Zusammenfassung

In Nachkommenschaften frei abgeblühter Pfropflinge von Bombax ceiba und Bombax insignis in Samenplantagen wurden sowohl gelb-grün gefleckte als auch total gelbe Chlorophyllmutanten festgestellt, was als Inzuchteffekt erklärt wird. Es überlebten nur Sämlinge mit hinreichender Chlorophyllausstattung.

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* Not seen in the original.

Supernumerary Chromosomes and Growth Rate in Picea sitchensis (Bong.) Carr.

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Introduction

Picea sitchensis shows a widespread polymorphism for supernumerary (B-) chromosomes throughout the southern half of its natural range (MOIR and Fox, 1972; MOIR and Fox, submitted to Silvae Genetica, 1976). In view of the importance of Picea sitchensis as a timber crop (FLETCHER and FAULKNER, 1972) and the frequent reports of B-chromosomes having detrimental effects on growth and fertility in some plant species (see JONES, 1975, for review) it is important to assess the effects of B-chramosomes on the economically-important characters of this species.

In this paper we have attempted to evaluate the effects that B-chromosomes have had on growth rate in three experimental plots of 14 year-old trees. In 1961 the Forestry Commission set up provenance trials near New Deer, Aberdeenshire. Each plot consisted of 195 trees and the provenances tested ranged from North Bend, Oregon (43° N) to Cordova, Alaska (60° 30' N.). Plots 25, 12 and 7 were derived from Sooke, Vancouver Island, close to a seed origin (66) used in a previous paper (MOIR and Fox, submitted to Silvae Genetica, 1976) which had a particularly high B-chromosome frequency of 1.52/plant. These plots thus constitute an excellent opportunity to assess the effects of various numbers of B-chromosomes on growth rate in Picea sitchensis.

Materials and Methods

(i) Determination of B-chromosome status. B-chromosome status was determined from chromocentre counts in interphase nuclei of the shoot basal meristem. In each block the outer two rows were not sampled, thus leaving 99/plot. One bud was sampled at random from each tree. Four trees from plot 25, which on casual observation appeared to contain 0, 1, 2 and 3 B-chromosomes respectively, were sampled in detail. Either the terminal bud or a lateral bud situated next to the terminal one was sampled from each branch of each whorl. In this way buds were sampled throughout these trees. Buds were collected in April and May, either just prior to flushing or at the time of flushing. Buds were fixed overnight in 6 parts alcohol : 3 parts chloroform : 1 part acetic acid prior to squashing in 2% lactopropionic orcein (MOIR and Fox, 1972). Chromocentre counts (100 cells/bud) were made only for the four trees sampled extensively.

ii) Determination of growth rate. Two characters were recorded for each tree, number of whorls and tree height. Height was measured by placing a pole, marked at 30 cm intervals by different colours, as near as possible to and parallel with the tree trunk and reading to the nearest 15 cms.

Results

i) Chromocentre frequency in *presumptive* 0, 1, 2 and 3 trees. Table 1 summarises the chromocentre frequencies observed in these four trees. No major differences were found in different parts of the same tree.

ii) B-Chromosome distribution between plots. Table 2 records the numbers of trees with different B-chromosome constitutions found in each plot. A j X j contingency χ^2 shows no significant differences between the plots ($\chi^2_{(6)} = 4.2918$, $P = 0.7 - 0.5$).

iii) Growth *rates* in the three plots. Data on whorl number and height are given for each B-chromosome class of each plot in Table 3. Analyses of variance for each parameter are given in Tables 4 and 5.

Discussion

i) The validity of the metltod for estlmating B-status.

MOIR and Fox (1972) showed that in the primary root meristem there is a close relationship between number of

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Table 1. — Chromocentre frequencies in interphase nuclei of 0, 1, 2 and 3 B-chromosome trees.

B-status	No. of buds	Chromocentre Class 0	1	2	3	4	4
0B	34	3400 (100%)	—	—	—	—	—
1B	49	156 (3.2%)	4474 (91.3%)	243 (4.9%)	25 (0.5%)	2 (0.04%)	—
2B	48	40 (0.8%)	1006 (20.9%)	3455 (71.9%)	267 (5.6%)	32 (0.7%)	—
3B	24	—	258 (10.7%)	749 (31.2%)	1218 (50.8%)	149 (6.2%)	26 (1.1%)

Table 2. — Frequencies of each B-chromosome class in the three experimental plots.

B-class	Plot 25	12	7
0B	45	37	41
1B	31	34	31
2B	15	11	21
3B	8	7	5
Gaps	0	10	1

ii) *Differences between the plots.* Although the three plots are growing within a few hundred metres of each other, there were differences in vegetative type at the time of planting. Plot 25 had 10% wet grass type *(e.g. Holcus lanatus)*, 90% dry grass type *(e.g. Deschampsia flexuosa)*, plot 12 had 80% wet grass type, 20% dry grass type and plot 7 had 100% dry grass type (R. Lines, Silviculturist, Forestry Commission, Northern Research Station, Edinburgh, personal communication). Other differences exist between them. In plot 7 the lower branches have been removed thus allowing more light penetration and encouraging the growth of bracken. Defoliation by aphids was evident in plot 12, particularly in one dry corner. There the ground had a thick needle litter and bracken thrived in parts of it. In contrast the wet zone was very damp in one corner with rushes and *Sphagnum* in abundance. Plot 25 was very dense with little light penetrating to the ground in some areas. *Calluna vulgaris* was abundant throughout this plot. In 1961 no *Calluna* was present in the area chosen for planting. This is an important consideration for, when *Picea sitchensis* is in direct competition with *Calluna*, it goes into check (Stewart, 1960). However, by 1968 *Calluna* was affecting plot 25 severely and this plot was treated with 2, 4-D (R. Lines, personal communication). This treatment also reduced *Picea sitchensis* growth for some time.

Table 3. — Mean ± standard error of whorl number and height for each B-class in the three experimenal plots. (Height in feet)

B-class	PLOT 25		12		7	
	Whorls	Height	Whorls	Height	Whorls	Height
0B	8.67 ± 1.49	12.32 ± 3.04	9.81 ± 1.85	14.03 ± 3.62	9.78 ± 1.93	12.87 ± 3.80
1B	8.48 ± 1.65	11.58 ± 3.20	9.74 ± 2.19	14.29 ± 4.17	9.10 ± 2.20	12.02 ± 4.96
2B	9.07 ± 1.28	12.03 ± 2.24	9.09 ± 1.58	13.05 ± 2.70	9.67 ± 1.54	12.88 ± 2.88
3B	7.38 ± 1.51	11.94 ± 2.15	9.71 ± 1.11	14.64 ± 3.35	9.80 ± 1.92	13.70 ± 2.66

Table 4. — Analysis of variance for whorl number in the three experimental plots.

Item	D.F.	S.S.	M.S.	V.R.	P
1. Between B-classes	3	8.0802	2.6934	1.1798	>0.2
2. Between plots	2	71.5232	35.7616	11.2536	<0.001
3. B-class x plot	6	21.3887	3.5648	1.1248	>0.2
4. Between trees within B-classes and plots.	274	868.3820	3.1693		
Total	285	969.3741			

Since the variances of items 3 and 4 did not differ significantly they were pooled and used as the error term in testing for significant differences between plots and between classes.

Table 5. — Analysis of variance for height in the three experimental plots. Procedure as in Table 4.

Item	D.F.	S.S.	M.S.	V.R.	P
1. Between B-classes	3	12.2953	4.0984	3.0849	0.2 - 0.1
2. Between plots	2	202.8451	101.4226	8.0220	< 0.001
3. B-class x plot	6	34.2307	5.7051	2.2427	0.2 - 0.1
4. Between trees, within B-classes and plots	274	3505.8107	12.7949		
Total	285	3755.1818			

B-chromosomes in metaphase cells and number of chromocentres in interphase nuclei. This technique was also used in a more recent paper (Moir and Fox, submitted to Silvae Genetica, 1976) though in this latter case it was found that the technique did present some difficulties when 3 or more B-chromosomes were present. In the present work, a different source of interphase cells was used, the vegetative bud basal meristem. The data in *Table 1* show that there is no difficulty in allotting trees to particular B-chromosome classes on the basis of chromocentre counts from the bud interphase cells.

A second cause of tree checking is frost. In May, 1965 and the following year, the effects of frost on height in the experimental plots were assessed. Two of the three Sooke plots (12 and 17) were moderately damaged and the Sooke trees as a whole were more severely damaged than any other provenance (R. Lines, personal communication).

Over 1962 and 1963, 19 tree replacements were made in the three Sooke plots. Thus the trees in the plots at the time of investigation were between 12 and 14 years old, with most of the latter age. Even so (see *Table 2)* there are at present 0, 10 and 1 gaps in the three plots respectively. We do not know which trees were replaced nor what the B-status of the replaced trees was. However, the analysis of B-chromosome frequencies in the three plots shows that they do not differ in this respect.

(iii) *The lack of influence of B-chromosomes on growth rate.*

Number of whorls per tree was one character used in the assessment of tree growth. One whorl is usually produced each year but if there is a check in growth there may be a

failure to produce a whorl or two whorls may merge into what appears to be one due to trunk-stunting. In practice, counting the whorls was at times difficult for the very thin branches of the oldest whorls had sometimes broken off and left little evidence of their existence. A second difficulty arose when a tree had a large, well-needled middle crown region for it was impossible, due to tree crowding, to stand back to view this region. In spite of these difficulties the results of the investigation of whorl number *(Tables 3 and 4)* and tree height *(Tables 3 and 5)* were quite unambiguous and agreed very closely with each other. There is no detectable effect of B-chromosome constitution on growth in the three plots nor is there any interaction between B-class and plot. This is in spite of highly significant differences in whorl number and height between the three replicate plots. The three plots are ranked in the same decreasing order (12, 7, 25) on both mean whorl number and mean height. It will be recalled that plot 25 was, and still is, the one most seriously affected by *Calluna* and the initial differences in vegetation types between all plots (see p. 140) may indicate other environmental differences between the plots which were subsequently important for the growth rate of *Picea sitchensis*.

While this study is only a preliminary investigation it does suggest that the B-chromosome of *Picea sitchensis* is unlikely to have a major effect on growth since the environmental differences between these plots was sufficient to produce differences in growth rate yet no effect was detectable between B-classes within the plots.

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Summary

1. B-chromosome status, whorl number and height were investigated in three experimental plots of 14 year old trees of *Picea sitchensis*.
2. Seeds from which the trees were grown were collected at Sooke, Vancouver Island. Trees had 0—3 B-chromosomes/cell and the three plots did not differ from each other in B-chromosome frequency.
3. Although the three replicate plots are close to each other, there are major differences in associated vegetation between them.
4. There are highly significant differences between plots for both growth parameters (whorl number and tree height) but no significant differences between B-chromosome classes within plots, nor a significant B-class × plot interaction.

Key words: Sitka spruce, B-chromosomes, growth rate.

Zusammenfassung

1. Auf 3 Versuchsflächen mit 14jähriger *Picea sitchensis* der Herkunft Sooke/Vancouver Island wurden die Frequenzen der B-Chromosomen, die Anzahl Astquirle sowie das Höhenwachstum bestimmt. In der Auswertung der Ergebnisse werden die Versuchsflächen als künstliche Populationen angesehen.
2. Die Frequenz der B-Chromosomen war in den 3 Populationen gleich. Sie betrug in allen gezogenen Stichproben 0—3 B-Chromosomen pro Zelle.
3. Trotz räumlicher Nähe wiesen die 3 Versuchsflächen bedeutende Unterschiede zwischen den begleitenden Pflanzengesellschaften auf. Ebenso unterschieden sich die geprüften Wuchseigenschaften — Anzahl der Astquirle und Höhenwachstum — in den 3 Populationen signifikant voneinander. Signifikante Unterschiede in der Frequenz der B-Chromosomen waren hingegen zwischen den 3 Populationen nicht festzustellen.

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Untersuchungen zur autovegetativen Vermehrung von Aspen und Graupappeln

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1. Problemstellung

Nach einer Phase der eindeutigen Bevorzugung der Schwarz- und Balsampappeln scheint sich das Interesse der forstlichen Praxis auch den Pappeln der Sektion Leuce Duby zuzuwenden. Dies mag an der besonders hohen standörtlichen Toleranz einzelner Arten dieser Sektion liegen. So können Aspen unter schwierigen standörtlichen Bedingungen noch ungewöhnlich hohe Leistungen erreichen. Sie sind also auf ungünstigen Waldstandorten eine Alternative zu den Nadelbaumarten.

In den letzten Jahren wurden auf zahlreichen Versuchsflächen Aspen- und Graupappelklone bzw. Nachkommenschaften aus gelenkten Kreuzungen von europäischen Aspen *(P. tremula* L.) oder von europäischen und nordamerikanischen Aspen *(P. tremuloides* Mich.) angebaut (Fröhlich und Grosscurth, 1973). Die deutliche Überlegenheit einzelner Klone hinsichtlich Massenleistung, Form- und Resistenzeigenschaften konnte nachgewiesen werden, so daß eine von geeigneten Aspen- und Graupappelklonen zum gewerbsmäßigen Verkehr im Sinne des § 3 Abs. 1 des Geset-