets may be found elsewhere (Markussen et al 2014).

Material and methods

The small stockless organic farm studied (Figure 1) covered 6.4 ha of which 5.6 ha were cropped. The farm produced more than 48 different vegetable crops. Data on all purchased goods for crop production and distribution, as well as a complete list of machineries and buildings were collected by on-farm interviews. In the analyses, data from 2009 and 2010 were averaged. The farm was managed to reduce inputs as much as possible. All seedlings were grown on the farm based on own produced potting compost and the use of imported animal manure was completely avoided. Soil fertility was maintained by the use of fertility-building crops in 7- or 9-year crop rotations. The only purchased materials for soil-fertility enhancement were 100 m^3 woodchips, which were composted on the site, and small amounts of lime and kali vinasse which were primarily used for seedling compost production. More details about the case study are described elsewhere (Markussen et al. 2014).

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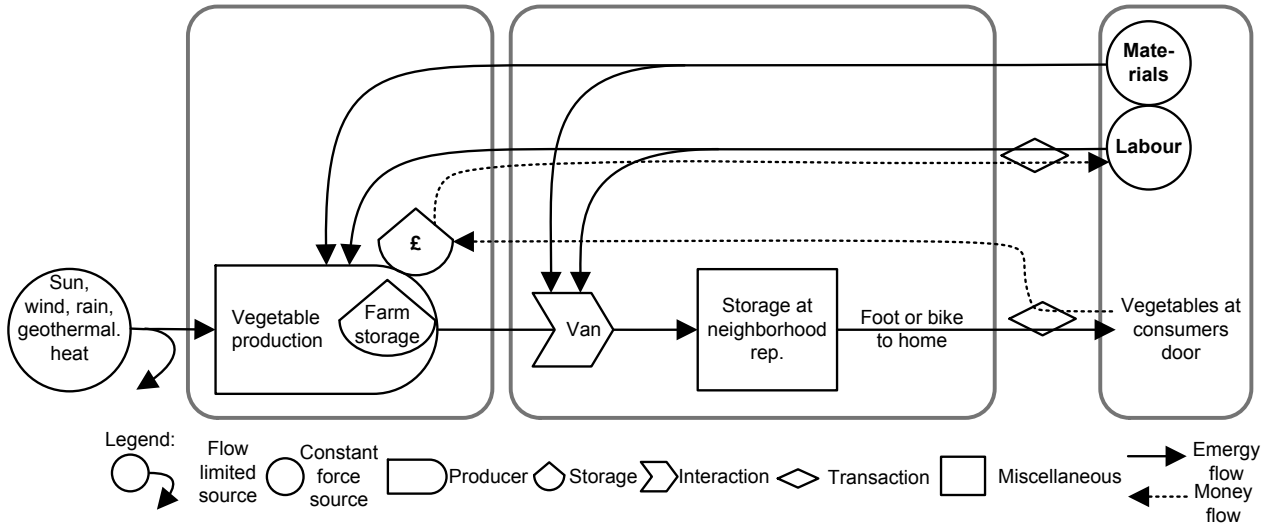


Figure 1. The studied system consists of a farm producing vegetables and the distribution of the vegetables via a box scheme

The farm managed its own box scheme where bags of vegetables were packed every week with a well-defined content depending on the season. These bags provided vegetables to 200-300 customers. The products were distributed through neighbourhood representatives within a 50 km radius, which means that once a week boxes were delivered to collection points throughout the delivery area. Customers could then pick up the vegetables at these places preferably by bike or on foot.

The resource use was assessed by emergy (spelled with an “m”) accounting. Emergy is defined as ‘the available solar energy used up directly or indirectly to make a product or service’ (Odum 1996). The emergy support required to provide a product or service is calculated by adding up all kinds of available energy (exergy) used after converting them to the same unit of solar equivalent joules (seJ). The conversion factor, the transformity (seJ/J), measures at the same time the efficiency of the corresponding processes in transforming solar energy into useful energy. Emergy assessment is particularly useful for studying agricultural systems as it accounts for non-commercialized natural resource inputs (e.g. solar irradiation, rain, soil etc.) as well as inputs from human-dominated systems (refined fossil fuels, goods, labour). From an emergy perspective, agricultural systems capture and transform local renewable available energy into products that are useful for society.

Results

The farm distributed in average around 45 tonnes of vegetables per year. Based on the nutritional value for each type of vegetables, the total food energy produced annually was calculated as 74.3 GJ, of which 87% originated from storable crops and the remaining 13% from fresh crops. In total this amount corresponds to the food energy needed for 19-23 people for one year (based on a daily intake of 8.8-11 MJ recommended by United Nations (2012) and disregarding the diet composition).

Based on emergy accounting, the total environmental and societal flows supporting the system were calculated. The emergy used for supporting direct labour within the system and indirect labour for manufacturing and supplying inputs made up 89% of total emergy used. As these numbers are based on the environmental support to the total UK economy, this reflects more the high national resource consumption than the specific business. Further, they emphasise that environmental support for labour in an industrial economy is inherently resource intensive. To avoid distorting the results of the actual system with the implications of being embedded in the UK economy, we considered in the following emergy indicators without accounting for labour.

Purchased materials for production constituted 87% of total emergy support without accounting for labour. Fuel used for cultivation, including irrigation, and electricity used for production of seedlings were the largest single flows with 26% and 11%, respectively, of total emergy used (Figure 2). Irrigation used in total 24% of all resources. Of these, 72% was water consumption (17% of total emergy flow). The woodchips used as soil-fertility enhancement and to produce potting compost contributed with 94% of the soil-fertility

enhancement (10% of the total emergy flow). Seed and seedlings, farm assets and distribution of the vegetables (mainly diesel consumption) each contributed with 7-8% of the total emergy flow. The direct energy use for distribution was estimated to 465 l/year. The fuel use for tractors, delivery vehicles and other machinery corresponded to around 7.5 litres per year per family supplied with vegetables and the total electricity use on the farm corresponded to that of an average household.

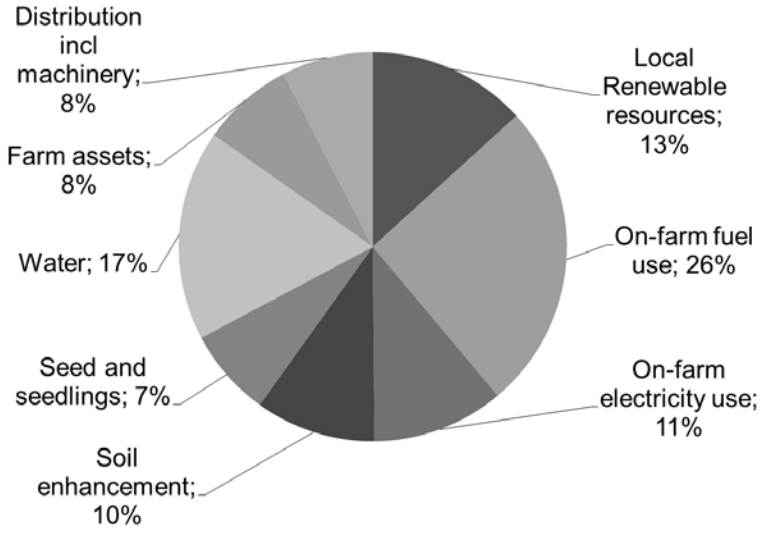


Figure 2. Emergy profile visualizing the different inputs required from society and the renewable inputs received by the farm area

The transformity (seJ/J) summarizes the efficiency of the system in transforming renewable and societal resource into vegetables. To produce 1 J of vegetables, 5.54E+05 seJ were required (not accounting for labour). This efficiency was somewhat better than for a typical organic production system delivering a comparable amount in food energy of less diverse vegetables distributed via supermarkets (Markussen et al. 2014). The ratio of the total emergy flow to the emergy invested from society equalled 1.15 indicating that free local environmental services contributed with 0.15 seJ for each seJ invested from the society. In other words, the final service was based more on fossil fuel subsidized inputs from society than on sun, rain, wind and geothermal heat received locally on the farm area. The share of local renewable resources was only 13 % of total emergy input. These results are notable as the farm was managed with focus on energy savings and a strong preference to minimise external inputs and utilize local renewable resources.

The largest potential for improving the percentage of local renewable resources is to reduce the amount of imported fuels. However, also producing the woodchips or part of them within the geographical boundaries of the farm would improve the net-benefit for society. The woodchips were supplied from a nearby gardener who pruned and trimmed local gardens. In the present society, these woodchips are considered as a waste but in an emergy assessment they are considered as a resource which has required a large amount of solar energy to be produced outside the considered system boundaries.

Discussion

The emergy assessment provides a way to determine to which degree vegetables are produced and distributed based on local renewable resources as opposed to imported fossil fuel subsidized resources. Our study has shown that even this dedicated low-input system got 87% of the total environmental support from the society. While it is attractive to reduce fossil fuel subsidized inputs to enhance resilience and adaptability towards foreseeable constraints on high quality energy resources, the results also show that these inputs provide essential services. For instance, it is unlikely that delivery of vegetables by foot or bike or substituting diesel powered tractors with human or animal power is economically feasible. However, due to the focus on renewable resources and the local supply chain, the studied food supply system is likely to be in a better position to adapt to future environmental constraints than the dominating mass distribution systems which depend on economy of scale and large throughput of goods and fuel.

Acknowledgement

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References

Markussen MV & Østergård H (2013) Energy Analysis of the Danish Food Production System: Food-EROI and Fossil Fuel Dependency. Energies 6, 4170-4186.

Markussen MV, Kulak M, Smith L, Nemecek T & Østergård H (2014): Evaluating the sustainability of a small-scale low-input organic vegetable food supply system in the United Kingdom. Sustainability (accepted).

Odum HT (1996): Environmental accounting - Emergy and environmental decision making. New York/Chichester/Brisbane/Toronto/Singapore: John Wiley & Sons, Inc.

United Nations (2012): What is Hunger? | WFP | United Nations World Food Programme - Fighting Hunger Worldwide. http://www.wfp.org/hunger/what-is

Bridging the gap between scientific knowledge and practice: how can we assist organic farmers in sustaining wild bees and pollination on their farms?

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Key words: pollination, wild bees, farm assessment, clover seed, apple, landscape

Abstract

Wild bees (bumblebees and solitary bees) are declining in Denmark as in the rest of Europe, resulting in reduced yield stability in insect pollinated crops and insufficient pollination of wild plants. Farmers are the most important actors influencing wild bee conditions in farmland, and organic farmers are especially attentive to pollination due to both production stability and biodiversity in general. Therefore the challenge is to provide farmers with tools to evaluate their farm for its quality for wild bees, thus offering an option to be proactive in improving on farm bee conditions. The tool proposed in this paper is a science based scoring system, based on an existing scientific model linking resources and wild bees on landscape level and modified to the Danish context. The tool guides farmers through an field estimation of nesting and flower resources on the farm during the season. Development of the tool is done in collaboration with organic red clover seed producers and apple growers, who test the tool and offer feedback on user friendliness to adjust the tool. Farmer use of the tool will increased trust and improve yield stability in insect pollinated crops.

Introduction

Wild bees (bumblebees and solitary bees) are two important groups of wild pollinators in temperate zones, delivering pollination services to crops and wild plants. It is well documented that wild bees are declining nationally and regionally in Europe (Biesmeijer et al., 2006) threatening crop pollination estimated to 14 mia. euro/year. Wild bees are dependent on presence of high quality flower resources and on suitable nesting and overwintering sites locally (Strandberg et al., 2011). In the agricultural landscape, availability of these resources depend on land use, i.e. distribution between arable land and uncropped areas, crop distribution and management as well as quantity and quality of permanent grasslands, hedgerows, road verges, etc. Although organic farms have the potential for harboring wild plants with high flower intensity due to absence of herbicides and crop distribution (Henriksen et al., 2013), organic farms in practice vary highly in availability of food and nesting resources temporally and spatially.

Establishing general measures to improve conditions for wild bees on organic farms is not simple. Wild bees use a range of floral resources including agricultural crops such as red clover, field bean, apple etc., in addition to wild flowers and ornamental plants. Foraging and nesting requirements are species specific which means that different species of bees are associated with different habitats and plant species. Although foraging distances vary from a few hundred meters to up to several kilometers, most wild bees forage on a local scale, often less than 300 m from the nest (Osborne et al., 2008). Flower resources and nesting sites are unevenly distributed spatially and temporally and resources in one year may affect populations the following year. However, for organic farmers with insect pollinated crops like seed crops, seed legumes and tree fruit pollination is a key issue and they face the risk of yield reduction due to insufficient pollination. In many agricultural contexts these high value crops form the economic base of organic arable farmers, and securing yield stability and decreasing risk is of outmost importance. For these crop types, the importance of wild bee pollination ranges from being vital (red clover seed, apples) to being supplementary to honey bee pollination (field beans) but in general yield stability and quality is improved by wild bee pollination (Garibaldi et al., 2013). Thus, farmers have a strong motivation to improve living conditions for wild bees. Farmers with insect pollinated crops often depend on managed honey bees for pollination. However a decline in honey bee keeping in Europe (Potts et al., 2010) and reports on Colony Collapse Disorder (Vejsnaes et al., 2010) indicate that pollination of crops by honey bees may become insufficient. Furthermore recently it has been shown that pollination by wild insects increase crop yield independent of honey bee abundances (Garibaldi et al., 2013).

Most available scientific knowledge on wild bees in agricultural landscapes has focused on certain species or groups in specific contexts and thus offers valuable pieces of knowledge to the picture. However making the existing knowledge operational for farmers and policy makers is difficult but nonetheless required, taking the

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urgency of the problem into account. In this paper we will present an example of the type of fragmented results which are available and discuss whether and how this type of scientific knowledge may be applied in practice and be brought into action. .

Material and methods

Two groups of wild pollinators of importance in temperate zones, bumblebees and solitary bees, were trapped (pan traps) in road verges bordering 14 organic (organic sites) and 14 conventional (conventional sites) winter wheat fields. Pairs of organic and conventional were located in agricultural landscapes with similar proportions of semi-natural habitats in a circle with radius 1 km around the sampling site, ranging from 10 to 42%. The quantity and quality of local flower resources in the road verge and adjacent field headland were estimated as overall density of dicotyledonous herbs in the flowering stage (quantity) and density of plants containing combined high pollen and nectar amounts (quality). Potential flower and nesting resources in the surrounding landscape were assessed using semi-natural habitats as a proxy at four different scales (for details see Henriksen,2013).

Results and discussion

As shown in many other studies the organic farming system had a positive effect on plant species richness and density of plants and thus on the overall flower resources for bees. Here, also the quality of the flower resource for bees were assessed, and the availability for bees of species evaluated as “high value bee plants” in the flowering stage were significantly higher in both wheat fields and road verges in organic sites compared with the conventional sites. This shows that organic farming practices not only enhance species richness and the quality of the flower resource (high value bee plants) in the arable field, but also contribute to creating a more diverse and higher flower quality in adjacent uncropped habitats (here road verges) compared with the conventional farming system. The more abundant flower resources in organic wheat fields, mostly originating from annual weeds, contributed to the greater numbers of individuals and species of solitary bees in the organic farming system, as solitary bees exploited the flower resources at short distances from the nest. In contrast bumblebees did not respond positively to organic compared with conventional farming, but higher numbers of individuals and species was seen with increasing proportion of semi-natural habitats in both organic and conventional sites at 1000 m scale (figure 1). The lack of response by bumblebees to organic management of arable fields was probably seen because bumblebees depend more on flowers of perennial plants found in semi-natural habitats and the flower resource of mostly annual plant species in organic arable fields play a minor role for this group. Also the solitary bees benefitted from a higher proportion of semi-natural habitats, as this resulted in increased number of individuals and number of species at smaller spatial scale than the bumblebees (250 m and 500 m scale) at both organic and conventional sites.

The results from our study exemplifies the type of data currently available on wild bee conditions and responses. They all offer a small piece of the picture but are difficult to make operational and use for targeted actions. If the goal is to provide organic farmers with practical tools, thus offering an option to be proactive in improving on farm bee conditions, one way to proceed is to attempt to develop an assessment tool. It must be science based but pragmatic, acknowledging that our knowledge is detailed, but fragmented. Recently existing knowledge has been integrated into a predictive model, which link land use on farm scale with pollinator requirements to predict pollinator abundance and pollination (Lonsdorf et al., 2009). In a planned project, we hope to modify this model to create a science based assessment tool for farmers. The tool would be made to guide farmers through a field estimation of nesting and flower resources on their farm during the season, and the development, user tests and validation will be done in collaboration with motivated organic farmers, e.g. clover seed producers, apple growers and field bean producers. If successful, such a tool could make the best available knowledge accessible for organic farmers in a robust form and facilitate improvements for wild bees, crop pollination and help document biodiversity benefits of organic farming practices.

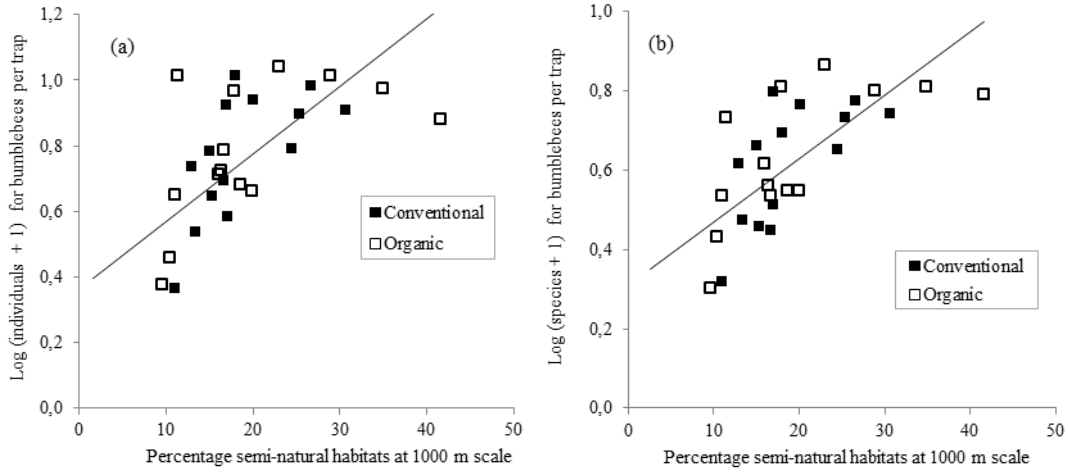


Fig. 1. Effect of semi-natural habitats at 1000 m scale on (a) number of individuals and (b) species of bumblebees.

References

Biesmeijer, J. C., Roberts, S. P. M., Reemer, M., Ohlemuller, R., Edwards, M., Peeters, T. et al. (2006). Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands. Science, 313, 351-354.

Garibaldi, L. A., Steffan-Dewenter, I., Winfree, R., Aizen, M. A., Bommarco, R., Cunningham, S. A. et al. (2013). Wild pollinators enhance fruit Set of crops regardless of Honey Bee Abundance. Science, 339, 1608-1611.

Henriksen, C. I. (2013). Bumblebee and solitary bees - effects of farming and semi-natural habitats. PhD thesis. Copenhagen University.

Lonsdorf, E., Kremen, C., Ricketts, T., Winfree, R., Williams, N., & Greenleaf, S. (2009). Modelling pollination services across agricultural landscapes. Annals of Botany, 103, 1589-1600.

Osborne, J. L., Martin, A. P., Carreck, N. L., Swain, J. L., Knight, M. E., Goulson, D. et al. (2008). Bumblebee flight distances in relation to the forage landscape. Journal of Animal Ecology, 77, 406-415.

Potts, S. G., Roberts, S. P. M., Dean, R., Marris, G., Brown, M. A., Jones, R. et al. (2010). Declines of managed honey bees and beekeepers in Europe. Journal of Apicultural Research, 49, 15-22.

Strandberg, B., Axelsen, J.A., Kryger, P., Enkegaard, A. (2011). Bestøvning og Biodiversitet. National Environmental Research Institute, Aarhus University.

Vejsnaes, F., Nielsen, S. L., & Kryger, P. (2010). Factors involved in the recent increase in colony losses in Denmark. Journal of Apicultural Research, 49, 109-110.

Aerts S, Lips S, Spencer S, Decuypere E & De Tavernier J (2006): A new framework for the assessment of animal welfare: integrating existing knowledge from a practical ethics perspective. Journal of Agricultural and Environmental Ethics 19, 67-76.

European Commission (2007): A new health strategy for the European union (2007-2013) where "Prevention is better than cure", Bruxelles, 26p

Rousing T, Bonde M & Sorensen JT (2000): Indicators for the assessment of animal welfare in a dairy cattle herd with a cubicle housing system. In: Blokhuis HJ, Ekkel ED & Wechsler B (eds): Improving health and welfare in animal production. EAAP-publication 112, 37-44.

The challenges organic food processors meet at small emerging market – Estonian case

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Key words: processing, market

Abstract

Estonian organic food market is still in emerging stage and the main bottleneck is lack of organic processing. The main purpose of the study was to find out the current situation of organic processing companies in Estonia: what are the structure and characteristics of companies; how do they evaluate organic processing certification procedure; what are their main problems and how do they see the future of organic market. 27 organic food processors were questioned in spring 2013. Most of the organic processors are micro- and small-scale companies. One of the main obstacles for organic processors is higher price of products. Weak points are unstable production chain, high logistics costs, and lack of modern/new equipment, investments, know-how and advisors. Organic certification process was considered "rather easy" for most of the respondents. More strategic planning and cooperation at the local and national level are needed to secure balanced development of organic processing sector.

Introduction

Organic farming is a growing trend all over the world (Willer et al., 2013). In Estonia the share of organic land is 15% of all agricultural land and the number of organic farmers is growing (Vetemaa and Mikk 2013). Estonian organic food market is still in forming stage. At the end of 2012 there were 158 certified processors, but most of them are just packaging or storing, not producing new products (Agricultural Board). Market share of organic food products is marginal - 1,6% of food market in 2011 (TNS Emor 2012a) and significant share of organic production is still processed as conventional food. The main purpose of the study was to find out the current situation of organic processing companies in Estonia: what are the structure and characteristics of companies; how do they evaluate compliance with legal requirements related to organic processing; what are their main problems; how do they see the future of their business and organic market.

Material and methods

To find out the situation of organic processors, a questionnaire of 24 up to 26 open and closed questions was conducted for different types of companies. Studied companies included 1) companies who process mainly their own produced raw materials (farmers), 2) companies who buy in all raw materials and process organic products (some of them produce both conventional and organic), 3) companies who are certified for some organic products beside conventional processing, but actually are not marketing, 4) companies who had backed out of organic certification in 2013. All the studied companies were certified for producing new products (those who are just packaging or storing were not included). During March and April 2013, 27 processing entrepreneurs were questioned.

Results

Most of the studied companies were micro- (67%) and small-size (22%) enterprises. The number of employees in micro enterprises is most commonly (78%) from 1 to 5. Availability of organic raw material in region was considered "satisfying" for 52% of respondents, "poor" for 20% and "good" for 28% respectively. Availability of processing equipment and handling materials was considered "good" by 59% of respondents, "satisfying" for 37% and "poor" for 4%. Most of the companies had "used" or "combination of used and new equipment" (85% of companies) when they started organic processing and only 15% of companies used new equipment. Mostly universal type of production lines were used (70%), which provides more flexibility and variety in production.

Half of the companies have used financial support scheme and/or bank loan in addition to self-financing, for 38% of cases two different financial support/loan combination were used. Currently there is no specific financial support for organic processing available in Estonia. Availability of financial support was considered "poor" by 39% of respondents and "good" by 15%, while 46% did not answer to this question.

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Availability of necessary know-how was considered “satisfying” by 58% of companies, “poor” by 15% and “good” by 27%. Currently there are no advisors who are specialized in organic processing in Estonia.
Access to marketing channels was considered “good” by 62% of companies, “satisfactory” for 17% and “poor” by 21%. Main obstacles of marketing are considerably higher price of organic food, also limited access to bigger chains and shortage of financial support. Currently most organic goods are sold via direct marketing and specialized organic stores in Estonia (TNS Emor 2012a). Supermarkets have generally lower proportion in sales of organic goods in most European Union member states (Wier et al., 2008), but increased availability of organic goods would promote regular consumption of organics (Zagata 2012).
The number of substitute products in the market is considered “big” by 45% and “small” for 36% of respondents, while 19% did not answer. Processing volume is based on orders (38% of respondents), it shows that production is not planned in long-term. The actual capacity is bigger than production and actual market potential is still not used. The competition between organic processors was mostly considered “average” (50%) or “small” (38%). Based on study in 2011, some organic farmers (23%) are ready to start organic processing and preparation of organic products for the market (The Agricultural Research Centre 2011).

A direct need for legislative amendments related to organic processing was not identified. Organic certification process was considered “rather easy” for 72% of companies and “rather complicated” for 28%. Respondents were not very optimistic about the growth of organic sector. The future prospects were considered “good” or “very good” by 48% of companies, “satisfying” for 30% and “weak” by 22% of respondents. On the other hand organic farming and demand for organic goods is continually rising (TNS Emor 2012a). Main factors that hinder business activities according to respondents are: substantially higher price of organic food and smaller demand; problems with marketing; availability of high-quality local raw material with competitive price; lack of financial support. The availability of raw material is hindered by transport and logistics costs, because organic farms are often small and located all over Estonia.
Consumer research in 2011 showed that Estonian consumers are very price sensitive and 53% of respondents were not willing to pay higher price for organic goods. Only 3% of consumers are willing to pay extra 20% price for organic goods (TNS Emor, 2012b). Also according to international study in 2011, main obstacle in organic food consumption is its higher price: consumers are not willing to pay more than 15% extra for organic food (OECD 2011). Main factors that favour organic food business activities according to Estonian organic food processors are: positive attitude towards organic farming, organic farming as a rising trend and consumer demand. 85% of respondents see a good perspective in sector cooperation, especially in product development and marketing.

Discussion

One of the main obstacles for organic processors is considerable higher price of end product compared to conventional food and small purchase power of local consumers.
Weak points are unstable production chain, high logistics costs, lack of modern/new equipment, shortage of know-how, lack of advisors and investments. Poor availability of organic raw products and know-how is especially highlighted by the companies who are certified but have no products available on market yet.
Organic certification process was considered “rather easy” for most of the respondents. Fear of bureaucracy in connection with organic certification is often mentioned by conventional food companies as obstacle. More information on certification legislation and presentation of good examples of organic processing companies would obviously lead to new organic certified companies.
Strategic planning and cooperation is required at the local and national level to secure balanced development of organic processing sector.

Acknowledgements

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References

Agricultural Board (Organic register).
Available: http://www.pma.agri.ee/index.php?id=104&sub=128&sub2=319

OECD (Organisation for Economic Co-operation and Development). 2011. Greening Household Behaviour: The Role of Public Policy, 2011.
Available: http://www.oecd.org/env/consumption-innovation/47235947.pdf

The Agricultural Research Centre. Research concerning marketing of organic goods and agro technical methods used by organic farmers.
Available: http://pmk.agri.ee/pkt/files/f13/Mahe_e_uuring_2011.pdf

TNS Emor 2012a. Research concerning Organic Market in year 2011.
Available: http://www.agri.ee/public/juurkataloog/UURINGUD/2013/uuring-maheturg2011-2013.pdf

TNS Emor 2012b. Reseach concerning Estonians purchase preferences and attitudes towards foods 2012.
Available: http://www.agri.ee/public/juurkataloog/UURINGUD/2013/uuring-2012-ostueelistused.pdf

Vetemaa, A., Mikk, M., (Editors) 2013. Mahepõllumajandus Eestis 2012. Organic farming in Estonia 2012.
Available: http://www.maheklubi.ee/upload/Editor/trykis-mahepollumajandus-2012.pdf

Wier, M., Jensen, K.O., Andersen, L.M., Millock, K. 2008. The character of demand in mature organic food markets: Great Britain and Denmark compared. Food Policy, 33, 2008, pp 412-413.

Willer, H., Lernoud, J., Home, R. The World of Organic Agriculture Statistics and Emerging Trends 2013, FiBL and IFOAM Report,
Available: http://orgprints.org/22324/

Zagata, L. 2012. Consumers' beliefs and behavioural intentions towards organic food. Evidence from the Czech Republic. Appetite, 59, 2012, pp. 88

The metabolomic fingerprinting and microbiological quality of winter wheat (*Triticum aestivum* L.) in different organic growing systems

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Key words: metabolomic fingerprinting, microbiology, wheat, organic systems

Abstract

Growing system is important for soil fertility as well as for quality parameters of crops. The aim of this study was to investigate the influence of green manures as winter cover crops and their combination with composted cattle manure on microbiological quality and metabolomic fingerprinting of winter wheat in a crop rotation experiment in three organic systems. The study showed that green manures in combination with cattle manure had impact on metabolomics and significantly increased expression of metabolites of winter wheat. Also the abundance of mesophilic bacteria and the ratio of bacteria/yeasts and moulds was higher in wheat of the same growing system.

Introduction

Growing system does not only influence the soil fertility, but through that also the quality parameters of crops (Olesen et al 2009; Mäder et al 2002). In organic agriculture soil fertility is essential for harvesting high quality crop yields. Therefore, it is important to develop sustainable growing systems which have rotations with appropriate crops and cover crops. In organic farming green manures and cattle manure are used to ensure fertile and biologically active soil and to enhance biodiversity. Green manures offer supporting services, such as nutrient cycling, promotion of beneficial insects for pest control and soil formation. Also the catch crops on winter period are essential to reduce nutrient leaching (Stark and Porter 2005).

For estimation product quality depending on plant growing systems different methods are developed. In recent years food metabolomics has been used as a novel method for `fingerprinting` or for ´profiling´ food samples (Hajšlova et al 2011). `Fingerprinting` of food samples enables to perform comparative analyses aimed at detection of differences. ´Profiling´ is used for identification individual, differential sample components (both primary and secondary metabolites). Production system and interaction among the microbial population are important factors that also affect food safety and shelf life (Guerzoni et al 1996). Among the microorganisms, some moulds, yeasts, bacteria, and viruses have both desirable and undesirable roles in our food. Most bacteria, moulds, and yeasts, because of their ability to grow in foods, can potentially cause food spoilage, however mere microbial presence does not reduce the quality of food, except in the case of some pathogens (Ray 2005).

The aim of present study was to find out the influence of green manures as winter cover crops and these combined with composted cattle manure on metabolomic fingerprinting and microbiological quality of winter wheat in a crop rotation experiment in three organic systems at the Estonian University of Life Sciences in 2012.

Material and methods

The variety of winter wheat was `Olivin` and it was orginated from farming systems experiment established in 2008. In a five-field crop rotation, barley undersown with red clover, red clover, winter wheat, peas and potato were grown in succession. System Org 0, as control, follows this rotation. In System Org 1, green manures as winter cover crops were used: after winter wheat - ryegrass, after peas -winter oilseed rape and after potato - winter rye. In System Org 2 green manures plus cattle manure at 40 t/ha was applied. Thus, in both Systems Org 1 and 2 all plots had green plant cover in winter. The soil type of the area is sandy loam Stagnic Luvisol by the World Reference Base (WRB) 2006 classification (FAO 2006).

Winter wheat was analysed by ultrahigh liquid chromatography – q-Tof mass spectrometry (LC-MS) using reversed-phase LC columns and both positive and negative electrospray ionisation. Mass Profiler Software and R statistical programmes were used for PCA and ANOVA. Raw data are aligned and analyzed for a

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differential effect of agricultural production system on the concentration of individual compounds in the winter wheat, and compounds of interest are identified.

Microbiological quality was analysed post harvesting (autumn 2012) and in the end of storage time (spring 2013). For the enumeration of total microorganisms (aerobic mesophilic bacteria) on winter wheat Colony-count technique at 30 ºC (EVS-EN ISO 4833:2006) and for enumeration of total yeasts and moulds Horisontal method at 25 ºC (ISO 21527-1:2008) was used. Statistical analyses were done using R programme. One-way ANOVA was applied to test the effect of farming systems on counts of total microorganisms and yeast and moulds.

Results

Metabolomic fingerprinting

Initial data analysis on one dataset with approximately 3500 detected metabolites (mass spectral features) shows that 120 compounds were differentially expressed ($p<0.05$) between the Org 0, Org 1 and Org 2. The highest number of expressed metabolites was in Org 2 ($p<0.05$). Org 1 had more expressed metabolites than Org 0, but no statistical differences occurred. PCA of winter wheat showed that it was possible to differentiate between systems Org 0, Org 1 and Org 2.

Microbiological quality

In winter wheat of all systems aerobic mesophilic bacteria was presented in bigger numbers than yeasts and moulds in both times – post harvest - in autumn and after storage period – in spring. The tendency was observed that the counts of bacteria were bigger in the end of storage than in post-harvesting period. The highest amount of aerobic mesophilic bacteria was in wheat of system Org 2 ($p<0.05$) than from other systems in post harvesting period and in spring. The counts of yeasts and moulds decreased during storage period, their smallest amounts were in wheat of Org 0 in autumn and in spring in wheat of Org 2 ($p<0.05$). In post harvesting period and in the end of storage the ratio of bacteria/yeasts and moulds was higher in wheat of Org 2 than in other systems.

Discussion

Our study showed that growing system determines the quality of wheat. In organic farming it is important to use systems that assure sufficient yields with high quality. In growing system the use of green manures as winter cover crops in combination with composted cattle manure had impact on metabolomics and significantly increased expression of metabolites of winter wheat. The studies of Zörb et al (2006) and Belleggia et al (2013) showed also that cultivation method infuences the metabolomics of wheat. Our study was also shown growing system influence on microbiological quality of winter wheat.. The abundance of mesophilic bacteria and the ratio of bacteria/yeasts and moulds was higher in winter wheat in the growing systems where green manures were combined with cattle manure. The lower number of yeasts and moulds could be explained by the ability of bacteria to suppress yeasts and moulds. Oliveira et al (2010) have shown that lettuce fertilized organically and conventionally had different bacteriological quality and content of yeasts and moulds. But several authors (Moreira et al 2003; Phillips and Harrison 2005¸ Seidler-Lozykowska et al 2008) have not found significant differences in amounts of bacteria, yeasts and moulds in spring mixture of multiple salad, thyme herb and Swiss chard from different farming systems. The investigations should be continued for the clarification of growing systems influence on the microbiological quality of product.

Acknowledgement

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References

Beleggia R, Platani C, Nigro F, De Vita P, Cattivelli L ja Papa R (2013): Effect of genotype, environment and genotype-by-environment interaction on metabolite profiling in durum wheat (*Triticum durum Desf*.) grain. Journal of Cereal Science 57, 183-192.

EVS-EN ISO 4833:2006. Microbiology of food and animal feeding stuffs – Horizontal method for the enumeration of microorganisms – Colony-count technique at 30 °C.

EVS-ISO 21527-1:2008. Horisontal method for enumeration of total yeasts and moulds at 25 °C.

FAO. World Reference Base for Soil Resources (2006): Available at ftp:// ftp.fao.org/docrep/fao/009/a0510e/a0510e00.pdf

Guerzoni ME, Gianotti A, Corbo MR & Sinigaglia M (1996): Shelf-life modelling for fresh-cut vegetables. Postharvest Biology and Technology 9, 195– 207.

Hajšlova J, Vaclavik L, Schulzova V & Novotna H (2013):. Metabolomic fingerprinting / profiling: the challenge in organic crops authentication. Book of Abstracts. Eds: Pulkrabova J. et al. First International Conference on Organic Food Quality and Health Research, May 18–20, 2011, p35.

Maeder P, Fließbach A, Dubois D, Gunst, L, Fried P & Niggli U (2002): Soil fertility and biodiversity in organic farming. Science 296, 1694–1697.

Moreira MDR, Roura SI & del Valle CE (2003): Quality of Swiss chard produced by conventional and organic methods. Food Science and Technology 36, 135–141.

Olesen JE, Askegaard M & Rasmussen IA (2009): Winter cereal yields as affected by animal manure and green manure in organic arable farming. European Journal of Agronomy 30, 119–128.

Oliveira M, Usall J, Viñas I, Anguera M, Gatius F & Abadias M (2010): Microbiological quality of fresh lettuce from organic and conventional production. Food Microbiology 27:5, 679-684.

Phillips CA ja Harrison MA (2005): Comparison of the microflora on organically and conventionally grown spring mix from a California processor. Journal of Food Protection 68:6, 1143-1146.

Ray B (2005): Fundamental food microbiology. Third edition. Normal microbiological quality of foods and its significance. Vegetables, fruits and nuts. Chapter 4.

Seidler-Lozykowska K, Golcz A, Kozik E & Wojcik J (2008): Quality of Thyme (*Thymus vulgaris* L.) from organic cultivation. 16th IFOAM Organic World Congress, Modena, Italy, June 16-20.

Stark JC & Porter GA (2005): Potato nutrient management in sustainable cropping systems. American Journal of Potato Research 82, 329–338.

Zörb C, Langenkämper G, Betsche T, Niehaus K & Barsch A (2006): Metabolite profiling of wheat grains (Triticum aestivum L.) from organic and conventional agriculture. Journal of Agriculture and Food Chemistry 54(21), 8301-8306.

Study on Identification of Gaps and Intervention Needs of Smallholder Organic Farmers in Ethiopia

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Key words: Organic, smallholder and gaps

Abstract

A study on identification of the major gaps of organic farmers in Ethiopia in terms of technical, technological, institutional and financial is conducted in year 2011 in order to develop strategic programme that fill their gaps. Both primary and secondary information were collected from 80 respondents representing 14 cooperatives that covered 12 districts and 3 regions. The study revealed that 65% of the respondents identified technical and technological gaps are the number one where as financial, institutional and other developmental gaps are identified as major by 20%, 5% and 10% of the respondents respectively. Among the technical and technological gaps shortage of organic inputs (seeds, fertilizer and pesticides), limited access to modern information technologies, warehouse, farm and processing equipments, packaging materials and quality transport services are the prominent. Besides the intervention needs, the sector scenario and suggestion to tackle these gaps are also discussed.

Introduction

The Ethiopian economy is predominantly agrarian which is characterized by smallholder farmers accounting 11 million with an average of less than 1 ha of cultivated land and provides a livelihood for 85% of the population. Mixed farming (livestock and crops), agro-forestry, and pastoralist are the prevailing farming practices in the highlands, semi-arid and arid parts of the country, respectively. Even though the concept of organic agriculture have been co-existed and introduced in Ethiopian farming systems with the main driving forces: food security, biodiversity conservation and better income long time ago; certified organic agriculture was nonexistent until 1990s. Despite its vital contribution for sustainable livelihood improvement of smallholder farmers; the beneficiaries from organic sector is insignificant. The institutional supports and interventions were also minimal. In order to develop strategic plan which maximize farmers' benefits from the sector, this study is carried out.

Material and Methods

The study was conducted in year 2011 and both primary and secondary information were collected through a closed and open ended questionnaire and desk review. A field visit, key informative interviews and group discussion were also undertaken. A total of 80 respondents representing farmers' cooperatives, unions, individual farmers and private companies from 14 cooperatives that include 12 districts and 3 regions (Oromia, SNNP and Addis Ababa) were participated in the study. The managers of the eight unions and two cooperatives leaders from each selected model cooperative per union were used for the questionnaire and key informative interviews to collect the basic information. Five model farmers depending on the availability from each selected cooperatives with 3:2 male to female ratio were selected for the group discussion. The detail composition of the respondents is presented below and the age of the respondents ranges between 20 and 78 years.

The respondents were selected in consultation with the Ethiopian Association of Organic Agriculture (EAOA) and based on the criteria that all the responding organizations and individuals either has to be already organic certified or in process of application. In regard to private companies the information is collected from two organic certification companies. Then the collected data is well studied and compiled using simple mathematical tools of Excel and in order to enrich the findings of the study, secondary information was added from internet, books, published and unpublished sources.

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Table 1. Number of Interviewed respondents for the study by type of Organisation

No.	Type of Organisation	Number of selected respondents
1	Farmers Federation	1
2	Union	8
3	Cooperative Leaders	14
4	Farmers Group	52
5	Private Investors	3
6	Certification Companies	2
	Total	**80**

Results

Major Gaps

The study was conducted to identify the major technical, technological, institutional and financial gaps of organic producers in organic production, certification, and marketing at union, cooperative, private and farmer's level. The result of the study showed that the type and extent of the major gaps were different at different levels (private, farmers, cooperative and unions) where most of the challenges were clustered under technical and technological gaps. Among the 80 respondents 65 % grouped technical and technological gaps in to major gaps where as 20%, 5% and 10% of them identified financial, institutional and other developmental gaps respectively, as major gaps.

The major technological and technical gaps that were identified at farmers, cooperatives, private producer and unions are summarized as follow:

- Very limited access to organic inputs such as organic fertilizers (compost, liquid and vermi-compost) and improved varieties due to both shortage of raw materials, facilities and skills in preparation and application of compost or limited supply of organic fertilizer and improved seeds in the local market.
- Shortage of modern farm equipments and processing machineries such as coffee pulping and bee hives or use of out-off date processing machineries
- Lack of skills in farm equipment and processing machineries maintenance and accessories
- Shortage of quality packaging materials and transport services providers that meet the organic export standard and certification requirements
- Limited skills and awareness among farmers and cooperatives in organic standard, certification, marketing and production
- Lack of market research and information service
- Lack of skills in adaptation and mitigation of climate change such as high yield fluctuation, drought and flooding
- Shortage of extension services in organic production, quality management and certification
- Shortage of capital for organic and other speciality market certification and ICS development.

Moreover, limited source of revenue/income, shortage of sufficient and on time credit access and services, lack of timely and consistent quality product supply, weak membership base and limited communication and information system among cooperative and farmers and union were identified as the prominent financial and internal management gaps of the smallholder farmers. There were sixteen institutions that provided technical, technological and financial support for the unions, cooperatives and farmers. However, there were institutional gaps identified during the study and among them the major gaps were:

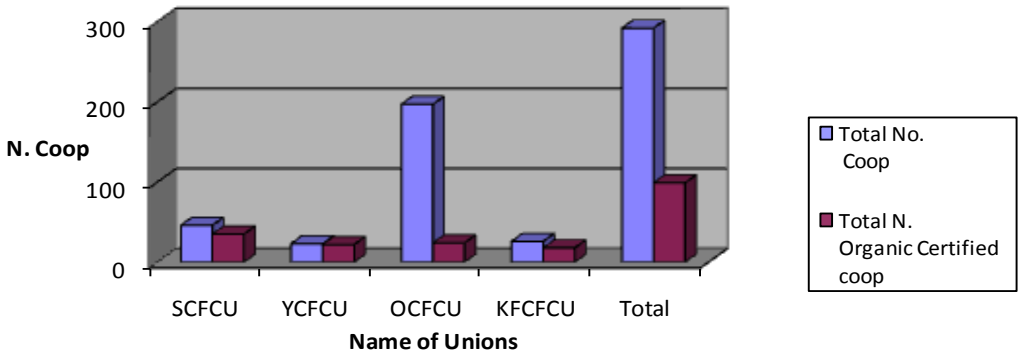
- No any institution that gave any kind of support in farm equipment and processing machinery maintenance and women organic farmers empowerment
- limited institutional support in facilitation of credit access and services
- There is no specialized institution that targeted to support organic producer groups except the frizzing Ethiopian Association of Organic Agriculture(EAOA)
- Lack of institutional integrated development programme that addresses the impact of climate change on smallholder organic farmers.

Besides, the study also found out that there were additional gaps that identified and clustered in to developmental gaps such as lack of adult education, limited access to family planning, health centre, schools, clean water, electric power and all weather roads.

The Organic Scenario of the Smallholder Farmers

Before analysis of the identified gaps the organic scenario of the four certified unions were collected. Out of the total 292 member cooperatives of the four unions 99 of them were certified organic which shared only 34% of the total member cooperatives. SCFCU has the largest number of organic certified cooperatives 35 followed by OCFCU with 24 cooperatives (Figure 1). There were 108,883 organic certified farmers which accounted only 37% of the total number of members of the unions. Among the four unions YCFCU had the highest percentage (99%) of organic certified number of farmers followed by SCFCU (87%) and the least percentage of certified number of farmers observed from OCFCU (11%).

Figure 1. Total Number of Organic Certified Cooperatives of the four unions in Ethiopia in year 2010



The total amount of certified area and production of the four unions were 124, 428 ha and 28,069.5Mt respectively (Table 2). In same year 136'436 hectares of certified organic land were managed by 123'062 certified organic smallholder farmers and three large processing companies in the country. The total certified organic production in country was 79'231.18 metric tons where it has increased by 47 percent and 50 percent respectively, compared with 2008 and 2009.

Table 2. Area, Production, Sale Volume and Value of Organic of four Unions in Ethiopia in Year 2010

Organisations	Total land Area(ha)	Organic Certified Area	Total Production(tons)	Total Organic certified Production	Total Export	Total Organic Export	Total Sale(USD)	Total Organic Sale(USD)
SCFCU	71091	54091	12531	9535	4290	589	20339572	2800833
YCFCU	28063	27804	30000	26843	1000	890		
OCFCU	313613	40252	234970	29623	5329	131	24590595	586556
K FCFCU	6098	2281	3194	1140				
Total	418865	124428	280695	67141	10619	1610	44930167	3387389

Among the core certified organic products, coffee continues to take the largest share followed by sesame, honey and beeswax. The four unions produce only coffee and the organic certified land area accounted 30% and SCFCU was with the largest organic certified area (54,091 ha). OCFCU was the second largest certified organic land area and KFCFCU had the least certified area. The share of certified organic coffee production

to the total production accounted 24% of the total production (28,069.5Mt) and out of which only 161Mt tons of certified coffee exported and rest exported as conventional.

Gaps Analysis and Intervention Needs

After Identification of the major technical, technological, institutional and financial gaps, the gaps were thoroughly analyzed and compared to the sector scenario to identify the intervention areas and to develop strategic plan that fill these gaps are estimated in numbers and percent. The results of the analysis showed that only 30% of area and 37% of total area under the unions' members' management and total number of members were certified which indicate there is gap of increasing the number by 63% and 70 % respectively. One of the main technical gaps of production is shortage of capacity building training for farmers and based on the average data collected form the selected cooperatives of the four unions, only 37% of the total farmers has got training so far which means there is a gap of 63 % farmers that need training. The percent of farmers that got access to organic improved seeds, fertilizers and pesticides were less than 2% and covered only 25% of their organic inputs needs. Almost all of the 99 cooperatives were in shortage of qualified experts in wide range of professions particularly in mechanics, Industry and production quality manager, IT person, ICS expert, accountant and purchaser. The average numbers of educate employees per a cooperative were three out of the seven employees where the average number of female was one. The numbers of farmers that have got technological support were also very limited. None of the cooperatives and unions has got credit facilitation services from any of the supporting institutions except covering of certification fee costs. The institutional support was also limited in terms of the type, amount and geographical boundaries.

In order to address the major technical and technological gaps the following possible strategic interventions were suggested as quick wins and short term. Quick wins strategic interventions are improving extension service, cooperative governance, translation of organic standards, and production manuals into the working languages of the producers and organize training on quality management and processing machineries maintenance. In short term train one ICS expert and quality manager officer at each cooperative, improve the information and communication systems, facilitate supply of organic inputs, packaging materials, modern farm equipments and create access to market information.

Discussion

Even though the organic sector development has shown growth in the past 16 years, yet it is at infancy stages and this study identified the major gaps of the smallholder farmers that are clustered in to technical, technological, institutional and financial. The extent of the gaps also varied among regions, cooperatives and unions and their needs of interventions were also tremendous. Many of the organic projects in Ethiopia are focusing only in organic standard and certification where as the study showed there are other ignored or under estimated issues related to modern farm equipments, youth unemployment, processing machineries, marketing packaging, logistics, climate change, adult education, access to water and health care that are emphasized in the four principle of organic(IFOAM). So, there is a need of shift in the world and country organic agenda to address the mutisectorial challenges identified in this study or else other part of the world with similar research findings.

Suggestion to Tackle the Major Gaps of Smallholder Organic Farmers

The organic smallholder farmers challenges goes beyond regulation and equivalency where most of global funds goes and the distribution of other funds lack also equity. Personally I doubt the significant contribution of these policy projects for livelihood improvement of the smallholder farmer who has been a source of our pleasant organic life and delicious tasty food. On top of this I also suggest shift of the organic agenda to a comprehensive development plan with infrastructure, adult education, value addition, creating more job opportunities for youth and women.

The Finnish Organic Food Chain – An Activity Theory Approach

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Key words: organic, food chain, activity theory, co-creation

Abstract

This article aims to find the reasons why the Finnish organic food chain has not developed sufficiently to reach the goals the authorities have set for production volume and consumption. The reason is partly that organic products do not meet the quality needs of consumers, and that consumers have been left out of the development of the food chain and decision-making for food selection. The criteria for evaluating the stakeholders' actions and results are only quantitative and financial, instead of being qualitative and being built on accommodating to the values of the consumers. According to extensive research into consumers' opinions on organic production and food, people value safety, ecology, health, ethicality and taste. By adding those factors to the evaluation criteria the food suppliers would enlist consumers as co-creators and enable the stakeholders of organic food production to better face the challenges and meet the goals set for the organic food chain.

Introduction

The Finnish Government has set several goals for the development of the organic food system in Finland (MMM 2001, MMM 2012, MMM 2013, Aakkula et al. 2006). None of the previous goals have been reached. Several other European Union countries, such as Denmark, Austria, Germany and Sweden, have higher volumes of production and consumption in the organic food than Finland (Willer, Kilcher 2012, Willer 2012). In many countries, the food chain is driven by retail markets and the food industry. Decision-making regarding the quality of the food chain and its products is not based on consumers' values and needs. It is based only on quantitative facts such as profitability (Aakkula et al. 2006, Kuosmanen, Niemi 2009, Kottila 2010, Kottila, Rönni 2008, Kottila, Rönni 2006). In this article, the principles of co-creation theory are integrated into the activity theory frame (Engeström 1987) in the Finnish food chain concept in order to identify the weak points of the food chain and to present a solution for reaching the goals set for the development of the organic food chain in Finland.

Material and methods

This article uses Yrjö Engeström's model of Vygotsky's Activity Theory (Engeström 1987, Engeström 1995, Engeström 2008). The theory has been used successfully in many different concepts, including the organic food chain concept (Seppänen 2004). This model of the system's activity offers a tool for analysing the inter-relationships among the elements of the system like the food chain (Burnard, Younker 2008). It also gives us a tool for identifying institutional barriers and planning future activities (Yamagata-Lynch, Smaldino 2007). The theory forms a triangle (Figure 1), in which the actors and actions of the Finnish food chain might appear as follows: *Subject*: the companies and operators separately with no co-operation (Kottila, Rönni 2006), *Tools:* doing business to reach the object, and *Object:* earning money. There are also other factors: *Rules:* everyone's own rules and company culture, *Community:* there is no food-chain level co-operation, *Division of labour:* unfair competition, increased price margins (Kuosmanen, Niemi 2009) and *Outcome of the activity:* does not lead to the development of the organic food chain. Some other factors were implemented in this, Engeström's activity theory model: *The link between the food chain and the consumers is weak*; *the evaluation of the quality of the food chain process and food is based only on the quantitative aspects, not on consumers' needs* (Kottila 2010), and *the government's interaction with the rules of the food chain is weak.*

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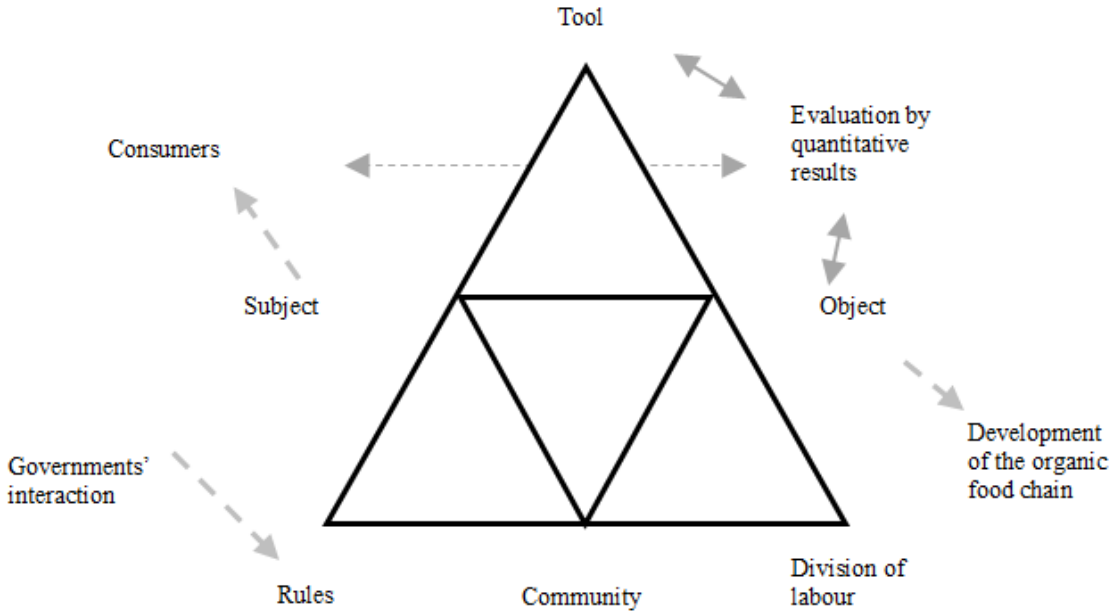


Figure 1. The situation of the Finnish food chain in Engeström's theory

Because the consumers have been left out of the food chain, the principles of co-creation theory are also used to solve the problem of the underdevelopment of the Finnish organic food chain. The main idea of co-creation theory is to get the customers (consumers) involved in the creation and development of products and services as co-creators (Gylden 2012, Zwick et al. 2008). That will ensure that the products are accepted by the user. According to many studies on consumers' willingness to use organic products, safety, ecology, health, ethicality and taste have been found to be the most important factors (Sirieix et al. 2006, De Lorenzo et al. 2010, Oughton 2009, Midmore et al. 2005, Ness et al. 2010).

Results

If the consumer's values and opinions are introduced into the activity of the food chain, the evaluation criteria for the activity and business results (object) would also be qualitative such as safety, ecology, health, ethicality and taste. That would force the food chain operators into mutual target setting and improved co-operation (subject, rules and community). The government's improved interaction to the widening price margins would reduce unfair competition. With regulations and taxation (Schou, Streibig 1999, Millock et al. 2004) the government could develop the organic food chain towards the goals it has set. Figure 2 shows thechanges needed o reach the goals set by the Finnish government.

Discussion

The organic food system gives us a model for a more sustainable food system. It has several challenges to meet and to be accepted by the food chain stakeholders. Only by listening to the consumers' needs and values and taking those among the criteria for evaluating the quality of the food production process and food will the organic food chain develop to meet better the goals set for its production and consumption. The government's interaction with the food system is needed in the form of more effective taxation, subsidy policies and legislation. Those should guide us towards better sustainability.

Suggestions for tackling future challenges of organic animal husbandry

The future of organic animal husbandry is dependent on meat consumption and the co-operation of its stake holders. The consumers' willingness to buy organic meat products is based on their own values. The food-related scandals make transparency of the meat chain important. The consumers should be better aware of the positive effects of the organic production method for the ethicality and ecology of production as well as the safety, healthiness and taste of meat products.

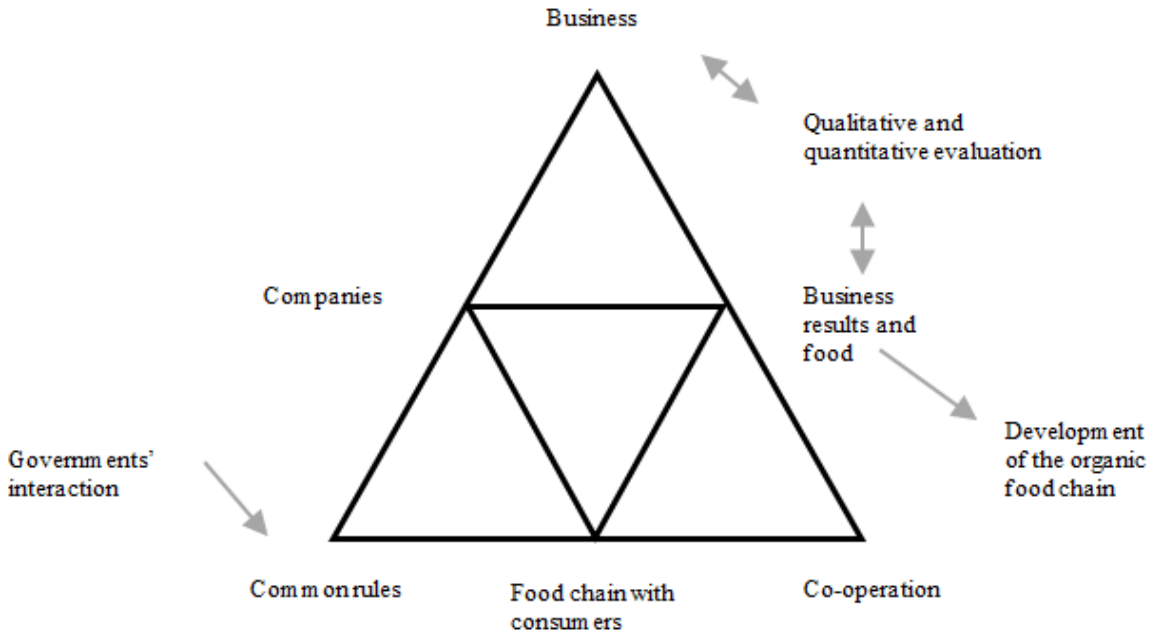


Figure 2. The changes needed to reach the goals set by the Finnish government

References

Aakkula, J., Forsman-Hugg, S., Jakosuo, K., Kottila, M., Rönni, P. & Sarkkinen, E. 2006, "Views of consumers and other food chain actors on organic food and its production", Joint Organic Congress, Odense, Denmark, 30-31.5.2006.

Burnard, P. & Younker, B.A. 2008, "Investigating children's musical interactions within the activities systems of group composing and arranging: An application of Engeström's Activity Theory", *International Journal of Educational Research,* vol. 47, No. 1, pp. 60-74.

De Lorenzo, A., Noce, A., Bigioni, M., Calabrese, V., Rocca, D.G.D., Di Daniele, N., Tozzo, C. & Di Renzo, L. 2010, "The Effects of Italian Mediterranean Organic Diet (IMOD) on Health Status", *Current pharmaceutical design,* vol. 16, No. 7, pp. 814-824.

Engeström, Y. 2008, "Enriching activity theory without shortcuts", *Interacting with Computers,* vol. 20, No. 2, pp. 256-259.

Engeström, Y. 1995, "Objects, contradictions and collaboration in medical cognition: an activity-theoretical perspective", *Artificial Intelligence in Medicine,* vol. 7, No. 5, pp. 395-412.

Engeström, Y. 1987, *Learning by Expanding,* Orienta-Konsultit Oy, Helsinki.

Gylden, R. 2012, 05/29-last update*, Co-creation and rapid prototyping in service product development*. Available: https://wiki.aalto.fi/download/attachments/68001084/Gylden_ABB_Co-creation+with+Customer+and+Rapid+Prototyping+in.pdf; [2012, 07/29].

Kottila, M. 2010, *Understanding the organic chain - The framework of the interaction between actors in organic chains in relation to the ecological modernisation of food production*, Helsinki University, Faculty of Agriculture and Forestry.

Kottila, M. & Rönni, P. 2008, "Collaboration and trust in two organic food chains", *British Food Journal,* vol. 110, No. 4, pp. 376.

Kottila, M. & Rönni, P. 2006, "Consumption of organic products: Challenge for performance of supply chain", *Joint Organic Congress*, 30-31.5.2006.

Kuosmanen, T. & Niemi, J. 2009, "What explains the widening gap between the retail and producer prices of food?", *Agricultural and food science,* vol. 18 (2009), pp. 317-331.

Midmore, P., Naspetti, S., Sherwood, A.M., Vairo, D., Wier, M. & Zanoli, R. 2005, *Consumer Attitudes to Quality and Safety of Organic and Low Input Foods: A review*, University of Wales.

Millock, K., Nauges, C. & Sterner, T. 2004, *Environmental taxes: A comparison of French and Swedish experience from taxes on industrial air pollution*, CESifo DICE.

MMM 2013, 16.5.2013-last update*, Lisää luomua! Hallituksen luomualan kehittämisohjelma ja luomualan kehittämisen tavoitteet vuoteen 2020* [Homepage of MMM], [Online]. Available: http://www.mmm.fi/attachments/luomu/6GeZ5BZPA/Luomualan_kehittamisohjelmaFI.pdf [2013, 11/10].

MMM 2012, *MMM:n suuntaviivoja luomualan kehittämisohjelmalle "LUOMU 20/2020"* [Homepage of Maa- ja metsätalousministeriö], [Online]. Available: http://www.mmm.fi/attachments/luomu/678W6W0V9/luomuohjelma_FINAL_nettiin.pdf [2012, 08/23].

MMM 2001, *Ehdotus luonnonmukaisen elintarviketuotannon kehittämisestä* [Homepage of Maa- ja metsätalousministeriö], [Online]. Available: http://wwwb.mmm.fi/julkaisut/tyoryhmamuistiot/2001/TR2001_10.PDF; [2011, 09/09].

Ness, M., Brennan, M., Oughton, E., Ritson, C. & Ruto, E. 2010, "Modelling consumer behavioural intentions towards food with implications for marketing quality low-input and organic food", *Food Quality & Preference,* vol. 21, No. 1, pp. 100-111.

Oughton, E. 2009, *, Consumer expectations and attitudes* [Homepage of QualityLowInputFood, Subproject 1.], [Online]. Available: http://orgprints.org/view/projects/eu_qlif.html; [2011, 06/12].

Schou, J.C. & Streibig, J.C. 1999, "Pesticide Taxes in Scandinavia", *Pesticide Outlook,* vol. 10, No. 6, pp. 227.

Seppänen, L. 2004, *Learning Challenges in Organic Vegetable farming - An Activity Theoretical Study of On-Farm Practices*, University of Helsinki.

Sirieix, L., Alessandrin, A. & Persillet, V. 2006, "Motivations and values: a means-end chain study of French consumers" in *Sociological perspectives of organic agriculture: from pioneer to policy*, eds. G. Holt & M. Reed, 15th edn, Athanaeum Press, Gateshead, UK, pp. 70.

Willer, H., & Kilcher, L. 2012, *, The World of Organic Agriculture: Part 2: Land use and crop data*. Available: http://www.organic-world.net/fileadmin/documents/yearbook/2012/fibl-ifoam-survey-data-2010-crops.pdf [2012, 6/7].

Willer, H. 2012, *The European market for Organic Food*, Forschungsinstitut für biologischen Landbau (FiBL).

Yamagata-Lynch, L.C. & Smaldino, S. 2007, "Using activity theory to evaluate and improve K-12 school and university partnerships", *Evaluation and Program Planning,* vol. 30, pp. 364.

Zwick, D., Bonsu, S.K. & Darmody, A. 2008, "Putting consumers to Work: "Co-creation" and new marketing govern-mentality", *Journal of Consumer Culture,* vol. 8, pp. 163.

High variability of symbiotic nitrogen fixation in farming conditions

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Key words: On-farm research, organic farming, SNF, spatial heterogeneity, *Trifolium pratense* L.

Abstract

Symbiotic nitrogen fixation (SNF) in perennial legume-grass leys is the primary source of N to organic farming systems in northern countries. This work aimed to quantify SNF in organically managed red clover (Trifolium pratense L.)-grass leys and to relate SNF to explanatory variables. The study was carried out on 27 farms located in the coastal regions of Finland and included 117 ley crops subjected to regular organic farming practices. In the accumulated first and second cuts of one- and two-year-old red clover-grass leys, SNF averaged 185.4 kg N ha^{-1} yr^{-1} (SD ± 90.0 kg N ha^{-1} yr^{-1}); fixation in the aftermath added 62.1 kg N ha^{-1} yr^{-1} (SD ± 49.8 kg N ha^{-1} yr^{-1}). Due to the poor persistence of red clover, SNF declined with ley age. Between- and within-field coefficients of variation of SNF in one- and two-year-old leys averaged 51.1 and 51.8%, respectively. SNF was positively related to soil fertility parameters, mainly to soil structure. It is concluded that the preceding crop value of legume-grass leys needs to be assessed individually. The spatial heterogeneity of soil properties can be reduced through site-specific amelioration and regular applications of animal manure.

Introduction

Correct assessment of symbiotic nitrogen fixation (SNF) is crucial for the design of crop rotations and the N-supply of single crops. Legume growth, and thereby SNF, depend on species, stand age, weather conditions, soil properties, and management (Mela 2003). The spatial heterogeneity of soil properties is high not only between but also within single fields (Geypens et al. 1999). Legume growth is likely to reflect this variability. In northern countries, perennial red clover (*Trifolium pratense* L.)-grass leys are of paramount importance for the N-supply of organic farming systems. The objectives of this work were (i) to quantify SNF in organically cropped red clover-grass leys, (ii) to explore between- and within-field variations of SNF, and (iii) to relate SNF to stand age and environmental conditions. On farm-research was expected to high-light issues unresolved at farm level for further experimental research.

Material and methods

SNF was assessed in 117 organically managed perennial red clover-grass leys. These ley crops were integrated in the crop rotation cycles of 27 different farms and subjected to regular agricultural practices. The location of the farms in two distinctly different regions, the southern and the north-western coastal zones of Finland (= south and northwest, respectively), was expected to elucidate possible impacts of different climate and soil conditions on SNF.

The rotations of all farms included ley and grain crops. The leys were undersown in cereal nurse crops, except in one of the farms. The seed mixtures included mainly red clover (27 farms), timothy (*Phleum pratense* L.; 25 farms), and meadow fescue (*Festuca pratensis* L.; 18 farms). In some cases white clover (*Trifolium repens* L.) or alsike clover (*Trifolium hybridum* L.), or both, were added in small proportions. The average clover content (by weight) of the seed mixtures was 31.7% (SD ± 16.9%). The harvest regimes were limited to two cuts per season, which is the generally recommended strategy for perennial mixed leys in Finland (Mela 2003).

Herbage samples were collected during two growing seasons, 2001 and 2002. Newly established leys were sampled at the end of each growing season (n = 38). Samples from one-, two-, and three-year-old leys (= three production years) were taken prior to the first and to the second cuts (n = 79). Here, the average interval between samplings and cuts was 6 days in the south, and 5 days in the northwest. Samples from the aftermath were obtained at the end of the growing periods (n = 52). In each site and at each occasion samples were always taken from four 0.25 m^2 plots situated at equal distances along the longest diagonal across the field. The herbage was cut with shears at 20 to 30 mm above the soil surface and separated by hand into a clover and a grass fraction (the latter also including dicotyledonous herbs others than clovers), which were then dried with air-flow dryers at 25-30ºC to a constant weight. All biomass weights were corrected to dry matter weight (DM).

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Simulation with a grassland growth model (Riesinger et al. 2008) showed that when the farmers cut the leys the herbage production on average was 13.0% higher than at the time of sampling. Since the final statistical models for observed and simulated data were the same, only observed data and results of analyses based on these are reported here. SNF was calculated from clover herbage dry-matter yield with an empirical model that estimates total SNF in cut one- and two-year-old red clover-grass leys in temperate climate under low external input conditions (Høgh-Jensen et al. 2004). SNF was related to sampling year, ley age, geographical location, interaction between ley age and geographical location, and soil properties by general linear modelling (GLM) in SPSS 15.0 (SPSS Inc. 2006). Soil properties included cation-exchange capacity (CEC), soil organic matter content (SOM), pH-value, and concentrations of phosphorus (P), potassium (K) and magnesium (Mg). Within-field variation of SNF was assessed as the coefficient of variation of SNF in the four sub-samples from each field.

Results

The autumn growth of newly established leys on average fixed 38.6 kg N ha^{-1} yr^{-1} (SD ± 25.2 kg N ha^{-1} yr^{-1}). SNF in the accumulated annual growth of one- and two-year-old leys averaged 247.5 kg N ha^{-1} yr^{-1} (SD ± 114.4 kg N ha^{-1} yr^{-1}); of that the contribution of the aftermath was 62.1 kg N ha^{-1} yr^{-1} (SD ± 49.8 kg N ha^{-1} yr^{-1}) (Table 1).

In the statistical model, sampling year was retained as a significant explanatory variable only in the model for the aftermath, in which SNF was lower 2002 than 2001. Being a function of clover herbage biomass, SNF in the first cut was significantly lower than that in the second cut. Clover herbage biomass and SNF were consistently negatively related to ley age. During the production years, percentages of clover and SNF were significantly higher in the south than in the northwest.
However, once soil properties were included into the analysis, region lost its previous significance as an explanatory variable for SNF. SNF was significantly positively correlated with soil-CEC and with concentrations of soil-K and -Mg (not shown).

Table 1: Symbiotic nitrogen fixation (SNF) in organically cropped red clover-grass leys in the coastal regions of Finland (n = 52; means averaged over two growing seasons, standard deviations in parenthesis)

	Accumulated cuts (kg N ha^{-1} yr^{-1})[a]		Aftermath (kg N ha^{-1} yr^{-1})		Accumulated growth (kg N ha^{-1} yr^{-1})[b]	
	South[c]	Northwest[c]	South[c]	Northwest[c]	South[c]	Northwest[c]
One-year-old leys	287.3 (108.2)	145.5 (81.3)	78.6 (70.1)	61.9 (47.2)	365.8 (113.6)	207.4 (121.0)
Two-year-old leys	194.9 (86.6)	113.8 (83.8)	77.4 (54.4)	30.6 (27.6)	272.2 (115.1)	144.4 (109.0)
Three-year-old leys	NA[d]	67.8 (77.6)	NA[d]	18.2 (20.2)	NA[d]	86.0 (94.9)

[a] First and second cuts
[b] Accumulated first and second cuts plus aftermath
[c] South = southern coastal region, northwest = north-western coastal region
[d] Not assessed due to termination subsequent to the second cut

Calculated over the three annual growth cycles of one- and two-year-old leys, the coefficients of between- and within-field variation of SNF averaged 51.1 and 51.8%, respectively, being about twice as high as those of herbage production (not shown). The between- and within-field coefficients of variation of SNF decreased from the first to the second cut but increased with ley age. Whereas the variability of herbage production did not differ between the regions, the between- and within-field variations of clover percentages (not shown) and SNF were considerably higher in the northwest than in the south (for SNF: Tables 1 and 2). The lower was SNF on a field level, the higher was its within-field variation (not shown).

Table 2: Coefficients of within-field variation of symbiotic nitrogen fixation (SNF) in organically cropped red clover-grass leys in the coastal regions of Finland (averaged over two growing seasons)

	First cut (%)[a]		Second cut (%)[a]		Aftermath (%)[b]	
	South[c]	Northwest[c]	South[c]	Northwest[c]	South[c]	Northwest[c]
One-year-old leys	40.8	87.2	32.2	52.7	33.4	58.2
Two-year-old leys	63.8	68.5	38.2	56.5	45.8	81.4
Three-year-old leys	102.4	101.0	63.6	106.1	NA[d]	117.6

[a] n = 79
[b] n = 52
[c] South = southern coastal region, northwest = north-western coastal region
[d] Not assessed due to termination subsequent to the second cut

Discussion

Between-field variation of SNF did not exceed its within-field variation, indicating that the variability of clover growth was caused by soil properties rather than by management (including fertilization practices). The positive correlation between SNF and soil-CEC emphasized the importance of soil structure for red clover growth. CEC increases with clay and humus contents, i.e., factors that define porosity, and therefore water and gas transport in the soil, storage of plant-available soil water, mineralization of SOM by the decomposer population, chemical reactions, and penetrability of the soil by roots. To avoid soil compaction, the load of machinery, the number of passes, and the intensity of tillage ought to be reduced (Reintam et al. 2009).

Soil structure is enhanced especially by certain perennial crops and animal manure. Under green manuring where organic matter (OM) and plant nutrients are cycled within a narrow area, within-field variation will increase. In contrast, the re-cycling of OM and nutrients through harvest of forage and application of animal manure to the field decreases the heterogeneity of soil properties between and within fields. Application of animal manure also allows for a higher share of non-leguminous crops in the crop rotation, which helps breaking legume disease cycles.

Conclusions, as well as suggestions to tackle with the future challenges of organic animal husbandry

The spatial variability of SNF between and within fields was high. Consequently, the preceding crop value of single ley crops needs to be assessed from case to case. Soil properties, especially soil structure, appeared to be decisive for the productivity of organic crop husbandry. Site-specific soil amelioration obviously offers a huge potential to increase crop yields on a field level. Within-field variation of soil properties can be reduced through an integration of crop and animal husbandry.

References

Geypens M, Vanongeval L, Vogels N & Meykens J (1999): Spatial variability of agricultural soil fertility parameters in a gleyic podzol of Belgium. Precision Agriculture 1, 319-326.

Høgh-Jensen H, Loges R, Jørgensen FV, Vinther FP & Jensen ES (2004): An empirical model for quantification of symbiotic nitrogen fixation in grass-clover mixtures. Agricultural Systems 82, 181-194.

Mela T (2003): Red clover grown in a mixture with grasses: yield, persistence and dynamics of quality characteristics. Agriculture and Food Science in Finland 12, 195-212.

Reintam E, Trükmann K, Kuht J, Nugis E, Edesi L, Astover A, Noormets M, Kauer K, Krebstein K & Rannik K (2009): Soil compaction effects on soil bulk density and penetration resistance and growth of spring barley (*Hordeum vulgare* L.). Acta Agriculturae Scandinavica Section B-Soil and Plant Science 59, 265-272.

Riesinger P, Eckersten H, Torssell B & Forkman J (2009): Radiation-use efficiency in leys: influences of growth period and clover proportion. Acta Agriculturae Scandinavica, Section B, Soil and Plant Science 59, 465-474.

SPSS (2006): Statistical Package for the Social Sciences, Version 15.0. SPSS Inc. Chicago, Illinois.

Novel feeds in organic dairy chains

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Key words: agroforestry, by-products, digestibility, feed value

Abstract

The objective of the current work was to collect information on various novel and underutilized feeds and thus increase the awareness of various novel feeding solutions to support organic and low-input dairy production. A sample set of various feeds such as food and winery industry by-products, forestry materials and novel legumes was collected from Spain, Romania, UK and Finland and analysed for chemical composition and digestibility. The range of potential novel and underutilized feeds is large. The results can be used to aid in exploiting the potential of different feed resources and in ration formulation, and demonstrate potential to widen the basis of feed supply on organic and low input dairy farms. The economic effects of use of novel feeds is greatly dependent on the pricing of the feeds but may in many cases be expected to be positive.

Introduction

Innovative use of novel and underutilized feed resources has the potential to improve the efficiency of the "green economy". Increasing the supply of new feed ingredients acceptable in organic production would in many cases allow for an increase in the supply of organic milk, and farm flexibility in terms of feeding strategies. Increasing organic food production of e.g. vegetable and oil based products and wine also provides the opportunity to produce organic by-products suitable for animal feeding. Further, on-farm production of novel or underutilized forages may provide new opportunities for the feed supply. Agroforestry may be one opportunity as well as introducing new forage crops from other regions or rediscovering the use of neglected crops.

The objective of the current work was to collect information on various feeds and thus increase the awareness of various novel feeding solutions, and it builds on a previously conducted literature review on the same topic (Rinne et al. 2012). The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/ 2007-2013) under the grant agreement n° FP7-266367 (SOLID, for more information, see: www.solidairy.eu).

Material and methods

A sample set of various novel and underutilized feeds was collected from Spain, Romania, UK and Finland in order to evaluate their potential as feed ingredients for organic and low-input dairy production. Their chemical composition was analysed using standard procedures in the participating laboratories following guidelines of AOAC. The results of a selected sample set are presented in Table 1.

Results and Discussion

The analyses of the composition of the by-products obtained from the tomato, olive oil and pomegranate industries revealed a high range of variation, with lower protein and higher fibre content for olive by-products than for tomato and pomegranate ones. Ensiling both olive oil and tomato by-products is feasible and provides a cheap way of preserving material that is high in moisture. The dry matter (DM) digestibility of the ensiled material ranged from 590 g/kg DM for olive pulp and leaves silage to 751 g/kg DM for tomato silage. Based on the composition observed in this study, it is suggested that olive by-products could replace medium quality roughage, while tomato derived feeds may partially replace cereal grain in the ration of ruminants, which would contribute to reducing the feeding associated costs on the farm.

Wineries generate substantial quantities of wastes that, according to environment-specific rules, have to be properly disposed. Their use as a feed resource for ruminants is a convenient option, especially in low-input production systems. While grape marc crude protein level is similar to that of cereals (115 g/kg DM), there are digestibility concerns, which are currently investigated. As part of the grape marc is processed for oil extraction, some quantities of grape seed meals are also available. When wine is produced in an organic

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system, the wastes are also eligible for organic milk production, provided appropriate processing technologies (e.g. mechanical extraction of oil) are used.

Another feed source is the cakes from the cold-extraction of oils from various oilseed plants, such as Camelina, safflower etc. The potential use of these cakes within organic dairy production system is favoured by several facts: they are low-input, easy to manage cultivars; there is a practice of contracting the harvest with oil-extracting companies and getting back the cakes and, in many cases, the oil processing is mechanical (suitable for organic systems), and they have a high nutritive value. For example, the analyses of Camelina meal revealed a high content of crude protein (379 g/kg DM) and a relatively high content of residual oil (157 g/kg DM). Such feed is a useful component in dairy rations.

Agroforestry, the integration of trees and agriculture, is valued as a multifunctional land use approach that balances the production of commodities (food, feed, fuel, fibre, etc.) with non-commodity outputs such as environmental protection and cultural and landscape amenities (IAASTD, 2008). Browse from trees and shrubs plays an important role in feeding ruminants in many parts of the world, particularly in the tropics, and there has been considerable research into the nutritional potential and limitations of many tropical fodder species, but comparatively little is known about the potential of temperate browse species. Although the feed values were low, willow may have a role in multifunctional systems, where it can provide additional values in grazing situations such as microclimate benefits for livestock and a range of ecosystem services.

Wood-derived hemicellulose products from a pressurized hot water extraction represent a novel industrial by-product. The material has a reasonable energy value for ruminants, but currently there is no supply for feed markets.

Novelty is a very subjective term. A good example of this is maize silage, which is a very common feed plant in Central and Southern Europe, but novel in Northern Europe. The analyses revealed that when grown under the Northern climatic conditions, the feeding value of it is very different from what would be expected, i.e. the DM and starch concentrations of it were low indicating too early maturity of the plants at harvest, and relatively low value in dairy rations.

Some feed plants may be known since ancient times, but have recently been used only rarely. In new situations, they may have potential. The use of legumes is of particular interest for organic farms. Faba bean and pea whole crops as pure stands or in combinations with cereals (wheat or oats) resulted in reasonable feed values even when grown in Northern Finland.

Based on the current sample set, the range of potential novel and underutilized feeds is large. The current results can be used to aid in exploiting the potential of different feed resources and in ration formulation.

Conclusions

Novel and underutilized feeds provide opportunities to supplement diets of organic and low input dairy farms in order to improve the nutrient supply and subsequently milk production of the animals. Improved supply of feeds may be particularly favourable in situations when the basal feed supply is reduced due to e.g. weather conditions. The economic effects of use of novel feeds is greatly dependent on the pricing of the feeds but may in many cases be expected to be positive. Widening the type of on-farm produced feeds may also have beneficial effects beyond simply feed supply such for crop rotation, self-medication, microclimate or other ecosystem services. In some cases, use of novel feeds may also include risks e.g. to animal health (antinutritional factors), milk quality, or consumer acceptability, and these factors must be kept in mind when innovative solutions are developed.

Table 1. Characterization of a selected set of "novel" feed samples.

	Origin	n	Dry matter, g/kg	In dry matter, g/kg						Digesti-bility*
				Ash	CP	Starch	NDF	ADF	Lignin	
Tomato fruit waste	Spain	11	615	101	103		191	139	49	910
Tomato silage	Spain	3	521	112	119		516	234	121	751
Olive pulp	Spain	18	676	111	99		632	430	236	512
Olive leaves	Spain	16	515	119	74		418	282	167	544
Olive pulp and leaves silage	Spain	3	575	127	88		390	240	145	590
Pomegranate pulp	Spain	8	671	52	121		121	89	21	760
Grape marc	Romania	6	876	63	115		657	566		
Camelina meal	Romania	4	907	62	379		164	130		
Willow silage	UK	12	278	80	195		389	278	74	506
Dried willow	UK	16	356	68	129		529	376	155	437
Wood derived hemicell. extract	Finland	7		12	5					623
Maize silage	Finland	9	162	51	116	92	507			787
Faba bean whole crop	Finland	9		54	162	82	414			766
Faba bean+cereal whole crop	Finland	12	199	66	120	101	512			659
Pea whole crop	Finland	12		60	167	67	404			767
Pea+cereal whole crop	Finland	12	185	77	142	56	520			661

CP = Crude protein NDF = Neutral detergent fibre ADF = Acid detergent fibre

*In vitro pepsin cellulase solubility (Huhtanen et al. 2006) for Finnish and UK samples, Ankom in vitro digestibly procedure (Martín-García et al. 2004) for Spanish samples

References

Huhtanen, P., Nousiainen, J. & Rinne, M. 2006. Recent developments in forage evaluation with special reference to practical applications. Agricultural and Food Science 15: 293-323.

IAASTD, 2008. Executive summary of the synthesis report. International Assessment of Agricultural Knowledge, Science and Technology for Development.

Martíın-Garcíıa, A.I., Yáñez Ruiz, D.R. Moumen, A & E. Molina Alcaide. 2004. Effect of polyethylene-glycol on the chemical composition and nutrient availability of olive (Olea europaea var. europaea) by-products. Animal Feed Science and Technology. 114: 159-177.

Rinne, M., Dragomir, C., Kuoppala, K., Marley, C., Smith., J. & Yáñez -Ruiz, D. 2012. Novel and underutilized feed resources – potential for use in organic and low input dairy production. The 2nd IFOAM Animal Husbandry Conference, September 12-14, 2012, Hamburg, Germany. vTi Agriculture and Forestry Research, Special issue 362. p. 417-420.

Living on farm – a new approach of community supported agriculture (CSA)

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Key words: community supported agriculture, accommodation, elderly, inclusion

Abstract

Results gained from case studies on CSA-farms in Finland show that emerging CSA enterprises offer increasingly also accommodation and services for elderly. This development requires vocational training in green care and inclusive farming. Both the farmers and the residents are winners: farms create additional income and customers enjoy the salutogenetic impact of rural landscape, organic farming and its products.

Introduction

According to a public consultation 26.165 participants (58 %) consider the economic and social dimension of organic farming as the most needed areas of research and innovation (European Commission 2013). Hospitals, institutions and enterprises caring for people with special needs, even prisons utilise the salutogenetic impact of organic agriculture (Dessein 2008, Gallis 2007, Hassink and van Majken 2006). Salutogenesis (Antonovsky 1997) may also be a reason why community supported farms increasingly emerge in Europe and USA. CSA seeks to create a direct relationship between farmers and those who eat their food (Cone and Myhre 2000). A new CSA phenomenon is that community members do not only procure their food from the farm but also intend to move to the farm as residents, especially elderly people (Sahramaa 2012). In this paper the development of living on farm is described from an agricultural engineer's point of view focussing on opportunities for elderly in Finland.

Material and methods

The methods applied are literature review, personal communication, and analysis of case studies made during visits on the spot since 2008. Based on the collected material an analysis of the new development is made showing the challenges and problems. Recommendations are given to support this development and to bridge the gap between scientific knowledge about salutogenesis and implementation into practice.

Results

Wietheger 2003 and Wiechmann 2006 described first community living of elderly on farms in Austria, Germany and Switzerland. Documentations of recent community living of elderly in Finland concern mainly urban areas (Helamaa and Pylvänen 2012). The first successful community of elderly rose in the city of *Helsinki*. A society of elderly founded a shareholder company which in turn built a block of flats supported by local authorities (Minkkinen and Dahlström 2009). Inspired by the success of Loppukiri a similar venture



started in *Saarijärvi*, a municipality in the rural area of middle Finland (Pesonen 2013). Both cases are valuable examples how to establish a senior community that cares for its own accommodation facilities. Many of the gathered experiences are transferable to farm level where accommodation for elderly is a concern.

CSA has many roots: eco-village, local food production, community living, and social services on farm. Table 1 shows an overview of Finnish farms offering accommodation within the frame of CSA. There are three main groups: Anthroposophical social farms, farms governed by a strict ecological philosophy of life, and

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farms looking for diversification concerning ecology, business and on-farm living communities. However, the boundaries between these groups are fluid.

The anthroposophical social farms were already established in the fifties and sixties of the last century and focus on inclusion of humans with special needs into farming, food processing, and craft activities. They have the longest experience. Meanwhile many of the co-workers retired and the need for accommodation facilities suitable for elderly is recognised. A great part of the farm income is created by offering social services.

Table 1: Community supported farms in Finland offering residential accommodation

Type	Name, place, web site
Anthropo-sophical communities	• Myllylähde-yhteisö, *Hämeenkoski* • Rihun biodynaaminen tila, *Heinola,* www.phnet.fi/kylat/paistjarvi/kylatoiminta.htm • Sylvia-koti, *Lahti*, www.sylvia-koti.fi • Tapolan kyläyhteisö, *Orimattila,* www.tapola-camphill.net/
Communities with a strict eco-philosophy	• Gaijan Luomukylä, *Ähtäri*, *www.gaija.org* • Kangasalan Yhteiskylä, *Kangasala*, www.yhteiskyla.net • Keuruun ekokylä, *Keuruu,* www.keuruunekokyla.fi/
New on-farm living communities	• Heinolan tila, *Haarajoki*, http://heinolantila.wordpress.com/ • Labbyn kartano, *Isnäs*, www.labby.fi, www.edesby.fi/ • Livonsaaren yhteisökylä, *Livonsaari*, http://www.yhteisokyla.net/ • Svarfvarsin luomutila, *Karja*, http://www.svarfvars.fi/fi/ • Yhteisökylä Kurjen tila, *Vesilahti*, http://kurjentila.fi/

Community supported farms with a strict ecological philosophy of life emerge since the nineties of the last century. They are more or less selective in respect of the community members and strive rather for ecological objectives e.g. permaculture and self sufficiency than for economic success or social services.

New on-farm communities appeared during the past ten years and are open for every-body independent from age and profession. They create additional income outside the farming activities. Target group are people which carry inside an imagination of a beautiful countryside, where farms, fields, animals, forests, and water bodies form a cultural landscape of a perfect organic wholeness. Several families have built their houses on the Livonsaari farm near the city of *Turku* and on the farm Kurjen tila near the city of *Tampere*. If the Heinola farm close to the capital region could already offer a suitable simple log home, customers would immediately move in.

The realisation of the idea faces with many obstacles: municipality authorities consider the farm yard as part of an industrial production unit not suitable for housing. Change of use of agricultural buildings is extremely difficult. Public authorities are concerned about possible infrastructure investments like street lightening to be paid from public funds. Also the land-use plans do not allow the erection of additional accommodation buildings. Water, sewage, and electric power connection requires special efforts and high investments. Because of restricted funds, ecological construction solutions like renewable energy sources, rain water tank, and natural sewage treatment plant are difficult to realise.

However, the farm may create additional income by offering accommodation, janitorial and transport services, basic and other services to people, who want to live on the farm. Thus, the traditional target of community supported farms - processing and selling the farm products to a community of customers - is considerably extended. In the long run, the increasing number and the aging of the dwellers may create new working places for nursing services personnel, which in turn may recreate doing compensating work on the farm (Wietheger 2003). However, the idea of the Klostersee farm, that green care farming offers recuperation of overloaded nursing staff, is up to now not realised yet but an option for the future.

Discussion

Creating facilities for living on farm requires some convincing in respect of authorities as well as new technical solutions in renewable energy supply, water supply, waste processing and nutrient recycling. Living on farm for elderly requires new skills in both disciplines: agriculture and geriatric care. Industrial farming and food processing do not coincide with salutogenetic aims. Therefore living on farm is, like CSA, a domain of organic farms. Especially the combination of organic or bio-dynamic agriculture with its demand for a healthy soil and nature and an integrated social work is very effective and provides a positive impact on people, nature and landscape. Animal husbandry is essential for CSA and inclusive farming. As part of the ecosystem, they produce food, fibre, and fertilisers, are partners of humans in animal assisted therapy of green care enterprises, support human welfare and salutogenesis, and shape the landscape.

The considerable financial investments required to establish the facilities for living on farms call for new financial business models where competition and maximising the share holder value have to be replaced by co-operation and active partnership of producers and customers. The Darwinian evolution model opining, that only the best survive is deconstructed by ecology scientists (Odum 1996). The maximum power principle of nature proves to be a co-operative network. The lion does not kill as much antelopes as he can, but as much as he needs. This law, also named the fourth law of thermodynamics, applies *mutatis mutandis* to community supported farms which are moving from egosystem to ecosystem awareness (Scharmer and Kaufer 2013).

The farm of the future is more than a bulk production unit. Production and processing of valuable and healthy food, including persons with special needs and elderly as co-workers, may open additional sources of income and working places. These farms consider elderly or disabled people not as being ill, but as real co-workers and partners with specific ranges of performance, able and willing to contribute to an added value of the society and the farm. Exploiting the specific agricultural work and life-setting provides more and improved social welfare structure in rural locations where service coverage is traditionally weak. As a following emerge better labour opportunities fostering rural economic development.

It is obvious that this demanding issue needs specific education and skills. Therefore a curriculum for a new occupation called "Expert for inclusive farming and rural development" is subject of the Inclusive Farming project (INCLUFAR) within the Leonardo Lifelong Learning programme funding scheme of the European Union (www.inclufar.eu). This project is also an excellent example how to bridge the gap between scientific knowledge and practice.

References

Antonovsky A (1997): Salutogenese. Dgvt Verlag, Tübingen, Germany.

Cone C & Myhre A (2000): Community-supported agriculture: a sustainable alternative to industrial agriculture? Human Organization 59(2), 187-197.

Dessein J (ed) (2008): Farming for Health. Proceedings of the Community of Practice Farming for Health, 6 - 9 Nov. 2007, Ghent, Belgium. ISBN 9789081100762. Merelbeke, Belgium.

European Commission (2013): Report on the results of the public consultation on the review of the EU policy on organic agriculture conducted by the directorate general for agriculture and rural development (15 January-10 April 2013), Directorate H. Sustainability and Quality of Agriculture and Rural Development H. 3. Organic Farming, 132 p. http://ec.europa.eu/agricu
lture/organic/files/eu-policy/of_public_consultation_final_report_en.pdf

Gallis C (ed) (2007): Green care in Agriculture: Health effects, Economics and Policies. 1st European COST Action 866 Conference. Proceedings (Vienna, Austria), University Studio Press: 13-24, Thessaloniki.

Hassink J & van Majken D (eds) (2006): Farming for Health: Green-care Farming Across Europe and the United States of America. Wageningen UR Frontis Series 13, 357p.

Helamaa A & Pylvänen R (2012): Askeleita kohti yhteisöasumista. Selvitys yhteisöasumisen muodoista ja toteuttamisesta. (Steps towards community living. Report about way and realisation of community living). Tampere University of Technology, School of Architecture, Tampere, Finland, 177p.

Minkkinen S, Dahlström M (2009): Loppukiri (Final Spurt). Werner Söderström Corporation – WSOY, Helsinki.

Odum HT (1996): Environmental Accounting: Emergy and Environmental Decision Making. Wiley.

Pesonen R (2013): Maaseutukunnan iäkkäille yhteisöasumiskerrostalo. Kuinka ryhmä-rakennuttaminen sopii maaseudulle? Maaseutuasumisessa mahdollisuuksia. Asuinmaa-seutu 2013 -seminaari 8.4.2013. (A community living block of flats for elderlies in a rural municipality. How community construction of buildings fits to rural areas?) In: Opportunities for living in rural areas. Rural area housing 2013 - seminar 8.4.2013). Rural Policy Committee (YTR), c/o Ministry of Employment and the Economy, PO Box 32, FIN 00023 Government. www.maaseutupolitiikka.fi/files/2725/Pesonen_OMATOIMI_daesitys_20130404_Hki.pdf

Sahramaa S (2012): Farm as a provider of senior housing and support services for the elderly. Master's Thesis, HAMK University of Applied Sciences, Hämeenlinna, Finland, 108p.

Scharmer O & Kaufer K (2013): Leading from the Emerging Future: From Ego-System to Eco-System Economies. Berrett-Koehler Publishers Inc, San Francisco.

Wiechmann N (2006): Der landwirtschaftliche Betrieb - alternativer Wohn- und Lebensraum im Alter. Altenwohnprojekte auf landwirtschaftlichen Betrieben im deutschsprachigen Raum. Diplomarbeit. Universität Kassel, Witzenhausen, Fachbereich Ökologische Agrarwissenschaften, 105 p.

Wietheger L (2003): Im Alter auf den Biohof – Fallstudie eines Pilotprojektes. Diplomarbeit. Institut Für Soziokulturelle Studien, Universität Kassel, Witzenhausen, Fachbereich Ökologische Agrarwissenschaften. www.orgprints.org/1026/

The carbon footprint of organic dairying in Europe

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Key words: organic milk, dairying, carbon footprint, GHG, LCA

Abstract

Dairy farming is the largest agricultural contributor to greenhouse gas emissions in Europe. In this study, the carbon footprint of organic dairying was evaluated by means of a life cycle assessment, based on real farm data from six European countries: Austria, Belgium, Denmark, Finland, Italy and United Kingdom. A total of 34 farms were analysed. The assessment was carried out using an attributional approach with system boundaries from cradle to farm gate. For the dairy production, a functional unit of 1 kg of energy corrected milk was used. The results gave an average of 1.04 ± 0.29 kg CO_2 equivalents per kg of energy corrected milk, which is consistent with recent previous studies. The main contributor to this is enteric fermentation from producing animals, resulting in 43 % of total GHG emissions, which is also consistent with previous studies.

Introduction

Greenhouse gas (GHG) emissions have been of great environmental concern and a focus for life cycle assessment (LCA) studies worldwide. According to Gerber et al. (2013) global cattle farming contributes an annual total of 4.6 Gt CO_2-eq, of which milk production contributes 1.4 Gt CO_2-eq per year. Lesschen et al. (2011) estimated the GHG emissions originated in the dairy sector to be 195 Tg CO_2-eq per year. Hagemann et al. (2011) quantified the carbon footprint of 38 countries ranging from 0.80 to 3.07 kg of CO_2-eq per kg ECM milk. All such previous studies show enteric fermentation to have a large impact on GHG emissions. In this paper, we have assessed the carbon footprint of a variety of organic farms in six countries. GHG emission hot spots in organic dairy production are described. The aim of this study is to evaluate the carbon footprint of organic dairy farming in Europe based on using LCA approach, and to provide details of emission hotspots for use in mitigation design.

Material and methods

LCA approach was used to assess the carbon footprint of organic dairy farming in Europe. The farms included in the study represent a variety of organic farms. Inventory data from farms was collected from six European countries that were considered to give a variable sample of organic dairy farming in Europe. A total of 34 organic dairy farms were included: 8 from the United Kingdom, 8 from Denmark, 7 from Finland, 2 from Belgium, 4 from Italy and 5 from Austria. The farm size varied from 9 dairy cows to 482 and annual production volumes from 40 to 2,230 tonnes. Herd turnover data was corrected using a standard protocol. The parameters included in the calculation were herd parameters including age and weight, feed characteristics, own production of feed, crop yields, fertiliser use, housing systems including manure management, and energy use including traction and air conditioning.
The carbon footprint was calculated using the LCA method described by Schmidt & Dalgaard (2012). An attributional approach based on ISO 14040 standards was used as the basis for the life cycle assessment methodology applied. System boundaries were set from cradle to farm gate. The carbon footprint was calculated per farm and the result was given as weighted average. The calculation model uses the milk yield, weight and ages of the cattle to calculate the feed requirement based on IPCC (2006) and Kristensen (2011). Emissions from plant cultivation, manure management, enteric fermentation and methane were calculated according to IPCC (2006). Using the attributional approach, emissions were economically allocated between milk, beef and energy plus nutrients in manure.

Results

Based on data from six countries and a total of 34 farms, the result for the average European organic milk carbon footprint is presented in Table 1. Emissions are divided between processes.

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Table 1. Average carbon footprint of European[a] organic dairy farming allocated in different processes.

European average	Milking cows	Raising heifers and bulls	Crop cultivation	Total
Direct emissions	[CO_2 –eq]	[CO_2 –eq]	[CO_2 –eq]	[CO_2 –eq]
CH_4 enteric fermentation	0.450101	0.158822		
CH_4 ,manure handling and storage	0.069109	0.018117		
N_2O	0.031963	0.014283	0.032889	0.77484
Emissions outside animal activities				
Feed inputs	0.0390485			
Indirect land use change related to feed	0.0181518			
Manure land application	0.0019600			
Purchased manure and live animals	0.001214			
Fuels	0.029855			
Electricity	0.069349			
Transport	0.002207			
Destruction of fallen cattle	0.000051			
Farm, capital goods and services	0.103624			0.259617
			Total	**1.041343**

[a] Included countries Austria, Belgium, Denmark, Finland, Italy and United Kingdom, n_{farms} = 34.

On farms, emission hotspots mainly consist of methane emissions from the enteric fermentation of dairy cows (58 %) and from raising youngstock (21 %). A considerable proportion of emissions originate in manure management, 9 %. Of emissions from non-animal sources, the largest contributors are capital goods and services and electricity, which account for 40 % and 27 %, respectively. Feed inputs also play a large role, accounting for 15 %. Of the total carbon footprint, enteric fermentation by dairy cows contributes 43 % and raising youngstock contributes 15 %. Farm emissions account for 10 % of the total and manure management and electricity combined contribute 7 %. Feeds contribute 4 % of total GHG emissions. Taken together, the above factors contribute 86 % of all GHG emissions. Of these, the main contributor is therefore enteric fermentation, which accounts for one third of all GHG emissions in total. The total carbon footprint of organic dairy farming in Europe averaged 1.04 kg CO_2 equivalents per kg of ECM milk, with a standard deviation of 0.25, whereas the averages per country were 1.16 ± 0.17 (AT), 0.96 ± 0.23 (BE), 1.12 ± 0.44 (DK), 1.00 ± 0.14 (FI), 1.04 ± 0.22 (IT) and 0.95 ± 0.10 (UK) kg CO_2 equivalents per kg of ECM milk.

Discussion

The current study reveals variations between organic dairy farms and between countries. This result is consistent with recent studies from the perspective of the overall carbon footprint (Thomassen et al.2008, Yan et al.2013, Kristensen et al.2011, Flysjö et al.2012, Casey and Holden,2005), although methodological variations make a direct comparison difficult.

Here, the enteric fermentation was the largest contributor to the total CF. In mitigating this effect, improving feed quality and the nutrient efficiency of feeds would be beneficial. Feed digestibility could be improved, even if it is already high in Western Europe, at 77 %(Gerber et al. 2013). Housing, energy use and manure management could also be developed in a sustainable direction.

Besides farm activities, the method for calculating the CF could be improved; this calculation does not take account of carbon sequestration– doing so would benefit the farms using more grass-based permanent pastures and it would provide a more complete picture of GHG emissions from organic dairy farms.

Suggestions to tackle with the future challenges of organic animal husbandry

Dairy farming is the largest agricultural contributor to GHG emissions in Europe and organic milk production is responsible for its proportional share. Thus, also for organic milk production, mitigation strategies need to be adapted. It is important that such mitigation strategies do take into account the other important features of

organic dairy production like impact on biodiversity and on changes in soil carbon sequestration. Although enteric fermentation is the largest contributor to GHG emissions, development of more sustainable practises should therefore not only be in feed design, but in overall tactical management on farms. Organic dairy farming can lead by example in this.

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References

Casey, JW & Holden, NM (2005): Analysis of greenhouse gas emissions from the Irish milk production system. Agricultural systems 86, 97-114

Flysjö, A, Cederberg, C, Henriksson, M & Ledgard, S (2012): The interaction between milk and beef production and emissions from land use change – critical considerations in life cycle assessment and carbon footprint studies of milk. Journal of Cleaner Production 28,134-142

Gerber, PJ, Steinfeld, H, Henderson, B, Mottet, A, Opio, C, Dijkman, J, Falcucci, A & Tempio, G (2013): Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome.

Hagemann, M, Hemme, T, Ndambi, A, Alqaisi, O & Sultana, MN (2011): Benchmarking of greenhouse gas emissions of bovine milk production systems for 38 countries. Animal Feed Science and Technology 166-167, 46-58.

International Panel on Climate Change (2006): Guidelines for national greenhouse gas inventories. IPCC, Geneva. Available at: http://www.ipcc-nggip.iges.or.jp

Kristensen, T, Mogensen, L, Knudsen MT & Hermansen, JE (2011) Effect of production system and farming strategy on greenhouse gas emissions from commercial dairy farms in a life cycle approach. Livestock Science 140, 136-148.

Lesschen, JP, van der Berg, M, Westhoek, HJ,Witzke, HP & Oenema, O (2011): Greenhouse gas emission profiles of European livestock sectors. Animal Feed Science and Technology 166-167, 16-28.

Schmidt, JH & Dalgaard, R (2002): National and farm level carbon footprint of milk – Methodology and results for Danish and Swedish milk 2005 at farm gate. Arla Foods, Aarhus, Denmark.

Thomassen, MA, van Calker, KJ, Smits, MCJ, Iepema, GL & de Boer, IJM (2008): Life cycle assessment of conventional and organic milk production in the Netherlands. Agricultural systems 96, 95-107.

Yan, MJ, Humphreys, J & Holden, NM (2013): The carbon footprint of pasture-based milk production: Can white clover make a difference? Journal of Dairy Science 96, 857-865.

Experiences on different types of on-farm research in Eastern Finland

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Key words: cereals, clover grass, legumes, pinch cut, protein, self-sufficiency

Abstract

Three different methods of conducting on-farm research were tested during the growing season of 2013 on Finnish organic farms. The yield of clover-grass silage was measured by the farmer using his own machinery and by small plot measures of 0.25 m^2 taken by a researcher. Different pea-cereal mixtures were tested in two fields and yields were measured by farmers using a combine harvester equipped with scales. Samples for feed quality analysis were collected by an advisor from several legume-cereal-whole-crop mixtures on farms. There was no preference for different methods of conducting on-farm research based on these cases. More important was to find the best way to answer the actual question. These kind of on-farm research actions were a rapid way to answer to the needs of farmers. Observational actions were most suitable to be conducted by a researcher or an advisor in the small plots, but the overall yields of fields or larger plots were better to harvest with farm-scale machines.

Introduction

In Finland, as well as in many other countries, on-farm research is becoming more and more common. The reasons are many-fold. Agricultural research stations are closed down due to economic constraints. Instead, applied field trials have been carried out in cooperation with farmers. Advisors consider on-farm research as a new and efficient tool to show for farmers good cultivation practices. For farmers it is an attractive way of testing suitable farming practices in the environment of their own.

There can be a range of types of doing on-farm research. An important part is to involve the farmers in the research process. The involvement of farmers can vary from on-farm trials that are designed and carried out by researchers on farms, through to research in which farmers set the agenda, design the assessment methods and carry out the assessments themselves. It is important that the outcome measures are of meaning and high value both to researchers and farmers (Lockeretz & Anderson 1993).

In eastern Finland, three different ways of conducting on-farm research were used by two projects during the growing season of 2013. In SOLID project (Sustainable Organic and Low Input Dairying; EU FP7 grant agreement n° FP7-266367; www.solidairy.eu), one work package concentrated in developing participatory research where on-farm research was an essential part of the actions. The other project was a nationally funded Skarppi project, where the aim was to develop local beef production. All on-farm research actions aimed at increasing the self-sufficiency of farms in their protein feeding of cattle by developing the cultivation practices of the protein crops.

Material and methods

The first on-farm research case was a combination of small plot measurements and use of farm scale harvester by the farmer. The aim was to increase the protein content of the first cut of a mixed red clover (*Trifolium pratense* L.) and grass (*Phleum pratense* L., *Festuca pratensis* L.) silage on the organic farm. The aim was to increase the clover content of the yield by using a pinch cut. The trial included an early spring pinch cut of grass to suppress grass growth in relation to red clover. This should give more time for red clover to develop and produce higher proportion of red clover into the first silage harvest. The pinch cut trial was carried out on two fields of an organic farm. The fields were divided into two parts, and the other part was pinch cut on May 31 while the other part was left untreated. In the previous year 20 t ha^{-1} organic slurry was directly injected into the red clover grass. The botanical composition, yield and height of clover and grasses including apex height were measured at the time of pinch cut by a researcher. The botanical composition and protein content as well as the digestibility were determined in the first silage cut on June 12.

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The yield was measured both by small plot sampling (0.25 m^2) with five replicates and by weighing machine harvested yield from around 5 000 m^2.

The second case of on-farm research was carried out totally using farm scale machines. On two organic dairy farms, five mixtures of peas (*Pisum sativum* L.) and cereals (spring wheat; *Triticum aestivum* L. or spring oats; *Avena sativa* L.) were used. The aim was to find out the most productive pea cereal mixture with a high pea yield and high quality for grain. The role of the cereals is to prevent the stand from lodging, but cereals might also shade the peas and smother them out. All the mixtures were sown on the same field in the spring by the farmer. The seeds of peas and cereals were in different boxes of the sowing machine and the amount of seeds could be adjusted electronically from the tractor. Establishment was observed in June by the advisor. The yield was measured by the farmer using a combine harvester that was able to measure the yield from the harvested seed flow. Legume and protein content of the yields were determined from the samples taken by the farmer.

The third case included collection and analysis of plant samples from whole-crop silage stands on organic farms. Altogether, nine farmers cultivated legume-cereal mixtures for whole-crop silage in 13 fields. Legumes in mixtures were vetch (*Vicia sativa* L.), fodder pea (*Pisum sativum* L.) or faba bean (*Vicia faba* L.). The cereals were spring wheat (*Triticum aestivum* L.), spring oats (*Avena sativa* L.) and/or spring barley (*Hordeum vulgare* L.). The cropping practices were done by the farmer and the samples were taken from small plots (0.25-0.75 m^2) by the advisor. Samples were weighed for yield and sorted by species for botanical composition and analyses of protein content and digestibility.

Results

Spring 2013 was warmer than in average resulting in more vigorous and rapid early growth of red clover than usually. The swards were pinch cut when height of grass averaged 40 and 47 cm in the first and the second field, respectively. In the same fields, the height of red clover averaged 26 and 30 cm, respectively. Often difference in height between grass and red clover is greater than this time. The apex height of timothy averaged 8 and 20 cm, respectively. The idea was to cut timothy apex without damaging red clover. This was not possible under these circumstances and it was decided to pinch cut at the height of 30 cm in both fields.

Time between the pinch cut and the first harvest was less than two weeks, which was too short for red clover to develop and to increase protein content of the forage. Clover content did not differ significantly between treatments and fields, but total dry matter production was decreased due to pinch cut in both fields. The decrease was greater in the field which was longer at the time of the pinch cut.

There was a difference between methods, when comparing yield data measured by small plot sampling and by weighing system of the farmer's harvest machinery. Yield of large scale harvesting averaged 63 % of that from small plot sampling, but the difference was constant between fields and treatments. Thus the conclusion from the results was the same despite the harvesting method although yield data was at the different level according to measuring method.

The total yield of different pea-cereal mixtures did not differ even though the amount of peas in the seed mixture varied from 50 to 75 %. Pea contribution in the yield varied according to its contribution in the seed mixture. Peas were the most valuable fractions for the protein content. The other aim of the trial was to study whether wheat or oats is a more suitable companion for pea. This could not be fully evaluated since the fertilization rate of manure on the fields differed. The lodging was severe in the field with higher manure application.

The information about the contribution and quality of the different species in the whole-crop silage yield was interesting. The results confirmed the earlier research results (Nykänen et al 2009). It was important for the farmers to see how these results worked in their fields. Most probably farmers will change their cultivation techniques according to these results to obtain more protein and higher digestibility of the forage.

Discussion

These kind of on-farm experiments were easy to carry out because of good machinery and high interest of the farmers. Farmers were very keen on the results as the research question came from them. So establishment of the experiments caused no major difficulties because farmers were working themselves with the aid of high-tech machinery. It was also useful to get the information about the fertilization even though it was primarily not a target. On the other hand, the performance of whole-crop silage trials was convenient for farmers since the advisor took all the samples and measurements.

The confounding effects of variable use of manure as fertilization and soil types in different fields hindered interpretation of the results. More fields under investigation could have helped in this problem, but that would have made the experiments more expensive.

The samples were analysed in a commercial feed laboratory. Results were provided fast with low cost, but their reliability was lower than that of scientific laboratories. On the other hand, those laboratories are used by farmers in their every-day farming and they have to make the decisions based on them. In some cases, the experiments could not be established due to time constraints of the participating farmers, which changed the plans and affected the results.

The most important phases in the on-farm research process were the discussions before and after the experimental work. Discussions took place together with farmers, advisors and researchers to define the questions, and to conclude from results and experiences afterwards. Successful cooperation of networking farmers, advisors and researchers was shown in these cases. Targets to get more information for the farmers themselves and to disseminate to other farmers by professional magazines, Internet and open field days by trials were met.

We need to find ways how to complement scientific work with on-farm research. A scientific debate should be initiated whether on-farm results will be valid for scientific and congress publications, and funders should be aware of different ways of conducting research.

Conclusions

Under scarcity of funds for research on organic production, on-farm research is a valuable tool to develop the sector. There was no preference for different ways of doing on-farm research based on these cases. More important was to find the best way to answer the actual needs and questions. The interest of the farmer was the key point, when there was a need to do extra actions by him. In many cases on-farm research was a rapid way to give practical answers and increase both organic production and common knowledge in the topic. This kind of work was valuable also for science. Observations and measurements in the small plots could be randomized and replicated sufficiently to decrease variation and meet scientific demands for statistical analyses. If there was a chance to introduce a number of farmers and large-scale fields to participate, validity of the study increased also with farm-scale harvesting machinery. Otherwise variation between fields was demanding to be managed.

References

Lockeretz, W., Anderson, M., 1993. Agricultural Research Alternatives. Vol 3. University of Nebraska Press, Lincoln, 239 p.

Nykänen, A., Jauhiainen, L. and Rinne, M. 2009. Biomass production and feeding value of whole-crop cereal-legume silages. Agronomy Research 7 (Special issue II): 684–690.

Policy goals regarding the organic sector in Finland

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Key words: food policy; policy document analysis; policy impact; barriers and drivers; implementation

Abstract

A number of relevant national policy documents were examined in order to clarify justification and proposed measures in support of organic food and their linkage to sustainability. The implementation of the goals is discussed by considering them in relation to the actual use of organic food within the municipal catering.

With the public catering sector as the path breaker the aim is to increase the use of organic food. However, its use in professional kitchens has increased slowly. In addition to price constraints availability and delivery problems are accentuated in sparsely populated Finland.

Organic food is a value choice, and the municipal authorities are in key position. Organic option should be included into the municipal development strategies. Attention needs to be paid to the research results dealing with environmental and human wellbeing interpreted in own situation. It is important to involve local actors in developing the food sector by appreciating the caterers' expertise and the customers' experiences.

Introduction

The strategic goals of the Finnish food policy are to develop agriculture and food production as a sector of strong expansion both for domestic markets and for export, to improve sustainability of the food sector and to harness the public catering sector as the path-breaker in sustainable food consumption (Food Strategy 2010, VN 2010, 2011).

Regarding sustainability, organic production provides a clear alternative, the production of which is controlled so as secure the environmental and human health and animal welfare. Today organic production in Finland comprises about 8% of the cultivated area and about 1.3% from the food purchases both within the public and private sector (MMM 2012). Encouraged by country brand working group visioning organic production to contribute at least 50% to the Finnish food sector by the year 2030 (Country Brand Delegation 2010) marked growth is expected in the coming years.

The aim of this policy impact study is to scrutinize the Finnish food policy goals regarding the organic sector, and their linkage to the sustainability strivings as articulated in the policy discourse. In concluding section the impact of the policy goals is discussed by considering their implementation in praxis with the focus on the statutory municipal catering sector.

Material and methods

The study is based on a scrutiny of about 20 national policy documents from the past decennium relevant in view of sustainability, food and organic sector. The method was that of the qualitative content analysis using the sustainable food[2] as the conceptual frame in the analysis. The documents were scrutinized in order to look for the quotations dealing with organic food, its production and consumption. The quotations were identified as dealing with problems, justification, aims, measures, and impacts, and coded accordingly. The quotations were further sorted so as to refer to different actor groups, farmers, SME:s, public catering sector and consumers. Attention was specifically paid to the quotations dealing with the public catering sector.

Results

The overall food policy goal is to expand the use of organic food (Food Strategy 2010, VN 2010, 2011). This is done by diversifying and increasing organic production so as to meet the demand, by developing the organic food chain and by improving the degree of upgrading of organic food. The domesticity is stressed both in supply and in use of organic products (Food Strategy 2010, VN 2010, 2011, Ministry of the Environment 2012).

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[2] 1 SusFood (2012). Sustainable food production and consumption. EU 7th framework program. http://www.susfood-era.eu/index.php?index=30.

The institutional kitchens of the public sector are obliged to act as good examples in environmentally responsible food purchases and in increasing the use of local and organic food (SRE 2008, Ministry of the Environment 2009, 2012, MMM 2012). Organic food is justified as one means to promote overall sustainability within the public sector (Ministry of the Environment 2009, 2012). Often the justification refers also to local food rather than strictly to organic food (e.g. VN 2009). This is because it is recognized that assessing sustainability of food products is not unambiguous[3], and local, organic, seasonal and vegetarian are presented as options to promote sustainability (Ministry of the Environment 2009, 2012).

It is noted that organic production does not solve the global problems of food availability, but the natural circumstances and physical resources in Finland provide good opportunities to promote organic production as a response to consumer demand (SRE 2008). The role of the small and medium-sized enterprises (SMEs) in improving the status of the Finnish organic food products is acknowledged (SRE 2008, Food Strategy 2010, VN 2010, 2011).

Factors hampering the use of organic food (as well as local food) and making the responsible choices unduly difficult within the public catering sector deal with the strategic decision-making, lack of knowledge on purchasing procedure, lack of education among the municipal procurers and with the underdeveloped purchasing process focusing only on price (VN 2010). The most sever practical problems regarding use of organic (and local) food are the uneven availability and low degree of processing of the products as well as the impact on the purchasing costs (Ministry of the Environment 2009, VN 2009). In addition, the co-operation along the organic food chain is not satisfactory, and the field is fragmentary (SRE 2008, VN 2010).

The measures aim at settling the legislative, informative and practical hinders in use of organic food and at securing decent resources both for food purchasing and for the actors' education (SRE 2008, VN 2010). Communication campaigns, certification schemes and clear criteria for sustainable food procurements are offered as means to improve actors' awareness on environmental and health impacts of food. The need to clarify procurement law by providing instructions regarding promotion of seasonal, vegetarian and organic food is acknowledged. Instructions are needed also in putting out tender calls with request for traceability, freshness and nutritional quality (Ministry of the Environment 2009, 2012). Improved purchasing know-how within public catering sector and inclusion of qualitative criteria in competitive tendering as well as legislative procedures are also seen to strengthen the competitive power of the SME:s. The implementation of the measures requires actions both from the organic sector itself and from the government (VN 2011).

The aims expressed in several of the policy documents have been brought together and concretised in the strategy for developing organic food markets in Finland. The overall goal is to consolidate Finnish organic food products in domestic retail and catering sectors as well as in export. The basis for development is customer orientation, efficient collaboration, learning and innovation and clear profile. R&D of organic sector is encouraged for new innovations and in order to upgrade organic production and to streamline supply and demand. The concrete aims by the year 2015 were specified as follows: the share of organic products is 6% from domestic food retail and 10% from food exports, all public institutional kitchens use organic products, and in private catering sectors there is a yearly increase of 15% in use of organic products. Further, organic food is a natural part of the food sector's communication (Organic strategy work group 2006, Kottila 2011).

In support of the food policy aims to turn the share of organic food into a strong upsurge (VN 2011), the government prepares a promotion program for the organic sector for the years 2012-2020 (MMM 2012). The program emphasizes the role of organic animal husbandry and that of public procurements, in which the use of organic products is to be expanded so as to cover all kitchens within the public sector. The need for improved efficiency in processing, marketing and export of the Finnish organic food items and niche products is stressed. The concrete aims by the year 2020 are defined in line with those of the sustainable consumption and production: an overall three-fold increase in sales of domestic organic food products both in retail and within public catering sector. This means the share of 20% from cultivated area as well as from food served in schools and in day care centres, and the share of 10% for organic products from the Finnish food export (Ministry of the Environment 2012).

[3] Sustainable meal service has been defined as "a product of shortest possible supply chain or an organic product or a product that has been produced traceably in line with the responsibility principles" (Ministry of the Environment 2009).

Discussion

In the analysed national policy documents there are three clearly articulated aims related to organic food: increased use of organic food with the public catering sector as the path breaker, improved sustainability of the food sector and marked expansion of the organic food sector (Kottila 2011, Ministry of the Environment 2009, 2012, MMM 2012, SRE 2008, VN 2006a,b, 2007, VN 2009, 2010 2011).

Organic food has, however, not really found its way into the institutional kitchens, and expanding its use in professional kitchens has proved to be a very slow process. Even though the *Steps to Organic* -training program[4] has been running now for 12 years and it is well known among the caterers (Muukka et al. 2009), the use of organic products in public kitchens is still modest. With the share of the order of 1%, it is about the same as that in retail (MMM 2012).

Appreciating the growing interest in organic food abroad, the growth of the organic sector is sought especially from the exports. In general, the domesticity of organic food is not an issue; only the most recent documents stress the domesticity of organic food supplies both in retail and public catering (Ministry of the Environment 2012, MMM 2012). However, stressing domesticity does not necessarily help the Finnish organic sector, because the appreciation of domestic conventional food as pure, safe and tasty has slowed down the demand of explicitly organic products (SRE 2008). This effect may be accentuated by the fact that in the policy documents, local and organic are often used in parallel, and sustainability is given as an overall justification for both organic and local food (e.g. Ministry of the Environment 2009).

Over the past decade, several factors hampering the use of organic products have been repeatedly pointed out in the policy documents. In institutional kitchens the problems crystallise into the availability of organic products suitable for the needs of the professional kitchens and into their higher price compared to conventional products, both problems being accentuated with animal based products (Muukka et al. 2009).

The policy relies on the top-down approach, the implementation of which is at the responsibility of the municipalities. In praxis, the municipalities are constrained by the EU regulations regarding competitive bidding of the public purchases and by the economic resources allocated in the budget for the catering sector. Because of the municipalities' tight economic situation the focus has long been on the price-based competition. The EU regulations, however, also offer the possibility to stress quality aspects and to require organic food (EC 2011). A conscious strategy to develop the public catering sector and a firm knowledge on purchasing procedures is needed to accommodate these requirements within the "combined affordability" in the tender calls.

In concluding, there are several reasons for the slowish growth of the organic sector in Finland. There is laxity in the policy aims, and the practical obstacles have not been addressed in the real-life context of the municipalities. Within the frame of the regulations regarding competitive bidding it is fully possible to require organic products, but it is useless to do so, if the bottlenecks have not been identified and opened. The same approach cannot be offered as an overall solution for all municipalities, but the problems need to be addressed in the concrete situations and regarding the concrete products. Par excellence, organic food is a value choice, and it requires determined political will among the municipal authorities. The loose policy articulation leaves enough play room for the municipalities to outline own food strategies based the best available knowledge. It is important to pay attention to the research results dealing with environmental and human wellbeing and to interpret these in terms of own situation. The outcome of the strategy will be enhanced, if the practical actors are involved in strategy planning (Mickwitz et al. 2009). With the actor-oriented approach attention is paid both to the views and experiences of the catering professionals and to the needs of their customers. So far, such municipal food strategies are rare, but the available evidence shows that change is possible (e.g. Kakriainen and von Essen 2005). It is therefore, suggested that adoption of organic food could be characterized by polycentrism at local level instead of collective top-down action. The pilot municipalities can learn from each others' experiences and innovations; sharing this knowledge can eventually influence also the national food policy

[4] The Steps to Organic -training program is a voluntary program aimed at helping professional kitchens to increase their use of organic products as means to support sustainable development within the catering sector. http://www.portaatluomuun.fi

References

EC 2011. Buying green! A handbook on green public procurement. European Commission http://ec.europa.eu/environment/gpp/pdf/handbook.pdf

Food Strategy 2010. Promotion program for Finnish food culture [in Finnish]. http://www.mmm.fi/attachments/mmm/tiedotteet/5qZTC31Sw/Huomisen_ruoka_-_Ehdotus_kansalliseksi_ruokastrategiaksi.pdf

Kakriainen, S., von Essen, H. 2005. Obstacles and solutions in use of local and organic food. Ekologiskt Lantbruk 44, 1-7. http://orgprints.org/7067/1/ekolant44.pdf

Kottila, M. 2011. Revised strategy for organic sector 2011-2015 [in Finnish]. Pro Luomu ry. 10 p. http://www.luomu.fi/wp-content/uploads/2011/08/Luomualan-kasvu-ja-kehitysohjelma.pdf

Mickwitz, P., Hildén, M., Seppälä, J. & Melanen, M. 2011. Sustainability through system transformation: lessons from Finnish efforts. Journal of Cleaner Production 19: 1779-1787.

Ministry of the Environment 2009. Sustainable public procurement. Public sector becomes a pioneer in sustainable public procurement. http://www.ymparisto.fi/download.asp?contentid=103507&lan=fi>.

Ministry of the Environment 2012. Revised program for sustainable consumption and production 2012. [in Finnish]. Helsinki. Ministry of the Environment. www.ymparisto.fi/julkaisut:

MMM 2012. Proposal of the Ministry of Agriculture and Forestry for organic promotion and development program "Organic 20/2020" [in Finnish]. Helsinki:Ministry of Agriculture and Forestry. http://www.mmm.fi/attachments/luomu/66XvsujSO/mmm_luomuohjelma_2012.pdf:

Muukka, E., Kuosmanen, L., Ylinampa, M., Blomquist, U., Kärkkäinen, I., Soininen, T. & Soininen, J.-. 2009. Local food in municipal catering. A survey on local food purchasing in Finnish municipalities. Savo Vocational College Publication. EkoCentria. Savonlinna, Finland.

Organic strategy work group 2006. The strategic goals 2007- 2015 in developing the Finnish organic markets. [in Finnish].

SRE 2008. Promotion program for Finnish food culture [in Finnish]. Helsinki: Ministry of Agriculture and Forestry. http://www.sre.fi/ruoka.fi/www/fi/liitetiedostot/Microsoft_Word_-_ruokakulttuuriohjelma_paeiv.pdf

VN 2006a. Towards sustainable choices. Nationally and globally sustainable Finland [in Finnish] Publications of the Prime Minister's office, 5/2006. http://www.ymparisto.fi/download.asp?contentid=53983&lan=fi

VN 2006b. Government decision-in principle on sustainable development strategy [in Finnish]. Prime Minister's office. http://www.ymparisto.fi/download.asp?contentid=60377

VN 2007. The program of the Prime Minister Matti Vanhanen government [in Finnish]. Prime Minister's office. http://www.aka.fi/Tiedostot/Strategiat/hallitusohjelma2007.pdf

VN 2009. [Resolution of the Finnish government on promoting sustainable choices in public procurements 8.4.2009. [in Finnish].http://www.ymparisto.fi/download.asp?contentid=101162&lan=en.

VN 2010. Government report to parliament on food policy. [in Finnish]. Prime Minister's Office. http://www.mmm.fi/attachments/maatalous/maatalouspolitiikka/newfolder_14/5tTDQgjLk/selontekosuomi.pdf

VN 2011. The program of the Prime Minister Jyrki Katainen government. [in Finnish]. Prime Minister's office, Helsinki. http://www.vn.fi/hallitus/hallitusohjelma/pdf332889/fi.pdf -

Optimizing nitrogen utilization by integrating crop and animal production

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Key words: nitrogen, intensity, utilization, efficiency, BNF, integration

Abstract

The farm model was built according to the data from 9 Finnish organic farms. 20 % of area produced cash crop and 80 % was used as fodder in milk production on the farm. The model indicates that there is high potential (up to 30% compared to Finnish average) to reduce nitrogen losses in agriculture. The key factors are integration between crop and animal production, limited nutrient intensity according to the system itself and BNF. The crop rotation used in model can support milk production with relative high intensity. In this model no external fodder is used, however, it may be necessary to have a small amount of high quality processed protein concentrate, if the annual milk yield exceeds 8000 kg/cow. Crop yield by means of nitrogen yield was about 10 % lower compared to Finnish average.

Introduction

There are always limited resources available for food production, thus resource efficiency is always the key issue. Modern agriculture is using resources like external nutrients (fertilizers) and non-renewable energy in large scale. The high production intensity results in high production per hectare; however, it often results in serious environmental damages.

Organic farming has a greater emphasis on internal and renewable resources than conventional farming. Very often it also results in lower production intensity and lower production per hectare. A common criticism against organic agriculture is that it has an inefficient use of land and an inefficient use of nutrients and energy per output unit.

In this survey the whole production system is introduced and all the main nutrient flows are presented. The main focus is on nitrogen efficiency.

Based on the data from the Finnish organic farms, a farm model was constructed to illustrate the characteristics and fundamentals of integrated crop and animal production. The main focus is on nutrient flows, especially the nitrogen flow.

The two main ideas behind the organic farm model are:

1) the ratio between crop and animal production equals the Finnish average (i.e. 20 % of area for direct human consumption as crop products and 80 % for livestock fodder);
2) running the production system with the intensity based on the local renewable resources and the system itself, i.e. biological N-fixation (BNF), crop rotation, and nutrient recycling. (i.e. also feeding strategy on livestock production is based on almost 100% self-sufficiency)

Material and methods

The data was collected from nine organic farms in southern Finland for two consecutive years on each farm (2011 and 2012). Data was collected through face to face interviews with the farmers.

The evaluation of nutrient flows is based on the concept of primary nutrients developed by Seuri (Seuri 2002, 2008; Seuri and Kahiluoto 2005). In addition, surface balance was calculated and surface efficiency was defined as the ratio between harvested yield and nutrient inputs to the field. The standard statistics for Finnish agriculture were used for comparison to the model.

Farm model

T The main production line is milk in the farm model, the average annual milk yield is 8000 kg/cow. In addition, about 20% of total crop yield is sold, reflecting the average share of direct human consumption of crop yield in Finland (Table 1.).

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Table 1: Crop rotation, yields (dry matter and nitrogen) and biological nitrogen fixation (BNF) in the farm model

	legume	non-legume	N-legume	N-non-leg	N-harvested	BNF	
	(d.m. kg/ha)	(d.m. kg/ha)	(%)	(%)	(N kg/ha)	(N kg/ha)	
red clover+timothy	2000	2000	3.5	1.5	100	100	
red clover+timothy	1600	2000	3.5	1.5	86	80	
barley/wheat		2200		2	44	20	
pea+oats	1000	1100	4	2	62	50	
barley+grass seed		2300		2	46	20	

The primary source of nitrogen in the system is biological N-fixation by legumes and the amount of N-fixation determines the maximum yield potential of non-legumes. The value of 5.0 kg BNF/100 kg harvested legume biomass has been used in the model calculations. However, some BNF is not related to harvested yield, i.e. the under sown ley and yield of ley regrowth. Both were estimated to be 20 kg/ha BNF. The average total BNF was 54 kg/ha in the 5-year crop rotation. In addition to BNF, 5 kg/ha N has been added to total external input as atmospheric deposition, i.e. primary nitrogen totals 59 kg/ha.

All the other harvested crops are used as a fodder on the farm except for the cash crop yield. The amount of nitrogen in manure has been estimated to be 50% of total nitrogen content in fodder. Thus, from a total harvested N-yield (68 kg/ha) about 9 kg/ha is sold in the form of cash crop and about 30 kg/ha is left on the farm as farmyard manure (FYM). This amount of manure can be spread for one crop in a 5-year crop rotation, i.e. under sown cereal receives FYM (147 kg/ha total N). Evaluation of nutrient efficiency and comparison between the model and Finnish agriculture is presented in Table 2.

Results and conclusions

Table 2: Evaluation of nitrogen flows in the farm model and comparison with Finnish agriculture

	Model		Average for Finnish agriculture
Primary nitrogen, p	59	N kg/ha	95
Secondary nitrogen, s	30	N kg/ha	35
Total N input to the field = p+s	89	N kg/ha	130
Circulation factor, c = (p+s)/p	1.5		1.37
N-yield, y	68	N kg/ha	75
N surface balance=(p+s)-y	21	N kg/ha	55
N surface efficiency, S = y/(p+s)	0.76		0.58
Primary efficiency, P = y/p = c x S	1.15		0.79

*80 kg/ha N-fertilizers, 5 kg/ha atmospheric deposition, 5 kg/ha BNF, 5 kg/ha imported fodder

The model results in about 30% more efficient nitrogen utilization compared with the Finnish average, i.e. primary nutrient efficiency in the model is 115% versus 79% in Finnish agriculture.

According to the law of diminishing returns, the utilization efficiency decreases when the use of the input increases (production intensity increases). The average nitrogen intensity in Finnish crop production is 130 kg/ha whereas in the model it is 89 kg/ha. However, it is not likely that only a lower nitrogen intensity explains the difference in N surface efficiency (0.76 vs. 0.58). The biggest difference in nitrogen flows between the model and average Finnish agriculture is the primary source of nitrogen: in the model it is BNF, whereas in Finnish agriculture it is nitrogen fertilizers. It is obvious that utilization efficiency of BNF is very high since almost all BNF is related to harvested yield. It can be estimated that the nitrogen efficiency origin from BNF is around 85% (total BNF is 54 kg/ha, 8 kg/ha has been estimated to be related to non-harvest BNF yield). A rough estimation of nitrogen efficiency origin from FYM is 60% (the weighted average from BNF and FYM results in 76% surface efficiency when BNF efficiency is 85% and FYM efficiency is 60%). The average nitrogen utilization efficiency of FYM has been estimated to be around 20% and the efficiency of nitrogen fertilizers around 70% in Finnish agriculture.

The nitrogen yield level in the model is only 10% lower than the Finnish average. However, the difference is slightly higher (20%) if measured in terms of energy (dry matter) content of yield. The difference in cereal yields (dry matter and nitrogen basis) is around 30%, but ley yields are almost equal to the Finnish average. The proportion of leys in a crop rotation is slightly higher in the model than for the Finnish average. The main difference between the model and the Finnish average is in the protein crops: peas are hardly grown in Finland in conventional farming and rape seed is the main protein crop, but its proportion is even less than the peas in the model.

Discussion

The present agriculture (conventional and organic as well) is based on highly specialized production. It is quite doubtful to improve nutrient utilization in large scale without improving integration between the specialized production lines, i.e. integration between crop and animal production. Other key issues to improve nutrient utilization are limited nutrient intensity according to the system itself and BNF.

References

Seuri, P. 2002 Nutrient utilization with and without recycling within farming systems. In: Urban areas – rural areas and recycling – the organic way forward? / eds. Jakob Magid et al. DARCOF Report 3: 175-181.

Seuri, P. 2008. Nitrogen utilization in integrated crop and animal production. In: Cultivating the future based on science: vol. 1 organic crop production / eds. Daniel Neuhoff et al. Bonn: International Society of Organic Agriculture Research p. 142-145.

Seuri, P. & Kahiluoto, H. 2005. Evaluation of nitrogen utilization by means of the concept of primary production balance. In: Shaping sustainable systems: 15th IFOAM organic world congress, 20-23 September 2005 Adelaide, South Australia: congress handbook. p. 92.

Designing mixed horticultural systems

MARC TCHAMITCHIAN[1], EMMANUELLE GODIN[2]

Key words: orchard; vegetable production; collaborative design; computer assisted design

Abstract

In the abstract should be a short introduction and the main results resp. conclusions. It should be understandable without the rest of the paper. The abstract should not exceed 1000 letters (incl. spaces).

Introduction

Organic vegetable production systems are a solution to address the current concerns about the environmental impact of agriculture (Bellon and Hemptinne, 2012). However, these systems remain relatively specialized. Agroforestry systems mixing fruit trees and vegetable crops make a better use of biodiversity and offer a good response to economic challenges such as being able to fulfill the local market requirements, continuous provisioning of vegetable but diversified food.

Designing mixed cropping systems based on fruit and vegetable is a real challenge because they combine interactions of different nature (ecological, economical and social), which take place both in time and space. Therefore, automatically building prototypes exploiting the advantages of agroforestry would be of great help. The goal of this study is to assess the validity of the methodological choice to design mixed fruit-vegetable cropping systems by automatic inference using the constraint satisfaction problem approach. The following part surveys the knowledge necessary to describe such mixed systems and how it has been modeled as constraints. The next part presents and discusses the results obtained so far.

Material and methods

Knowledge base

The necessary knowledge encompasses the agronomic knowledge concerning the potential crops, fruit trees and vegetable crops. We have chosen to focus on only one fruit tree variety, apple, and on a selection of vegetable crops that would allow for variable planting dates along the year and would need different cropping duration: lettuce, tomato, onions, melon and carrots. We have added a green manure, as it is a required practice for the restoration of the soil fertility. This knowledge has been augmented with the necessary information concerning the potential interactions: root extension dynamics and crop sensitivity to shade and microclimate modifications. In many case, it has not been possible to obtain a quantitative description of these effects. In such cases, local agricultural advisers' knowledge has been used. Other interactions represented were in relation to the development of the roots of the different crops, leading to competition or sharing of water and trophic resources.

Model formalism

The main inference challenge in the present study is linked to the combination of time and spatial dimensions in the problem. Recently such a problem has been solved using the Weighted Constraint Satisfaction Problem (WCSP) methodology (Akplogan et al., 2011). It consists in representing the problem to solve in a set of variables, which can take a finite number of states, and a set of constraints, algebraic relations linking variables. In the WCSP approach, the search for a solution tries to minimize the sum of these weights (or costs), and finally proposes all solutions associated to this minimum.

The problem being to allocate crops (annuals and perennials) on a piece of land, is has been represented as a set of variables representing a unit land area at a given time (a cell). Visually, it results in a set of matrices of cells, each matrix corresponding to the same cultivated plot, the sequence of matrix giving the evolution in time of its occupation by the crops. The inference engine used is an open-source solver, toulbar2 (de Givry et al., 2005). Because of its limitations and of the maximum size of the problem it is known to be able to handle, we have limited our problem formulation to about 1,000 (one thousand) variables. Therefore, we chose to represent the piece of land of interest as a square grid of 10x10 cells. We also divided time into four

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seasons for the within year evolution, and in three periods for the tree growth. The first period corresponds to young trees, the second to intermediate growing trees, not yet producing fruits and the third period corresponds to their maturity. The evolution of their potential shade is presented in Figure 1. On the contrary, the roots extend progressively along these periods. Each tree growing period may last several years, however a one year rotation is represented for each period. Therefore, we have 12 time intervals, 4 seasons x 3 periods to represent. The final model consists of 12 matrices of 100 variables each.

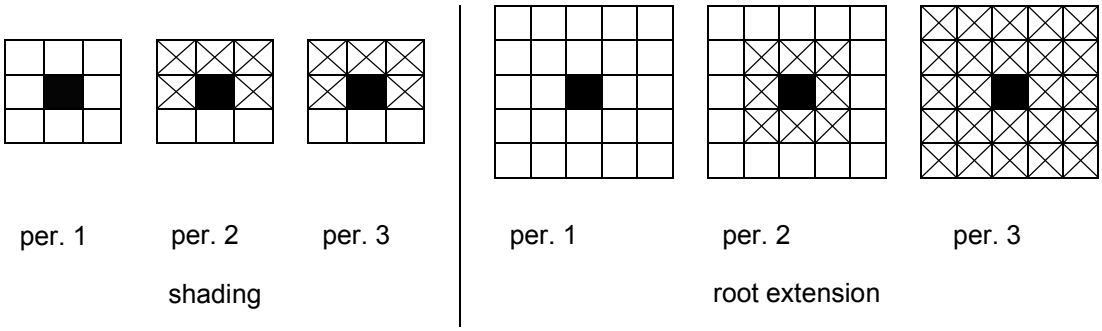


Figure 1. Evolution of the spatial influence of the trees. Dark cells host a tree, checked cells are shaded in periods 1, 2 and 3 (left) or host tree roots in periods 1, 2 and 3 (right).

Conclusion

The work described here showed that the WCSP formalism can tackle the problem of designing complex agroecosystems needing to allocate crops both in time and space in one same rationale. However, it also showed that the available mathematical tools had limitations which deprecate the interest of the proposed solutions. It also showed that some key knowledge on the interactions at play in these systems are still lacking, although they are essential to the sustainability of these mixed cropping systems, especially when grown organic. This draws line for future research, both in the agronomic domain and in operations research.

Figure 2 shows an example of a solution. Crops taking benefit from the tree proximity (tomato in summer for example) are located in the areas where they are shaded in summer. On the contrary, crops that suffer from tree shade (melon in summer for example) are placed in cells not shaded. Although no constraint expressed any necessity to diversify the system, it can be noted that the solution makes use of all the possible crops. Moreover, bare soil is a rare option; it only appears in fall where the choice of crops was very limited.

While some major interactions have been successfully represented (access to trophic resources in the soil, competition for light), no information concerning the natural regulations have been found on these specific mixed fruit-vegetable cropping systems. Natural regulations, enhanced by a higher biodiversity within the systems, are a key element for the stability and the sustainability of mixed systems (Trenbath, 1993). Not being able to represent any of these interactions is a crucial drawback that must be addressed before any use such an approach to collaboratively design new cropping systems. Moreover, the technical limitations of the solver used, which is one of the few available, lead us to simplify the time and space description. Discretizing the time into seasons forbids for example the representation of constraints describing the work load associated to each agricultural operation, therefore depriving the solution from another key element, the manageability of the proposed prototype.

Results and discussion

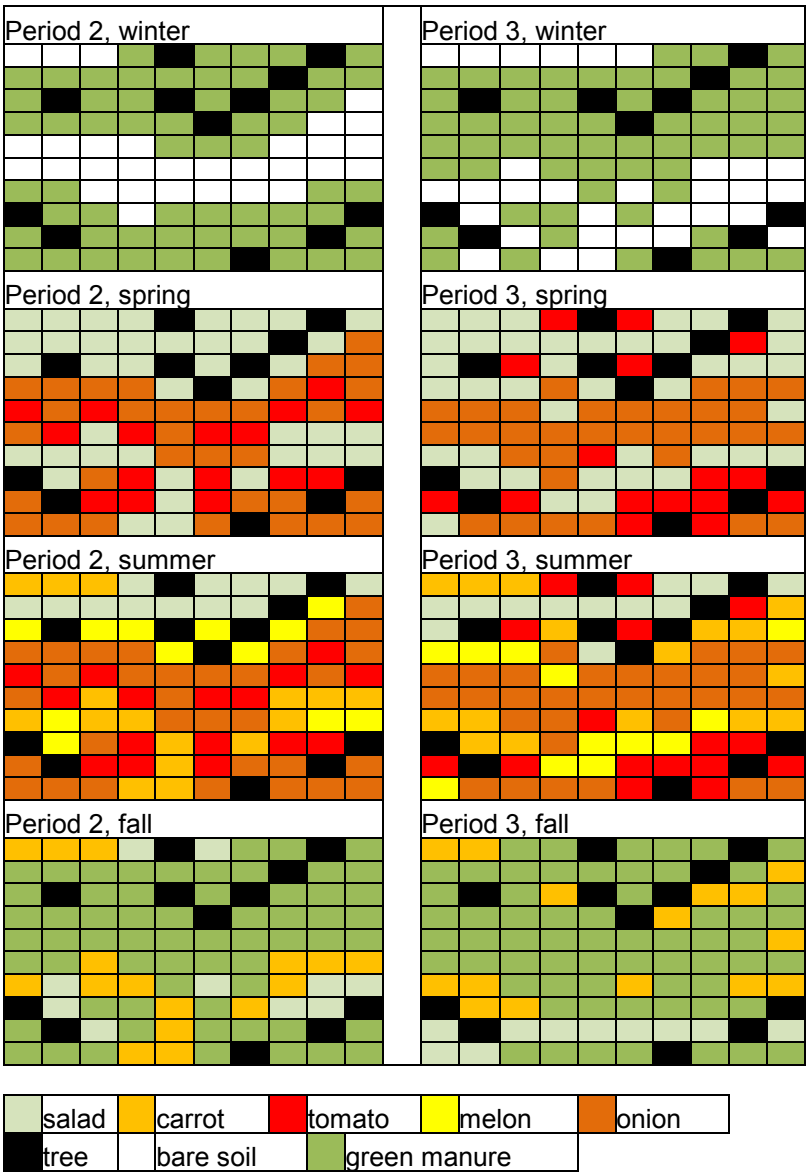


Figure 2. Mixed system prototype (period 1 is not represented because no interactions take place between trees and vegetable crops)

References

Akplogan M, Dury J, de Givry S, Quesnel G, Joannon A, Reynaud A, Bergez J-E & Garcia F (2011): A Weighted CSP approach for solving spatio-temporal farm planning problems. In Boussart H, Berthier G, Monod H, & Lavigne C (eds): Modélisation de paysages agricoles pour la simulation et l'analyse de processus, Colloque PAYOTE, Rennes (FRA). INRA, AgroCampus Ouest.

Bellon S & Hemptinne J-L (2012): Reshaping boundaries between farming systems and the environment. In: Darnhofer I, Gibbon D & Dedieu B (eds): Farming systems research into the 21st century. The new dynamic. Springer Verlag, Heidelberg (DEU) 311–337.

de Givry S, Zytnicki M, Heras V & Larrosa J (2005): Existential arc consistency: Getting closer to full arc consistency in weighted CSPs. In: IJCAI-05, Edinburgh, Scotland (GBR).

Trenbath BR (1993): Intercropping for the management of pests and diseases. Field Crops Research 34, 381–405.

Information needs and thematic priorities of the organic food and farming sector in France

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Key words: information, survey, AKIS, actors' needs, typology, research priority setting

Abstract

A large survey was performed among French actors committed to organic food and farming (OF&F) to identify their information needs. This survey highlights the need for increased information dissemination. This analysis identifies four publics with specific needs. Structuring variables include professional experience, degree of commitment to OF&F and professional category. Legal and economic information about food quality and processing is generally of interest to senior actors with low-level needs. On the contrary, junior actors actively involved in the developmental and educational aspects have the greatest needs over a wide range of themes. Thematic priorities also depend on professional categories and types of information. While technicians and farmers require scientific and technical information on plant production issues, only young farmers give priority to animal production issues. These results allow OF&F actors to reflect on the improvement of the overall device of information dissemination.

Introduction

Unlike intensive or high external-input agricultural systems, organic agriculture is considered as knowledge-intensive (Kummer et al., 2010). Knowledge about OF&F is emerging and widely diffused. The availability of information about OF&F in the sciences has exponentially increased since the 1990s (Ollivier et al., 2011). OF&F is an ongoing and complex process involving specific adaptations of practices by local actors to a number of constraints at each stage, ranging from production to consumption. Far from the classic "one problem-one solution" scheme, actors must combine a number of alternatives to address one 'symptom'. Information must therefore be multiple, dynamic and integrated within a systemic approach. Many authors agree on the need for the increased dissemination of information. Gardiès et al. (2011) and Kummer et al. (2010) found that information practices among organic farmers are generally intuitive and experiential. They advocate the need for further mediation and structuring of the information. An increasing number of projects and tools are emerging that are dedicated to information dissemination (organic e-prints, VOA3R, organic.edunet, etc.), highlighting the focus on knowledge infrastructure through facilitation techniques. Alfoldi (2013) and Dehaudt (2013) proposed a coordinated mix of dissemination tools and channels to maximise the impacts of research projects. The aim of our work is to better understand the diversity of users' information needs. This paper is in line with previous publications (Bellon et al., 2011; Ollivier et al., 2011) whose goal has been to enrich reflections on the way research priority setting and projects could better respond to users' needs and diversity. In 2012, an on-line survey was performed among the different OF&F actors in France: farmers, advisors, researchers, processors and distributors, educators and administrators. Data on their profiles and information needs, including themes, were collected and analysed to characterise this diversity.

Material and methods

The survey consisted of 52 questions to establish users' profiles, information needs and practices. Respondents were enlisted from the mailing lists of the project partners. A total of 532 completed questionnaires were returned, with a final response rate of 10%. The respondents were diverse in terms of professional activity (Fig. 1), number of years in activity (yrAct) and work time devoted to OF&F (timeOF). Respondents were asked to prioritise information types according to their usefulness (typ_info1) and to express the level of their information needs (need_intens). We submitted a 22-theme grid covering the different dimensions of OF&F. The respondents answered the question: "Among these themes, which ones inspire you to look for information?".

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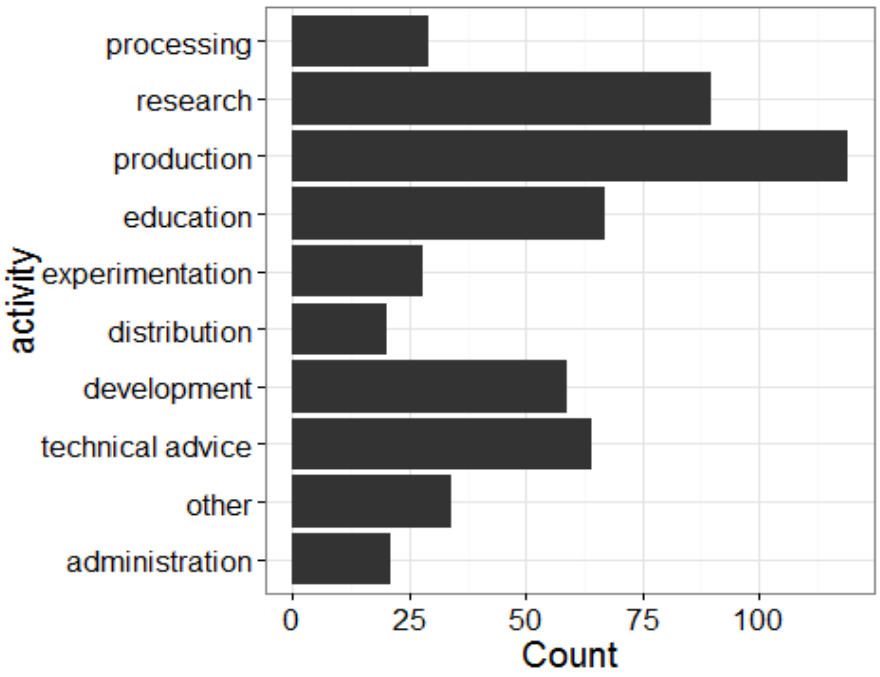


Figure 1: Distribution of respondents' professional activities

These variables allow to identify different thematic areas of interest that can be described by the professional characteristics of the respondents. To do this, we used the Hierarchical Clustering on Principal Component (HCPC)[2] from the R FactoMineR library to partition the population of individuals on the basis of their coordinates in the N first dimensions of a multivariate analysis. By measuring statistical links between clusters and the modalities of the variables used, we interpreted the structures in the data and identified individuals with similar characteristics.

Results

First, information needs follow a normal distribution with a majority of responses between "medium-high" (21%), "high" (45%) and "very high" (27%). Figure 2 makes it possible to identify thematic priorities according to their occurrence. Information about organic regulations, system and practice design, soil quality and management, pests and diseases, crop management sequences, environmental performances, technico-economic references and economy are judged insufficient by a majority of respondents. However, this representation hides a diversity of responses. While information needs concerning OF&F regulations are consensual, system design and soil management are more specific to some respondents.
An in-depth analysis was performed to cross information needs with profile variables, type and thematic information needs. The HCPC method identifies four clusters (Fig. 3). The first cluster includes respondents who give priority to food quality and processing rather than agronomic themes, and who require legal and economic information. They are generally involved in a processing activity, but may also be involved in research, production or technical counselling. They tend to be experienced and have low-level information needs. The second cluster comprises respondents who give priority to themes related to plant production: pests and diseases, technical management sequences, soil management, system design and plant breeding. They are generally involved in experimentation and, to a lesser extent, in production. They primarily require scientific and technical information but not economic one. The third cluster comprises respondents that give priority to themes related to animal production: feeding, health and breeding. They are mostly young farmers interested in technical but not scientific information. Finally, the fourth cluster includes respondents that give priority to socio-economic themes (institutions, transitions, references, etc.), along with most of the other themes. These respondents, generally involved in development and education, have little experience and are very committed to OF&F. They have technical rather than scientific information needs.

[2] http://factominer.free.fr/classical-methods/hierarchical-clustering-on-principal-components.html

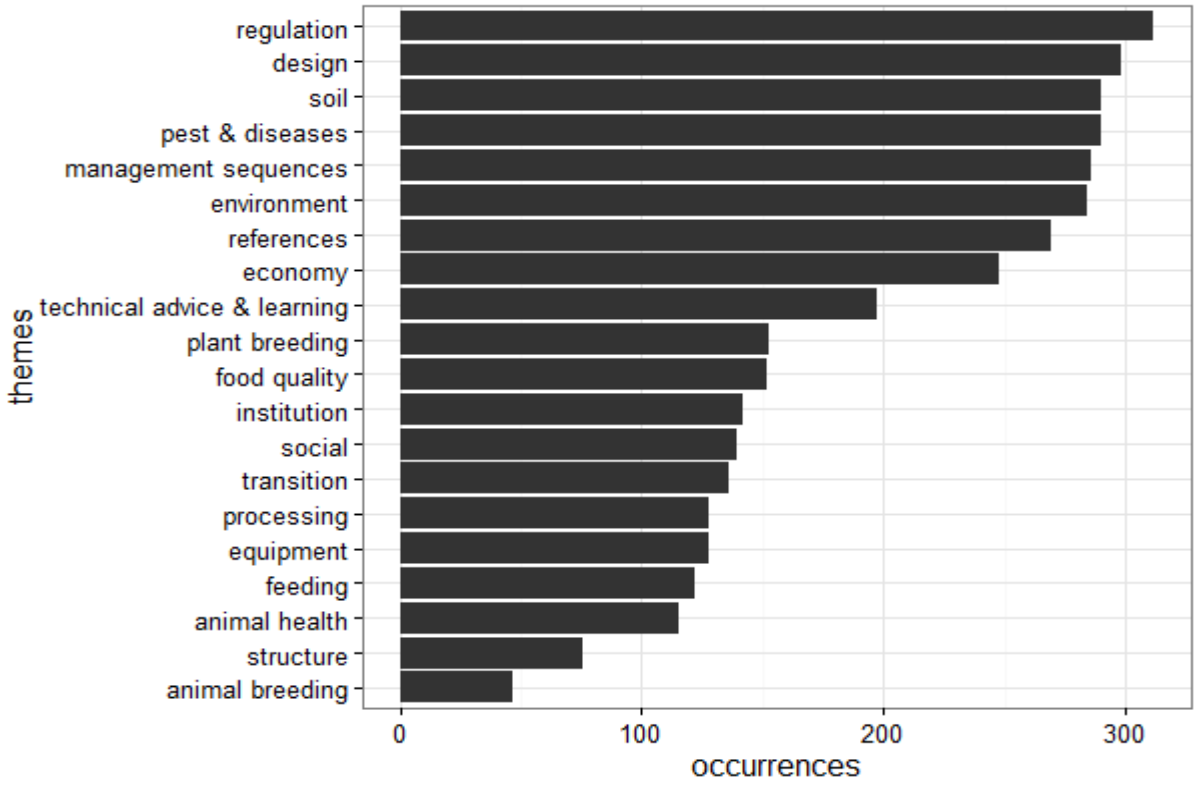


Figure 2: Thematic priorities sorted by the number of occurrences in the actors' responses.

In terms of information systems, the analysis confirms the relevance of segmented offers of information both as to form and content in order to better fit actors' profiles and needs. Structuring variables include activity, experience and commitment to OF&F. Other variables, particularly information practices, must be tested. If the offer is to be segmented, care must however be taken regarding the structuring of information. A total of 56% of the respondents agree that information resources are already too dispersed. The multiplication of tools and channels (Alfoldi, 2013; Dehaudt, 2013) must thus be done in agreement with users' practices and needs. The results could be also used, under certain conditions, to enrich reflections about setting research priorities. This analysis highlights some gaps between research and different knowledge users-producers concerning their priorities. Whereas scientists have little interest in OF&F and focus on specific themes, farmers and upstream stakeholders are fully devoted to OF&F instead and focus on different types and themes of information. Therefore, how can research priorities be established given these different views on thematic priorities? What are the trade-offs between offer and demand for knowledge production? Further analyses must be performed to test selection criteria for setting priorities such as the most cited items or 'weak signals', the professional category or the degree of commitment to OF&F.

Conclusion

This survey highlights the need for increased information dissemination. This analysis identifies four different publics with specific needs. Structuring variables include professional experience, degree of commitment to OF&F and professional category. Legal and economic information about food quality and processing is generally of interest to senior actors who have the lowest information needs. On the contrary, junior actors actively involved in the developmental and educational aspects of OF&F have the greatest information needs over a wide range of themes. Thematic priorities are also different depending on professional categories and types of information. While technicians and farmers call for scientific and technical information on plant production issues, only young farmers give priority to animal production issues. The dataset must be further analysed but it already provides insights for recommendations on information dissemination and the establishment of research priorities.

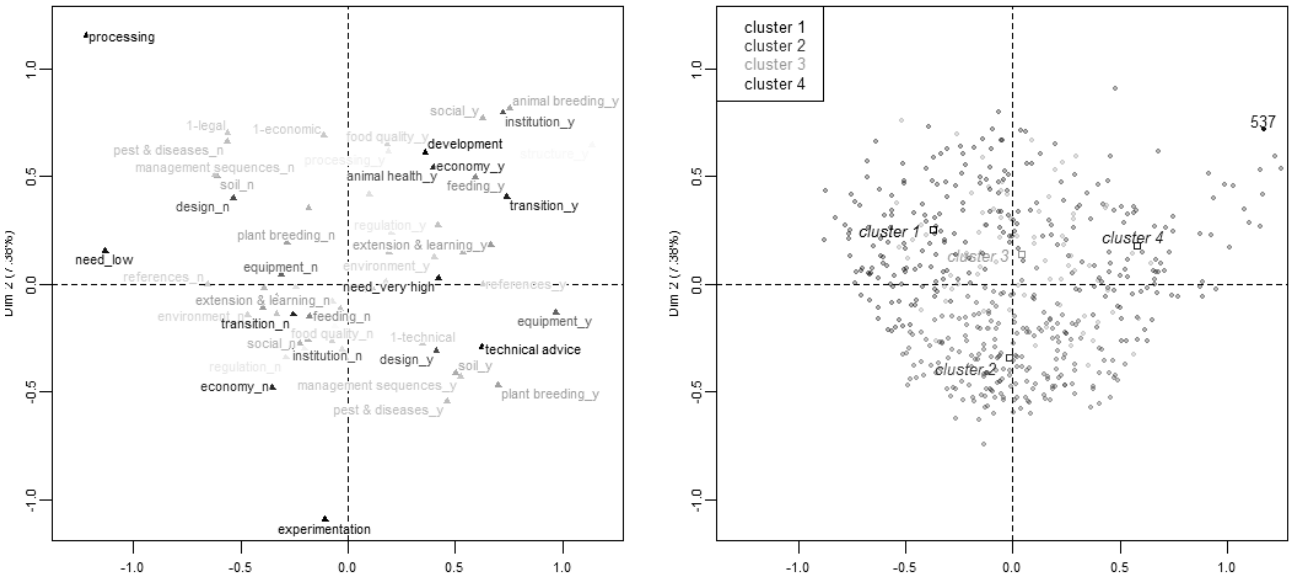


Figure 3: Multiple Correspondence Analysis; 45 of the most frequently mentioned themes are visible here

References

Alföldi T., Weidmann G., 2013. Dissemination: Tips, tricks, and lessons learnt. Core Organic research seminar, 15 May 2013, Amsterdam, the Netherlands.

Bellon S., Penvern S., Ollivier G., Debaeke P., Cabaret J., 2011. Promouvoir des travaux sur l'AB dans un institut de recherche. Colloque "Les transversalités de l'agriculture biologique", 23-24 juin 2011, Strasbourg.

Dehaudt V., 2013. Outils et méthodes de diffusion de résultats aux utilisateurs finaux. Salon Tech-n-Bio, 18 Septembre 2013, Valence, France.

Gardiès, C., Fabre, I., & Dumas, M., 2011. Place de l'information professionnelle dans la construction de savoirs émergents: le cas des agriculteurs biologiques, 11 p.

Kummer S., Aigelsperger L., Milestad R., Chowdhury A.H., Vogl C.R., 2010. Knowledge systems, innovations and social learning in organic farming – An overview. Proceedings of the 9th European IFSA Symposium, 4-7 July 2010, Vienna, 664-669.

Ollivier, G., Bellon, S. & Penvern, S., 2011. Thematic and citation structure dynamics of Organic Food & Farming research, in Neuhoff, D. (Ed), Proceedings of the 3rd ISOFAR Scientific Conference at the 17th IFOAM Organic World Congress. Gyeonggi Paldang, Republic of Korea.

Is leaf litter removal more efficient than leaf litter shredding to control apple scab? An answer in a commercial organic orchard

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Key words: apple, scab, sanitation, litter, removal, ploughing-in

Abstract

In organic apple orchards, sanitation practices are a keystone of a sustainable scab management. Because the suppression of the inoculum by leaf litter removal could be a promising practice, we carried out an experiment to assess the interest of leaf removal versus leaf shredding on disease development and fruit damages. For one of the two cultivars studied, we showed that leaf litter removal can significantly decrease scab damages on fruit and leaf in comparison to leaf shredding.

Introduction

Apple scab, caused by *Venturia inaequalis*, is one of the most serious diseases in apple, especially in organic orchards. In France, the management of apple scab in organic orchards mainly relies on copper and sulphur based products. However, copper and sulphur have respectively environmental side-effects on soil microbial activity, beneficial arthropods and earthworms (*e.g.*Van Zwieten et *al*., 2004).

V. inaequalis primary inoculum mainly comes from ascospores released from pseudothecia on overwintered infected leaves in the leaf litter. The suppression or reduction of this inoculum can be done by application of compounds active on leaves degradation or *V. inaequalis* inhibition such as urea (Sutton et al., 2000). However, urea compound is not registered in the European organic farming standards (Appendix II, R EEC/2092/91). Another way to reduce ascosporic inoculum is to induce leaf decomposition by shredding (Vincent et al., 2004) or to remove leaf litter (Gomez et al., 2007). Devices to mow weeds are more commonly used by farmers and can be used to shred leaf litter in the alley. The removal of leaf litter in the alley could be more efficient than leaf shredding to reduce scab inoculum, indeed Gomez et al. (2007) showed a 95% reduction of aerial ascospore concentration with removal of leaf litter. However, specific devices for leaf removal in orchard are not commercialised. Devices adapted to other use can be use but they imply modifications and a specific investment.

In order to assess the interest of leaf litter removal to control scab, we conducted a 4-year experiment to assess the effect of leaf removal *versus* leaf shredding on disease development and fruit damages.

Material and methods

The orchard (1.2 ha) planted in 2001 was located in Loriol (Drôme, France). This commercial organic orchard included two apple cultivars: Pinkgold® Leratess (7336) and Galaxy (6716), both considered as very susceptible to scab. In the orchard composed of 30 rows, 4 rows of Pinkgold® alternated with 4 rows of Galaxy. Planting distances were 4.0m between the row and 1.25m within row. Rows were north-south oriented. The alleys between rows were regularly mowed. An automatic retractable cultivator that tilled and ridged the soil was used to control weeds within rows. In November 2009, the orchard was divided in 4 blocks. Each block was composed of 4 rows of Pinkgold® cultivars and 4 rows of Galaxy cultivars, except for the block n°4 composed 4 rows of Galaxy cultivars and 2 rows of Pinkgold® cultivar.

Two treatments were tested:
(i) 'reference': in the alley, leaf shredding of leaf litter using a Chabas® FU 2.50 m device equipped with hammers used to shred wood; within the row, leaf ploughing using an automatic retractable disc cultivator.
(ii) 'leaf removal': in the alley, removal of leaf litter using an Amazone Tondobalai® (Tondobennable LGD 180) device; within the row, leaf ploughing using an automatic retractable disc cultivator as for 'reference' treatment.

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Leaf removal and leaf shredding treatments were applied at the same date after leaf fall the 20 November 2009 and 16 February 2010 (season 2010), the 19 January 2011 (season 2011), the 15 December 2011 (season 2012) and the 22 February 2013 (season 2013). Within the row, leaf ploughing was realised at the same date for both treatments with the cultivator. Except for leaf litter management, the orchard was managed according to usual practices in organic orchards in Rhône Valley. Scab was managed by copper and sulphur-based products applied before announced rain.
Scab assessment was done on Pinkgold® and Galaxy cultivars.

For each cultivar, 16 trees were selected within the two inner rows of each plot, excluding trees of the plot edge. Two growing shoots and 10 fruits were selected at random from each tree. On leaf, incidence (percentage of scabbed leaves) and severity (mean number of scab lesions per leaf) were assessed on a sample of 128 shoots / treatment / cultivar. On fruit, incidence (percentage of scabbed fruits) and severity (mean number of scab lesions per fruit) were assessed on a sample of 640 fruits / treatment / cultivar. Scab damages on leaf were observed in May when the scab lesions associated with the first contamination event were observed and in June at the end of the primary infection period. Scab damages on fruit were observed before harvest. An analysis of variance (ANOVA) was performed on the leaf and fruit scab incidence and severity to evaluate differences between leaf shredding and leaf removal. Anova were computing using Statgraphics plus 5.1 software (Manugistics, Rockville, MD, USA). The normal distribution of ANOVA residuals was checked using Shapiro-Wilks test, the independence of ANOVA residuals and the intra-treatment variance equality were visually checked using the residuals/predicted values graph.

Results

Scab development conditions

In 2010 and 2011, climatic conditions were unfavourable for the development of scab in the orchard. Because such conditions didn't allow assessing the effect of the two different sanitation practices, these results are not presented in this document. Only 2012 and 2013 results are presented in this study.

At a local scale, from 18 March 2012 to 4 July 2012, 16 risks of infection occurred:, 7 risks 'Light', 5 risk 'Moderate' and 4 'Severe', according to the levels of Mills and Olivier infection periods (Olivier, 1986). From 23 March 2013 to 9 July 2013, 18 risks of infection occurred: 4 risks 'Angers', 4 risks 'Light', 6 risk 'Moderate' and 4 'Severe'.

Scab damages on leaf

In 2012, no significant effect of the treatment on scab incidence was observed at the 15 May on Pinkgold® (p=0.07) and Galaxy (p=0.16) cultivars (data not shown). The 26 June 2012, *i.e.* 42 days later, a significant decrease of leaf scab incidence and severity was observed on Pinkgold® cultivar on the 'leaf removal' treatment (table 1). No significant difference of scab incidence and severity was observed on Galaxy cultivar (p=0.07 and p=0.17, respectively), but the same trend can be noticed.

In 2013, the incidence and severity of scab observed the 23 May was very low and no significant effect of the treatment was observed (data not shown). The 27 June 2013, a significant decrease of leaf scab incidence and severity was observed on Pinkgold® cultivar on the 'leaf removal' treatment (table 2). Scab incidence and severity was respectively decreased by 22% and 35% on the 'leaf removal' treatment. No significant difference of scab incidence and severity was observed on Galaxy cultivar (p=0.09 and p=0.08, respectively), but the same trend can be noticed as in 2012.

Table 1: Leaf scab incidence and severity observed the 26 June 2012 on Pinkgold® and Galaxy cultivars.

	Leaf incidence		Leaf severity	
	Pinkgold®	Galaxy	Pinkgold®	Galaxy
Reference	37.29 a	27.65 a	3.25 a	1.73 a
Leaf removal	24.61 b	20.41 a	2.12 b	1.20 a

Table 2: Leaf scab incidence and severity observed the 27 June 2013 on Pinkgold® and Galaxy cultivars.

	Leaf incidence		Leaf severity	
	Pinkgold®	Galaxy	Pinkgold®	Galaxy
Reference	48.04 a	22.40 a	4.31 a	1.01 a
Leaf removal	37.57 b	14.62 a	3.00 b	0.59 a

Scab damages on fruit

In 2012, a significant decrease of fruit scab incidence and severity was observed on Pinkgold® cultivar (table 3). Scab incidence and severity was respectively decreased by 26% and 46% on the 'leaf removal' treatment. No significant difference of fruit scab incidence and severity was observed on Galaxy cultivar (p=0.71 and p=0.96, respectively). In 2013, no significant effect was observed on both cultivars (table 4).

Table 3: Fruit scab incidence and severity observed the 18 July 2012 on Pinkgold® and Galaxy cultivars.

	Fruit incidence		Fruit severity	
	Pinkgold®	Galaxy	Pinkgold®	Galaxy
Reference	35.47 a	32.19 a	1.68 a	0.98 a
Leaf removal	26.25 b	35.31 a	0.91 a	0.97 a

Table 4: Fruit scab incidence and severity observed the 16 July 2013 on Pinkgold® and Galaxy cultivars.

	Fruit incidence		Fruit severity	
	Pinkgold®	Galaxy	Pinkgold®	Galaxy
Reference	22.19 a	29.69 a	0.62 a	1.02 a
Leaf removal	18.28 a	23.44 a	0.53 a	0.70 a

Discussion

The contribution of overwintered conidia located on shoots or buds have to be mentioned because they could interfere with the reduction of ascosporic inoculum. However, Holb et al. (2004) have demonstrated these conidia only slightly contributed to early spring epidemics in orchards with high levels of scab infection in autumn. Moreover, Gomez et al. (2007) have shown that ascospores reduction strongly decreased spring scab development in a continental climatic context. Thus, the contribution of overwintered conidia can be considered as negligible compared to ascospores contribution to the scab epidemic under our climatic condition.

The leaf removal method used in this trial leads to a significant decrease of scab incidence observed on leaf (2012 and 2013) and fruit (2012) on Pinkgold® cultivar. Although the results observed on Galaxy cultivar are not significant, conclusion for this cultivar needs to be nuanced because results observed on leaf follow the same trend as Pinkgold® cultivar and *p-value* are close to the threshold value of 0.05. In this study, the leaf removal method is compared to a leaf shredding method usually employed by organic growers. This study points out the results observed by Gomez et al. (2007) showing an interest to remove leaf in comparison to the shredding of leaf litter.

References

Carisse O., 2004. Apple leaf shredding as a non-chemical tool to manage apple scab and spotted tentiform leafminer. *Agric. Ecosyst. Environ.* 104: 95-604.

Gomez C., Brun L., Chauffour D., De Le Vallée D., 2007. Effect of leaf litter management on scab development in an organic apple orchard. *Agric. Ecosyst. Environ.* 118: 249–255.

Holb, I.J., Heijne, B., Jeger, M.J., 2004a. Overwintering of conidia of Venturia inaequalis and the contribution to early epidemics of apple scab. *Plant Dis.* 88, 751–757.

Olivier, J. M., 1986. La tavelure du pommier, conduite d'une protection raisonnée. *Adalia* 1, 3-19.

Statgraphics, 2001. Statgraphics Plus, Version 5. 1 for Windows. User Manual. Manugistics, Rockville.

Sutton D.K., MacHardy W.E., Lord W.G., 2000. Effects of shredding or treating apple leaf litter with urea on ascospore dose of *Venturia inaequalis* and disease buildup. *Plant Diseases* 84: 1319-1326.

Van Zwieten L., Rust J., Kingston, T., Merrington G., Morris, S., 2004. Influence of copper fungicide residues on occurrence of earthworms in avocado soil. *Science of the Total Environment* 329: 29-41.

Vincent, C., Rancourt, B., Carisse, O., 2004. Apple leaf shredding as a non-chemical tool to manage apple scab and spotted tentiform leafminer. *Agric. Ecosyst. Environ.* 104: 595-604.

Plant based-diversity practices in conventional and organic farming: a farmers' survey in france

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Key words: plant-based diversity, cropping practices, France, survey

Abstract

Enhancing plant-based diversity within agroecosystems might help designing more resilient and low-input agricultural systems. The objectives of this study were (i) to describe the plant-based diversity practices (ii) to identify the farmers' motivations to apply them and (iii) to compare their application in organic or conventional farming systems. The survey was carried out in five French regions with 196 farmers that apply at least one plant-based diversification practice. Five diversification practices were studied. Simultaneous intercropping and agroforestry are less applied compared to catch crops and semi-natural landscape elements because they imply a deeper change in the cropping system. Organic farmers apply more often simultaneous intercropping and agroforestry and 40% of them applied more than 4 diversification practices (compared to less than 20% of the conventional farmers). Organic farmers seem thus to be a step further on the path transition towards agroecological systems.

Introduction

Nowadays, agriculture has to face up different global changes such as climate change, consumers' expectations in terms of product quantity and quality, environmental impacts and inputs availability and cost. This changing environment leads farmers to make changes in their cropping and farming systems. The collective awareness on the impacts of agriculture on environment and human health requires designing more resilient and low-input agricultural systems. Several authors highlight that enhancing diversity into the agroecosystems, either by adding species and/or varieties into existing systems or by a complete redesign of the cropping system (i.e. combination of innovative practices and management of the system), may be an efficient way to achieve this objective (Altieri, 1999; Malézieux et al., 2008; Griffon, 2010; Médiène et al, 2011; Wezel et al., 2013). This diversification could occur both in time (e.g. including cover crops in rotations, lengthening crop rotations by adding new crops) and/or space (e.g. agroforestry, semi-natural landscape elements, intercropping) (Malezieux et al, 2008; Médiène et al, 2011; Wezel et al, 2013).

The challenge of designing more resilient and low-input systems is at stake for both conventional and organic farmers although organic farmers are already more aware to cropping system management with low inputs. According to IFOAM (2008) organic farming "*relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects".* Thus, it could be assumed that, compared to conventional farmers, organic farmers are more widely applying diversification practices in their farming systems.

The objective of this study was to describe plant diversification practices implemented in organic and conventional farms in France and identify motivations which drove farmers to perform such practices. The second objective was to compare the integration of such practices in organic and conventional farming systems and assess if organic farmers are more likely to apply such practices.

Material and methods

A survey was carried out in 2012 with 196 farmers (51 farmers in organic) in five French regions, ranging from 35 to 42 farmers in each region (Aquitaine, Midi-Pyrénées, Nord-Pas de Calais, Pays de la Loire, Rhône-Alpes) (Fig. 1). These farmers have been selected because they were considered as innovative as they were applying at least one of the following diversifying practices:
(1) Diversified crop rotations: crop rotations that include more than 3 different cropped species; (2) Simultaneous intercropping: cultivation of two or more crops in the same field at the same time (same date for sowing and harvest); (3) Cover cropping: short cycle crops that are cultivated between two main crops of

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the rotation, they could be temporarily associated with main crops; (4) Agroforestry: combination of trees with cash and/or forage crops on the same plot; (5) Semi-natural landscape elements: integration and/or management of semi-natural landscape elements such as hedges, vegetation strips, either within or around the field.

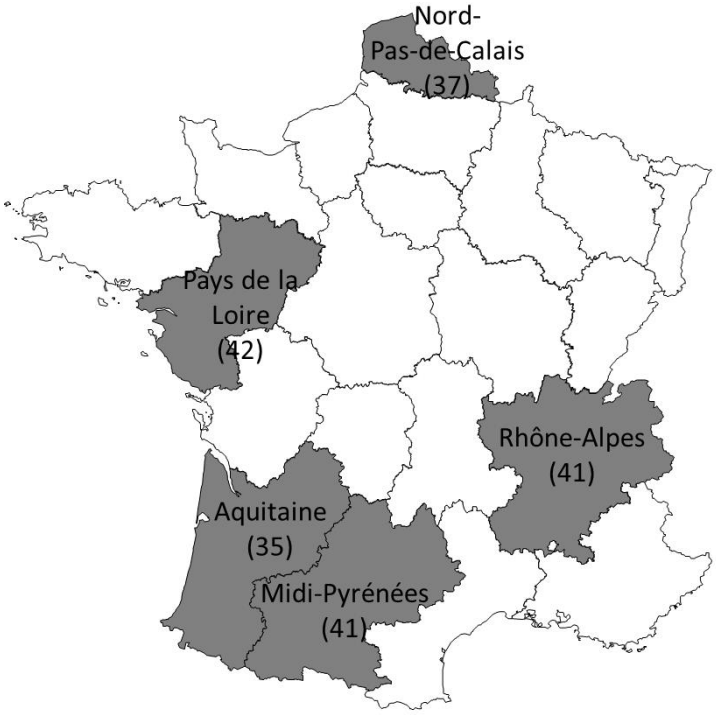


Figure 1. The five surveyed regions (grey colour, number of interviewed farmers within brackets)

These farmers were identified thanks to various farmers' networks. Phone interviews with farmers were performed during autumn and winter 2012 to fulfill a questionnaire with closed-ended questions. The questionnaire encompassed general information about the farm, detailed description of crop rotations (including cover cropping and simultaneous intercropping), and general information about crop management (fertilisation, tillage, irrigation and pest and disease management). It also addressed farmers' motivations for applying diversification practices and their satisfaction with regard to agronomic and socio-economic effects of the practices on the farming system. Finally, we identified their information sources for each practice (e.g. networking, advising services). We performed student tests to check the effect of organic farming on diversifying practices.

Results and discussion

Cover cropping and semi-natural landscape elements are the most widely applied practices with 85% and 80% of organic and conventional farmers applying them, respectively (Fig. 3). The third ranking practice is the diversified crop rotations (66% of farmers). Simultaneous intercropping and agroforestry are less applied with 37% and 6% of farmers applying them, respectively. The wide application of cover cropping in France may be linked to the regulation on vulnerable water areas where bare soils are prohibited. Indeed 67% of farms applying cover cropping are located on nitrate-vulnerable zones. Nevertheless, only 39 of the 167 interviewed farmers applying cover cropping cited the regulatory constraint as their main motivation and none of them are organic farmers. The presence and maintenance of semi-natural landscape elements are also frequently found in the famers' answers. This is linked to the French regulations (buffer strips close to rivers), and also because the management of existing hedgerows does not require a lot of change in farming systems.

Interviewed farmers are applying simultaneously from 1 to 5 of the previously listed practices. Ten percent of farmers are applying only one practice: cover cropping (42% of them), semi-natural landscape elements (32% of them) or diversified crop rotation (26% of them). Such practices generally do not imply a large redesign of the farming systems (Wezel et al., 2013). That makes them probably easier to implement. Seventy-seven percent of interviewed farmers are applying 2 or 3 practices (respectively 27 and 40%). Most of the farmers (77%) that are applying two practices combine cover cropping with another diversification practice. When 3 practices are combined in the same farm, the main combination is cover cropping, semi-

natural elements and diversified rotation (65%). Twenty-two percent of farmers combine 4 diversification practices. In such configuration, they usually combine cover cropping, semi-natural elements and diversified rotation with simultaneous intercropping (84% of farmers that apply 4 practices), with this last practice considered as a more complex diversification practice than the others (Wezel et al., 2013). Only one farmer is applying the 5 selected diversification practices, including the four previously discussed and agroforestry. This survey seems to highlight how agroforestry and, to a lesser extent, simultaneous intercropping are the most complex plant diversification practices, since only low fraction of surveyed farmers implement them.

The comparison of organic and conventional farmers interviewed in this survey highlighted that organic farmers apply a significantly higher number of diversification practices (3.11 ± 0.27 and 2.61 ± 0.15 respectively) (Fig. 2). With the exception of agroforestry practices, the rate of application of each practice was also slightly higher for organic farmers than for conventional farmers (Fig. 3). The difference between organic and conventional farms was larger for cover cropping, semi-natural elements and diversified rotation (Fig. 3). This shows that most of the organic farmers have already integrated these 'less complex' practices in their farming systems. The diversification is already well integrated by organic farmers as a tool to enhance sustainability of their farming systems. Indeed, the combination of at least 4 diversification practices is performed by 40% of the organic farmers while the ratio is lower than 20% for the conventional farmers. This seems to confirm that organic farmers implement more plant based-diversity practices into their systems, compared to conventional farmers, allowing low input cropping systems.

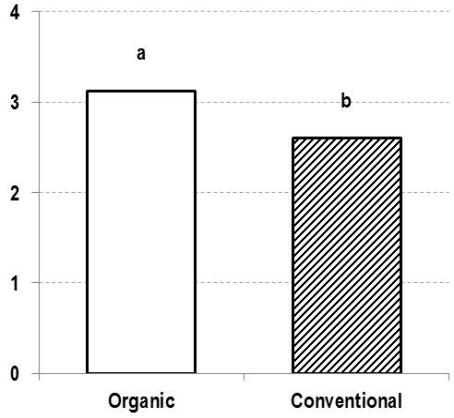


Figure 2. Average number of diversification per farmer (student test, p-value <0.05)

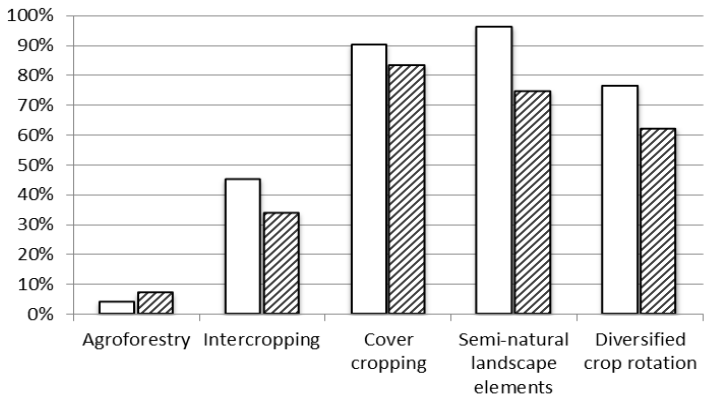


Figure 3: Rate of organic (white bars) and conventional (dashed bars) farmers applying each type of plant diversification practices

Conclusions

This study revealed that the two most common diversification practices applied in the five surveyed regions are cover cropping and semi-natural elements. Most farmers of our sample (63% of total sample) combine at least 3 of the 5 selected diversification practices on their farm. The complexity of diversification seems to correlate with the number of combined practices: cover cropping, semi-natural elements and diversified rotations being the simplest practices to implement and agroforestry, and to a lesser extent intercropping, being more complex to apply. Finally, we showed that organic farming systems use more plant-based diversity practices than the conventional method, suggesting that they have higher cultivated plant species in their cropping systems. This may place them in a better position regarding the current context of agroecology development and biodiversity concern in France.

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References

Altieri M A (1999): The ecological role of biodiversity in agroecosystems. Agric. Ecosyst. Env. 74, 19-31.

Griffon M., (2010): Pour des agricultures écologiquement intensives. éd. L'aube. 112p.

Malezieux E, Crozat Y, Dupraz C, Laurans M, Makowski D, Ozier-Lafontaine H, Rapidel B, de Tourdonnet S and Valantin-Morison M (2008): Mixing plant species in cropping systems: concepts, tools and models. A review. Agro. Sust. Dev. 29, 43-62.

Médiène S, Valantin-Morison M, Sarthou J-P, de Tourdonnet S, Gosme M, Bertrand M, Roger-Estrade J, Aubertot J-N, Rusch A, Motisi N, Pelosi C and Doré T (2011): Agroecosystem management and biotic interactions: a review. Agro. Sust. Dev. 31, 491-514.

Wezel A, Casagrande M, Celette F, Vian J-F, Ferrer A and Peigné J (2013): Agroecological practices for sustainable agriculture. A review. Agro. Sust. Dev., 1-20.

Nitrogen leaching from organic agriculture and conventional crop rotations

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Key words: leaching, nitrate, arable crops, ceramic cups

Abstract

The Seine basin, characterised by intensive arable crops, has most of its surface and ground-water contaminated by nitrate (Nitrate Directive EU, 1991). The goal of our study is to investigate nitrogen leaching from arable crops in organic (OF) and conventional farming (CF) in the North of France. In 2012-13, a network of ceramic suction cups have been installed in 8 farms taking into account complete rotations. Our first results showed a gradient of sub-roots concentrations : legumes have the lowest subroots concentrations whereas crops fertilised after legumes have the highest. Catch-crops, when efficient, can decrease leaching by a factor 2. Soil and climatic variations have a major impact on the nitrogen leached, due to the amount of infiltrated water (30 to 400 mm). The leaching means are 10 to 36 kgN.ha^{-1}.yr^{-1} for OF and 26 to 41 kgN.ha^{-1}.yr^{-1} for CF in Seine & Marne. In final, OF leads to a decrease of nitric contamination of 20-50% in the different areas.

Introduction

Nitrate (NO_3^-) is the final form of nitrogen produced in the soil in aerobic conditions, following organic matter mineralization and subsequent nitrification or from mineral fertilization (Billen et al, 2013). NO_3^- pollution of groundwater from agriculture is very common (Addiscott et al. 1991) and a huge concern for the European Union (Directive n°91/676/CEE). Long time series in conventional agriculture in the Seine Basin already exist. These scored an average of 25 ± 4 mg N.l^{-1} (standard for drinking water is 11 mg N.l^{-1}) for different types of soil, crops and climatic conditions (Calvet et al., 1990). Such measurements are very scarce for other agricultural systems such as organic farming (Mondelaers et al. 2009). Organic farming (OF) is already recognized as a good alternative for pesticide pollution, but its impact on nitrate contamination is still controversial. Only few articles have dealt with the impacts of organic and conventional agriculture on nitrate leaching in Europe. Most of the studies showed a reduction in nitrate leaching due to organic practice with a global reduction of 40% N leached compared to conventional practices (Hansen et al. 2000, Korsaeth and Eltun 2000). However ample variations were shown and depended of local factors such as rotations, soil characteristics and climate. The objective of this work was to quantify nitrogen concentrations below the root zones for complete organic rotations and to compare them the conventional ones in the immediate surroundings. Such concentrations are essential to document the constraints of the Riverstrahler model of biogeochemical nutrient fluxes developed for drainage networks (the Seine Basin in particular) and to possibly explore agricultural scenarios (Thieu et al. 2011) and their impact at the coastal zone in terms of eutrophication (Garnier et al. 2010).

Material and methods

To overcome the lack of data on nitrate leaching (in concentrations and fluxes), the ABAC project (DIM-Astrea AESN) was designed to equip several farms with porous ceramic cups (Stopes et al. 2002a) although lysimeters are also a well-adapted method, especially used for long perennial experimental plots. Here we used vertical ceramic cups (90 cm) that can be set up quickly without any destruction of the soil horizons of the plots. In each farm, all the terms of the rotation were equipped with 6 ceramic cups (i.e. 230 cups). Sampled water in the sub-root zone can be directly analyzed for nitrate concentrations. In field determination of nitrogen residual in the soil before and after winter period was also determined. In 2012-2013, a total of eight managements systems of arable crops have been equipped on complete rotations (5 in OF and 3 in CF), in three soil types and climatic situations. The three situations are located in the East, North and South of Paris and respectively characterized by clay-silt loam soil with drains, clay-silt loam without drains and sandy-silt loam and efficient rainfall (rainfall – evapotranspiration) of 200, 30 and 400mm. Organic farming systems differed in their nitrogen management, but had similar long crops rotations (average of 8 years) starting with two/three years of alfalfa (generally exported), wheat, cereal, legumes (as faba beans), wheat,

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cereal. Conventional farming was dominated by the rotation wheat-oat-rape seeds or maize in the same region. Exogenous fertilization averages on complete rotations were around 30 kgN.ha^{-1}.yr^{-1} in organic systems, and 150 kgN.ha^{-1}.yr^{-1} in conventional ones. The input after exportation, due to biological nitrogen fixation, was around 100 kgN.ha^{-1}.yr^{-1} in both systems from alfalfa in OF and peas in CF (Anglade et al., in prep).The principle of suction cups is to suck the water sub-root via a set-vacuum 48h prior sampling (Bowman et al. 2002). Samples were taken approximately from every ten to fifteen days throughout the period of drainage. Additionally, soil samples were analyzed at three soil horizons for nitrogen concentrations, granulometry and physico-chemical properties. Nitrogen concentrations (ammonium, nitrite and nitrate) were determined with a colorimetric autoanalyzer (Quaatro, Bran & Luebbe). Climatic data were also gathered for determining water fluxes in three soils layers with rainfall and evapotranspiration.

Results

Regarding organic rotations, the lowest concentrations were found for parcels cultivated with legumes (alfalfa: 2.8 mgN.l^{-1}). The first year after alfalfa was overturned, leaching from mineralization was around 15 mgN.l^{-1} and decrease to 8.5 mgN.l^{-1} in the second year. Crops of the fourth or fifth position in the rotation were generally fertilized with vinasse, poultry droppings or compost which was led to the highest sub-roots concentrations. Legumes with grains (faba beans, lentils, position 4 in the rotation), never fertilized in the organic rotations studied, had a median sub-root concentration of 9.8 mgN.l^{-1}. However, crops after those legumes, sometimes fertilized, had a median sub-root concentrations of 22.7mgN.l^{-1}. At the end of the rotations, cereals with low N input showed a median sub-root concentration of 8.7 mgN.l^{-1}. In total, a median nitrogen concentrations in the sub-root zone of the organic rotations studied was 9.2mgN.l^{-1}. For conventional rotations, crops with intercultures (IC) led to the lowest concentrations (8 mgN.l^{-1}); fertilized crops resulted in a N concentration of 27.7mgN.l^{-1} whereas wheat after legumes, generally fertilized as well, reached 30.2 mgN.l^{-1}. Median sub-root concentrations for such a three years rotation was 30.2 mgN.l^{-1} (Figure 1).

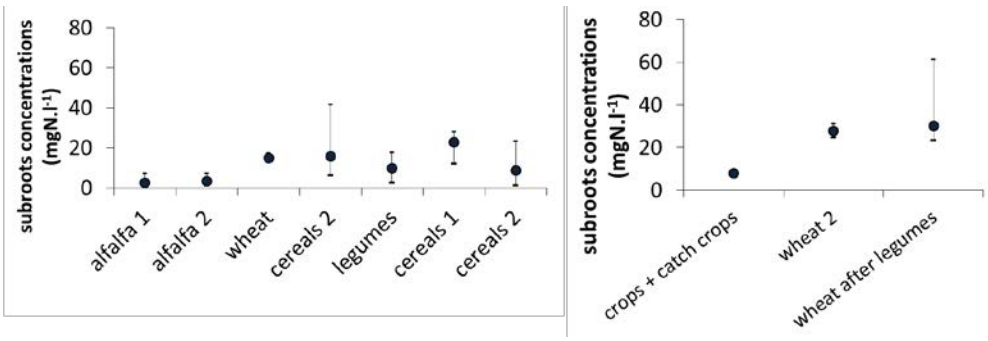


Figure 1: Minimum, maximum and median of nitrate sub-roots concentrations in function of crops in organic (N=39 parcels x 10 samples) and conventional (N=8 parcels x 10 samples).

When converting the concentrations to leaching fluxes (concentrations x runoff water) the final contribution of the farms to nitrate contamination changed. Indeed, the farms in the Yonne with the lowest concentration in fact to a higher leaching (30 kgN.ha^{-1}.an^{-1}) than in the Oise (around 10 kgN.ha-1.an-1). The leaching means were 10 to 36 kgN.ha^{-1}.yr $^{-1}$ for OF and 26 to 41 kgN.ha^{-1}.yr $^{-1}$ in the Seine & Marne. In final, the organic farming systems showed a reduction in nitric contamination from 10-50% in Seine & Marne to 20-50% in Oise, compared to conventional ones. Leaching data are significantly different between regions (Anova, R, 0.0107 *) (Figure 2).

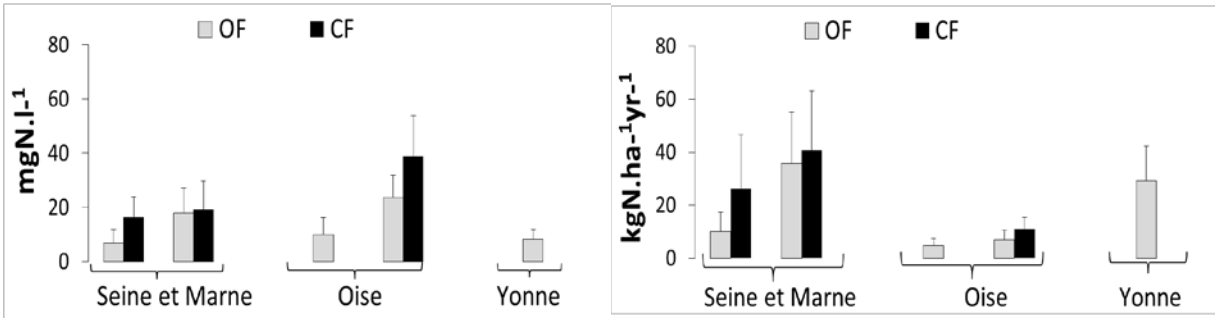


Figure 2: Concentrations and leaching from the different farms in Seine-et-Marne, Oise and Yonne department, for organic farms (OF) and conventional farms (CF).

Discussion

Leaching from agriculture depends on N management, soil water capacity and efficient rainfall. N management is especially important in organic agriculture, where the resort to mineral fertilizer is forbidden. In the North of France and for 50% of organic arable crops, nitrogen fertilization is mainly based on biological nitrogen fixation; however the quantity and quality of N mineralized is still a controversial question. In the farms studied, crops fertilized after legumes are common and appear to have the highest sub-roots concentrations; also, the date of application, the quality and the quantity of fertilizer is very variable in function of the systems so that different degrees of improvements are still possible concerning nitrate leaching. Catch crops can have an important impact on nitrate leaching, however different modality can be experimented, e.g. the incorporation of legumes, the dates of seeding and harvest, their integration into the N balance for the fertilization (Beaudoin et al., 2012). Water retention in soils depends on texture (silt, clay and sand), substratum and depth, so that each parcel may have its own potential of vulnerability for N leaching. A good understanding of the soil and its substratum is needed to limit the risk of leaching within a territory (farm, watershed, catchment areas of groundwater). The network of investigated farms has been extended in 2013-14 to investigate annual variations and a wider panel of N managements (17 farms equipped and a total of 500 ceramic cups).

Suggestions to tackle with the future challenges of organic animal husbandry

Because organic rotations are generally characterized by the introduction of alfalfa and legumes animal husbandry would be complementary. Indeed, when alfalfa, not used as feed, is left on the ground, an excess of nitrogen may contaminate groundwater and rivers. Conversely, promoting animal husbandry within a territory would be beneficial for organic agriculture requiring organic fertilizers . In conclusion, arable crops production associated with animal husbandry would contribute to a more sustainable agriculture.

References

Anglade J, Billen G, Garnier J (in prep): A meta-analysis of symbiotic nitrogen fixation in forage and pulse crop legumes and implications on N balances in organic farming systems.

Calvet A (1991): Nitrate-Agriculture-Eau, International Symposium organized by Institu National Agronomique Paris-Grignon, November 7-8, 1990, Editor R Calvet.

Beaudoin N, Tournebize J, Ruiz L, Constantin J, Justes E (2012): Chap.4 Nitrate et eau en période d'interculture. Réduire les fuites de nitrate au moyen des cultures intermédiaires.

Billen G, Garnier J, Benoît M, Anglade J, (2013): La cascade de l'azote dans les territoires de grande culture du Nord de la France. Cah Agric 22

Addiscott TM, Whitmore A P, Powlson DS (1991): Farming, fertilizers and the nitrate problem. 170 pp. CABDirect2.

Bowman MS, Clune TS, Sutton BG (2002): A modified ceramic sampler and lysimeter design for improved monitoring of soil leachates. Water research 36 (3): 799–804.

Garnier J, Gilles B, Laverman A, Amsaleg C, Tronquart O, Martinez A, Mercier B (2010): Nutriment Export Role on Eutrophisation. Indicators and model Scenarios (NEREIS)

Hansen B, Kristensen E, Grant R., Høgh-Jensen H, Simmelsgaard SE, Olesen JE (2000): Nitrogen leaching from conventional versus organic farming systems—a systems modelling approach. European Journal of Agronomy 13 (1): 65–82.

Korsaeth A, Eltun R (2000): Nitrogen mass balances in conventional, integrated and ecological cropping systems and the relationship between balance calculations and nitrogen runoff in an 8-year field experiment in Norway. Agriculture, Ecosystems & Environment 79 (2–3) (juillet): 199‑214.

Mondelaers K, Aertsens J, Huylenbroeck G (2009): A meta-analysis of the differences in environmental impacts between organic and conventional farming. British food journal 111 (10): 1098–1119.

Stopes C, Lord E I, Philipps L, Woodward L (2002): Nitrate leaching from organic farms and conventional farms following best practice. Soil Use and Management 18: 256–263.

Thieu V, Billen G, Garnier J, Benoît M (2011): Nitrogen cycling in a hypothetical scenario of generalised organic agriculture in the Seine, Somme and Scheldt watersheds. Regional Environmental Change 11 (2): 359–370.

Diversity of conservation agriculture practices among European organic farmers "TILMAN-ORG session"

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Key words: conservation agriculture, European organic farmers, survey, diversity of practices

Abstract

The interest of organic farmers for adopting conservation agriculture practices is currently growing. But, there are few technical and scientific references available for organic farmers when they start applying conservation agriculture practices. The main objectives of this study are (1) to explore the diversity of crop management practices using conservation agriculture methods among European farmers, and (2) to identify main farmers' strategies. We carried out a survey of 159 farmers located in 10 European countries. Data were analysis to identify groups of farmers that share the same type of spring and winter crop managements. Organic farmers in Europe show very diverse crop management. The high diversity of crop management can be described by two main strategies: 'low soil cover' and 'soil conservation' strategy. Distinct geographical distribution of both strategies suggests that applicability of conservation agriculture practices is strongly context oriented.

Introduction

The interest of organic farmers for adopting conservation agriculture practices is currently growing. Conservation agriculture relies on 3 main concepts: (1) Minimum soil disturbance; (2) Diversified crop rotation and (3) Permanent soil cover (use of green manure). These practices aim at preserving soil fertility. Nevertheless, conservation agriculture has major constraints in organic farming, such as weed control (Peigné et al., 2007). As organic cropping systems are very different from conventional ones, there are few references available for organic farmers when they start applying conservation agriculture. The main objectives of this study are (1) to explore the diversity of crop management practices using conservation agriculture methods among European farmers, and (2) to identify main farmers' strategies. Results from this study performed as part of the CORE Organic project TILMAN-ORG will help researchers to understand what farmers do and might inspire them for further experiments.

Material and methods

We carried out a survey with 159 organic farmers located in Estonia, Germany, United Kingdom, Ireland, Belgium, France, Switzerland, Austria, Italy and Spain. Selected farmers are applying at least two of the three conservation agriculture techniques:

(i) No-tillage: a conservation tillage practice in which the crop is sown directly into soil not tilled since the harvest of the previous crop.

(ii) Reduced tillage: Any tillage practice with a depth shallower than the conventional practice and/or a non-inversion method such as chisel ploughing.

(iii) Green manures: any crop that is grown primarily or solely for the purpose of soil protection and improvement including: increasing soil N supply to the subsequent crop, increasing soil organic matter,

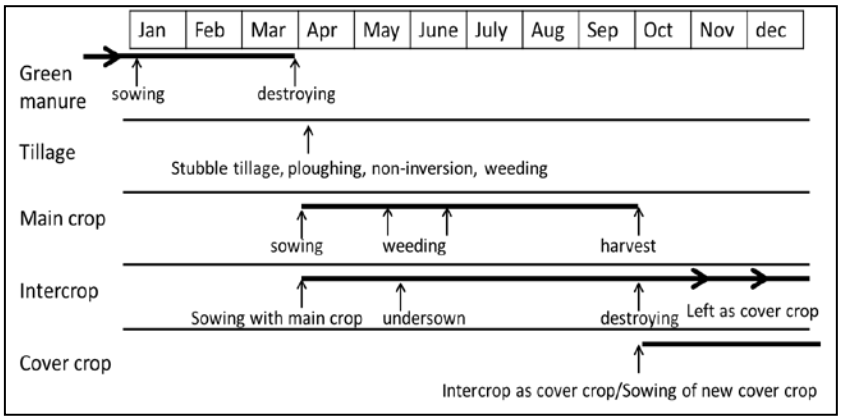
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regulating the populations of pests and diseases, reducing competition by weeds in subsequent crops, and minimizing soil erosion.

A questionnaire with closed-ended questions was filled by farmers. Crop management practices were described for one winter crop and/or one spring crop by farmers. They detailed the crop cycle by five successive steps: (1) operations before sowing (green manure, weeding, stubble cultivation, and soil tillage), (2) sowing of the main crop, (3) operations after sowing and before harvest (weeding, green manure management if present), (4) harvest and (5) operations after harvest (stubble cultivation, green manure sowing and destruction). For each operation, farmers detailed: type and date of application, used machinery, and depth of tillage. In order to get the same data photos of machinery with a lexicon were provided to the investigators. We collected all the answers of the farmers and carried out a Multi Factor Analysis (MFA) followed by clustering to identify groups of farmers that share similar crop management respectively for winter and spring crops. We analysed such crop management groups to identify common strategy within the groups.

Results

Among the 159 interviewed farmers, we collected 117 and 125 winter and spring crop management descriptions, respectively. The main winter crop type was cereal, while other crop types, such as field vegetables or legumes were not widespread. The most frequent preceding crop was cereal (36%) or legume (29%), similarly to the following crop which was also mostly cereal (38%) or legume (17%) or cereal+ legume (12%). 55% of farmers have mainly sown a leguminous green manure before main winter crop. The main spring crop types were 43% cereal, 21% legumes, 15% field vegetables, 13% oilseed crops and 8% other crops. Preceding crop was usually a cereal (54%) or a legume (28%), similar to the following crop with mostly cereals (44%) or legumes (29%). 77% of farmers have sawn a green manure before the main spring crop, the green manure was often a legume crop in combination with another type of crop (*Brassica sp.,* grass) (43%), or a pure legume crop (35%), although *Brassica sp.* was also present (7%). As shown for spring crops in the figure 1, there was a large diversity of crop management options ranging from deep tillage without soil inversion to no-till. The same diversity was found for winter crops.



Spring crop management options (125 farmers)

Green manure before main crop sowing: 77%

Tillage**:** No till (14%) vs. Tillage (86%, mainly non inversion)

Weeding*:* before sowing (56%) and 1.5 weeding operations during the crop cycle

Intercrop: intercropping with the main crop or undersowing with the main crop (36%)

Cover crop: intercrop used as a cover crop (18%) and sowing of a new cover crop (22%)

Figure 1. Range of crop management options of spring crops from the farmers 'survey - On the left side of the figure, the graphs show the range of different recorded farmers' practices - On the right side of the figure, we indicate the percentage of farmers applying each practice among the interviewed farmers.

MFA and cluster analysis provided groups of farmers sharing similar crop management for winter and spring crops, respectively. Figure 3 shows that there were similar strategies when comparing the groups of the two types of crops (spring and winter sawn). The combination shows two main strategies when farmers used conservation agriculture techniques: 'the low soil cover' strategy and 'the soil conservation' strategy.

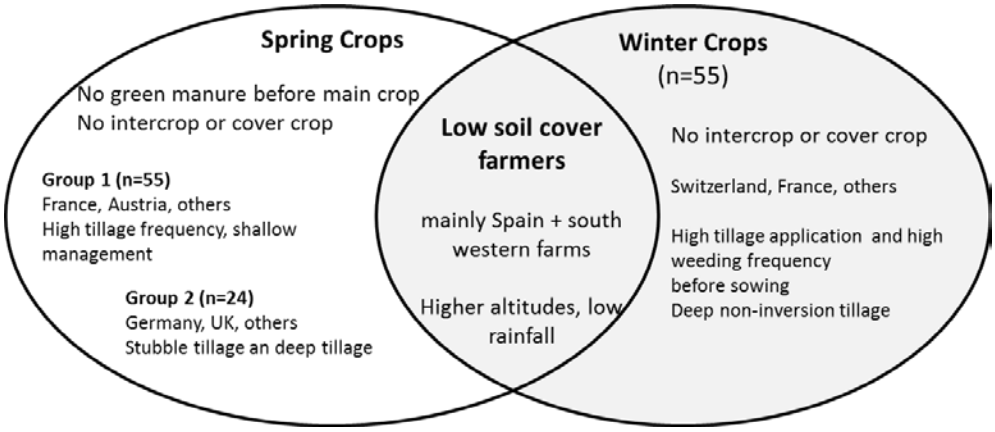


Figure 2. 'Low soil cover' strategy for spring and winter crops: no or very limited use of green manures in the crop management – Each oval represents a group of farmers with similar crop management—intersection represents common characteristics

The 'low soil cover' strategy was characterized by the lack of intercropping, green manure and intensive tillage application (Fig. 2). Farmers mostly came from the mountainous areas in Spain, but also from other European countries (e.g France, Austria, Switzerland). This strategy brings together farmers who did not apply green manure or cover crops. This kind of management increased the frequency of weeding applications to cope with weed pressure. Soil cover was expected to be higher in the Southern countries to reduce erosion losses. But low precipitations and high altitude can lead to a scarcity of water resulting in competition between the main crop and possible intercrops. Soane et al. (2012) suggested, that main benefit of reduced- tillage in Southern Europe could be water conservation, however the weed pressure seems to be a strong constraint in organic farming where there is no herbicide option. The detrimental effects of low soil cover on weeds could be somewhat compensated with stubble tillage and deep non inversion tillage practices in this strategy.

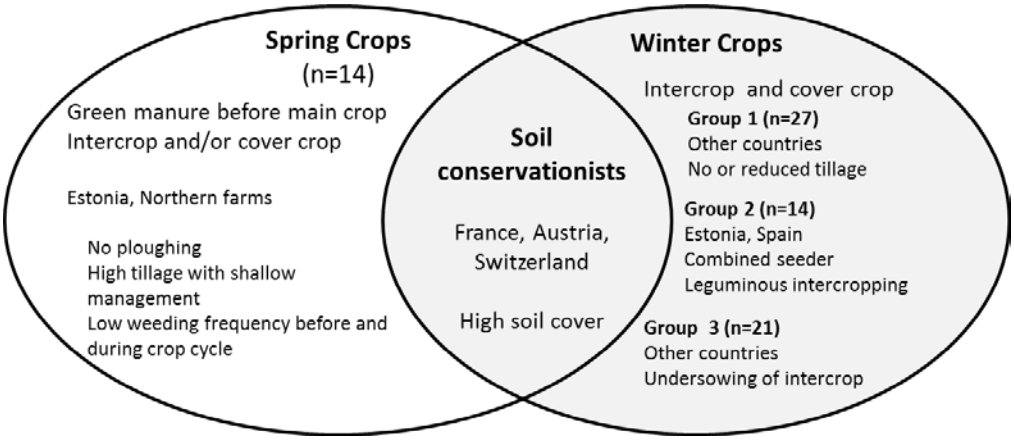


Figure 3. 'Soil conservation' strategy for spring and winter crops: a lot of green manures are included in crop management – Each oval represents a group of farmers with similar crop management—intersection represents common characteristics

The 'soil conservation' strategy was characterized by the intensive use of green manure before sowing the main crop, intercropping and/or cover crop after harvest (Fig. 3). A common feature of this strategy was the use of reduced intensity in tillage practices. Most of the farmers sharing this strategy were from France, Austria and Switzerland. Estonian farmers and farmers from northern Europe were also part of this group. Generally, medium or low weeding frequencies were recorded. In this group, the generally high soil cover, mainly with the use of green manures probably enhances weeds suppressing due to competition or allelopathic effects (Köpke and Schulte, 2008).

Discussion

Organic farmers in Europe, applying conservation agriculture practices, show very diverse crop management. Indeed the high diversity of crop management can be described by two main strategies: ‘low soil cover’ strategy and ‘soil conservation’ strategy. Distinct geographical distribution of both strategies suggests that applicability of conservation agriculture practices is strongly context oriented and thus related to environmental conditions (precipitations, temperature) and available technology and knowledge.

Acknowledgments

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References

Köpke U, Schulte H (2008): Direct Seeding of Faba Beans in Organic Agriculture. Poster at Cultivating the Future Based on Science: 2nd Conference of the International Society of Organic Agriculture Research ISOFAR.

Peigné J., Ball B.C., Roger-Estrade J., & David C. (2007): Is conservation tillage suitable for organic farming? A review. Soil Use and Management 23, 129–144.

Soane B. D., Ball B. C., Arvidsson J., Basch G., Moreno F., & Roger-Estrade, J. (2012): No-till in northern, western and south-western Europe: A review of problems and opportunities for crop production and the environment. Soil and Tillage Research, 118, 66-87.

Nutritional value of organic raw material for poultry

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Key words: raw material, poultry, animal nutrition, protein supply

Abstract

The regulation asking for 100 % organic raw materials in poultry feeds will increase the organic protein demand. In order to limit the use of Soya in formulas, it will be necessary to develop alternative organic raw materials. Within the framework of two research programs, three experiments were conducted to evaluate through a known in vivo method the nutritional value of 22 raw materials (analytical and digestibility value). In the group of meals, Soya is the best product in terms of protein (content and utilization). Processing as extrusion and de-hulling improve digestibility of raw material. Animal products may represent alternatives to Soya. There are technical opportunities to reduce the dependence to Soya for poultry feeding; Technology is often requested to improve nutritional value of products, such as linseeds, cannabis and animal products. But there is a need for more specific data about organic raw material to improve sustainability.

Introduction

There is an increase of demand for organic poultry meat in European countries (Le Guen, 2011). However, the development of organic production has to face to two major questions: supply organic feed containing 100% of organic raw materials (in 2015), and reduce the dependence to Soya (Padel & Sundrum, 2006). Organic data tables giving composition and nutritional values are requested by organic poultry producers to improve organic poultry nutrition. So within the framework of two projects, CORE ORGANIC II ICOPP and CASDAR AVIALIMBIO, experiments were conducted to evaluate by *in vivo* method the main available raw materials on the French market. The objectives were 1) to get nutritional values for main organic raw material used in poultry feed, 2) to estimate the variability of the main protein sources and 3) to investigate on new protein sources for organic poultry nutrition.

Material and methods

Three experiments were conducted, according to the referenced method developed by Bourdillon & *al* (1990), and adapted to slow growth strain. In each experiment, 200 day old male broilers (strain JA 657) were raised in one house from D1 to D31, with a commercial organic starter feed. Water and feed were provided *ad libitum* all along the experiment. At D31, based on live weight, groups of 10 birds were selected and allocated, according to a completely randomized factorial design to 1 of the experimental treatments in individual metabolic cages, kept in an environment controlled room. Experimental period was divided in two phases: 5 days for adaptation to the diet and to the cage and 3 days of balance period with total excreta collection. Birds were fed *ad libitum* and feed intake was measured individually. In addition, broilers were starved for 17h before weighing at the beginning and at the end of the collection period. Individual excreta were stored at -20°C, freeze-dried, then left 48h at ambient temperature to stabilise the moisture content before weighing, grinding (0.5mm) and analyses.

For each experiment, one group was affected to the basal diet. For others, experimental diets include the tested raw material (10 to 30 %). The amount of mineral, trace and vitamins were 3% for all diets, and 17 to 20 % of protein.

Apparent metabolizable energy (AME) of diets was calculated as the difference between GE intake and energy losses in excreta. AME values were then corrected for nitrogen retention (AMEn) using a factor of 34.4kJ/g. Protein utilization was calculated as the ratio between protein intake and protein excreted (with total nitrogen excreted corrected by nitrogen of ureic acid in excreta). Values of the raw materials were then calculated by difference between basal and experimental diets according to the dry matter content (Lessire & *al*, 1985).

Investigated raw materials were of different origins and supplied by producers:

i) Current protein sources ; ii) Unusual or new products ; iii) Animal products

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Results

All results are presented in **table 1.**

Current protein sources

Soya bean and sunflower meals are the main organic protein sources used in poultry feeds in France, and tested samples were provided by different manufactories. It is well known that their fat content is higher than for conventional meals. For Soya, fat content is not as constant as expected, and correlatively AMEn and protein utilization varied in a large range, 2678 to 3123 Kcal / kg DM and 79.92 to 85.90 % respectively. For Sunflower meal, high variability was observed for all criteria, fat and protein as well as AMEn and protein utilization. When compared with values of conventional raw materials (based on INRA table, Sauvant, 2002), Soya, Sunflower and Organic Rapeseed meals presented a higher AMEn value and a lower apparent digestibility of protein than conventional meals. Nutritional values of organic extruded soya bean, alfalfa concentrate, pea and horsebean are quite similar to the values of the same conventional products. Pea and Horsebean presented a higher utilization of protein than Soya meal, but with lower protein content. Alfalfa concentrate presented a high protein content but with low digestibility.

Unusual or new products

Extruflax was a new product, with the objective to promote the use of linseeds in poultry nutrition. To be used in poultry, linseed must be heated to destroy antinutritional factors. Extruflax had a high fat content and a high AMEn value, but protein content and utilization were lower than Soya value. For Cannabis meal and dehulled seeds protein level is lower than Soya meal, 31.7, 32.3 and 45.3 % respectively. However digestibility is good and improved by dehulling. Camelina meal and Lupine seeds are not of current use in poultry, due to their fiber and ANF (antinutritional factors) content. In this study, feed containing Camelina was not well ingested by animals, so digestibility results were low or too variable. For Lupine digestibility results are good, but with a diet containing 20 % of Lupine and for a short period. One of the objectives of this study was to give a nutritional value to forages : grass may represent till 10 % of the dry matter ingested (Germain & *al*, 2013). Tested products were dried, of high quality (25 & 27 % of protein), and included to the diet at 10%. Energy value was low, mainly correlated to soluble sugars, but protein utilization was closed to Soya meal value.

Discussion

Regarding to the energy and protein utilization of a large range of organic raw materials:

- Organic Soya bean meal gave good results but with variability in fat content and protein utilization
- For other meals, Sunflower, Rapeseed, Cannabis, Camelina, protein content and digestibility were lower than Soya meal. Digestibility may be negatively affected by their ANF content.
- For all tested products, processing –extrusion, dehulling- improved digestibility of protein and energy.
- Seeds and beans presented good protein utilization. However their protein content is lower than Soya meal and their amino acid profile is not optimal for poultry.
- Forages, if they are of good quality, may represent a contribution to protein supply of broilers
- Sea products, like *Crepidula fornicata,* presented high protein content and nutritional value. However to be used in poultry feed, the product must be dried and there is a risk for fish taste in poultry meat.
- Larva of insect may represent an opportunity, but their digestibility is low and not constant.

Table 1 : Analytical and nutritional values of raw materials

	Dry matter (%)*	Ash (%)*	Protein (%)*	Fat (%)*	Gross Energy (Kcal/Kg)*	AMEn (Kcal /kg) *	Protein utilization (%) *
Soya bean meal	90,89 (90,35-91,69)	6,65 (6,50-6,85)	45,28 (44,93-45,49)	6,97 (4,66-9,06)	4998 (4909-5044)	2966 (2678-3122)	83,73 (79.92-85.90)
Extruded soya bean	90,60	6,00	41,45	12,24	5608	3856	86,50
Sunflower meal	91,94 (91,18-92,76)	5,60 (5,36-6,00)	24,36 (21,76-28,18)	16,47 (12,97-18,25)	5366 (5199-5455)	2374 (2275-2597)	79,27 (76.47-81.55)
Alfalfa protein concentrate	93,40	12,76	52,31	ND**	5244	3267	71,56
Rapeseed meal	88,84	7,24	31,78	12,79	5123	2722	75,69
Pea	87,40	3,30	22,87	0,89	4409	3272	87,01
Horsebean	87,70	3,60	31,04	1,05	4511	3247	83,30
Cannabis meal	90,35	6,91	31,68	14,13	5299	3135	81,88
Dehulled cannabis seed	92,50	6,93	32,33	49,92	7049	6453	86,70
White lupine bean	88,90	3,40	35,64	10,85	5279	3246	94,80
Camelina meal	90,50	6,60	34,55	15,95	5300	ND **	46,49
Extruflax	92,17	2,62	18,92	23,40	5692	4472	79,80
Fescue	94,10	11,40	25,06	2,51	4445	1364	82,10
Rye grass	93,80	13,40	27,53	3,14	4478	1282	79,90
Larva of insects	84,40	8,36 (7,57-9,15)	42,50 (37,76-47,23)	28,63 (22,22-35,03)	6407 (5786-7028)	4636 (4517-4755)	68,69 (62.68-74.70)
Sea product	91,35	22,04	51,85	2,85	3646	3837	100,00

(*) : values into brackets are the lowest and the highest
(**) : Non determinated

Animal products
For larva, the two tested products came from the same species, but differ on ash, protein and fat content, and consequently on digestibility values.
The sea product, *Crepidula fornicata*, is well known as a parasite for oysters and is available in large amount. This product presented a high level of protein and a very high digestibility. To be used in poultry feed, the product must be dried.

Suggestions to tackle with the future challenges of organic animal husbandry

The opportunity of using larva of insect in organic monogastric nutrition must be allowed by regulation.
There is a need for complementary studies about: i) amino acid profile of these raw materials; ii) the combination of these raw materials in the broiler diets and during the life of animals; with the objective to improve sustainability of organic production.

References

AERTS S, LIPS S, SPENCER S, DECUYPERE E & DE TAVERNIER J, 2006. *A new framework for the assessment of animal welfare: integrating existing knowledge from a practical ethics perspective*. Journal of Agricultural and Environmental Ethics 19, 67-76.

BOURDILLON, A., CARRE, B., CONAN, L., FRANCESCH, M., FUENTES, M., HUYGHEBAERT, G., JANSSEN, W.M., LECLERCQ, B., LESSIRE, M., MCNAB, J., RIGONI, M. & WISEMAN, J. (1990) *European reference method of in vivo determination of metabolisable energy in poultry: reproducibility, effect of age, comparison with predicted values*. *British Poultry Science* , **31** : 567-576.

GERMAIN K., LETERRIER C., MEDA B., JURJANZ S., CABARET J., LESSIRE M., JONDREVILLE C., M. BONNEAU M., D. GUÉMENÉ D., 2013. *Elevage du poulet de chair biologique : l'utilisation du parcours influence de nombreux paramètres biotechniques*. 10èmes JRA-JRFG, La Rochelle, 211-215,

LE GUEN R., 2011. *Les perspectives de développement de la production de poulets issus de l'agriculture biologique*. 9èmes JRA, Tours, 34-38.
LESSIRE, M., LECLERCQ, B., CONAN, L. & HALLOUIS,J.M., 1985. *A methodological study of the relationship between the metabolizable energy values of two meat meals and their level of inclusion in the diet*. *Poultry Science* , **64** : 1721-1728.
PADEL S. & SUNDRUM, A., 2006. *How can we achieve 100% organic diets for pigs and poultry?* Poster presented at What will organic farming deliver COR 2006, Edinburgh, 18-20 September 2006.
SAUVANT D., PEREZ J.M, TRAN G.. *Table de composition et de valeur nutritive des matières premières des animaux d'élevage*. Inra Edition, septembre 2002.

Organic Farmers in Europe: motivations and problems for using Conservation agriculture practices. "TILMAN-ORG SESSION"

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Key words: Farmers, conservation agriculture, organic farming, motivations, challenges, principal component analysis

Abstract

Conservation agriculture and organic farming are currently considered as environmentally friendly options for producing food. This study explores the motivations and problems of organic European farmers that apply at least two conservation techniques: (i) no-tillage, (ii) reduced tillage and/or (iii) green manure. We carried out a survey with 159 farmers located in 10 European countries. Data were analysed with a principal component analysis followed by clustering to identify groups of farmers with similar motivations and problems. The most important motivations are related to soil preservation and problems are mainly linked to agronomic conditions and crop management. There are three groups of farmers that share the same type of attitude: "atypical farmers", "soil conservationists" and "agro-technically challenged farmers". Further research may address in priority agronomic problems, such as weed infestation, caused by adoption of conservation agriculture in organic agriculture.

Introduction

Conservation agriculture (CA) and organic farming (OF) are currently considered as agricultural options for producing food while minimizing environmental impacts. Nevertheless they are still rarely combined. Conservation agriculture relies on three main concepts: (1) Minimum soil disturbance due to tillage; (2) Diversified crop rotation and (3) Permanent soil cover with the use of green manure. The objectives of conservation agriculture are to reduce risk of runoff and soil erosion, increase soil water storage and reduce labour and fuel use. Organic farming could benefit from conservation agriculture; however, some specific problems can occur: difficult weed control, limited nitrogen availability, intensive use of machinery. Several review papers provide an overview on management options and challenges of reduced tillage systems in Europe and the United Sates (Peigné et al., 2007; Mäder and Berner; 2011; Carr et al., 2013). But there is little scientific data describing why some organic farmers are applying conservation practices and what type of problems they are faced with. Thus, the objective of this paper is to explore the motivations and problems of European farmers when combining organic farming and conservation practices. To achieve this objective, farmers' perceptions about no-tillage, reduced tillage and green manures have been assessed in a European survey conducted in 10 countries, performed in the project TILMAN-ORG (www.tilman-org.net).

Material and methods

We carried out a survey with 159 farmers located Estonia (17 farmers), Germany (10 farmers), United Kingdom (16 farmers) and Ireland (1 farmer), Belgium (9 farmers), France (31 farmers), Switzerland (19 farmers), Austria (16 farmers), Italy (7 farmers) and Spain (33 farmers). Farmers are applying at least two of the three following conservation agriculture practices:
(i) No-tillage: a conservation tillage practice in which crop is sown directly into soil not tilled since the harvest of the previous crop.

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(ii) Reduced tillage: any tillage practice with a depth shallower than the conventional practice and/or a non-inversion method such as chisel ploughing.
(iii) Green manures: any crop that is grown primarily or solely for the purpose of soil protection and improvement including: increasing soil N supply to the subsequent crop, increasing soil organic matter, regulating the populations of pests and diseases, reducing competition from weeds in subsequent crops, and minimizing soil erosion.

A questionnaire with closed-ended questions was filled by farmers. Each farmer assessed with a Likert-scale a list of 12 possible motivations (Tab. 1) and 12 possible problems (Tab. 2) for each conservation practice. Possible motivations and problems encompassed socio-economic, technical, agronomic, environmental and soil conservation topics. We ranked motivations and problems according to their average Likert-scale value. For each conservation practice, we carried out a principal component analysis (PCA) followed by clustering on principal components to identify groups of farmers. Such groups of farmers are sharing the same type of motivations and problems.

Table 1: Tested motivations in the questionnaire for no-tillage (NT), reduced tillage (RT) and green manure (GM) practices

Applicable to NT, RT and GM	Applicable to NT and RT	Applicable to GM
reducing costs	increasing organic matter content in the soil	increasing on-farm nitrogen production
limiting erosion/avoiding soil surface crust formation	enhancing residues mineralization	producing industrial/fuel crops/forage/seeds
improving yields	minimizing environmental impacts	limiting N leaching
technical/innovative challenge		
improving general biodiversity		
improving soil structure		
improving biological soil quality		
advice from network/neighbor		
limiting weeds, pests and diseases		

Table 2: Tested problems in the questionnaire for no-tillage (NT), reduced tillage (RT) and green manure (GM) practices

Applicable to NT, RT and GM	Applicable to NT and RT	Applicable to GM
weed infestation	limited weed control efficiency	weed control
lack of specific technical skills	problem with mixing residues	heterogeneous green manure development
soil structure problems	limited nitrogen supply	competition between crop and GM
increasing labour requirements	limited crop emergence	unfavorable establishment conditions
	limited available information	lack of available N for non-leguminous green manure
	adequacy of machinery	limited biomass of green manure
	not stablecrop yields	cost of seeds
	destroying pasture	destroying the green manure

Results

Reduced tillage and green manure are the two practices that are more often applied than no tillage by the farmers (Fig. 1). Only 26% of the interviewed farmers apply no-till practices. There is a geographical gradient of conservation practices application: more farmers are applying no-till in Southern Europe region whereas green manure is more frequent in the more humid North area (data not shown).

Farmers' main motivations for applying conservation practices are related to soil preservation (improving soil structure, biology, and soil organic matter) and environmental concerns. Agronomic conditions and crop management (weed infestation, destroying of the previous crop) and socio-economic concerns (increasing labour requirements, yield stability) are the most important problems. Organic farmers are thus strongly motivated by soil conservation. Knowler and Bradshaw (2007) show that one of the drivers for adopting conservation practices in conventional farming is the awareness of soil problems. Weed infestation is the first problem for farmers. Indeed, weed control is often considered as a strong technical constraint to the application of conservation practices in organic farming (Berner et al., 2008; Sans et al., 2011). Weed management is a central problem in the case of organic farming because herbicides are not used for controlling weeds. Thus, compared to conventional studies, conventional and organic farmers are both interested in improving soil conservation but organic farmers are facing more technical constraints.

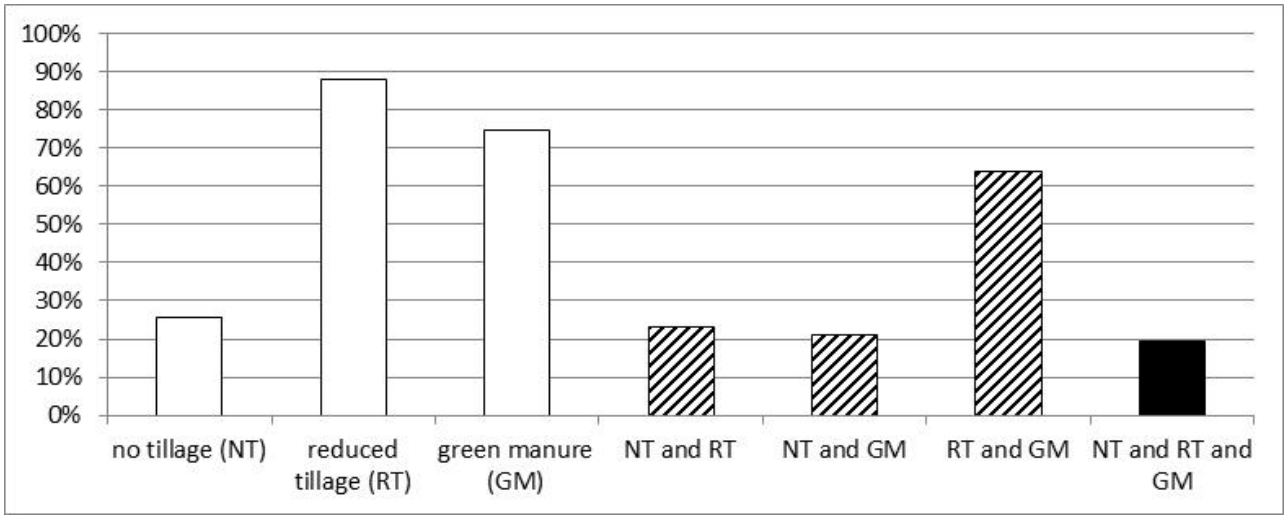


Figure 1. Percentage of farmers using conservation agriculture practices in the survey

Whatever the considered conservation practices, PCA analysis and clustering shows that there are three groups of farmers that share the same type of attitude: "atypical farmers", "soil conservationists" and "agro-technically challenged farmers". "Soil conservationist farmers" expressed strong motivations towards soil preservation. "Agro-technically challenged" farmers expressed that they are facing agronomic problems and challenges. The perception of the problems by farmers differs depending on the groups: "soil conservationists" perceive a small number of problems while "agro-technically challenged" farmers may overestimate the agronomic problems. Although farmers' grouping seems to depend on farm characteristics (such as size and location) we did not identify a clear pattern. Whatever the location of farmers, they could be either "soil conservationists" or "agro-technically challenged", meaning their motivations and problems are more dependent on their environmental attitudes and beliefs than on their farm characteristics or location.

Discussion

This study provides insights on the motivations and problems that European organic farmers are facing when applying conservation practices. The most important motivations are related to soil preservation concerns and problems are mainly linked to agronomic conditions and crop management. According to this study, research may address in priority agronomic problems, such as weed infestation, caused by adoption of conservation agriculture in organic agriculture. Soil benefits due to conservation agriculture should also be studied to strengthen farmers' motivations.

Acknowledgments

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References

Berner, A, Hildermann, I., Fliesbach, A, Pfiffner, L., Niggli, U., & Mader, P. (2008). Crop yield and soil fertility response to reduced tillage under organic management. Soil and Tillage Research, 101(1-2), 89–96.

Carr, P., Gramig, G., & Liebig, M. (2013). Impacts of Organic Zero Tillage Systems on Crops, Weeds, and Soil Quality. Sustainability, 5(7), 3172–3201.

Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. Food Policy, 32(1), 25–48.

Mäder, P., & Berner, A. (2011). Development of reduced tillage systems in organic farming in Europe. Renewable Agriculture and Food Systems, 27(01), 7–11.

Peigné, J., Ball, B. C., Roger-Estrade, J., & David, C. (2007). Is conservation tillage suitable for organic farming? A review. Soil Use and Management, 23(2), 129–144.

Sans, F. X., Berner, A, Armengot, L., & Mäder, P. (2011). Tillage effects on weed communities in an organic winter wheat-sunflower-spelt cropping sequence. *Weed Research*, *51*(4), 413–421.

Promoting organic research & development: lessons from an interdisciplinary group from France (2000-2013)

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Key words: organic R&D, partnership, topicality, interdisciplinarity, research evaluation

Abstract

At INRA, the CIAB (INRA Internal Committee of Organic Agriculture) is the main driver of an organic research program. This paper addresses whether funded projects comply with the main objectives set out in the program. A database was built with all of the 40 project proposals that were finally approved. It enabled to depict participation in collaborative networks. The analysis highlights three major benefits: (i) Structuring scientific and professional partnerships, (ii) Mobilizing new research teams in the organic program, (iii) Supporting interdisciplinary approaches.

Introduction

Organic agriculture (OA) presents itself as a knowledge-based agriculture. It raises specific or new research questions. It is also connected to other forms of agriculture, while expanding the range of study situations explored. At INRA (French National Institute for Agricultural Research), the CIAB (Internal Committee of Organic Agriculture) is the main driver of an organic research program. This committee is responsible for promoting and enhancing research in OA, namely through the launch of national calls. Seven calls were launched in the last 13 years, supporting 40 projects. The aim of this paper, written by research workers who contribute to CIAB, is to analyse whether these projects comply with the main objectives set out in the program. Two of the objectives were: (i) meeting R&D challenges in OA and (ii) fostering a dynamic network with partners and between INRA units (Sylvander and Bellon, 2003). This also enables us to assess the conditions of the production of scientific knowledge on and for OA, as well as the degrees of interdisciplinarity and partnership in these projects. Finally, we draw lessons on the relevance of associating skills for the identification, management and evaluation of research projects.

Material and methods

To analyse the projects supported and coordinated by this organic research program, we created a data base with all of the 40 project proposals that were finally approved. We categorized project participants according to their affiliation (institution type> institution> laboratory) and discipline (based on the disciplines declared and a categorization according to the disciplinary areas of the Web of Science). The analysis then focused on a set of indicators: duration, weight (number of entries) and diversity (Shannon diversity index and evenness, quoted E). These indicators reflect connections among the institutions and disciplines mobilized. We interpreted their value with the topics of the calls, the source of funding (INRA or joint calls), and the overall context of research in OA. The data base that we built also made it possible to depict participation in collaborative networks at different levels (individuals, laboratories, disciplines). The data were analysed using *Gephi* software[4], enabling us to identify the key actors according to their structural characteristics in the collaborative network, using the indicator of betweenness centrality (Degenne and Forsé, 2004). This approach in terms of collaborative network can handle the cross-partnership in the research program.

Results

Structuring a network of scientific and professional partnerships

INRA remains the main institution involved (60% of the participants over the period concerned). It is the only one over the entire period that answered all of the calls. Our analysis also identifies more than 55 partner organizations, including 28% from the development sector (technical institutes, associations), 10% from the educational sector (universities, agricultural schools) and a few private companies (1%).The range of the

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partnership is on average 5.2 institutions and 6.3 laboratories per project. Partner institutions invest rather homogeneously (Equitability = 0.8). This investment significantly increases in the two joint calls (2/7 calls), where the technical or professional expertise of projects was also requested. Three of the projects funded in this joint call included 14 to 18 partners, with a strong problem-oriented approach (reduction in the use of copper, fertilization, participatory plant breeding). Joint calls also entailed a longer process. Almost two years elapsed before starting the project, with: the combination of professional expectations and scientific knowledge synthesis, a double evaluation of pre-projects, seminars for co-building projects. Conversely, some of the topics addressed in three projects supported only by INRA were mostly led by researchers (e.g. on organics as commons). The call topics also determine partnerships and disciplinary contributions.

Mobilizing new research teams in the organic program

The program also aimed at encouraging new teams and new partnerships to develop research projects in OA. This incentive function also facilitated the construction of collectives that can later leverage other funding. The analysis of participants in the 40 projects funded shows a large "turnover": 61% of the organizations only answered the calls once. This turnover was also observed in the INRA units. A total of 70 units and 258 INRA employees contributed to projects, whereas 69% of the units responded to one single call. Conversely, 5.5% of the INRA units were present in 4 out of the 7 calls. Smaller organizations dedicated to research and experiments in OA also contributed regularly (presence in 5/7 calls with 26 entries for GRAB and 18 entries for ITAB[5], from 2000 to 2010), which shows their ability to engage in partnerships.

Resulting networks and partnerships

The program resulted in an effective networking of research and professions, likely to enhance or initiate structuring. A matrix combining research units and projects was designed, based on the contribution of each unit (duration, n° of calls, centrality) and partnerships among units (hierarchical clustering). This highlights some inertia around thematically related projects (e.g. meat sheep livestock systems). In contrast, some projects or laboratories seem more dispersed, resulting in high degrees of cross and thematic partnerships. ITAB exhibits the highest degree of partnership. In addition, analysis of the centrality of these institutions according to their participation in various projects makes it possible to visualize the partnership network (Fig. 1).

This figure confirms the inertia observed for projects in sheep production and the pivotal role of the some research units (e.g. URH in the right-hand corner). ITAB is influential through its participation in many projects. Other structural entities, are represented by GRAB and some INRA units (Innovation, Agronomy, etc). However, partnerships are also built pragmatically and geographical proximity is an important factor. Several regional poles can be identified (Brittany, Ile de France, Southeast, and Auvergne). Their experience in terms of institutional practices for collaborative research led to the development of unifying projects in response to the needs of professionals (e.g., potato breeding, sheep production).

[5] GRAB : Research Group on Organic Agric.; ITAB : French Technical Institute of Organic Farming

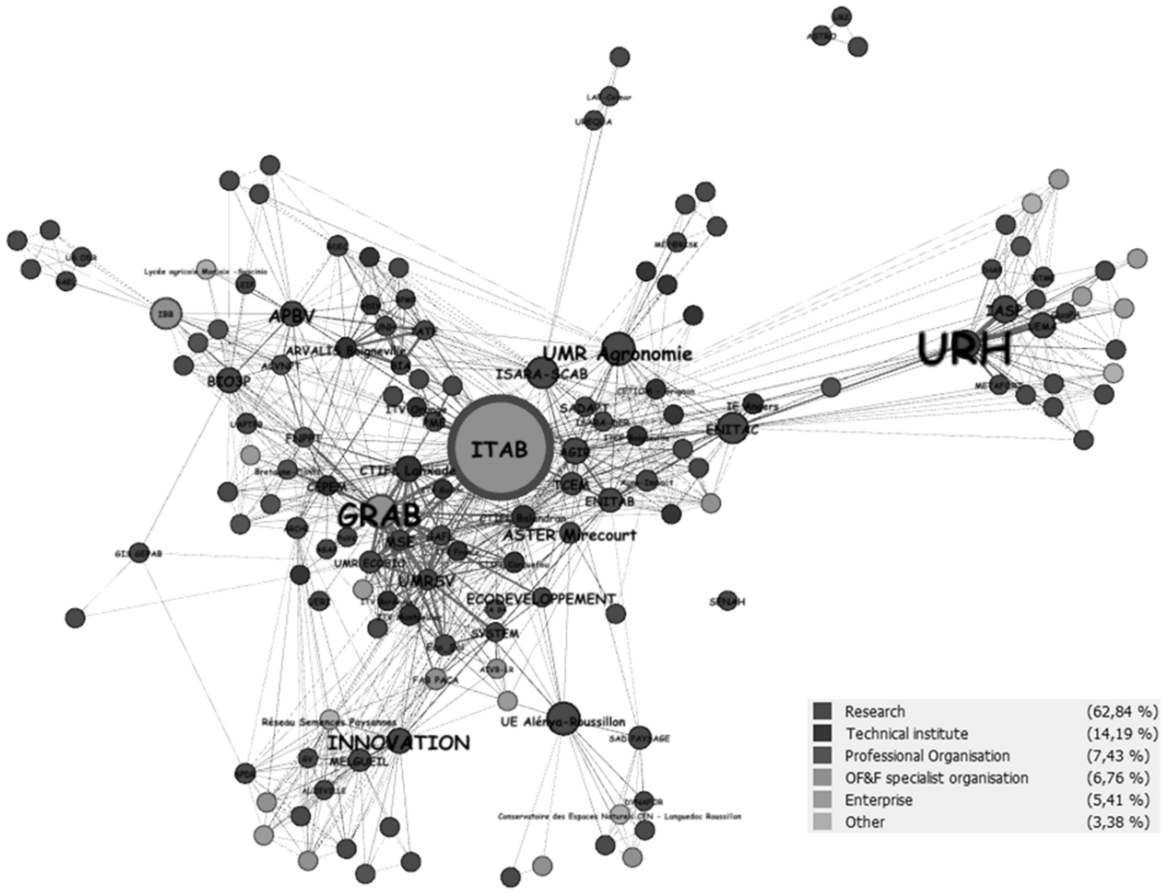


Figure 1: Partnership network of collaborations and ranking of research units according to their structural characteristics: indicator of betweenness centrality (Node size: betweenness; Color: type of institution; Label: number of entries; Links size: number of co-participants in projects)

Combining disciplinary and interdisciplinary approaches

Although agronomy largely dominates (45% in all calls), especially in joint calls, a total of 27 disciplines were mobilized in the 40 projects. The simultaneous presence of these disciplines gives INRA a specific asset for an integrated expertise and a diversity of approaches on many of the issues that may arise in OA. On the average, four disciplines are associated per project. In the first calls, research was mainly focused on analytical approaches and almost exclusively on plants. There was, in fact, an urgent need for mastering production techniques (fertilizer, seeds and seedlings, plant health, etc) with relatively limited resources. These questions were not addressed by conventional technical institutes, and professionals in OA solicited support from public research. Only a few projects had a systemic approach and clear interdisciplinary ambitions (organic bread, transition trajectories). This combination is consistent both with the interdisciplinary composition of CIAB and with the premises of the research program: systemic work can help to identify hypotheses to be tested analytically; analytical work is also useful for understanding processes in order to better manage them (e.g., with life cycles of diseases or pests).

Discussion and conclusion

The calls and subsequent projects cover a wide range of topics, as expected in the INRA research program. Topics addressed can be grouped into three categories: (i) understanding and supporting OA as a production system; (ii) shifting from a means-based approach to a better mastery of OA performances, (iii) supporting the development of OA as a prototype of innovative agriculture (Bellon and Penvern, in press). Although many projects were oriented towards solving practical problems, some projects can be considered as more prospective.

The low presence of the private sector in projects is also due to the focus on issues related to the control of production processes, with a few exceptions. Moreover, the "turn-over" observed in partners and teams also

questions the duration of the partnership and the ability to support ambitious projects of longer duration. Our analysis was restricted to one specific program, whereas some continued with other calls (from regional to EU). It could be expanded in two directions: (i) including research results (knowledge and impacts) of this program, and (ii) extending the analysis to other projects, using the data base presented in this paper.

The analysis of institutional partnerships revealed the benefits of unifying joint calls, with a number of partners mobilized around a common project. However, a large number of partners does not guarantee the scientific quality of the project and may result in high transaction costs in terms of coordination.

A research project in OA and for OA is a complex learning process, as much about the phenomena as the actors (roles and responsibilities) and mechanisms at work. Research teams operate in partnership with and among the professionals involved. This approach involves alliances to mobilize financial and cognitive resources and to build social capital. It also acts as a gateway to the sciences that goes beyond certain boundaries between different models of agricultures.

References

Bellon S., Penvern S. (Eds.), (in press). Organic Food and Farming, prototype for sustainable agricultures. Springer Editions.

Degenne A., Forsé M., 2004. Les réseaux sociaux. Editions Armand Colin, 296p.

Sylvander B., Bellon S., 2003. The INRA and organic farming : toward a research program. In Organic Agriculture: sustainability, markets and policies. CABI publishing/OECD, 383-392.

From selection to cultivation with the support of all stakeholders: first registration in France of two bread wheat varieties after VCU in organic farming system

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Key words: variety, winter bread wheat, plant breeding, Value of Cultivation and Use (VCU), organic farming

Abstract

As bread wheat is the most important cash crops for French organic farmers, the question of the kind of varieties farmers should be using is therefore very important. Most of varieties available were bred for intensive "conventional" farming systems (with high inputs of mineral fertilizers and pesticides), thus screening current varieties for organic conditions becomes a necessity to identifiy suitable varieties for organic farming conditions in a short term experiment. After 20 years of selection and screening combined in two different crop management systems, low inputs and organic, two lines, Hendrix and Skerzzo, have been registered in the French official catalogue with the special mention « organic farming ». For the second year of seed production, 150 hectares were sown in autumn 2013 to be sold to organic farmers in September 2014. This successful process was possible with the support of the whole agricultural organic sector associated in the initiative.

Introduction

The acreage of winter bread wheat is considerable in French organic agriculture (about 48 000 ha in 2013). As bread wheat is one of the most important cash crops, available varieties are of great importance for farmers. That is why it is essential to evaluate wheat varieties to achieve a better understanding of their productivity and quality (and stability across years and sites) under French organic conditions. At the end of the years 1990, the request has been rising for new adapted varieties for organic farming conditions. Responding to this demand, French wheat breeders from Genetic and Plant Breeding department of INRA have decided to test their best breeding lines for hardiness in organic conditions from 2000-2001. We define a "hardy" genotype as a new variety, multiresistant against pests and which provide relative high yields in environments with high levels of constraints.

Materials and methods

These inbred lines initially intended to be cultivated in Integrated Pest Management (IPM) were selected in very low input conditions. Then their abilities to combine high yields with low nitrogen supply and to get high baking quality despite poor grain protein contents were evaluated in organic conditions. Just a few of them have supported these two strong constraints. In the first part of the programme three INRA stations located in North-West France (Lusignan, Le Moulon and Rennes) and organised as a network have supervised several variety on-farm trials in organic conditions during five years. The best lines were then tested in the ITAB network. This large network (about 30 locations each year) of comparative trials was created in 2002 to evaluated new released French and European varieties which were supposed to be suitable for organic conditions. This is the context in which agronomic abilities and baking quality of the two INRA inbred lines CF99102 (Skerzzo) and RE04073 (Hendrix) were evaluated during three years (2006 to 2008). As they obtained good and quite stable results on the trials network, the question of their registration on national catalogue arose.

After a first failed attempt initiated in 2005 by a French private breeding company, ITAB network's participants and the entire French breeding sector have supported in 2009 the proposition formulated by INRA to set up an original registration test dedicated to organic conditions. This demand was accepted by the CTPS (French Permanent Technical Committee for the Selection of Cultivated Plants) and several VCU's (Value for Cultivation and Use) trials were led applying the methods of the standard experimentation. In the same time and for the first time in France, eight organic on-farm trials have taken place in north-west France.

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These trials were sown and monitored with the assistance of several French actors involved in the organic sector: cooperatives (as BIOCER in Normandy), organic farmer group (GRAB Normandy), advisors (agricultural chambers from Ile-de-France, Maine-et-Loire, Nord-Pas de Calais, Picardie; technical institutes as Arvalis Institut du Végétal) and Agri-Obtentions which commercialise INRA's varieties.

Varieties assessed in the ring-test had traits that are supposed to best answer organic constraints: good response to low level of nutrients, good competitive ability against weeds (leaf area, leaf inclination). Agronomic and quality parameters were assessed: yield (t/ha) and grain protein content (%) , test weight (kg/hl), height (cm), ground cover, diseases notations, bread-making quality data evaluated by the French BIPEA test (NFV03-716).

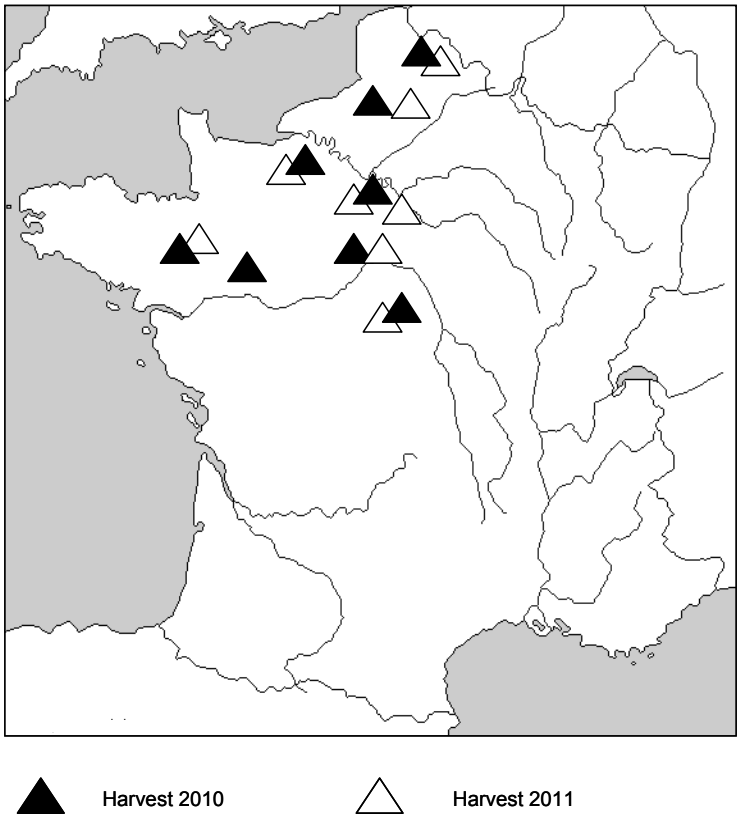


Figure 1: Location of wheat variety VCU trials in organic farming in France

Results

For 2 years (harvests 2010 and 2011), in this original VCU experimentation supervised by GEVES (official Variety and Seed Study and Control Group) in the ITAB network, Hendrix and Skerzzo obtained higher yields than the two most cultivated organic varieties in France, Renan and Saturnus (Figure 2). In the same time the two INRA lines obtained the same baking notations than Renan (Figure 3), which is the reference for baking quality in organic conditions in France, allowing them to be inscribed in the official French catalogue with the special mention "organic farming". Apache a variety selected for high input conditions was productive but lost her baking ability (certified in high input management) under organic conditions.

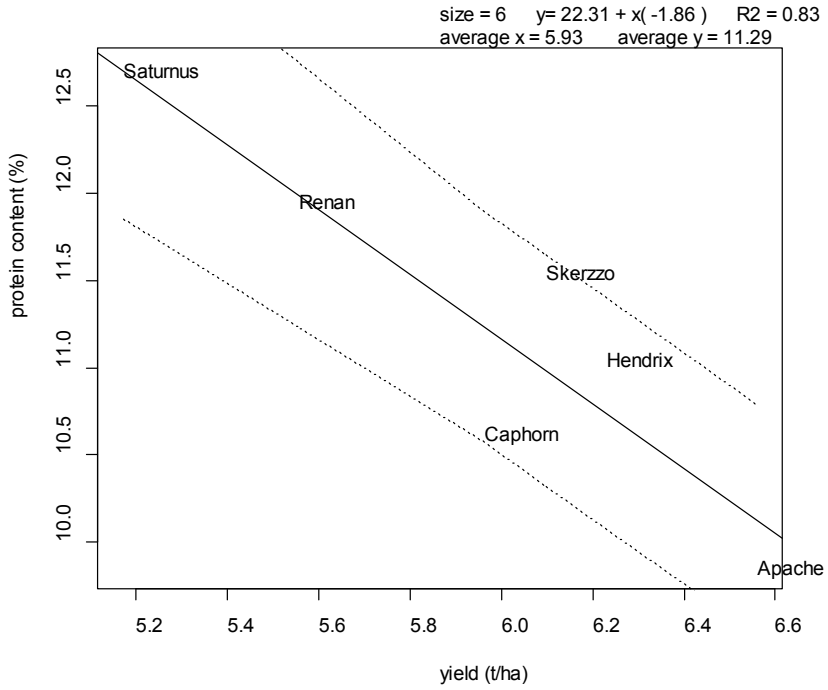


Figure 2: Relative performance (yield and protein content) for years 2010 and 2011 (data combined across 14 organic sites)

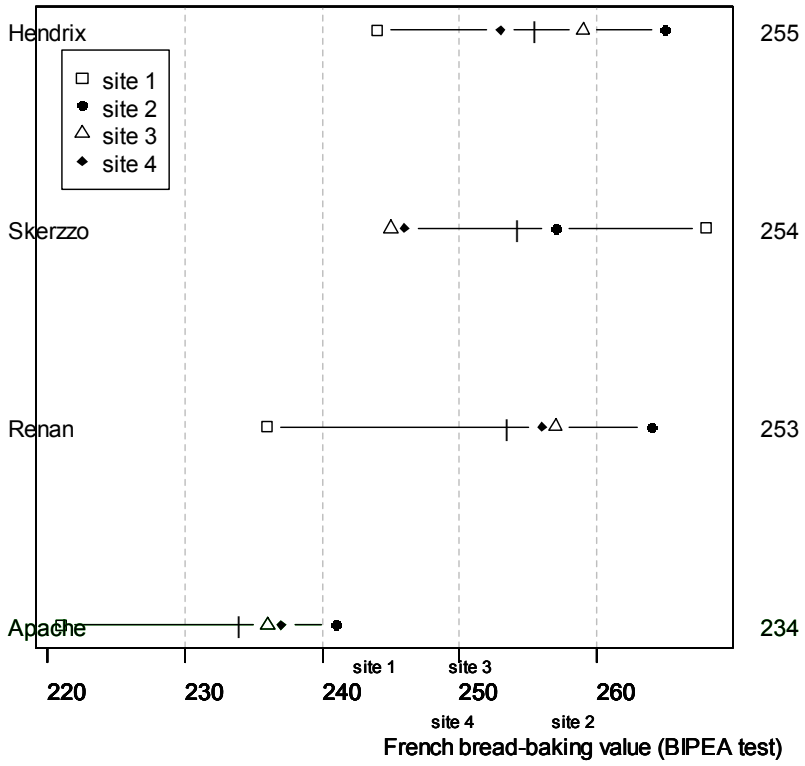


Figure 3: Relative performance of wheat varieties for baking value, for year 2010 (datas combined across 4 trials).

Discussion

Results have demonstrated that CF99102 (Skerzzo) and RE04073 (Hendrix) provided higher yield than the two most cultivated varieties in organic farming system. Furthermore their baking qualities were good, according to French test. Besides, it is important to underline that this organic trial network is used to study specific traits required for organic farming, such as competitive ability against weeds, in order to transfer them as selection criteria in dedicated breeding programs. These official trials gave also the opportunity to show the relevance of a professional VCU testing under organic conditions. This experience, supported by all stakeholders, had dissolved many doubts expressed by several contradictors.

Conclusions

Organic farmers need bread wheat varieties suitable for both organic conditions (agronomic traits) and organic market demand (quality traits). Nine years of selection and screening under low input management followed by nine more years under organic conditions, led to the registration of Skerzzo and Hendrix in the French catalogue with the special mention « Organic Farming ». This work was realized thanks to a strong collaboration between INRA, GEVES and all organizations involved in the ITAB network.
Now the way is open in France for new organic registrations in the official catalogue, like in Austria or Switzerland. INRA's breeders are carrying on their researches to create new varieties with all the traits researched by producers and particularly a strong ability to cover the soil to suppress weeds more efficiently.
For the second year of seed production, 150 hectares were sown in autumn 2013 to be sold to organic farmers in September 2014. This successful process has been possible thanks to the support of the whole agricultural organic sector associated in the initiative.

Acknowledgments

We gratefully acknowledge all organisms and people which managed organic variety trials: Chambres agriculture (Maine-et-Loire, Nord Pas de Calais, Ile de France, Picardie), Arvalis-Institut du Végétal (Jeu-les-Bois, Ouzouer-le-Marché), GRAB Haute-Normandie, Biocer, INRA (UE Auzeville, Lusignan, Le Moulon, Rennes and UMR Rennes), Agri-Obtentions Orsonville.
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References

Fontaine L., Rolland B., Bernicot M.-H. (2008): Contribution to organic breeding programmes of wheat variety testing in organic farming in France. Proceedings 16th IFOAM Organic World Congress, 2d ISOFAR scientific conference, *vol 1 p.692-695*, 18-20 June 2008, Modena, Italy. (Oral communication).

Goyer S., Al Rifaï M., Bataillon P., Gardet O., Oury F.X., Rolland B. (2005): Selection index for bread wheat cultivars suitable for organic farming. Proceedings of the COST SUSVAR/ECO-PB Workshop on Organic Breeding Strategies and the Use of Molecular Markers, 17-19 January 2005, Driebergen (NL). p. 84.

Przystalski M., Thiemt E., Rolland B., Ericson L., Osman A., Østergård H., Levy L., Wolfe M., Büchse A., Piepho H.-P., Krajewski P. (2008): Comparing the performance of cereal varieties in organic and non-organic cropping systems in different European countries? Euphytica 163-3: 417-434.

Rolland B., Bernicot M.-H., Fontaine L. (2010): Wheat varieties in competition with weeds for sustainable agriculture, in particular organic farming. Breeding for resilience: a strategy for organic and low-input farming systems? Conference Eucarpia Paris, 1-3 december 2010.

Rolland B., Le Campion A., Oury F.X., (2012): Pourquoi sélectionner de nouvelles variétés de blé tendre adaptées à l'agriculture biologique ? Courrier de l'Environnement de l'INRA 62, 71-85.

An alternative approach to plant health: The procedural concept applied to common bean seed systems

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Key words: plant health, common bean, *Phaseolus*, organic seed production, crop biodiversity

Abstract

The pathogenic bacteria causing Common Bean Blight (CBB) is regulated as quarantine pest on bean seeds in the European Union. While they may reduce damage to crops and delay the global spread of pathogens, such phytosanitary regulations can represent a market barrier to small scale organic seed producers. Under the hypothesis that different conceptions of plant health are confronted in debates on CBB and seed quality, a procedural concept for the definition of plant health is applied to the case of small-scale organic bean seed production. Questions within the thematic areas of (i) the socio-technical networks, (ii) pathosystem and biology, (iii) epidemiology, (iv) crop environment and (v) anthropocentric aspects are treated in the framework of an ongoing research project to obtain a situated, contextualized understanding of plant health and management strategies.

Introduction

Common bean (*Phaseolus vulgaris*) constitutes a valuable source of protein in human diets worldwide. While its production remains high in many African and Latin American countries, it has decreased in Western Europe. Seed production follows the same trend: While common bean seed production decreased from 10.760 to 2.230 tons between 1962 and 2012 in Western Europe, it has increased from 51.160 to 249.710 tons in Eastern Africa (FAOSTAT). However, some small scale, mainly organic, artisan seed producers produce and market common bean seed in Western Europe, often seeds of traditional varieties for gardeners and vegetable producers selling to local markets. Several seed-borne pathogens, including fungi, viruses and bacteria, represent one of the challenges to the production of this seed. *Xanthomonas axonopodis* var. *phaseoli* (Xap), causing Common Bean Blight, is regulated as quarantine pest on seeds in the European Union (EU 2000). Such phytosanitary regulations can represent a market barrier to small scale organic seed producers, as contaminated seed lots are banned from commercialization, potentially causing serious economic damage. In addition, such regulations may threaten agro-biodiversity. In the case of Xap, pathogen-free seed lots are no longer available for some traditional common bean varieties, making their multiplication difficult as curative measures are not available.

We emit the hypothesis that different conceptions of plant health are confronted in debates concerning Xap as a quarantine pest. In what might be termed as a *hybrid forum*, stakeholders are unable to find common definitions of the problem, let alone identify its causalities or measure its effects (Callon, 1999). Rather than defining plant health as an objective entity, Döring *et al.* (2011) propose a procedural concept consisting of a set of topics and rules for debate in order to incorporate different viewpoints on the continua between naturalist and normativist approaches, negative and positive definitions, reductionism and holism and functionality and resilience. After a brief overview of the set questions for debate suggested, they are applied to the case of common bean seed produced by small-scale organic seed producers in Western Europe as treated by an ongoing research project.

The debate procedure applied to common bean seed production

The procedural concept proposed by Döring *et al.* for the definition of plant health consists of a set of questions grouped according to five topics. These can be summarized as [i] the socio-technical network (the perception of the pathosystem by the people involved), [ii] pathosystem and biology (co-evolution of plant and pathogen, effect of pathogenic organism on the plant's vital functions), [iii] epidemiology (development and effect of the disease in individual plants and populations, response of affected plants to stress conditions and pathogenic organisms), [iv] crop environment (the role of the environment and management) and [v] anthropocentric aspects (genetic potential of plants; affects of pathogen on yield, quality, ecosystem functions, human health and welfare and socioeconomic functions). While the first three topics may be

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tackled with disciplinary knowledge within social or natural sciences, the other two call for interdisciplinary approaches and the involvement of practitioners and other stakeholders in the debate.

Research was started in 2012 in the framework of the FP7 project SOLIBAM to study seed health in the context of small-scale bean seed production from several perspectives and disciplines. The topics for debate on plant health are approached as follows.

Considerations on the socio-technical network

Questions referring to the socio-technical network seem very relevant in the case studied here, as the very research subject resulted from small-scale seed producers' observation that phytosanitary regulations do not match practical experience and feasibility in bean seed production. Debates on Xap and plant health involving seed producers, seed testing institutions, researchers and other stakeholders lead to the hypothesis that different conceptions on plant health exist. On one hand, the ideal of pathogen-free seed, leading to the regulation of pathogens as quarantine pests in extreme cases, is one strategy to "protect plants" and prevent "the introduction and spread of dangerous pests" (EPPO website). While this strategy reduces damage to crops and delays the global spread of pathogens, it may on the other hand be regarded as an overly reductionist approach to plant health disfavoring the resilience of cropping systems (Demeulenaer 2013). A more normativist approach based on a positive concept of plant health may be more suited for organic, small scale seed production. Indeed, ecological plant protection relies on interactions in the ecosystem to provide regulation of pathogens and pests. It is more likely to embrace a salutogenic position "focusing on more complex interactions between plants and pathogens, such as induced resistance phenomena" in order to "move towards health" (Döring *et al.*, 2011). To validate calls for a more complex and holistic understanding of phytosanitary issues, a qualitative survey will be realized with bean seed producers, researchers and other stakeholders. Comprehensive interviews will include topics such as criteria for seed quality, seed and crop management strategies and forms of social organization.

Pathosystem and biology

A set of questions concerning the effect of pathogens on plant functions and the development of pathogens under certain pedoclimatic conditions can be answered by reviewing literature on relevant plant diseases. As a model crop of global importance, a lot of research has concentrated on common bean pathogens, leading to a wide range of scientific literature and text books (reviewed by Broughton *et al*., 2003; Singh and Schwartz, 2010). Research conducted under laboratory, green house or experimental station conditions produces knowledge that is out of context, but which nevertheless provides elements to better understand the pathosystem we are dealing with. Knowledge on possible biological interactions between Xap and its host and on the damage potential of the pathogen helps to explain and situate field observations.

Epidemiological aspects

Another set of questions refers to the effect, severity and spread of plant diseases. Whereas general information on the prevalence of Xap in certain regions of the world can be found in literature, the epidemiological development of the pathogenic bacteria is strongly dependent on environmental conditions and famer practices. For instance, inoculum thresholds of seedborne bacteria leading to epidemic development are likely to depend on plant-pathogen-environment interactions (Darrasse 2007). These aspects are therefore tackled by on-farm field trials with the varieties of implicated producers. Field trials with 4 traditional bean varieties and one commercial check were set up on three farms with contrasting pedoclimatic conditions in France and Luxembourg in 2012. For the following three years, bean seed will be multiplied and resown on every site under field conditions. Notations on disease symptoms, counts on the number of surviving plants, grain yields and seed testing for pathogenic microorganisms will allow assessing the development of seed-borne diseases in the plant populations and in time. As these trials are conducted under the conditions of small-scale organic production and with involved farmers' seed lots, the link to the fourth topic for discussion is obvious.

The role of the crop environment

When faced with large genotype*environment interactions, the exploitation of specific plant adaptation and the use of different methodologies and types of germplasm in decentralized crop breeding are recommended strategies for yield maximization (Ceccarelli 1996) or yield stability. In the field trials, the specific adaptation of seed lots to their environment is studied, as well as the interactions between plants, pathogens and other microorganisms. A large number of soil microorganisms have been shown to interact with plants and to

improve plant vigor and induce resistance not only to soil-borne pathogens, but also to foliar and systemic plant pathogens. Among them, arbuscular mycorrhizal fungi (AMF) and *Rhizobium* sp. play a predominant role for legume crops (Avis *et al.*, 2008). They may thus be considered as important factors in an alternative approach to plant health and crop resilience. However, the majority of research on the effect of these microorganisms on plant health has been conducted under laboratory or green house conditions, making it difficult to assess their role in real-life cropping systems. Assessing the symbiosis of bean plants with these microorganisms in farmers' fields thus allows (i) getting a broad view of the interactions between bean crops and soil microorganisms and the effect on plant health on-farm and (ii) drawing first conclusions on the perspectives of alternative plant protection strategies based on interactions with locally present endogenous microorganisms and induced resistance.

However, the question on the role of farmers' management practices goes beyond the mere description of practices and validation of the role of soil biology for plant health and resilience under field conditions. Farmers' understanding of their production systems influences the management strategies put in place. For instance, small-scale artisan producers combine the objectives of producing seed, managing crop biodiversity and maintaining the know-how and practices around seed production within their communities. Working with local networks and artisan techniques entails very different management strategies than the large scale seed production on a global market. A holistic approach to research which does not consider research results without their context calls for the participation of and active interaction between stakeholders (researchers included) in a research process that is not defined beforehand.

The anthropocentric view on plant health

A final set of questions aiming at the effect of Xap on grain yields, ecosystem functions of the crop and, finally, human health and welfare appears to be straight forward and measurable at a first glance, but actually leads to a discussion on human goals and values in seed and food systems: Measuring the effect of Xap on grain yields requires measuring the genetic potential of the bean crop. However, small-scale seed producers choosing to produce traditional bean varieties organically are seldom interested in the genetic yield potential of their bean variety under optimal conditions, but rather in the adaptation to their local crop environment. Or as one French farmer puts it: "We do not merely sow genes in our fields. We sow live seeds which are accompanied by a large diversity of microorganisms." Beyond grain yields and measurable product quality, the role of local agricultural systems from seed to soup in defining food quality and the importance of agro-biodiversity as an ecosystem function are only two topics that need to be discussed for individual communities. Pathogens may even be regarded as part of the production environment. Maintaining interacting networks of coevolving populations would thus enable hosts to respond better to future disease threats, as has been argued in the case of natural systems (Altizer *et al.* 2003).

Perspectives and challenges

By involving practitioners and other stakeholders in a debate procedure including different, possibly contradictory views and allowing for hesitation (Stengers 2006) on practices concerning plant health, the project described is one example of bridging the gap between scientific knowledge and practice. Such procedural approaches to research allow reconnecting academia, which has become ever more specialized in disciplines, with reality in the field. To result in social learning processes and develop relevant new forms of knowledge and networks, the rules for debating are as important as the topics themselves. A fair and equal debating process between appropriate discussion partners, a sufficient time frame for assessments and decisions and transparency are among the rules to be respected. These rules also represent important challenges for researchers. It is important to be aware that results of this form of research are situated and contextualized, and not universal as scientific results have long been regarded. How such results can be applied to seed production systems under present conditions, particularly regarding the regulatory framework of seed production, remains to be seen. Perhaps a procedural take on policy development would be one logical consequence for seed regulations?

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References

Altizer S, Harvell D & Friedle E (2003): Rapid evolutionary dynamics and disease threats to biodiversity. Trends in Ecology & Evolution 18, 589–596.

Avis TJ, Gravel V, Antoun H & Tweddell RJ (2008): Multifaceted beneficial effects of rhizosphere microorganisms on plant health and productivity. Soil Biology and Biochemistry 40, 1733–1740.

Broughton WJ, Hernández G, Blair M, Beebe S, Gepts P, & Vanderleyden J (2003): Beans (*Phaseolus* spp.) – model food legumes. Plant and Soil 252, 55–128.

Callon M (1999) : La sociologie peut-elle enrichir l'analyse économique des externalités? Essai sur la notion de cadrage-débordement. In: Foray D & Mairesse J (eds): Innovations et Performances: Approches Interdisciplinaires, Recherches D'histoire et de Sciences Sociales. Editions de l'Ecole des hautes études en sciences sociales, Paris, 399-431.

Darrasse A, Bureau C, Samson R, Morris CE & Jacques M-A (2007): Contamination of bean seeds by *Xanthomonas axonopodis* pv. *phaseoli* associated with low bacterial densities in the phyllosphere under field and greenhouse conditions. European Journal of Plant Pathology 119, 203–215.

Döring T F, Pautasso M, Finckh MR & Wolfe MS (2012): Concepts of plant health - reviewing and challenging the foundations of plant protection: Concepts of plant health. Plant Pathology 61, 1–15.

Demeulenaer É (2013): Les semences entre critique et expérience : les ressorts pratiques d'une contestation paysanne. Revue d'Etudes en Agriculture et Environnement, 94(4) : 421-441.

EPPO (2013): Data Sheets on Quarantine Pests: *Xanthomonas axonopodis* pv. *phaseoli*, prepared by CABI and EPPO for the EU under Contract 90/399003. http://www.eppo.int/QUARANTINE/bacteria/Xanthomonas_phaseoli/XANTPH_ds.pdf (accessed on the September 29th 2013 at 20h52).

EU (2000): Council Directive 2000/29/EC on protective measures against the introduction into the Community of organisms harmful to plants or plant products and against their spread within the Community, 63.

Singh SP & Schwartz HF (2010): Breeding Common Bean for Resistance to Diseases: A Review. Crop Science 50, 2199-2223.

Stengers I (2006) : La vierge et le neutrino, des scientifiques dans la tourmente. Paris, Les empêcheurs de penser en rond.

Optimizing and promoting mechanical weed control in arable crops

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Key words: mechanical weed control, weeds, organic farming, hoe, harrow

Abstract

Within an overall strategy of weed flora management, mechanical weed control practices are complementary solutions to agronomic levers (crop rotation, tillage...) in weed control. Acquiring knowledge and communicating on the efficiency of mechanical practices and tools appear essential. The "Mechanical Weed Control" project in France conducted between 2009 and 2012 made progress in this regard. The project shows that complementary research activities are to be continued (experimentation, analysis of practices) and should be complemented by promotion that focuses on participatory approaches where farmers are involved in the implementation of these new practices.

Introduction

Managing the weed flora is a major concern of agricultural production systems, particularly in the case of arable crops in organic agriculture (OA), where along with the preservation of soil fertility it constitutes the main problem cited by organic farmers. Control of the weed flora is based on a combination of agronomic solutions (crop rotation, tillage...) and mechanical solutions. The study of mechanical weed control practices (tools, implementing conditions...) and their evaluation (efficiency, cost, working time, environmental impacts...) are a prerequisite for a broad dissemination to farmers. The French project "Mechanical Weed control" (January 2009 - March 2012, CASDAR national funding) was set up to study, promote and optimize mechanical weed control on a technical level. An original feature of the project was to promote knowledge transfer from OA to conventional sector.

Material and methods

The objectives of the project were to (i) Obtain information on mechanical weed control practices used by farmers and evaluate the efficiency of these practices, (ii) Gain more knowledge about weeds to better control them, (iii) Study the conditions for transferring these technologies to farmers who are not applying them. Different, complementary approaches were applied to meet the project's objectives:

- Nearly 200 surveys of farmers practicing mechanical weed control were conducted in 7 regions in France (characterized predominantly by cereal or mixed farming). The descriptive analysis of the data revealed some information on the equipment used and the weeds considered to be the most problematic, and it also helped to identify sources of information used by farmers on mechanical weed control (Fontaine *et al.* 2010). 31 in-depth interviews were subsequently conducted to analyze precisely the mechanical weed control plan for main crops (including soil management through inter-cropping and mechanical weed control operations in the crops). Each weed control plan is defined by the objectives of the farmer and rules for decisions-making that enable the achievement of objectives, each one being evaluated according to calculations of technical, economic and environmental indicators.
- Field experiments: the results of mechanical weed control trials in winter cereals in OA were grouped (they constituted the most prevalent crops) and a synthesis was produced of 91 data (number of trials x conditions tested x weed types studied).
- Sociological studies were carried out at the level of catchment areas to assess the responsiveness of farmers on the acceptance of new practices. Two studies were conducted in western France in areas where water pollution originating from agriculture is a concern (Thareau, 2010, Lemarié, 2012).

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Results

1. Knowing and evaluating mechanical weed control practices

The survey results show a clear dominance of the use of the chain harrow and the hoe among organic farmers (respectively 90% and 79% of farmers surveyed use them). The rotary cultivator follows close behind (24% of use), its appearance being a recent phenomenon in many areas. In mixed farming the harrow is an essential tool (96% of use against 68% for the hoe). In cereal production systems the harrow and the hoe are used equally. In terms of the combination of tools nearly 80% of farms in OA employ two or three tools. The chain harrow/hoe combination is used in one out of two cases in all regions surveyed. The presence of three tools harrow/cultivator/hoe is used in 15% to 25% of organic farms according to the region with a dominant presence in specialized arable cropping systems. It is to be noted that a quarter of farms in mixed farming use only the chain harrow, certainly related to the presence of grasslands in rotations, that facilitate weed control.

The analysis of the results of interviews conducted with thirty organic farmers showed great variability in the mechanical weeding control plan (management of inter-cropping + direct weed control in crops). It actually depends on periods of crop establishment and row spacing, favourable weather and soil conditions for intervention, crop rotation and the intervention level by the farmer. For example, in the case of winter cereals, the average values are 6.5 runs per plot, 45 l/ha of fuel consumption and 2.5 hours of work, but they hide very large disparities. Not surprisingly, the mechanical weed control plan that requires more working time and more fuel consumption are those with the highest number of runs: spring crops, especially those with wider row spacing (potato, sunflower, corn).

It is worth to consider the results one by one as they reveal important information. The main weed control plans were reexamined and described in detail (decision-making rules, triggers of interventions, technical, economic and environmental indicators) in a brochure on mechanical weed control for each crop examined (ITAB, 2012a).

Analysis of results of weed control trials for winter cereals shows that the most effective strategies are those with multiple runs, beginning with an early run (between pre-crop emergence and the 3-leaf stage) with an average efficiency of 40%-50% (expressed as % of weed suppression). However, there is considerable variability in efficiencies depending on weed stages and the repetition of runs. However, when the hoe is the predominant tool in strategies used (with multiple runs) they are more efficient (ranging from 40% to 65%) (as shown by Davies *et al.*, 2002). In addition, the later the first run of weed control is conducted the more limited the efficiency will be. The strategies that include early runs and multiple runs appear to be the most effective.

In the trials analyzed average yields increased by 20%-80% compared to the unweeded control. In the trial conditions analyzed, the best strategies were obtained when there were at least two runs with hoes. In contrast, strategies based solely on the chain harrow and/or rotary cultivator appear less efficient. Two hypotheses can be advanced in this respect: (i) the implementation of hoeing, more effective on weeds, limits weed density as well as weed competition over the crop resulting in improved yield; (ii) the use of the hoe accelerates the mineralization of nitrogen, the crop can therefore benefit through improved yield. A combination of these two assumptions is likely.

2. Knowing weeds to better control them

In terms of the weeds considered to be of most concern, the species most cited by organic farmers in surveys conducted in 2009 are the dock (*Rumex crispus, Rumex obtusifolius*) and the thistle (*Cirsium arvense*) (respectively 90 and 86 citations out of a total of 700 citations) with a significant tendency for stagnation. Wild oats (*Avena fatua*) follow behind (54 citations) characterized by a sharp increase in recent years according to farmers affected (55% of respondents indicate a rising trend). No weed is mentioned to be decreasing in the plots, all are estimated mainly to stagnate or even to increase, for instance in the case of vetch. If we examine in more detail the cropping system, both farmers in mixed farming and cereal growers consider perennial weeds to be of greatest concern. Nevertheless, cereal growers more frequently mention thistle, while dock is more prevalent in mixed farming. Grasses (wild oat in particular) are of more concern to cereal growers (28% of farms) than to their colleagues who combine crops and livestock (16% of farms).

In order to help farmers better identify weeds present on their land and especially to manage them over time a brochure was developed in the project. It focuses on the knowledge and control of weeds in arable crops without herbicide use (ITAB, 2012b): it contains a description (elements of biology) of the main weeds

encountered in these systems, photographs are reproduced for ease of recognition and recommendations are made to help control weed development.

3. Disseminating and transferring mechanical weed control techniques

The 195 surveys conducted in 2009 provided some insight about farmers' views on information available on mechanical weed, showing a clear difference between the 157 organic farmers (48% of them do not feel sufficiently informed) and 36 conventional (71% feel adequatly informed) even though paradoxically, this type of weed control is much more prevalent in the first group. In OA the information need on weed control indicated by farmers equally concerns (i) the effectiveness of control methods, (ii) the characteristics of weeds (biology, harmfulness / tolerance), (iii) knowledge of tools. In conventional agriculture a large number of farmers are concerned about (i) the effectiveness of control methods and (ii) cost. The survey also showed that in the survey sample more than one third of organic farmers rely on information obtained from exchanges with other farmers, whereas in conventional the primary sources of information used are agricultural advisors (1/3 of respondents) followed by the agricultural press (27% of responses). It is interesting to note the contrast between the two modes of production and the fact that organic farmers stress the importance of exchanges between farmers as well as the need to have a better knowledge of weeds in order to better control them.

Sociological studies conducted in 2009 and 2011 on territories where water is a major issue show that environmental and health issues are now generally taken into account by farmers. However, mechanical weed control is clearly challenged by the solution that is more accessible to conventional farmers – namely to reduce the dose of chemical herbicides. The working time allocated to mechanical solutions constitutes an important obstacle, more so than a fear of lack of technical efficiency. The provision of practical technical information is important in addressing reluctance: efficiency of practices, work conditions, comparative evaluation of estimated working time and environmental impact. In addition, subsidies granted for such practices often act as triggers. Accompanying the farmer (individually, in group) is therefore critical to ensuring the gradual appropriation of mechanical weeding techniques. Exchange - and hence the organization of these exchanges - between practitioners of mechanical weeding is a key element for enhancing the dissemination of these practices.

Discussion

The different actions conducted in the project have pointed out the need expressed (1) for information, to help change the perceptions about mechanical weeding of farmers who are not (yet) practicing it; and (2) for references on mechanical weed control, to improve practices in terms of technical efficiency, working time, environmental impact, economic cost. The pursuit of field experiments and analysis of farming practices is to be carried out to meet expectations. Knowledge of weeds, the existence of improved tools and settings are other essential components.

Taking into account the expectations of farmers is essential for orienting future research. In addition, integrating their knowledge is also important and can be done by involving farmers to a higher degree in experimental programs. The technical details (types of tools and direct weed control plan in a rotation, main weeds targeted) and communication tools, however, have to be developed based on the target groups, for organic farmers on the one hand and for farmers leaning towards reduced herbicide use on the other, as their needs and modes of cultivation differ.

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References

Davies D., Welsh J. Weed control in organic cereals and pulses. http://orgprints.org/8162/1/5.pdf

Fontaine L., Lieven J., Zaganiacz V., Vacher C., Cairon A., Quillet M., 2010. Optimiser et promouvoir le désherbage mécanique : état de la situation chez des agriculteurs biologiques et conventionnels. AFPP, Actes de la vingt-et-unième Conférence du Columa, Journées Internationales sur la lutte contre les mauvaises herbes, Dijon, 8-9 décembre 2010, 10 pages.

ITAB, 2012a. "Désherber mécaniquement les grandes cultures". Restitution du Casdar 8135 Désherbage Mécanique, 82 p. Available on line at http://www.itab.asso.fr/programmes/desherbage.php

ITAB, 2012b. “Connaître les adventices pour les maîtriser en grandes cultures sans herbicide”. Restitution du Casdar 8135 Désherbage Mécanique, 89 p. On line at http://www.itab.asso.fr/programmes/desherbage.php

Lemarié P., 2012. Promouvoir le désherbage mécanique autour de captages d’eau potable. Restitution du projet Casdar 8135 Désherbage Mécanique, ITAB, 18 pages. Available on line at http://www.itab.asso.fr/programmes/desherbage.php

Thareau B., 2010. Comment promouvoir l’utilisation du désherbage mécanique ? Analyse sociologique des points de vue d’agriculteurs face au changement des pratiques de désherbage. Restitution du projet Casdar 8135 Désherbage Mécanique, 11 p.

Turner R.J., Davies G., Moore H., Grundy A.C., Mead A., 2007. Organic weed management: A review of the current UK farmer perspective. Crop Protection 26 (2007), 377–382. On line at www.sciencedirect.com.

Knowing, characterizing and assessing systems of organic crop rotations

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Key words: rotation, organic farming, cropping system, multi-criteria assessment

Abstract

The choice of crop rotations in organic stockless cropping systems is the first leverage used to manage technical issues (to maintain soil fertility, to control pest and weeds) and economic issues (to insure income). The RotAB project (French Casdar funding 2008-2010) implemented complementary approaches to better knowing, characterizing and assessing arable crop rotations. Their conception depends on numerous factors such as the types of soil and climate (on which depend the types of crops, yield potential, possibility of mechanical weed control) or the economic context (existence of outlets and continuity of markets). If nitrogen supply and weed control are the most important agronomic issues of organic farmers in stockless cropping systems, phosphorus availability appears to be the next important issue for soil fertility and system sustainability.

Introduction

The question of the choice of rotations in organic agriculture (OA) arises automatically upon conversion. However, very few studies offer advice that can help farmers in this field. The RotAB project was developed to better understand the rotations performed in or recommended by OA. The working hypothesis is that the choice of rotations in these production systems is key to controlling many problems, especially technical ones (maintaining soil fertility, pest control and in particular weed control) but also economic ones (ensuring an income for farmers). The challenge is even greater for specialized systems of arable crops as they raise the question of long-term sustainability in terms of maintaining soil fertility with little or no external organic inputs.

Material and methods

The objectives of the RotAB project *"Can we design rotations that limit environmental impacts while ensuring the economic viability of the farm?"* were to better understand the rotations practiced by stockless organic farms specialised in cereal production and identify their strengths and weaknesses. The project received French national funding from CASDAR. It ran from January 2008 to December 2010. Different approaches were developed to better understand stockless organic arable cropping systems through (i) the inventory of rotations commonly practiced in France (surveys by region), (ii) the construction of eight test cases representing 11 types of rotations in five regions partners in this project, on the basis of data provided by networks of reference farms and 37 in-depth interviews of organic cereal growers, (iii) networking between five long-term experimental sites testing innovative rotations in organic arable crops.

Results

1. Inventory of rotations practiced in arable crops in France

A simple typology was developed to classify rotations identified in each region examined in France: the presence (or not) of perennial fodder crop in the rotation, % of leguminous, % of hoed crops (hoeing practiced), % of spring crops.

The most striking characteristic is the presence or absence of a perennial fodder crops in the rotation such as alfalfa, clover, sainfoin ... that have many agronomic benefits. These rotations are usually quite long: often more than 7 years, sometimes up to 12 years. Other rotations are shorter, on average 3 to 6 years. The important nitrogen requirements of this second type of cropping systems involve adding fertilizers (improvements, organic fertilizers) that are usually expensive. Succession of winter / spring crops and the presence of hoed crops are generally better respected in these rotations. The "cleaning" approach to weeds

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through effect of perennial fodder crops in the rotation is clearly replaced by increased mechanical interventions and winter/spring crop succession that interrupts the weed cycle. These systems are found mainly in the southern part of France where the possibilities of mechanical weed control are facilitated by the climate.

2. Multi-criteria assessment of rotations

2.1 Comparative analysis of the RotAB test cases: Technical, agronomic, economic and environmental benchmarks

Comparisons were conducted on the gross and net margins in the rotation, on the working time per hectare as well as on energy consumption and greenhouse gas emission.

In summary, it can be said that the local pedoclimatic environment and the economic context greatly affect the economic success of each rotation (yield potential, specific opportunities). The analysis of net margins with subsidies, ranging between 220 €/ha and 730 €/ha, does not draw clear conclusions as to the comparative profitability of long or short rotations. However, in the test cases studied long rotations with alfalfa appear to be less sensitive to changes in the selling price or purchase price of inputs. This type of rotation has other advantages as well such as a shorter working time per hectare (if the alfalfa harvest is done by service provision, the cost is offset by recovery at marketing), less dependence on nitrogen across the rotation or easier weed control. However, the inclusion of alfalfa in the rotation remains extremely dependent on the existence of markets and therefore on the local context.

The test cases were also used to analyze the effect of the place of lucrative crops such as bread wheat in the crop rotation. It is thus clear that the cost of production of a wheat following alfafa (<200 €/t) is much lower than the cost of a wheat following faba bean (250 €/t) or rapeseed (275 €/t), although yields are higher (4.8 versus 4.5 and 4.3 t/ha). This underlines the importance of calculating not only the margins and costs of the crop, but of the entire rotation as the results of each crop balances out on the whole.

2.2 Multi-criteria assessment of rotations: technical, agronomic, economic and environmental strengths and limitations

A multi-criteria assessment through the aggregation of indicators was conducted in addition to the analysis of test cases. The MASC model was adapted to the organic arable cropping systems, and more specifically an agronomic decision tree was developed, which led to the elaboration of the MASC-OF model (Carof *et al*, 2012). MASC-OF was applied to 8 test cases/11 types of rotations from the RotAB project as well as 44 cropping systems from the Midi-Pyrenees, a cereal-producing region in the southwest of France (CitodAB project). The multi-criteria assessment conducted in this manner highlighted well the strengths and weaknesses of the systems examined (Colomb *et al*, 2012). Economic sustainability is the least well-maintained dimension over time as it is sensitive to climatic hazards (irrigators limit this factor) and it is dependent on changes in market prices. The social acceptability scores are very good. Maintaining the productive potential is variable based on the system: if overall control of pests and diseases is not a major problem, weed control appears more efficient in systems with alfalfa. Maintaining soil fertility appears highly variable and related to the presence of alfalfa, green manure or the level of efficiency of organic nitrogen inputs (therefore linked to climatic and soil conditions). In the Midi-Pyrenees region fertility management appears problematic because of the high proportion of rotations with a negative phosphorus balance. Finally, the preservation of the environment is the best-assured dimension of sustainability. However, some reservations must be noted on some relatively intensive rotations, consuming high levels of energy and water.

3. Networking between 5 long-term experimental sites in organic stockless systems

In methodological terms, networking between experimental sites helped to build a common toolkit to monitor soil fertility, a key issue for stockless farming systems. In addition, the collective approach (researchers in charge of the experiments, technical advisors and neighbouring organic famers associated to the process) applied to the questions raised on each site allowed to make progress on the design of the systems studied.

In terms of results, the networking aimed at sharing the references acquired on the evolution of soil fertility. The balance of nutrients (phosphorus, potassium and magnesium) was calculated and compared with the evolution of the levels observed in the soil. Levels of organic matter were also monitored. The most striking result was obtained for phosphorus for which the balance sheets plunge drastically: a relative decrease of 10% in content can be achieved by year of cultivation, the lowest levels (15 ppm of P Olsen) reaching levels generally considered critical in conventional agriculture. In other words, coming second after nitrogen, phosphorus can become a major limiting factor of performance in stockless arable cropping systems.

Discussion

Crop rotations depend on many factors

It has become clear that the two major agronomic concerns of producers are the nitrogen supply of plants and weed control that partially determines the choice of crop rotation. Management of nitrogen supply is carried out in part through the introduction of sufficient proportions of leguminous in the rotation (30% to 55% which is far superior to conventional systems). Weed control generally involves lengthening the rotation with a leguminous fodder plant for 2 to 3 years in the rotation or, if the weather permits (and/ or if irrigation is available), by planting hoed summer crops.

In economic terms the profitability of production systems studied appears ensured. However, it is dependent on the selling price to which the current context is rather favourable. The production context has a stronger influence on the profitability observed than the type of rotation. Indeed, on one hand, the pedoclimatic context determines the cultivable species, yield potential and opportunities for mechanical weed control. On the other hand, the presence of local markets strongly influences the choice of crops, by either allowing or not allowing cost recovery. The choice of crops is also influenced by social factors, especially the availability of labour that can be limiting especially during peak seasons.

From an environmental perspective overall a good contribution to the preservation of the environment can be observed. It is important to monitor levels of energy consumption, which vary according to the type of systems. Regardless of the indicators (biodiversity, energy, water...) methodological improvements are expected to better assess and discriminate systems.

Finally, it appears that the sustainability of agricultural systems is a central goal in OA, in particular concerning weed management and the maintenance of soil fertility. The introduction of forage legumes such as alfalfa provides an interesting response whenever it is possible. If the question of nitrogen supply is central to specialized organic arable crops, the study of the evolution of fertility on experimental sites of the RotAB network confirmed by the multi-criteria analysis of farms in the Midi-Pyrenees (CitodAB project) questions the availability of phosphorus in the medium and long term. The strong use of alfalfa also raises questions about the evolution of the soil's potassium content given the strong loss in this nutrient associated with this crop (dehydrated alfalfa or alfalfa hay).

Conclusion

The different approaches of knowledge, characterization and evaluation of arable cropping systems practiced in OA developed in the RotAB project are converging on the findings. The choice of the crop rotation has a strong impact on agronomic issues (especially nitrogen supply and weed control) and economic results. The role of leguminous plants in the crop rotation appears to be very important. Still, more studies should be implemented to assess their precise impact (agronomic, economic and environmental impact), and take into account disease risk that may rise.

Following this project the RotAB network has grown and continues its work: the number of sites increased from 5 to 12; the main themes currently explored are weeds and the problem of phosphorus (role of mycorrhizae) also associated with the multi-criteria assessment of the economic and environmental sustainability (particularly in terms of energy consumption) of these innovative cropping systems.

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References

Carof M., Colomb B., Aveline A., 2012. A guide for choosing the most appropriate method for multi-criteria assessment of agricultural systems according to decision-makers' expectations. Agr Syst. doi: 10.1016/j.agsy.2012.09.011

Colomb B., Aveline A., Carof M, Bergez J.E., 2012. Stockless organic farming: strengths and weaknesses evidenced by a multicriteria sustainability assessment model. Agron. Sustain. Dev. (2013) 33:593–608.
The final publication is available at link.springer.com

Colomb B., Aveline A., Carof M, 2011. Une évaluation multicritère de la durabilité de systèmes de grandes cultures biologiques. Quels enseignements? Restitution des programmes RotAB et CitodAB, INRA, 42 p. + annexes. Publication is available at http://www.itab.asso.fr/programmes/rotation.php

Fontaine L., Gerber M., Maurice R., Glachant C., Gouraud J.P., Morand P., Perret C., 2011. Les grandes cultures biologiques en France: état des lieux des rotations pratiquées en France. Restitution du projet RotAB, ITAB, 54 p. Publication is available at http://www.itab.asso.fr/programmes/rotation.php

Fontaine L., Garnier J.F., Bonte J.B., Aubert C., Fourrié L., Colomb B., Glachant C., Maurice R., Gouraud J.P., Morand P., Perret C., 2011. Rotations en grandes cultures biologiques sans élevage, 8 ferme-types, 11 rotations. Repères agronomiques, économiques, techniques et environnementaux. Restitution du projet RotAB, ITAB, 132 p. + annexes.
Publication is available at http://www.itab.asso.fr/programmes/rotation.php

Mangin M., Fourrié L., Bouttet D., Chareyron B., Garnier J.F., Quirin T., Prieur L., Fontaine L., 2011. Réseau expérimental RotAB : évolution de la fertilité des sols dans les systèmes de grandes cultures biologiques sans élevage. Restitution du projet RotAB, ITAB, 39 p.
Publication is available at http://www.itab.asso.fr/programmes/rotation.php

Can water quality problems motivate conventional farmers to convert to organic farming?

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Key words: water quality, environment, conversion, organic farmer, motivation

Abstract

Recently, the conservation of water resources has become a major issue in many countries because of the increasing problems of water pollutions by agriculture. In this context, organic farming (OF) is seen as a promising solution to this problem because of its regulation that prohibits the use of chemical fertilisers and pesticides. Our hypothesis is that water quality problems can be a motivation for conventional farmers to convert to OF. This research is based on 65 farmers' interviews (mainly conventional farmers). A qualitative analysis of the interviews was carried out. Six different farmer profiles have been identified depending on farmer's perception of the water question and on their declared willingness to convert to OF. Our results show that the existence of a local problem of water quality can lead farmers to convert to OF. Actions set to develop OF to respond the water quality problem can reach farmers who were not part of the classical pool of "potential converters".

Introduction

In Europe, problems of water pollutions by fertilizers and pesticides used in agriculture are increasing. Developing OF close to polluted water catchments is thus seen by some institutions as a potential solution. But this approach requires a substantial development of OF in these areas.
The literature on conversion to OF has mainly focused on farmers' motivations to convert (Lamine and Bellon 2009). It led to the identification of 2 types of organic farmers: the markets-oriented ones, who converted for economic reasons, and the values-orientated ones, who quote food and health issues as being their main motivations. Environmental concerns seem to have a relatively moderate impact on the farmers' decision to convert (Best 2009). Our hypothesis is that local problems of a water quality can nevertheless motivate conversions to OF. The following questions are addressed in this paper: how do farmers perceive the water quality problems? Would they be willing to convert to OF to solve them?

Material and methods

In France, recent policies have focussed on promoting OF development in areas facing water pollution problems, especially in cases of pesticides contaminations. This promotion of OF is targeted at the scale of water catchment areas. A water catchment area is defined as the area on which a drop of water falling on the ground will find its way to the catchment. Improve the water quality of a catchment implies a substantial change of farming practices in the whole catchment area. The promotion of OF at the scale of catchment area is a new challenge as it requires to target conventional farmers, whose farms are located in certain areas but who are not thinking of converting to OF.

This research was carried out in 4 different water catchment areas in France. Two are located in Rhône-Alpes and two in Burgundy. The catchment areas cover in most cases some hundreds or thousands of hectares. The 4 water catchments encounter agricultural pollution problems and have been listed as priority catchments. For priority catchments, the water catchment managers have to set up action plans to improve water quality. In the first catchment area, the water management is promoting since 2007 the development of OF to protect water quality. In the second and third catchment areas, the action plans to protect water quality have been set during our study. OF was mentioned as one possible action along with others such as reducing pesticides and fertilisers use etc. On the fourth catchment, no action plan has been set up yet.

The research is based on farmers' interviews. Farmers selected for the interviews had to have fields in the water catchment areas. 65 farmers have been interviewed in 2011 and 2012 but the local dynamics were followed on the 4 catchment areas from 2010 to 2013. 60 of the interviewed farmers were doing conventional farming and 5 of them had recently engaged a conversion to OF. The interviews were semi-structured and organized in 4 different parts. The first part aimed at understanding the farm and the farmer histories (farmer

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trajectory, farming system, selling system etc). The second part was dedicated to identifying the socio-technical and professional networks in which the farmer is integrated. The third part was about farmers' perception of the water question. Finally the last part of the interview was about farmers' attitude towards OF and towards a potential conversion to OF. The qualitative analysis of the interviews was carried out. For the analysis, we highlighted the different conceptions that farmers have of their occupation and their vision of professional excellence (Lémery 2003). This approach to the farmers' vision of their occupation helps us to identify different forms of agriculture considered by them as "suitable" and which constitute the frame in which they finally consider the opportunity to engage this or that change in their activity.

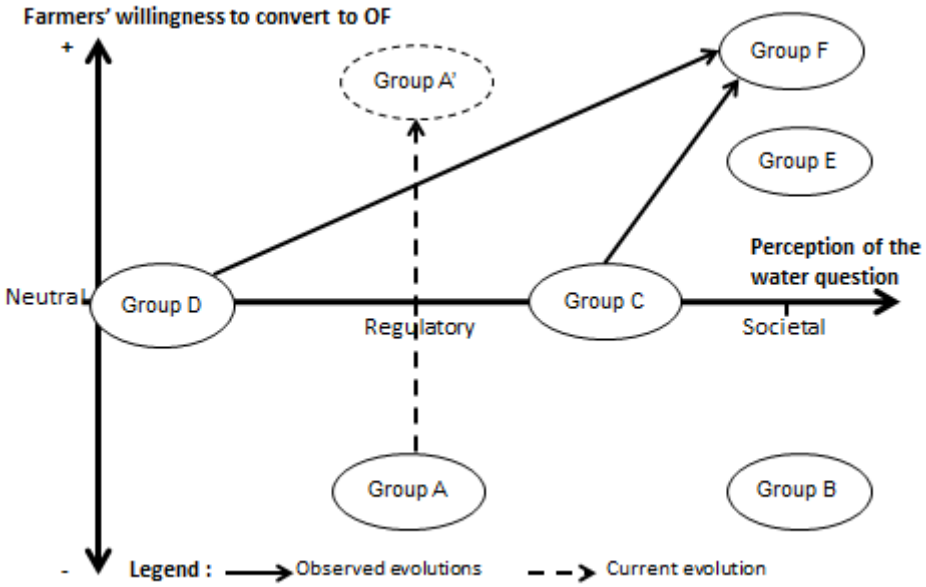
Results

A diversity of farmers' profiles

Six different farmer profiles have been identified based on the interviews' analysis (Figure 1). These profiles have been classified depending on two criteria:

- Farmer's perception of the water question. Three types of perception were identified. The "regulatory vision" is used for farmers who consider that the respect of the general regulations is sufficient to ensure a good quality of the environment and to prove that they are environmentally responsible. The "societal vision" correspond to the vision of farmers who underline that environmental issues are emerging concerns of citizens and that they will increasingly have to take them into account in the future. Finally, some farmers had a "neutral" perception when they did not express any clear opinion about the water problems.
- Farmers' declared willingness to convert to OF. The farmers were classified depending on whether they declared to be willing to convert to OF or not.

Figure 1: Farmers' typology depending on their vision of the water question and their declared willingness to convert to OF



Group A: Farmers having a regulatory vision of the water problems and opposed to converting to OF
Farmers of group A (31% of the interviewees) do not feel responsible for the water quality problems. They consider their current farming practices as non-polluting because they only use authorised products and respect the recommendations for use. They consider that pollution problems are due to old excessive practices. Regarding a potential conversion to OF, they say that OF is too risky or simply say that they do not want to change their farm system. They also put forward that OF does not correspond to the image they have of farming and of what being a good farmer means.

Group B: Farmers with a societal vision of the water problem but who do not consider a conversion to OF
Farmers of group B (11% of the interviewees) consider that the evolution of agriculture over the past decades has caused a number of environmental problems, including water pollution. They have a societal

vision of the water question and express the need for the agricultural sector to take actions to tackle these environmental problems. However these farmers are not planning to convert to OF. They exclude this option because they consider themselves as being too old to carry such a deep change on their farm (they are older than 50 and do not know yet whether they will a successor on the farm). Only clearer perspectives for the future could lead them to giving a different orientation to their farm.

Group C: Farmers having no clear position
Farmers of group C (23% of the interviewees) acknowledge the emergence of environmental problems. They are paying good attention to the increasing environmental concerns amongst citizens. They consider that they will have to take them into account in the future and to adapt their farming practices. Nevertheless, the question of a potential conversion to OF is not on the agenda for the moment. They still have fears related to technical aspects of OF. But they mainly insist on the consequences that a conversion would have on the work load and work organisation on the farm. Finally, they underline that being an organic farmer would be a new and different occupation and that they are not ready for it yet.

Group D: Farmers lost because of the diversity of challenges to face
Farmers of group D (11% of the interviewees) appear to be disoriented because of all the issues they have to take into account as farm managers: environment, profitability of their business etc. They have not really thought of the impact of their practices on water quality. They remain open to improving their practices, potentially even to a conversion to OF. But they are waiting for technical solutions and precise indications on how to proceed. They will not take the initiative of changing their current farming practices if they are not accompanied to do so.

Group E: Farmers having a societal vision of the water problem and thinking of converting to OF
Farmers of group E (17% of the interviewees) are well aware of the environmental issues, including water quality problems. They are in the process of questioning the sustainability of their current farming system. They have already taken the initiative of experimenting organic farming practices in some of their field. They are for example using no pesticides in some field. They are thinking of converting to OF. They are not satisfied with their current farming system, which is not fully in line with their representation of sustainable farming systems. In that sense, they perceive OF has being more in line with their values. However, they still express some fears related to financial consequences of the conversion.

Group F: Farmers who have engaged a conversion to OF to respond to local water problems
Farmers of group F (8% of the interviewees) became aware of the local water problems after actions have been carried out locally to alert farmers and present them the potentiality offered by OF. They have now started a partial or total conversion of their farm to OF. These farmers had never considered converting to OF before the actions started locally. They see OF as being a new personal challenge. But they also consider their conversion to OF as being their contribution to solving a local problem affecting more generally their fellow-citizens.

Water pollution problems as a "trigger event" to convert to OF

This typology shows that the existence of a local problem of water quality can lead farmers to convert to organic farming even if they had not yet considered this option before. This water quality problem can then be considered as a "trigger event" that will influence the farm trajectory (Sutherland et al. 2012). Sutherland *et al.* define "trigger event" as being the event that make the farmer realise that "system change is necessary to meet farm management objective, and/or exploit new opportunities". That is precisely what is expressed by farmers of group F who decided to turn the local conditions and their associated potential constraints into an opportunity for adapting or re-designing their farming system.

However, this result has to be put into perspective. Indeed all the farmers constituting group F have been met on the same catchment area, which is the one where actions are carried out locally since 2007 to inform farmers about the water quality problems and about the potential offered by organic farming. Conversion to OF requires for most farmer deep changes in their farming practices and in the organisation of their farming system. Such deep changes are slow to put in place. It is therefore necessary to carry out actions for several years to generate local dynamics of conversion to OF. Furthermore, in this water catchment area, the water manager has set up a large set of actions to support the development of OF: information meeting with farmers, financial support through agri-environmental schemes, involvement of the local agricultural cooperatives able to collect organic products in the areas etc. It is therefore the existence of a local dynamics involving different stakeholders that has encourage farmers to convert.

Surprisingly, farmers of group F are not originating from group E (the one of farmers who were already considering converting to OF, which can therefore be considered as the classical pool of "potential converters"). They originate from groups C and D (Figure 1). This means that actions implemented to solve a local problem of water quality by developing OF can reach farmers who were at first not interested by OF. Moreover, if farmers of group A may appear as being reluctant to changing, it appears that some of them are currently engaged in a conversion process on the catchment area where actions for the development of OF are implemented (as represented by Group A' on figure 1). Farmers of group A' keep a regulatory vision of the water question. Indeed, they consider their conversion to OF as an answer to the "pressure" existing locally and pushing them to do so. It is also a way to take advantage of the incentives offered locally to put their farming system in line with local environmental issues voluntarily. The representation they have of their occupation and of OF is nevertheless changing. This is in line with the findings of Barnes *et al.* (2011) who showed that farmers who at first show resistance to compulsory actions for water preservation can actually be quite engaged in the adoption of voluntary measures.

Discussion

The results presented in this paper show that the perception conventional farmers have of OF is changing. More and more farmers declare that they could consider engaging in a conversion to OF in the future. Furthermore, actions set to promote OF as a response to local water quality problem can reach farmers who were not part of the classical pool of "potential converters", that is who were at first not thinking of converting to OF. Indeed some conventional farmers having fields in water catchment areas have engaged in a conversion after actions have been set locally to promote OF. Water quality problems can in this sense be considered as a trigger event that can bring farmers to reconsider their representation of their occupation and to convert to OF. However, such local conversion dynamics are slow to put in place. It is therefore necessary to set up different types of actions towards farmers. Such actions have to be carried out at local level and for several years to be fruitful.

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References

Barnes A P, Willock J, Toma L & Hall C (2011): Utilising a farmer typology to understand farmer behaviour towards water quality management: Nitrate Vulnerable Zones in Scotland. Journal of Environmental Planning and Management 54(4), 477-94.

Best H (2009): Organic Farming as a rational choice. Empirical investigations in environmental decision making. Rationality and Society 21(2), 197-224.

Lamine C & Bellon S (2009). "Conversion to organic farming: a multidimensional research object at the crossroads of agricultural and social sciences. A review." *Agronomy for Sustainable Development* 29(1):97-112.

Lémery B (2003): Les agriculteurs dans la fabrique d'une nouvelle agriculture. Sociologie du Travail 45(1):9-25.

Sutherland L-A, Burton R J F, Ingram J, Blackstock K, Slee B & Gotts N (2012): Triggering change: Towards a conceptualisation of major change processes in farm decision-making. Journal of Environmental Management 104, 142-51.

Ex-post evaluation of GHG emissions and energy consumption in organic and conventional meat SHEEP farms in France over 26 years

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Key words: sheep, farming system, GHG, energy, organic

Abstract

This study aims at comparing GHG emissions and non-renewable energy use in meat sheep production, in organic farming (OF) and conventional farming systems. These two criteria have been calculated ex-post on 1261 French year-farms monitored over 26 years. The functional unit used is the carcass weight. Regarding GHG emissions, the results show that OF emit 5 % less GHG than conventional ones, with a higher proportion of methane and less indirect CO_2 associated to less inputs use. Given the methodological difficulties, it is hard to argue if carbon sequestration in soil is different between OF and conventional. For non-renewable energy, there is no significant difference between OF and conventional farms, due to compensations (more mechanization and less concentrates and fertilizer purchased in OF). Note the great variability in the results, both in OF and conventional farms. The two main explanatory factors are ewe productivity (for GHG) and forage self-sufficiency (energy consumption).

Introduction

Livestock farming environmental impact, particularly in terms of global warming has been considered as a major issue among many international institutions. Besides, depletion of non-renewable resources, including energy, requires accounting for the non-renewable energy consumption in farms evaluation criteria. However, these issues also matter in organic farming, which of course has a very positive impact on the environment due to the non-use of pesticides and fertilizers, but it is not possible to answer a priori positively or negatively to this assertion. In fact GHG emissions and energy consumption depend on both structural and technical factors, and the level of use of different inputs. Based on a network of French meat sheep farms monitored on the long run, we compare the performance of organic vs. conventional farms in terms of GHG emissions and energy consumption. Moreover, the analysis also addresses the question of the identification of specific factors that have large influences and could be used to improve these balances.

Material and methods

This work is based on a sample of 1261 farms-years surveyed from 1987 to 2012 in the center of France. It is a non-constant sample due to some entrances and exits of farms each year but it is kept stable as much as possible from year to year. The farms are located in mountain and piedmont areas (North Massif Central) with the use of hardy breeds, and in lowland low agronomic potential areas (North and North West of the Massif Central), with grassland breeds. Of these farms-years, 88 are involved in organic farming production but there number is largely concentrate in the second part of the period (from 1999). These farms were firstly investigated in order to identify factors explaining their economic performances. Many variables, about farms structure, production types and field patterns (grasslands, crops), mechanization and buildings characteristics, and other farms inputs (concentrates, fertilizers, and so forth), were recorded during the surveys. Yet, these investigations were not initially intended for environmental impacts' appraisal and thereby an intense methodological work was needed to overcome some missing information. Recently, two years of finer surveys (2011 and 2012) were used to build some relationships between economic data and missing quantitative information for the environmental impact assessment. For example, regression technics were used to fit an expressive relation between monetary values and environmental variables (GHG emissions and energy consumption) for the case of farm machinery, buildings and pesticides use. The estimated equations were then use for the previous years after adjusting for prices changes on the basis of an appropriate statistical series.

The balance of GHG emissions and non-renewable energy consumption has been made according to the Life Cycle Assessment (LCA) methodology. For the evaluation, we took advantage of the Dia'Terre tool developed by ADEME (French Environment and Energy Management Agency) and which in turn is largely based on GES'TIM (from French Livestock Institute). Dia'Terre is the result of a national consensus (France) aiming to conduct large-scale surveys of the entire French agriculture. In the GHG calculation, carbon

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sequestration was also accounted for, following the work of Arrouays et al. (2002). The Functional Unit (FU) is defined as the kilogram of carcass weight. Some allocation issues were also raised during the computations between meat and wool. Finally we made a mass allocation between these two products, for energy and GHG.

Results

The average total emission level of all farms is 37.2 kg of CO_2eq/kg carcass. After a mass allocation between meat and wool this level falls at 32.7 kg of CO_2eq/kg carcass because wool weighs approximately a little more than 12.1 % of the total mass of the unit's products. The average level of carbon sequestration in soils (difference between the storage of grasslands and the destocking related to the tillage of crops or grasslands areas) is around 4 kg of CO_2eq/kg carcass i.e., 12 % of the gross emissions. Methane (CH_4) is by far the most significant gas and represents about 61 % of the total emissions. It is followed by carbon dioxide (CO_2) and nitrous oxide (N_2O) which, respectively account for 21 % and 18 %. Enteric fermentation is the major source of methane emissions (78 %). CO_2 emissions derived mainly from animal feedstuffs purchase (35 %), fertilizers (20 %) and fuels (19 %). The N_2O emissions are firstly due to manure management in housing and pastures (58 %), then runoff and leaching (24 %), and the use of mineral nitrogen fertilizers (17 %). Gross emissions are lower on average by 5 % in organic farms. This difference is rather small but it is statistically significant (Wilcoxon non parametric test). In fact, the share of CH_4 is slightly higher for organic farms (68 % vs. 60 % in conventional farms) while the proportions of CO_2 and N_20 are smaller, in line with the lower level of inputs use.
About energy consumption, it is on average around 79.8 MJ/kg carcass. In proportion three inputs are comparable: fertilizers (25 %), animal feedstuffs (24 %) and, fuels and lubricants (23 %). Farm machinery accounts for about 8 %, electricity 4 % and buildings 3 %. There is no significant difference for the total amount of energy consumption between the two production systems (organic and conventional). In fact the lower level of some inputs like fertilizers (13 % against 26 % in conventional) and feeds (21 % vs. 24 %) in organic farming is compensated by a higher consumption of fuels (29 % vs. 22 %) and machinery (12 % against 8 %).

Discussion

A few studies using the LCA methodology have assessed the environmental impact in meat sheep farms (Table 1). Gross GHG emissions are low when ewe productivity is rather high and farming system based on grass, as in New Zealand. On the other side, emissions are higher when lamb weight is very low (Spain). However, the comparison might be biased because of the differences in the methodology adopted by authors, system boundaries, emission factors, functional unit and allocation issues. It also appears that other papers don't include organic farming systems in their analysis. A sensitivity analysis made on our sample of farms shows that the first factor explaining the GHG emissions is the ewe productivity (number of weaned lamb produced per ewe and per year). But the relationship is not linear: there is a threshold of 1.35 beyond which the gain in GHG reduction marginally decreases given the high level of inputs necessary to ensure high ewe productivity. Farms involved in organic farming have an average ewe productivity of 1.28 against 1.36 in conventional farms. Actually, high productive systems (three lambings in two years) are not affordable in organic systems (Benoit et al., 2009).The high importance of ewe productivity for low GHG emissions per kg carcass is directly related to the high contribution of enteric CH_4 in the total emissions. In fact, in this work the enteric methane was based on IPCC Tiers 2 method with a level of 11 Kg CH_4 per ewe and per year (Vermorel et al., 2008). This standard level was used as we were unable to rebuild all animal rations for each season and physiological stage of animals. Moreover, the quality of stored and grazed forages is not. However, for lambs we took into account their average duration of fattening and the average amount of concentrates used.

Table 1: Gross GHG emissions in some countries. GHG emissions per kg carcass or body weight is sometimes approximated with average 0.45 of carcass yield (Cf approx.).

Studies	Country	Per body weight	Per carcass weight
Dakpo et al., current study	France	14.7 (approx.)	32.7
Edwards-Jones et al. (2009)	Wales	12.9	28.7 (approx.)
Casey and Holden (2005)	Ireland	10.0	22.2 (approx.)
Williams et al. (2008)	UK	14.1	31.3 (approx.)
Ledgard (2010)	New Zealand	8.6	19.1 (approx.)
Ripoll-Bosch et al. (2013)	Spain	19.5 to 25.9	39.0 to 51.7

In terms of carbon sequestration, against all odds, conventional farms apparently sink more (by 25 %). This can be explained by the search of food self-sufficiency in organic farms (84.2 % vs. 83.1 % in conventional) which leads to the implementation of more crops areas, and therefore more plowed surfaces. We can consider there is a methodological problem because conventional farms use more purchased concentrates, grown in other farms. Assuming on one hand that the external crop surfaces for these concentrates destock one ton of CO_2eq per hectare and per year, and in the other hand that destocking is not possible beyond some threshold (for instance like in crops systems, destocking is note possible on the very long term), then the two type of systems show similar carbon sequestration's rate. One more point is that when applying the coefficient suggested by the JRC (Leip et al., 2010), the results are completely different. All this is showing that the issue of carbon sequestration issue is very sensitive.

We know that organic standards and principles lead organic farms to use less inputs especially fertilizers and concentrates feeds. But these gains (in terms of energy) are systematically cancelled due firstly to their lower ewe productivity and secondly to the higher levels of fuel consumption and machinery use per unit produced. In fact, the seeking of feed self-sufficiency lead these farms in the production of more on-farm concentrates which requires more fuels consumption and certainly more investment in farm equipment per unit produced.

Conclusion

As a conclusion, we found little difference in GHG emissions and energy consumption between organic and conventional production. However, there is a high variability within and between each farming system. The analysis also pointed out two major factors explaining the levels of environmental impact: animal productivity and fodder and feed self-sufficiency. It has already been proven that these factors are also determinants in the economic performance (Benoit and Laignel, 2011). Besides, it is important to remember that these LCA methodologies are complex (equations, adapted standards) and significant methodological developments are expected (especially for carbon sequestration). It is also important to keep in mind that ruminants have the unique ability to produce high-quality protein from fodder. And enteric CH_4 as a crucial determinant of this environmental assessment is intrinsically linked to this ruminants' ability. In addition, it appears that sheep farming activities help in maintaining harsh natural habitats and this environmental service should also be accounted for. Finally, in this comparison, we have not addressed all the environmental impacts and especially the major advantage of organic farms in pesticides use.

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References

Arrouays, D., Balesdent, J., Germon, J., Jayet, P., Soussana, J., Stengel, P., Bureau, D., 2002. Contribution à la lutte contre l'effet de serre (stocker du carbone dans les sols agricoles de France?). INRA.
Benoit, M., Laignel, G., 2011. Analyse sur le long terme de systèmes d'élevage ovins allaitants en France. Quelles trajectoires et quels facteurs de réussite économique? Productions Animales 24, 211.
Benoit, M., Tournadre, H., Dulphy, J., Laignel, G., Prache, S., Cabaret, J., 2009. Is intensification of reproduction rhythm sustainable in an organic sheep production system? A 4-year interdisciplinary study. Animal 3, 753-763.
Casey, J., Holden, N., 2005. Analysis of greenhouse gas emissions from the average Irish milk production system. Agricultural systems 86, 97-114.

Edwards-Jones, G., Plassmann, K., Harris, I., 2009. Carbon footprinting of lamb and beef production systems: insights from an empirical analysis of farms in Wales, UK. The Journal of Agricultural Science 147, 707.
Ledgard, S.F., 2010. A greenhouse gas footprint study for exported New Zealand lamb. Ministry of Agriculture and Forestry.
Leip, A., Weiss, F., Wassenaar, T., Perez, I., Fellmann, T., Loudjani, P., Tubiello, F., Grandgirard, D., Monni, S., Biala, K., 2010. Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS)–final report.
Ripoll-Bosch, R., de Boer, I., Bernués, A., Vellinga, T., 2013. Accounting for multi-functionality of sheep farming in the carbon footprint of lamb: A comparison of three contrasting Mediterranean systems. Agricultural Systems.
Vermorel, M., Jouany, J., Eugène, M., Sauvant, D., Noblet, J., Dourmad, J., 2008. Evaluation quantitative des émissions de méthane entérique par les animaux d'élevage en 2007 en France. INRA Prod. Anim 21, 403-418.
Williams, A.G., Audsley, E., Sandars, D.L., 2008. Environmental burdens of livestock production systems derived from life cycle assessment (LCA).

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