Bericht

Brief Report from the I.U.F.R.O. Joint Meeting of Working Parties on Genetics (Bordeaux, June 14-18, 1976)

The first proposal for a meeting devoted to advanced generation breeding was made by C. J. A. SHELBOURNE during the previous IUFRO Joint meeting of working parties of the genetics subject group (Stockholm 1974). There, all attendants agreed with the need to think deeply about concepts and methods concerning multiple generation strategy for domestication and breeding of forest trees. A new type of organization was tested, with only 8 invited papers all focused on the single general theme of advanced generation breeding and with most of the time spent in deep discussions.

This last I.U.F.R.O. Joint meeting was held in Bordeaux from June 14 to June 18, 1976, i.e. the week before the general IUFRO Congress in Oslo.

Four working parties were involved: population genetics, breeding theory, progeny testing and biochemical genetics. About 60 scientists from 15 countries attended the meeting. Besides an introduction and a final synthesis by W. J. LIBBY, the program included six half day sessions as follows:

Session 1: *Mating design* — (Chairman J. P. VAN BUIJTENEN
Session 2: *Methods of selection* (Chairman R. STONECYPHER)
Session 3: *Inbreeding and coancestry* (Chairman D. LINDGREN)
Session 4: *Genotype x environment interaction* (Chairman C. J. A. SHELBOURNE)
Session 5: *Juvenile-mature relationships* (Chairman A. NANSON)
Session 6: *Biochemical genetics and selection* (Chairman H.-J. MUHS)
subdivided in two sub-topics:
Terpenes (E. VON RUDLOFF)
and *Isozymes* (D. RUDIN)

Each session paper were prepared by the chairman and the co-chairman and in most cases they were sent to the attendants a month before the meeting.

One and a half days of field excursion permitted discussions on the maritime pine breeding program including progeny testing and selection in a large scale seedling seed orchard.

13 voluntary papers were distributed and in some cases used for group discussions but were not presented.

Before reporting on the scientific results of the meeting, it is interesting to briefly return to its working scheme. At the beginning of each session the review paper was presented in half an hour by the chairman and used as a frame for discussions which were held separately in four prestructured small groups (about 15 persons of mixed competence in each), fore one and a half hours in two periods.

Each group chose a permanent leader to act as a facilitator for the discussions and also a new reporter for each session to present the group conclusions to the whole meeting. At the end, the four groups came together for an hour: reporting by groups, discussing the questionable points of some reports and finally listening to the chairman's final conclusions. Such a new kind of organization allowed the maximum participation of everyone.

Small groups proved highly successful for lively discussions but were better in this instance for efficiently circulating information and ideas than for really developing concepts because of the mixed nature of the groups we had intentionaly choosen. Some key points were namely progressively clarified and became widely known, meeting after meeting : separation between production population and breeding population (often put forward by G. NAMKOONG) pedigree control and mating system minimizing inbreeding during several generations or alternatively mating between non related sublines coming from dividing the breeding population, environmental stratification response regarding stability, theoretical superiority and practical feasibility of multitrait and combined selection at more or less early stages, general interest of biochemical indicators, (population structure and identification, inbreeding control and heterosis prediction, mating system . . .). The heritability concept is being progressively replaced by the more general and better adapted one of genetic correlation. In this field the concept of "coefficient of genetic prediction" closed to that of generalized heritability seems to be promising for forest tree selection.

The meeting was closed by IUFRO business discussion on two main points: proposals for the next meetings and restructuring of the genetics subject group. Two possible meetings were suggested: *Population structures* to be held in tandem with the Provenance working parties in September 1978 in Vancouver, B. C. *Breeding strategies,* in 1981 in Göttingen.

It was proposed to join two working parties, Breeding theory (S2.04.02) and Progeny testing (S2.04.03) to form a single group on "Breeding theory and Practice". This proposal was in the end not adopted by the executive board of IUFRO.

The abstracts of the seven introductory papers and the general conclusions of the meeting are reported here and the whole proceedings are now available[1]).

Abstracts from Indroductory Papers

1-*Mating Designs* (J. P. VAN BUIJTENEN)

Mating designs provide a system to produce advanced generation populations and therefore the value of a particular design depends on the purpose of the population being produced.

For the purpose of roguing a seed orchard on the basis of progeny test information, factorial and diallel designs are more effective than nested designs. The polycross is most efficient.

For the purpose of producing a breeding population, partial and disconnected diallels have many advantages. Some forms of polycrosses also appear to have a good deal of merit. So many possibilities exist that there are many excellent alternatives.

For the purpose of providing estimates of genetic variances, diallel and factorial designs appear to be superior to nested designs.

Inbreeding needs to be avoided in commercially produced seed, but can be tolerated or even be desirable in a breeding population. Certain mating designs, such as circular matings result in earlier but more gradual inbreeding. Other systems such as the nested polycross can be designed to confine the inbreeding to the breeding population, and produce the commercial seed through outcrossing.

2-*Methods of Selection* (R. STONECYPHER, M. ARBEZ).

The accurate predicition of the value of individuals to be used as parents for the next (panmictic) generation in a recurrent selection program is to major importance. The assessment of breeding value, furthermore, must consider special constraints resulting from multiple-trait early selection and a limited set of genetic test environments.

At first, the classical developments of selection methods are considered. General superiority of combined and multiple-trait index selection is theoretically clear. However, special situations may justify the use of independent culling levels if the consequences of unfavorable genetic correlations between traits are known and taken into account.

The practical application of the selection methods are subsequently disscussed with due consideration given to the somewhat unique characteristics with which the tree breeder must deal. Such factors as possible genetic instability over time (affecting family and individual performances) need to be investigated on several fronts: 1) physiological factors and mechanisms, 2) biometric development of individual growth curves over time, and 3) computational procedures to include juvenile-mature genetic covariances in combined multiple-trait indexes and to predict genetic gain at mature ages.

For the time being, more caution seems required with the application of the classical heritability concept to predict future genetic gains: mainly when the values are only coming from the intraclass correlation coefficient of young sibs.

Environmental designs and their effect on selection methods are considered as well as the possible use of cloning as a tool in selection. Preliminary choise of elementary selected traits as good predictors of mature genetic and economic total value, as well as the practical use of combined multiple-trait selection index and prediction of genetic gains, are discussed.

Although stressing the importance of selection for breeding value, the paper does not ignore the possible use of non-additive genetic variance in achieving greater genetic gains (use of specific mating and/or multiple clone varieties). In this field, more experimental data and researches on the effect of such exploitation on integrated long term genetic strategies are highly desirable.

3-*Inbreeding and Coancestry* (D. Lindgren, H.R. Gregorius)

The possibilities of drawing conclusions based on experimental information concerning yield losses following mild inbreeding are critically discussed. It is suggested that more attention should be focused on experiments with full sib mating. Different population types are discussed concerning significance of inbreeding and coancestry. Inbreeding in the breeding population is impossible to avoid after a few generations and to try to avoid it may mean increased inbreeding in the production population. Therefore forest tree breeders ought to adopt a philosophy of allowing inbreeding in the advanced breeding populations. Inbreeding may also be used as a tool in breeding work. It increases genetic variance and makes it possible to keep a higher number of unrelated individuals in the breeding population. The effective size of the breeding population is also discussed. It is suggested that little attention should be focused on the possibility of losing rare genes, when discussing the effective size of the breeding population, as the effects at the population level may be more limiting. As effective population size decreases under mass selection, this is a good argument for considering pedigrees in selection work. The seed yield following mating of relatives is evaluted based on the assumption of independently acting and segregating recessive embryonic lethals.

4-*Genotype x Environment Interaction* (C.J.A. Shelbourne, R. Campbell)

Genotype-environment interactions affect tree improvement strategy in two main ways; environments must be grouped into breeding or plantation zones within which there are minimal interactions both of provenance and individual genotype with sites; secondly well adapted populations and genotypes must be selected for high and also stable performance. At the provenance level the variation between provenances usually shows some coherent pattern based on latitudinal and altitudinal clines which can form the basis of provenance transfer models. Interactions at the genotype level are likely to be much less predictable and an empirical statistical approach is necessary to elucidate them. Characterising environments for their interactive behaviour with populations (or genotypes) is likely to be a more useful strategy for tree improvement than the reverse as this will facilitate the grouping of environments into zones and identify sites which give best resolution of genetic differences.

5-*Juvenile Mature Relationships*

51-*Juvenile Mature Relationships mainly in Provenance and Progeny Tests* (A. Nanson)

An attempt at synthesis is made of the problems of testing and early selection chiefly in provenance and progeny tests and some important problems are discussed. To what extent early selection is efficient at the utilization stage and when it must be performed are considered as the basic problems.

An outline of the breeding theory is given covering the situation where the material used as well as tested is identical. Assumptions involve only a realistic part of those of classical quantitative genetics. Further experimental investigations are however desirable for some of them and for other points such as: juvenile-mature environmental correlations, value of parameters from old experiments, type of elements, competition, etc . . .

In forest tree breeding, the correlation concept should advantageously replace that of heritability because of its greater generality. The theoretical background is considered sufficiently clear but it is experimental data that are lacking. Through experimental values of correlations from old experiments (often of provenances) are generally very encouraging regarding growth and wood quality, much more data are needed especially from progeny tests, and with other traits; old experiments should be better investigated in this respect. The particular problem of early selection in relation to the problem of delays.

For any breeding programme the determination by use of experimental data of the best period for every trait at which early selection is most efficient and delays being taken into account is considered as the major issue.

52-*Use of Juvenile-Mature Relationships and Information from Selection Relatives in Combined Multitrait* (Ph. Baradat)

This paper examines the modification of the model used in selection using progeny information (mainly index selection) where selected juvenile traits and mature traits that the tree-breeder wants to improve are not identical. From the simple model of clonal selection, an extension is made to combined multitrait selection in half-sib families. The results can be generalized to any other kind of combined selection (especially within full-sib families from different mating designs): the matrix of juvenile-mature genetic covariances must be substituted for the matrix of genetic variances-covariances of juvenile trait. These covariances must be estimated by using parent-offspring regression, even if the parent trees are not replicated in clonal tests.

6-*Biochemical Genetics and Selection*

61-*Application of Isozymes in Tree Breeding* (D. Rudin)

Applications of isozyme technique are discussed in the light of the present state of isozyme investigations in forest trees and some results from other plant species. The desirable number of polymorphic isozyme loci optimizing the usefulness of this method should exceed the chromosome number in the gametes. Linkage studies are necessary to establish the distribution of available loci over the

[1]) Proceedings (207 p) available from I.N.R.A., Laboratoire d' Amélioration des Conifères, Pierroton, 33610 CESTAS, France; Prepayment (exept for attendants) of 60 FF is required to Crédit Agriole, 304 bd Président Wilson 33076 BORDEAUX-CEDEX, FRANCE, Account n° 01.638.408.000.46 M. Arbez, IUFRO Joint Meeting.

genome. The seven main steps necessary to bring a new enzyme system into a useful position are pointed out.

Experience with studies of *Avena, Bromus* and *Lolium* indicates that there are good possibilities for study of mating systems, response to different selection intensities and multilocus organisation.

The use of isozyme marker genes in different breeding strategies is discussed from the forest tree breeder's point of view. These strategies are: mass selection, hybrid varieties and recurrent selection. Some studies in seed orchards using isozyme marker genes are also suggested. The conclusion which could be drawn from this literature review is that the opportunities to use isozyme marker genes for forest tree breeding purposes are fairly good and isozymes will be an indispensable tool in the future.

62-*Biochemical Genetics and Selection. Composition of volatile Terpenes* (A.E. Squillace)

Composition of the volatile terpenes of conifers varies greatly both between and within species and is strongly inherited. Environmental effects are usually small. Some constituents are controlled by single genes with major effects. High content is usually dominant over low, but dominance is often not complete.

Monoterpene composition is of special interest in regions where oleoresins are commercially important, because of differences in value of the various constituents. But in addition, the unique features of simple inheritance and small environmental effects offer excellent opportunities to increase our knowledge of genetic relationship between and within species of trees and to solve problems encountered in tree breeding and genetics research.

Most of the earlier studies dealt with taxonomy at the species and generic level. Many of these were fruitful but more recent studies, showing high tree-to-tree variation within species, indicate that more extensive sampling is often required. Distinctive patterns, often clinal, frequently occur and these suggest the possibility of its use in seed certification has also become apparent. Where several constituents are simply inherited, such as in *Pinus elliottii*, relatives can often be identified and this is useful in detecting labelling errors in clonal orchards and progeny tests. Hybrids can also often be identified readily. Monoterpenes are currently being used in *P. elliottii* to estimate both the degree of selfing and the dedree of wild pollen contamination in clonal seed orchards.

Relationship between monoterpene composition and resistance to insects, diseases, and animal pests have been shown by several investigators. These relationships suggest good possibilities for use of monoterpene composition in indirect selection for resistance to such pests and diseases.

Closing Remarks and Summary (W.J. Libby)

This highly successful meeting was attended by approximately 60 scientists, with information exchanged and ideas developed during the formal presentation of 6 major topics, during discussions in small groups, and then in general whole-group discussions. This summary of the major points developed is presented in 3 sections.

Important topics not discussed in detail

1. *Molecular-Genetics Selection Techniques*

Techniques wich have been developed in molecular genetics will be useful for very early selection of rare events through mass screening. This will probably rely on cell and tissue culture, and on a much greater background knowledge of the molecular biology of forest trees than we now possess. The topic is premature at this meeting.

2. *Mixed-Species Plantings*

In some cases, mixed-species plantings will be desirable on their own merits; in others, they may be forced on us by a concerned public. In either situation, breeding strategies may need to be modified to effectively improve a multi-species forest. This topic may soon deserve greater thought and attention.

3. *Competition*

Competition was clearly recognized as contributing to many of our problems of design, analysis, and interpretation. It did not receive the attention it deserves as a topic in its own right.

Major Points of Near-consensus (20)

One or more of the participating scientists did not and do not agree with one or another of the following 20 points. However, it was agreed at the final discussion session that there was substantial consensus on each of these points, all of which were considered in some detail, and in retrospect were viewed as major topics among the many topics given our attention.

1. *Gene Conservation*

There was general agreement as to the desirability of and need for gene conservation. There was neither agreement nor polarized disagreement as to the number of trees to be conserved, nor as to the methods of conservation. We did differentiate genic conservation, in wich important alleles could conceivably be conserved in very few trees, seeds, or cell cultures; as contrasted to genotypic conservation, wich would require very large numbers of trees to preserve coadapted genomes and populations.

2. *Field-Plot Designs*

Small plots were favored over larger plots. In particular, single tree plots received much support, and non-contiguous plots combined the advantages of blocking and single-tree plots.

3. *Mating Designs*

The theoretical advantages of several kinds of complicated mating designs were presented and discussed. Exemples of their use for some specialized purposes were reviewed. There was, however, a tendency tho use simpler designs in actual spractice. Among tose frequently mentioned were open-pollinated families for some purposes, single-pair matings for other purposes, and small (2—5) matings per parent) disconnected diallels for still other purposes. There was a general preference for designs with complementary functions rather than use of a single complicated mating scheme to accomplish many purposes.

In some cases, the designs may be executed concurrently. For example, at the cost of $1^1/_2$ controlled pollinations per parent, a single-pair mating may be used for advanced — generation selection and a polycross may be used for progeny testing. In other cases, the experiments should be done sequentially. For Example, in studies of genotype-environment interactions, a few appropriate provenances, or families, or clones, can be used to determine the extent of interaction, and map out groups of similar environments. Then, candidate provenances, families, or clones can be subjected to one or more groups of similar environments, to test their suitability for those environments, and their stability.

4. *Open-pollinated Families*

Open-pollinated families vary in their proper uses, both because of differences between species and differences in the circumstances which produce the open-pollinations. Among the latter : in large plantations, few relatives will be nearby, and an essentially homogeneous background pollen cloud will exist (although some o-p families may

have a high proportion of full-sibs due to a neighbor prolifically producing pollen). In natural reproduction of a large plantation, there is the possibility of local family groups, with the possibility of crosses between halfs-sibs and full-sibs, but the background pollen cloud will still be homogeneous. In native or long-naturalized stands, crosses will be likely among cousins, among parents and offspring, among uncles and nieces, as well as among full-sibs and half-sibs. In addition, local stand differentiation will have probably occured making for a-non-homogeneous background pollen cloud.

5. Selection Indexes

We trust the theories which show that indexes of multiple traits and of combined individual-plus-relatives values, are superior to various alternative ways of selecting. However, we noted that they are frequently incompletely used or not used. In some cases, the reasons for not using good indexes were due to practical constraints. In other cases, it seemed to just be custom.

6. The Base Set of Parents

The number of parents first selected for a major physiographic region should be from 10^2 (over 100) to 10^3 (about 1 000).

7. Closed Populations

Over the time period considered for domestication of forest trees (1/10 to 10 × the time Homo sapiens has existed, i. e. 25 000 to 2 500 000 years), we felt that continuously closed breeding populations are not likely.

8. Single-Family Progeny Tests

Different kinds of single-family progeny tests should serve different purposes. For instance : the males of an open-pollinated test of mature trees are unlikely to contribute to the offspring of a seed orchard. The males of a seed orchard, used in a polycross progeny test, are likely to contribute to the open-pollinated offspring of that orchard in rather different frequencies. An open-pollinated progeny test of a fully-producing seed orchard is initiated very late, and may be accurate only for that particular orchard.

9. Concepts and Techniques

The statistical (or other) techniques used for measuring things should not dominate our concepts of these things. For instance, there is sometimes confusion between what a genotype-environment interaction is, and the statistical models we may use to estimate it.

10 Specificity of GE Interaction

Different characteristics may have quite different genotype-environment interaction patterns. This has implications for the size and shape of the breeding unit as selection criteria change.

11. Pedigrees

Pedigree control is useful and important. Although there are promising biochemical alternatives, they are not yet operational.

12. Selfing in Seed Orchards

For many species, selfing as a contributor to inbreeding depression is one of the least important of possible incestuous (consanguineous) crosses. This is particularly likely to be the case for polyembryonic conifer species.

13. The Seed-Orchard and Breeding Population

A separation of the breeding population and the seed-orchard-population is desirable, both conceptually and physically. This allows us to create non-inbred production seed, and to achieve a high short-term selection differential by selecting only a few clones for the seed orchard while maintaining a large breeding base.

14. Non — Inbred Production Forests

An inbreeding level of F = zero or less (by crossing a differentiated base population) is not only important and desirable, but we affirm that it achievable for an unlimited number of generations. The suggested solution of this problem is one of the major accomplishments of the Bordeaux meeting. See Departure point 5, below.

15. Timing of Inbreeding

Whether inbreeding in the breeding line is early or later, or begins with close crosses or distant crosses, is not important in terms of the long-term inbreeding sustained in such lines. Rather, the long-term inbreeding depends mostly on the initial number of parents founding the line.

16. Early Selection

The concept of juvenile selection, balancing a smaller but earlier gain and shorter generation time against larger but less-frequent gains, is important. At present, this is best (but still not well) calibrated by juvenile-mature correlations.

17. The "Coefficient of Genetic Prediction"

This general and unifying term was proposed and generally liked. It would include, among others:
heritability (trait 1 on itself)
correlated response (trait 1 predicting trait 2)
juvenile-mature correlation (trait 1 at time 1 predicting trait 1 at time 2)
genotype-environment interaction (trait 1 at place 1 predicting trait 1 at place 2).

18. Trait-Time Correlations

These correlation vectors are two-directional. A trait selected late will affect early characteristics which are genetically correlated, just as a trait selected early will affect later characteristics. Late characteristics tend to have economic importante, while early ones may be silviculturally important. Perhaps the most common situation is selection of a tree during its adolescence, thereby affecting both those earlier and later traits genetically correlated with the selected traits.

19. Personnel Note

The loss of information due to the death, promotion or transfer of personnel is a particularly serious and vexing problem in these fields of research.

20. Biochemical Promise and Caution

While terpenes and isozyme analyses, and other biochemical techniques, are recognized as valuable for many pertinent studies (such as investigations of population architecture, inbreeding progress, mating systems, etc. . . .), we note that there are problems, both of executing the analyses and of interpreting them. We further caution that a sufficient number of representative loci should be used.

Major departures from previous practice (6)

For some present at the Bordeaux meeting, one or more of the following 6 points was already a part of operating concepts or practice at the beginning of the meeting. It is unlikely that any of those present agreed with all 6 of these points at the beginning of the meeting, and indeed, many do not subscribe to all 6 of them at the end of the meeting. But each point would have had support of only a minority in the recent past, and each is now supported by a substantial majority of those in attendance.

1. Selfing Selection Designs

Selfing is seriously considered as an aid to selection. An important caution is that self -incompatibility systems which have evolved may be serving important purposes, and the reduction or loss of self-incompatibility by using successfully, selfed families may do indirect damage.

2. Rooted Cuttings

Rooted cuttings are being seriously considered, not only as a means of producing clones for research, but as a means of getting selected gene packages into production forests.

3. Biochemical Alternatives to F

Biochemical techniques such as isozyme analyses may be used to identify approximate levels of heterozygosity. This has two important advantages over the use of coancestry and path-coefficient analyses to estimate F. First, F is an estimate of average inbreeding, while these techniques may identify individual plants which have greater or less heterozygosity than the family average. Second, F tends to overestimate the reduction in heterozygosity, because it cannot accurately account for natural selection against homozygotes.

4. Advancing-Front Modified

An important modification of the „advancing front" seed-orchard scheme was suggested and generally accepted. Under this rule, any relative in the seed orchard is rogued out as soon as a new one (which must be judged better than the old one) begins producing pollen or seeds.

5. Subdivision of the Breeding Population

The breeding population should be subdivided, the number of separate lines to equal or exceed the number of clones in the seed orchard. The purpose of this strategy is to avoid inbreeding among the products of the seed orchards, i. e., in the production forest.

As an example, 400 selected parents would be divided into 100 groups of 4 parents, each founding a separate line. Each line would thus consist of the genes in the 8 haploid genomes of the original 4 parents. Each generation, these genes would be recombined and the 4 best offspring selected for further recombination and selection. Each generation, the one best individual in each of (say) the best 20 lines would be entered in the seed orchard. Thus, the seed orchard would consist of 20 clones, no 2 of which had any ancestors in common since the founding of the lines.

One possible problem is selection for stability among the increasingly homozygous line-offspring. It may be that progeny testing or clonal testing of outcrosses between lines will becombe useful. Thus, the trees planted in the forest may be highly heterozygous and stable mixtures of clones.

6. Seedlings in Seed Orchards

Much of the above reasoning leads to the conclusion that seedlings will no longer be desirable in either single-purpose or dual-purpose seed orchards. The exeptions to this conclusion will occur in those species where clonal propagation is not feasible. Dual-purpose clonally-propagated seeed-orchards, in which each unrelated entry family of inbred fullsibs is reduced to zero or one clone, remains a strong possibility.

M. Arbez

Persönliche Mitteilung

Für die Zueignung des Doppelheftes 5/6 im Jahrgang 1976 dieser Zeitschrift sage ich den beteiligten Autoren und dem Verlag J. D. Sauerländer, Frankfurt a. M. meinen aufrichtigen Dank. Es ist für mich eine besondere Ehrung, daß auf diese Weise der Vollendung meines 70. Lebensjahres gedacht wurde. Zugleich nehme ich mit Genugtuung zur Kenntnis, daß die Gründung der „Zeitschrift für Forstgenetik und Forstpflanzenzüchtung", der heutigen „Silvae Genetica", als positiver Teil meiner Tätigkeit auf unseren Forschungsgebieten gewertet wird.

Ich bitte Verständnis dafür aufzubringen, daß ich davon absehe, jedem einzelnen der Autoren gesondert zu danken. Wie viele Pensionäre leide auch ich unter chronischem Zeitmangel.

May I express my sincere thanks to the authors and to J. D. Sauerländer's Verlag, Frankfurt a. M. for the dedication of copy no. 5/6 of Silvae Genetica 1976. It is a special honour for me that my 70th birthday was remembered in this way. At the same time I notice with satisfaction that the foundation of "Zeitschrift für Forstgenetik und Forstpflanzenzüchtung", later on "Silvae Genetica" is valued as a positive part of my work in our research field.

May I ask you for your understanding that I am not thanking each author separately. The same as many retired people I am always short of time.

W. Langner

Die Wald- und Parkbäume Europas. Ein Bestimmungsbuch für Dentrologen und Naturfreunde. Von A. Mitchell, aus dem Englischen übersetzt und bearbeitet von G. Krüssmann. Paul Parey, Hamburg und Berlin 1975. 419 Seiten und 40 Farbtafeln; 1098 Abbildungen, davon 380 farbig, im Text und auf Tafeln. Balacron geb. DM 48,—.

Der Aufbau des Buches ist die Anlehnung an das bewährte System des Ornithologen Peterson vorgenommen worden. Dabei werden in der Einführung zunächst Fragen der Nomenklatur, Biologie und Bestimmung der Gehölze behandelt. Fachausdrücke werden in einem Glossar erläutert. Die 800 Baumarten und -Formen, die nördlich des Mittelmeeres wild vorkommen oder im Wald oder Park anzutreffen sind, sind botanisch-systematisch geordnet. Neben den wissenschaftlichen Bezeichnungen und den wichtigsten Synonymen werden auch die landesüblichen Namen in deutsch, englisch, französisch und holländisch angegeben. Die Beschreibungen selbst enthalten detaillierte Angaben über Herkunft, Verbreitung, Häufigkeit, sowie über Blätter und Nadeln, Blüten und Früchte, Rinde, Duft zerriebener Blätter und Kronenform, auf ähnliche Arten wird verwiesen. Die ausgezeichneten Abbildungen runden diese Angaben ansprechend ab.

Insgesamt wurde ein Bestimmungsbuch vorgelegt, das nach seiner handlichen Benutzbarkeit und Fülle der Information seinesgleichen sucht und seinem anspruchsvollen Preis durchaus gerecht wird.

O. Mohrdiek

Mitteilungen des Vereins für Forstliche Standortskunde und Forstpflanzenzüchtung. Nr. 25, 1976. Verlag Eugen Ulmer, Stuttgart. 81 Seiten mit 32 Abbildungen und 42 Tabellen. DM 20,—.

Das Heft enthält 9 Beiträge, von denen sich 7 mit forstpflanzenzüchterischen Themen befassen: Schlenker gibt in „Forstpflanzenzüchtung in Baden-Württemberg" einen Überblick über laufende Arbeiten und angestrebte Ziele, wie u. a. die Züchtung von *Populus trichocarpa*-Klonen mit guten Wuchsleistungen und geringer Wasserreiserbildung, Vegetativvermehrung von Buntholzarten für praktische Zwecke, Intensivierung der Samenplantagenarbeit, Auslese von Lärchenhybrid- und chlorosefesten Douglasien-Klonen. Werner behandelt „Ergebnisse 20-jähriger Pappelsortenvergleiche und das Verhalten bekannter und neuerer Klone unter verschiedenen Umweltbedingungen". Einige Möglichkeiten der waldbaulichen Verwendung unter den Gesichtspunkten der Vorwaldbegründung zur Erleichterung der Einbringung frostempfindlicher Baumarten, zur Humusanreicherung auf hitzigen Karbonatböden und Stabilisierung von Fichtenbeständen auf wechselfeuchtem Lehm werden diskutiert. Die „*Dothichiza*-Anfälligkeit der verschiedenen Pappelsorten im Populetum Reichenberg" behandeln Dagenbach und Schlenker. Die Autoren schließen, daß als relativ wenig befallene Sorten nur sehr wenige Klone verfügbar sind. In der Mehrzahl sind es Schwarzpappel-Abkömmlinge, die unter den starken Befallsgruppen rangieren. Für das weitere züchterische Vorgehen werden Folgerungen gezogen. H. Sachse gibt seine Ergebnisse aus „Vergleichende Untersuchungen über die Holzeigenschaften der Pappelklone 'Rochester', 'Harf' ('Regenerata Deutschland') und *trichocarpa* 603" bekannt. Sie zeigen ausgezeichnete Furnierqualität für 'Rochester', gute für 'Harff' und geringe für *trichocarpa* 603 wegen starker Wasserreiserbildung. In einem weiteren Aufsatz behandelt H. Sachse die „Ästigkeitsanalyse eines 40-jährigen Stammes des Klones 'Senior' der *Populus trichocarpa*". Aufgrund des 'krank' (schwarz)- Einwachsens der Wasserreiser im unteren 7,5 m langen Stammstück wird abgeleitet, daß waldbauliche Maßnahmen allein bei *P. trichocarpa* die Wasserreiserbildung nicht unterdrücken können. H. Dagenbach behandelt „Anlage und Pflege von Samenplantagen". Interessant sind vor allem die Hinweise,