illustrent les stades des plus importants de ce développement.

Des observations ont ete faites sur l'interruption de la méiose par les basses temperatures et la reprise des divisionc cellulaires plusieurs jours plus tard lorsque la température s'élève, ainsi que sur les irrégularités des divisions meiotiques qui en résultent; on pense que cela peut avoir une influence sur la fructification des mélèzes dans les régions ou il se produit, frequemment, au début du printemps, des alternatives de periodes chaudes et froides.

On a decrit un mécanisme unique de la pollination chez le mélèze: les grains de pollen sont captés et se fixent sur l'extrêmité du stigmate ou ils restent en repos pendant 5 a 7 semaines. Ils migrent ensuite vers le sommet du nucelle sur lequel ils germent; cette migration se fait dans le liquide exsude dans le canal micropylaire, liquide qui se concentre a travers le sommet du nucelle. On pense que l'exsudation et la concentration de ce liquide sont commandees par les variations de preasion de la seve et peuvent, par consequent, être influencées par l'humidite et la sécheresse atmospherique. Tous les grains de pollen captils sur le sommet du stigmate ne sont pas transportés vers le nucelle et pour cette raison son mecanisme semble moins efficacr que la germination des grains de pollen en place.

On donne une breve description des mecanismes de pollination, d'apres DOYLE et O'LEARY pour des genres Pinus, *Picea*, et Pseudotsuga.

L'efficacité de la pollination contrôlée des melezes peut être testée par le comptage des grains de pollen captés et fixés sur les stigmates.

L'epoque la plus favorable pour l'exécution des pollinations contrôlées des mélèzes fait l'objet d'une discussion; on reeommande chaque fois que cela est possible de polliniser toutes les inflorescences plusieurs fois a 1 ou 2 jours d'intervalle pendant toute la periode ou les fleurs sont réceptives, et cela, avec des pollens provenant de differentes extractions; s'il n'est possible de faire qu'une ou deux pollinations, celles-ci doivent être exécutées au milieu de la période de receptivite. Des photographies illustrent le développement des inflorescences femelles au cours de la période de receptivite et apres celle-ci. On propose une méthode pour contrôler le stade de développement d'une inflorescence. On pense que la forme des bractées et l'etat des stigmates sont des criteres de receptivite plus valables que la position des bractiles.

Il est nécessaire d'isoler les inflorescences femelles aussitôt que possible.

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Provenance Study of Douglas-Fir in the Pacific Northwest Region

I. Nursery Performance

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Introduction

Indiscriminate transfer of seed from collection area to nursery or to planting site and, more recently, from collection area to direct seeding site long has been of concern to agencies interested in forest regeneration. Results of such practices in other countries (1, 2, 22), and of early projects on provenance testing in the western part of the United States (15, 25) have indicated such transfer is risky. Reforestation of lands with trees poorly adapted to the new environment may well result in an inefficient use of the productive capacity of the land. The errors may be considered even more costly since the result may not become evident until 30 — 50, or even 80 years after establishment of the stand.

The general policy of planting or seeding plants or seeds from local sources of comparable altitude has been adopted in recent years. This procedure, while minimizing gross errors, also imposes great limitations on collection of seed from a species which produces only an intermittent crop varying widely in annual abundance and locality. Strict adherence to the "local seed" policy may leave a cut-over area without a proper seed source for several years — the very years, in fact, which probably are the most important for re-establishment of a new stand.

As a result of several meetings of foresters concerned with this situation, the Oregon Forest Research Center began planning in 1954 a region-wide provenance study of Douglas-fir (Pseudotsuga menziesii [MIRB.] FRANCO var. menziesii). Objectives of the study were to detect the genetic variation of this widely distributed variety, and to correlate the existence of distinct races if any, with geographical variables such as altitude and latitude. The present report presents performance in the nursery at Corvallis, Oregon, of 14 stocks originating from southern Oregon to the northern part of Vancouver Island, British Columbia.

Review of Literature

According to EDWARDS (5), a "provenance experiment" is designed to study the performance of seeds from different stands of trees, which may either be native to their place of growth, or are introduced from elsewhere. This should not be confused with "progeny trials" which essentially deal with evaluation of the breeding value of parents by suitable comparisons among their offspring (23).

As early as 1912, an experimental plantation of Douglas-fir of 10 provenances was established by Professor MÜNCH in the Palatine Wood (forest district of Kaiserslautern, Western Germany) as a parallel plantation to that instigated by Professor SCHWAPPACH at Chorin. This trial has been under observation for about 40 years, and has demonstrated the great importance of seed origin in Douglas-fir (20).

WILLIS and HOFMANN's report (26) on growth of Douglas-fir trees of known seed source was the first of its kind in the Northwest. In their experiment, seed was collected in the fall of 1912 in 13 different localities in western Washington and western Oregon, within a radius of 300 miles from Portland. From the same experimental plantation, MUNGER and MORRIS (15) later reported that height growth of the progeny was not affected by age of the parent tree, quality of growing site, spacing, and condition as to fungus infection. Results indicated, however, that progeny from two particular seed-sources made outstandingly good height growth.

LEO ISAAC, in the publication "Better Douglas Fir Forests from Better Seed" (10), has suggested a set of seven rules or limitations relative to the collection of Douglas-fir seed for reforestation of a specific area. These rules are based primarily on average annual temperature and frost-free period, and parallels the system in use in Sweden for Scots pine.

Recent investigations by IRGENS-MOLLER (9) have shown that genetic diversity exists among Douglas-fir seedlings of different origins with respect to time of cessation of height growth.

Various workers have found distinct differences in rhythm of growth between provenances as well as among individuals within provenances. As pointed out by SCHMIDT and STERN (21) and VAARTAJA (24), the growth rhythm of different races*) may be maintained as well as altered on different sites. Failure in growing stock of a certain provenance on only one site does not justify its rejection as a testing material, because the planting site may differ considerably from environmental requirements of the provenance in question. They, therefore, suggest that provenance tests be made on several sites varying in climate and soil.

Geographic variations in environmental conditions have resulted in great genetic diversity in species of wide distribution. The differences in selective pressures from locality to locality have led to evolution of more or less distinct types with regard to a number of physiological characteristics. Environmental conditions most often vary in a somewhat continuous manner; consequently the genetic constitution varies in a similar pattern. However, in other instances, occurrence of discontinuous distribution of plants may be due to, for instance, geographical barriers. The genetic variation then may be discontinuous (16).

The studies of Douglas-fir already cited suggest the existence of variation in physiology and morphology of Douglas-fir associated with geographic location or origin. However, the sampling of the variables of altitude, latitude, and longitude in these studies was neither precise nor systematic enough to elucidate the question whether variation is clinal or discontinuous. In other studies (such as MÜNCH's) the geographic area sampled included races which *a priori* could be expected to have very little silvicultural interest in the distribution of the var. *menziesii* forms.

In view of all these findings and suggestions provided by various investigators, a uniform latitudinal and altitudinal distribution of seed collection in the natural growing range of Douglas-fir in the Northwest region was planned so as to include as many different provenances as possible.

*) The term "race" is used in this paper in its most general meaning. When the distinguishing characteristics of a race are adaptive, the term is synonymous with Ecotype (23).

Table 1. — Geographic Locations of 14 Seed Sources and Their Respective Cooperators.

Region	Seed Source	Cooperator	Latitude	Elevation	Location
				Feet	
Vancouver Island	A	Canadian Forest Products, Ltd.	50° 30'	400 — 600	Nimpkish Forest
British Columbia	B	Elk Falls Company, Ltd.	49° 45'	1300 — 1700	Courtenay area
	C	MacMillan and Bloedel, Ltd.	49° 10'	2600 — 2900	Sugar Loaf Mountain
	D	B. C. Forest Service	48° 50'	570 — 750	Mesachie Lake
Washington	G	Simpson Olympic Tree Farm	47° 15'	100 — 500	Shelton Area
	H	Dept. of Natural Resources State of Washington	46° 45'	1850 — 2000	Elbe Area
Oregon	I	State Board of Forestry, Ore.	45° 30'	1600 — 2200	Tillamook area
	J	Crown Zellerbach Corp.	45° 10'	1600 — 2000	Clackamas Tree Farm, Molalla area.
	K	Crown Zellerbach Corp.	45° 10'	3200 — 3800	Clackamas Tree Farm, Molalla area.
	L	Jack Stump & Kenneth McCrae	44° 50'	200 —	Willamette Valley, Salem area.
	M	Oregon State College	44° 30'	1800 — 2000	McDonald Forest, Corvallis area.
	N	U. S. Forest Service	43° 45'	1800 — 2000	Oakridge area
	O	U. S. Forest Service	43° 45'	2500 — 3000	High Prairie, Oakridge
	P	Medford Corporation	42° 20'	2700 — 3300	Butte Falls
	*E	Univ. British Columbia	49° 10'	500 — 700	Haney, B. C.
	*F	Weyerhaeuser Co.	47° 30'	3900 — 4100	Snoqualmie Nat. Forest, Wash.

*) Not included in this report.

Sixteen seed sources were selected initially on the west side of the Cascade Mountains in Oregon, Washington, and British Columbia to test the hypothesis that distinct races of Douglas-fir exist.

Seed Source

Seed provenances and the respective cooperators for the study are summarized in *Table 1*. Geographic locations of seed provenances are pointed out in *Figure 1*.

Cone collections were started in the fall of 1954 in some localities, but the last lot of seed did not arrive at the nursery until the fall of 1957, because of the different periodicity of seed years in these localities. Each cone collection was confined to a designated area with a radius of 25 miles, and the number of trees sampled in these collections ranged from 14 to 89. Cones from some agencies were sent in to be extracted and cleaned, but several cooperating organizations did their own seed extraction. All lots of seed were sent through a clipper mill until a cutting test of at least 85 per cent was obtained. The cleaned seed then were stored in a cold storage room at 0^0 F at the Oregon Forest Nursery, Corvallis, until sowing.

Number of seeds per gram, crop year, and seed viability are recorded in *Table 2*.

Nursery Procedure

Seed samples were sent to the Seed Testing Laboratory at Oregon State College in Corvallis to learn the germination percentage so that an adjusted seeding rate could give uniform density of seedlings in all seedbeds.

Naked stratification was done by soaking individual lots of seeds in plastic bags with water for 48 hours. After water was drained off, the bags were placed in a cool room at 34 — 37^0 F and 95 per cent relative humidity for three weeks.

Owing to the variation in seed viability, the seeding rate was adjusted to three main classes based on LAVENDER's findings (13), 60 — 70 seeds a lineal foot for provenance G, N and P; 90 — 100 seeds a foot for provenances B, C, H, I, J, K, L, and O, and 130 — 150 seeds for provenances A, D and M. Subsequent analysis of covariance using the replication by seed source interaction, indicated that there was no correlation between the average seedling count to a foot, and height growth.

Sowing was started May 15 and completed May 17, 1957. Seeds were sown ½ inch deep and covered with ¼ inch of soil by a hand pushed one-row seeder. The 14 seed sources received in 1954-56 were planted in 4 replications of randomized blocks. The first indication of field germination was noticed on May 28.

Results

Two 1-foot sampling strips were installed randomly in each 32-foot replication block, which consisted of 8 rows of seedlings with 6-inch spacing between rows, for measurements of total seedling height and phenological variations made during first and second growing seasons.

The following are the results from field assessments.

Height Growth

At the end of the first growing season in 1957, only seedlings from seed source A obtained from the northern tip of Vancouver Island, British Columbia, were statistically smaller *(Table 3)* than the other seed sources. Seedlings from the remaining 13 provenances, however, did not differ

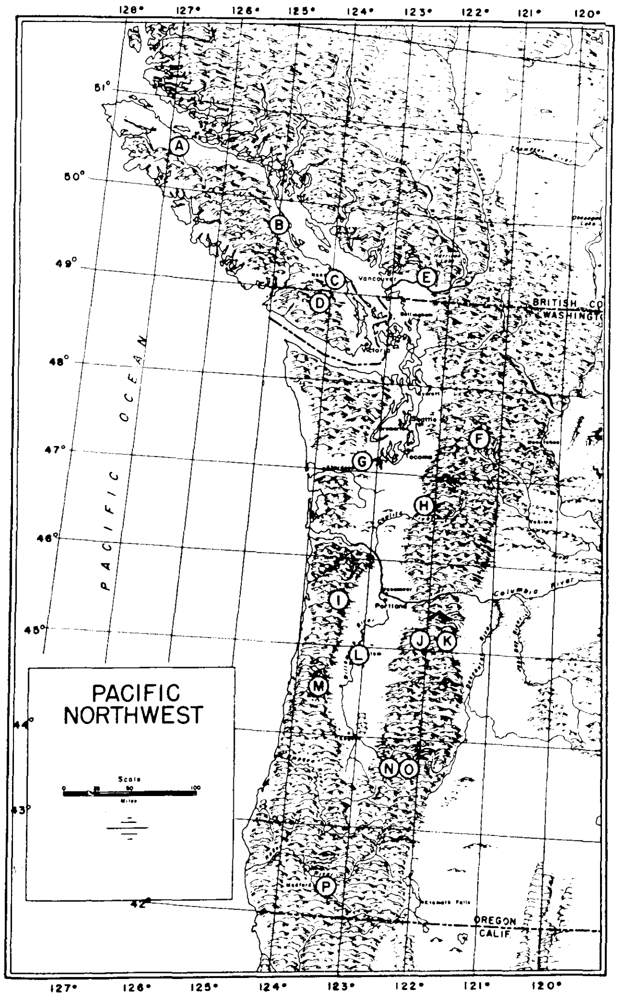

Figure 1. — Geographic distribution of seed sources in the Pacific Northwest Douglas-Fir Provenance Study. — *Note:* Data of seed source Nos. E and F were not included in this report.

significantly in total height growth. Variance caused by replication was not significant.

Significant differences in height growth were found among seedlings of different geographical locations at the end of the second growing season *(Table 3)*. Total height of 2-0 seedlings from seed sources B, C D of Vancouver Island and G of Shelton area in Washington, were significantly higher than those of other seed sources at the one per cent level of significance. Differences between replications again were not statistically significant. The northern-

Table 2. — Information on Seed Chosen for the Provenance Study.

Seed source	Crop year	Sound seeds	Germination in 1956	
			Laboratory	Field
		In a gram	*Per cent*	*Per cent*
A	1956	100	54	46
B	1956	92	58	24
C	1956	65	67	22
D	1955	91	45	14
G	1956	80	88	59
H	1956	75	75	45
I	1954 & 1955	76	75	31
J	1956	98	64	60
K	1956	59	76	41
L	1956	82	62	56
M	1955 & 1956	98	40	30
N	1954	72	80	77
O	1956	77	68	36
P	1955	67	87	32

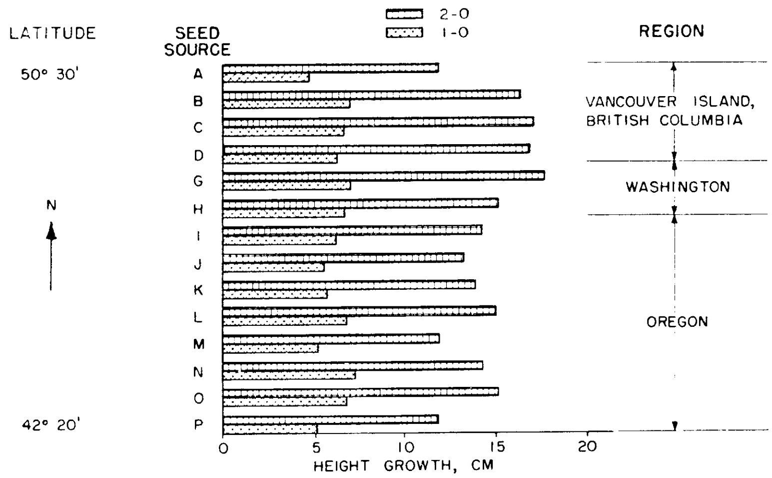

Fig. 2. — Relationship of height growth of 1—0 and 2—0 seedlings to the latitudinal distribution of 14 different seed sources.

most and the southernmost groups, seed sources A and P respectively, showed less growth than any plants from the remaining sources. A histogram *(Figure 2)* indicated clearly, that, except for seed source A, stocks originating from high latitudes were characterized by better height growth.

No correlation between altitudinal zone and seedling heights was found in 2-0 seedlings. For instance, among the six seed sources that fell into the med'um-elevation group (1000 — 2000 feet), some produced seedlings with excellent height growth, i. e., seed source B, while others were below the average, i. e., seed sources J and M.

Seed sources N from medium elevations near Oakridge, Oregon, and seed source G collected near Shelton, Washington in low elevation were characterized by good germination in the laboratory tests as well as in the nursery phase. Their vigor also was reflected in excellent height growth at the end of the first growing season; however, only the latter maintained its superior growth in the following season. Not all lots of seeds with low germinative capacity produced short seedlings; for example, seed source B grew exceptionally well, although its percentage of germination in the field was low.

Needle lengths of forty seedlings (five needles for each seedling) from each provenance also were measured at the

Table 3. — Mean Height Growth and Needle Length of Douglas-Fir Seedlings from 14 Provenances.

Seed source	First growing season		Second growing season		Needle length
	No. sampled	Mean height	No. sampled	Mean height	
		cm		*cm*	*mm*
A	148	4.8	196	11.9	21.1
B	145	7.0	126	16.3	25.6
C	135	6.7	117	17.1	25.4
D	133	6.2	100	16.8	26.4
G	142	7.0	156	17.6	25.5
H	146	6.6	172	15.2	22.7
I	139	6.3	146	14.3	24.6
J	153	5.4	192	13.3	23.0
K	139	5.7	150	13.9	22.7
L	147	6.9	214	15.0	22.2
M	143	5.2	183	11.8	21.8
N	152	7.3	161	14.3	22.8
O	140	6.8	152	15.4	22.8
P	130	5.1	143	11.8	23.1
LSD 5%		2.32		2.63	3 07
1%		3.10		3.52	4.14
Coefficient of variation (%)		20.3		17.8	7.8

end of the 1958 season *(Table 3)*. Analysis of variance shows that there were significant differences among the various provenances in needle length. A covariance analysis showed there was some correlation between needle length and total height growth of these 14 groups of Douglas-fir.

Phenology

Genetic variation within the species was investigated further by dates of bud burst and bud set. Quantitative data taken at different intervals in the growing season indicated wide variation existing among these 14 provenances.

Bud burst

Terminal buds of progenies of the 14 seed sources were examined at bi-weekly intervals with regard to bud burst at the beginning of their second growing season. The following classification was used: buds tight, buds swelling, and buds burst. A large number of seedlings, ranging from 150 to 343, from each replicated block were checked in the observation.

Table 4. — Order and Cumulative Percentages of Bud Burst in Bi-weekly Intervals in March-April for Seedlings from the 14 Provenances of Douglas-fir.

Rank	March 29		April 11		April 25	
	Source	Open	Source	Open	Source	Open
		%		%		%
1	P	11.3	H	54.8	B	99.4
2	H	9.4	L	54.5	H	92.8
3	B	6.5	P	44 0	C	92.7
4	M	3.9	N	39 6	L	92.4
5	G	3 5	M	38.5	K	91.4
6	D	3.3	C	34,5	A	90.9
7	L	3 3	D	32.4	D	90,1
8	K	2.7	A	29.3	N	89.2
9	N	1.9	B	29.3	P	88.7
10	I	1.7	K	22.2	G	85 8
11	O	0.4	O	22.1	O	85 3
12	J	0.3	J	19.9	J	83.9
13	A	0.3	I	19.5	I	78.9
14	C	0.0	G	17.7	M	70.7

Bud burst of seedlings from Medford (seed source P, 3000 foot elevation, southernmost collection in this study) was significantly earlier than in seedlings from any other source *(Table 4)*. Provenance B, Vancouver Island, and H, Elbe, Washington, also were found to be early in bud burst; they maintained the pattern of earliness, except the former slowed down somewhat during the middle of April.

Seedlings of seed sources A and C, originating from Vancouver Island, British Columbia, showed little or no sign of bud burst at the end of March. The percentage of budburst plants increased considerably after the first part of April, moved up to rank 3 and 6 for bud burst by the end of April, and demonstrated a narrow range of time interval between dates of initial and final bud burst. On the other hand, plants of seed source M, McDonald Forest, Corvallis area, started their bud burst early, but the percentage of plants with burst buds increased slowly, so only 70 per cent of the terminal buds had opened at the end of April.

Bud set

Data were taken at weekly intervals from the various stocks at the end of the second growing season in August,

Table 5. — Order and Cumulative Percentage of Bud Set by Weekly Interval in August 1958 from the 2-0 Seedlings of the 14 Provenances of Douglas-fir.

Order	Aug. 1		Aug. 8		Aug. 15		Aug. 22	
	Source	Set	Source	Set	Source	Set	Source	Set
		%		%		%		%
1	B	47.3	B	60.1	B	82.1	D	100.0
2	D	35.1	P	52.9	P	81.6	B	98.3
3	P	31.0	O	49.3	C	80.6	C	96.1
4	C	24.5	D	42.4	N	72.8	P	95.6
5	O	21.1	I	37.8	I	70.5	I	94.9
6	M	20.9	C	37.4	D	70.1	O	94 0
7	N	20.2	N	37.1	K	57.6	G	91.5
8	K	19.1	K	31.8	A	57.1	M	87.8
9	I	18.9	M	28.6	O	56.8	K	87.7
10	G	15 5	G	26.3	G	56.7	N	87.5
11	A	13.9	H	26.0	M	48.8	L	85.9
12	J	13.3	A	25.3	H	43.2	H	84.2
13	H	10.3	J	16.5	J	33.1	J	73.0
14	L	8.4	L	17.3	L	30.0	A	71.3

1958. About the same number of seedlings of each provenance lot checked for bud burst were studied in recording the bud set data *(Table 5)*. Recorded differences in bud set between replications of the same provenance were in the magnitude of 10 per cent in the early samplings and 5 per cent in the last sampling.

Some noticeable differences were indicated between the various seed sources with regard to time of terminal bud formation *(Table 5)*. Three of the four lots originating from Vancouver Island, British Columbia, i. e., seed sources B, C, and D, started to form distinct buds in July, but 30 per cent of the plants from the northernmost lot, seed source A, continued their growth late in August. Seed source P, of southern origin, also exhibited an early bud set pattern. Seedlings from lots H, L, and J (from Elbe, Washington; Willamette Valley, Oregon; low elevation site of Molalla area, Oregon, respectively), constituted a group of plants that formed buds late.

Order of bud set of seedlings from certain provenances appeared to be consistent throughout the four field observations, e. g., seed sources B, C, D, and P for the early group and seed sources A, H, J, and L, for the late.

Frost Damage

On March 18, 1958, after prolonged wintry weather having 27 days with minimum temperatures lower than 30° F, a field check of frost damage was made by actual counting of seedlings in the sampled areas of different provenances.

Table 6. — Actual Count of Frost Damage on 1-0 Seedlings of 14 Provenances of Douglas-fir Seedlings on March 18, 1958.

Rank	Seed source	No. seedlings sampled	Frost damage	Average height
			%	*cm*
1	B	174	4.0	7.0
2	G	226	15.1	7.0
3	A	308	15.9	4.8
4	N	260	16.2	7.3
5	K	221	16.3	5.7
6	D	151	19.2	6.2
7	C	165	20.6	6.7
8	H	265	23.8	6.6
9	P	164	26.8	5.1
10	I	180	27.2	6.3
11	L	343	31.8	6.9
12	O	217	32.7	6.8
13	J	292	32.9	5.4
14	M	208	36.1	5.2
LSD 5%			19.88	
1%			26.57	

The seedlings were classified into four groups according to damage: 0, no damage; 1, light damage, i. e., few needles showed reddish color, the terminal buds on all shoots undamaged; 2, medium damage, i. e., terminals damaged, needles killed back 1 cm; and 3, heavy damage, i. e., more than one-half the length of needles and buds were killed. Frost damage on the progenies of the 14 seed sources is shown in *Table 6*. There was evidence that seedlings of seed source B had lower frost damage than some of the others.

Discussion

Importance of establishing provenance tests to study the presence of genetic variation of a tree species has been emphasized by many investigators (10, 12, 24 27). As pointed out by Wright, *et al.* (27). at the end of the first generation the ideal provenance test should give nearly all answers needed to supply a true-breeding ecotype for a particular area.

Phytotronic facilities could provide reliable, rapid means to ascertain various physiological characters, including tolerance levels for environmental factors, reversibility of the temperature inhibitory effects, and relationship of parental environment and behavior of the offspring (8). We can see no way, however, for dispensing with field tests for any study of this nature, since, in nature, each individual tree that survives must encounter the impacts of a multifactored environmental complex. Therefore, this empirical approach to study the gross features of various ecotypes still pays dividends and deserves our close attention.

Studies made on other tree species growing in a continental climate (3, 6) have shown that when seed from high altitudes in the northern part of Europe were planted in the southern part or at low altitudes, resulting trees grew less rapidly and developed less well than trees grown in the same localities from seed of local origin. However, data collected in the nursery for the present study indicated a reverse trend. Stocks from Vancouver Island. except those from seed source A, grew well when compared with local seed source L of the Willamette Valley.

Pauley (19) points out that certain photoperiodic growth responses exhibited by trees appear to be under strong genetic control. Various experiments (4, 7, 11) have shown that short day-length usually induces dormancy and controls the elongation of new tissues in the plant. Data collected on bud setting reveal that three out of the four Vancouver Island lots native to an area with longer photoperiod, formed their buds and terminated their growth earlier than other plants. These results are in agreement with Pauley and Perry's findings (18) in *Populus*. One Vancouver Island lot, the northernmost seed source A. however, exhibited a different pattern in this respect, i. e.. instead of forming buds like other northern stocks, this Nimpkish provenance showed only 71 per cent of the examined plants having distinct buds in late August.

Studies of the effect of changes in photoperiod on species such as *Populus trichocarpa* (18) and *Tsuga canadensis* (17) showed that moving plants native to southern latitudes to northern latitudes (i. e., into a daylength regime longer than that of the native habitat) usually gave increased height growth. However, this certainly was not the result with seedlings from Medford, southern Oregon. Even though seedlings of this group have been transferred northward and to a low altitudinal area, there was little effect of stimulation of growth by this slight increase of photoperiod. The growth period of this particular group remained short in the nursery, probably as a result of natural selection for early cessation by its native habitat which is characterized by the severe summer droughts. This example indicates that some other factors, namely temperature and moisture, may overrule the photoperiodic effect.

Bud bursting of stocks from high altitudes generally occurs later than other stocks, as their nursery performance indicated *(Table 4)*, and this is probably an adaptation to avoid the late spring frost damage. Existence of the clinal variation in time of bud burst between provenance lots suggests that correlation between bud burst and origin or altitude is not simple and direct.

Within these fourteen lots of Douglas-fir, some may be classified into a group that has a comparatively long active growth period, while the other group has a lesser number of days for active elongation. This classification was based on earliness of bud burst and time of bud formation.

Provenance lot H, originating from Elbe, Washington, had a comparatively long period of active growth, i. e., an early bud burst and a late bud formation; however, its total height growth at the end of the second growing season did not indicate any superiority over the other seed sources. In the group with short period of active growth, there were some significant differences as far as the total height growth was concerned. Seedlings from seed source P of Medford origin was the shortest one, but plants from seed sources B and C from Vancouver Island were the tallest recorded in this two-year nursery study. This finding further verifies work reported by Morris, *et al.* (14), in that time of bud bursting (early or late) has no apparent relationship to annual height growth.

These early observations obtained from the nursery performance are not, by any means, conclusive. Nevertheless, apparent racial differences in height growth, phenology, and frost damage have been observed. The interaction of hereditary potentiality and environmental influences on these various groups of Douglas-fir undoubtedly will be revealed in the reciprocal planting plots at each of the seed collection sites. The reciprocal planting was accomplished in the spring of 1959. Growth rate, developmental characteristics, frost resistance, and other factors will be examined annually. Growth pattern, flowering habit, seed production, and wood quality will be studied at appropriate stages of the trees from the 14 provenances at the 14 sites.

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Summary

Douglas-fir seed from fourteen sites on the west side of the Cascade Range in the Pacific Northwest, in latitudes ranging from 42° 20' N to 49° 10' N were collected in 1954 and 1956.

Height, phenology, and frost damage were assessed for seedlings raised at the Oregon Forest Nursery in Corvallis from the seed collected.

Preliminary analysis of data showed distinct correlation between height growth in the second year after sowing and geographic location from which seed originated. Seedlings of northern provenances generally grew well in height. There were significant differences in needle length of different seed sources, and they were somewhat correlated with seedling height.

Bud burst of seedlings from southernmost seed source was significantly earlier than in seedlings from other provenances. Weekly check of bud set on various stocks at end of second growing season revealed time of bud set of seedlings from certain provenances appeared to be consistent throughout the four field observations. Seed source P, of southernmost origin, of high elevation, and three of the four lots originating from northern localities exhibited early bud set.

Zusammenfassung

Titel der Arbeit: *Provenienz-Untersuchung bei Douglasie aus dem pazifischen Nordwesten der USA. — I. Pflanzgartenbefunde.*

1955 und 1956 wurden Douglasiensamen von 14 Standorten auf der Westseite des Kaskadengebirges im pazifischen Nordwesten zwischen 42° 20' und 49° 10' nördlicher Breite gesammelt.

Höhenwuchs, phänologische Erscheinungen und Frostschäden wurden an Pflanzen untersucht, die aus dem gesammelten Samen im Pflanzgartenbetrieb Corvallis des Staates Oregon angezogen worden waren.

Die vorläufige Analyse der Daten zeigte eine deutliche Beziehung zwischen dem Höhenwuchs im zweiten Jahr nach der Aussaat und der Gegend, aus der der Samen stammte. Pflanzen von nördlichen Provenienzen zeigten gewöhnlich gutes Höhenwachstum. Signifikante Unterschiede zwischen den Nadellängen verschiedener Herkünfte wurden festgestellt; diese Unterschiede standen ebenfalls in einer gewissen Beziehung zur Höhe der Pflanzen.

Das Austreiben der Pflanzen der südlichsten Herkunft erfolgte bedeutend früher als das Austreiben der Pflanzen der anderen Provenienzen. Die wöchentliche Überpüfung der Knospenentwicklung an Pflanzen verschiedener Herkunft am Ende der zweiten Vegetationsperiode zeigte, daß die Zeit der Knospenentwicklung bei den Pflanzen bestimmter Provenienzen in allen vier Überprüfungen übereinstimmte. Herkunft P, die südlichste und von einer beträchtlichen Höhenlage stammend, und drei von den vier nördlichen Herkünften zeigten frühe Knospenentwicklung.

Résumé

Titre de l'article: *Etude sur les provenances de douglas dans la région du Pacifique Nord-ouest. — I. Comportement en pépinière.*

Des graines de douglas ont été récoltées en 1955 et 1956; elles provenaient de 14 stations situées sur le versant occidental de la Chaine des Cascades à une latitude variant de 42° 20' à 49° 10'.

Les semis nés de ces graines et cultivés à la pépinière de l'Etat d'Oregon à Corvallis ont fait l'objet d'observations portant sur la hauteur, la phénologie et les dégâts de gelée.

En première analyse on a trouvé une corrélation nette entre la hauteur des semis de 2 ans et la situation géographique des lieux d'origine des graines. Les semis des provenances septentrionales ont généralement une bonne croissance en hauteur. On a trouvé, également, des différences significatives dans la longueur des aiguilles des dif-

férentes provenances et une certaine corrélation de ce caractère, avec la hauteur des semis.

Le débourrage des semis des provenances méridionales était significativement plus précoce que celui des autres provenances. Le contrôle hébdomadaire de la formation des bourgeons (aoûtement) à la fin de la deuxième saison de végétation, contrôle effectué sur des lots de plants différents, a montré une homogénéité dans la date de l'aoûtement à l'intérieur d'une même provenance. La provenance P, méridionale mais d'altitude élevée, ainsi que 3 des 4 lots de provenance septentrionale, ont montré un aoûtement précoce.

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Eine einfache Kulturkammer für Sämlingsprüfung mit Nährlösungskultur

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Bei den Forschungsarbeiten auf dem Gebiet der forstlichen Genetik und der Forstpflanzenzüchtung wird besonderer Wert auf die Frühtestforschung gelegt; W. Schmidt (1957) gibt in seinem Bericht einen wertvollen Überblick über dieses Gebiet. Hierher gehört auch die Beobachtung von frühesten Wachstumsstadien, wie aus den Untersuchungen von Schröck und Stern (1953), Bartels (1953), W. Schmidt (1954), Stern (1956) und Schröck (1956, 1958) hervorgeht.

Ein einwandfreier Vergleich von Sämlingen, vor allem im Hinblick auf erbbedingte morphologische und physiologische Eigenschaften, ist nur möglich, wenn alle zu vergleichenden Pflanzen unter möglichst gleichen Bedingungen herangezogen werden, was bei Anzucht im Freiland nur schwer erreicht werden kann; außerdem fehlt hierbei die Möglichkeit einer Reproduktion und auch Kontrolle der Versuchsbedingungen. Wir haben deshalb versucht, durch Errichtung einer Kulturkammer, in der Licht, Feuchtigkeit, Temperatur sowie Ernährung der Pflanzen in gewissen Grenzen gesteuert werden können, Wachstumsbedingungen zu schaffen, die für eine kurzzeitige Prüfung von Waldbaumsämlingen ausreichen und leicht wiederherstellbar sind.

Vor einiger Zeit hat Ehrendorfer (1957) über seine Erfahrungen bei der Errichtung derartiger Vegetationsschränke berichtet. Im Grundprinzip sind wir seiner Methode betreffend Beleuchtung gefolgt, haben aber zusätzlich eine regelbare Heizung sowie künstliche Ernährung der zu untersuchenden Pflanzen eingeführt. Besonders die Ernährung mit immer gleichartig zusammengesetzten Nährlösungen erschien für die Reproduzierbarkeit der Versuche besonders wichtig, denn Erde kann kaum eine konstante Zusammensetzung aufweisen; außerdem ist zu befürchten, daß durch Erde verschiedene tierische und pflanzliche Schädlinge eingeschleppt und so die Versuchspflanzen gefährdet werden könnten.

Die Kulturkammer

Die im Grundriß rechteckige Kammer, Ausmaß 210×130 ×200 cm, zeigt im Inneren eine Aufteilung auf vier gleichgroße Teilkammern im oberen Teil, Ausmaß 105×65 cm, im unteren Teil ist eine gemeinsame Kammer vorhanden, in der sich die Zusatzheizung sowie Wasserwannen zur Erhöhung der Luftfeuchtigkeit befinden. Die zwei vorderen Teilkammern zeigt das Photo *Abb. 1.* Die Trennung der Kammer in vier Teilkammern hat den Zweck, unter sonst