REPORT ON AN 18-YEAR-OLD SCOTCH PINE PROVENANCE TEST IN NEW HAMPSHIRE

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In the first NEFTIC proceedings Dr. Baldwin described a Scotch pine provenance test that was established in New Hampshire in 1938 as part of an International Union of Forest Research Organizations project. He invited the Northeastern Forest Experiment Station to measure these plantings in the summer of 1955. This report is a summary of those 18-year measurements.

The plantings include 53 provenances, each represented by 1 to 7 plots. One replication consists of single rows of 15 trees each. The other plots are nearly square, containing about 200 trees each. The plantings were made on a 4.2 x 4.2 foot spacing.

Height, diameter, and diameter of the largest branch immediately below breast height were measured on 9 groups of 4 trees each in each 200-tree plot. The same measurements were made on all trees in the 1-tree row plots. All trees were scored for the presence or absence of the other 6 characters listed in table 2. Thirty-nine different analyses of variance were made on the height data to determine the significance of differences between provenance means and to group the provenances into regions (geographic ecotypes) having similar growth rates. Numerous Chi-square analyses were made on the characters scored as present or absent to determine the significance of provenance and regional differences.

The results of these measurements and scorings are presented in tables 1 and 2. With the few exceptions noted in table 2 and in the list below there are no significant differences between provenances grouped into the same region; but there is a sharp break in one or more characters between the provenances from different regions. The exceptions to the regional groupings are:

Height.--IUFRO 55 (G, Poland) is not significantly different from the F (Latvian) or G (German) population, and might belong to either. There was insufficient replication to establish the significance of differences among the I (Rumania), J (Italy), or K (Netherlands) populations or between these and the F (Latvian) or G (German) populations.

Basal Sweep.--IUFRO 36, 37, 38, 44, 45 (G, Poland, Germany) have as low percentages of basal sweep as do the F (Latvian) provenances.

Total Crooks.--INFRO 49 (D, Sweden) has as high a percentage of trees with crooks as does the G (German) population.

Large Crooks.--IUFRO 50 (B, Sweden) has almost as high a percentage of trees with large crooks as does the straightest provenance from Latvia.

Porcupine Damage.--IUFRO 3 (C, Finland) has as high a percentage of porcupine-damaged trees as do many of the G (German) provenances. Two Polish provenances have no porcupine-damaged trees.

Lean.--IUFRO 21, 23, 24 (G, Germany) have as high a percentage of leaning trees as does INFRO 18 (H, Belgium).

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Table 1. Summary of height data for the Scotch pine racial test (IUFRO) at the Fox Forest, Hillsboro, New Hampshire.

IUFRO No.	Height	IUFRO No.	Height	IUFRO No.	Height
	Feet		Feet		Feet
		E	Scotland	G	Germany, Poland Czechoslovakia Hungary
		17	14.8		
		Fox 261	13.8		
A	Scandinavia			53	20.0
1	4.9	F	Latvia	55	18.8
5	5.5		Esthonia	37	19.6
2	6.2			38	20.0
		Fox 243	19.4	39	20.0
B	Scandinavia	11	17.6	40	19.8
		32	19.2	41	19.6
4	9.4			54	20.0
46	10.0	H	Belgium	22	19.6
47	9.4			20	20.6
50	10.1	Fox 246	22.4	21	19.3
51	9.3	18	22.5	23	19.3
				24	19.2
C	Scandinavia	I	Rumania	35	19.9
				36	20.1
7	12.4	14	18.2	42	20.0
3	13.1	34	17.2	43	20.6
6	13.0			44	20.6
8	13.4	J	Italy	45	19.2
				25	19.0
D	Scandinavia	31	17.4		
9	15.0	K	Netherlands		
29	15.1				
30	15.0	19	18.6		
48	15.0				
49	16.0				

All provenances represented by more than one plot are included. Seed sown 1938; outplanted. 1942; spacing 11 feet by 4 feet; measured 1955.

Table 2. Summary of growth data of the Scotch pine racial test (IUFRO) at the Fox Forest, Hillsboro, New Hampshire

Region	Origins	Plots	Trees--		Ave. Height	Ave. D.b.h.	Ave. Branch diam.	Trees with					
			Living	Dead				Basal sweep	Lean	Crooks		Porcupine damage	Fruit
										Total	Large		
	No.	No.	No.	Percent	Feet	In.	In.	Percent	Percent	Percent	Percent	Percent	Percent
A Scandinavia	3	8	699	36	5.60^{f}	.40	.15	0	0^{b}	54^{a}	1^{f}	0^{b}	9^{ab}
B Scandinavia	7	23	1849	32	9.61^{e}	1.30	.39	0^{d}	0^{b}	65	11^{c}	(T)^{b}	13^{ab}
C Scandinavia	4	18	2083	22	13.11^{d}	2.21	.54	3^{c}	(T)^{b}	59	15^{c}	1^{b}	5^{ab}
D Scandinavia	9	24	2160	19	15.47^{c}	2.81	.72	2^{c}	(T)^{b}	54^{ab}	26^{b}	3	(T)
E Scotland	2	5	312	28	14.68^{b}	2.66	.47	2^{c}	2	49	15^{b}	0^{b}	9
F Latvia	3	15	1875	24	18.45^{b}	3.10	.69	7^{b}	2	63	27^{b}	5	1
G Germany Poland, Czechoslovakia, Hungary	21	76	8253	26	19.74	3.45	.80	21^{a}	5^{a}	68	40^{a}	5	1
H Belgium	2	6	521	32	22.47^{b}	3.80	.84	43^{b}	13^{b}	69	46^{c}	10	9^{b}
I Rumania	2	10	1055	30	17.90^{b}	2.88	.69	15^{d}	2	44^{b}	26^{b}	7	4
J Italy	1	2	148	20	17.40^{b}	3.42	.72	20^{d}	0	69	33^{d}	0	6
K Netherlands	1	2	361	11	18.63^{d}	3.33	.85	30^{d}	7	67	38^{d}	8	6

(T) - Trace less than 0.5 percent
a - Significant differences within region
b - Significantly different from Region G (Germany, Poland, Czechoslovakia)
c - Significantly different from Region F (Latvia)
d - Significantly different from Region D (Scandinavia)
e - Significantly different from Region C (Scandinavia).
f - Significantly different from Region B (Scandinavia)

Our interpretation of Scotch pine as consisting of a number of geographic ecotypes rather than of a series of clines (character-gradients) is somewhat at variance with other interpretations of the species. To determine which interpretation is correct, we have gone through the literature rather thoroughly. Langlet's very extensive study of Swedish Scotch pine is one of the few tests that has been conducted with sufficient precision or sufficient replication to be used in a valid comparison with the New Hampshire data. We have re-analyzed much of his data[2], and find that they show discontinuities similar to ours.

This experiment yielded useful information about experimental design. One of the most significant findings was that trees of very fast-growing and very slow-growing provenances made about the same height growth regard less of whether they were in 15-tree row plots or in the large square plots,. In these 15-tree row plots there was no significant accentuation of height -growth differences between provenances of different growth rates. This was contrary to expectations; it makes us look anew at the hypothesis that large plots are necessary to obtain useful silvicultural information on provenances that are sufficiently fast growing to be important.

The provenances from Latvia and Esthonia (Pinus sylvestris var. rigensis) seem to be the most suitable of those tested for timber and pulp wood plantings in New Hampshire. They are moderately fast growing and straight boled. Every plot of these provenances contained more than enough suitably spaced trees to form a fully stocked mature stand in which every tree will contain a straight basal log. The Scandinavian provenances are likewise free of bole defects but are slow-growing. The other provenances from continental Europe are somewhat faster growing than the Latvian trees but possess high percentages of bole defects. It is likely that Scotch pine's poor reputation in this region is based on plantings of these other continental provenances and that if all plantings had been made with Latvian and Esthonian material the species would enjoy an excellent reputation.

These analyses will be included in a more detailed report of these New Hampshire tests now in the course of preparation.

DISCUSSION

Heimburger What conclusion can you make out of your data so far as to the best suitable, for instance in New England, from these tests?

Wright The Latvian provenances were the most satisfactory from the standpoint of both growth rate and form.

Littlefield What races show the closest degree of yellow foliage color in the winter?

Baldwin I don't have here the results of the scoring I made last winter on color. Yellow is more characteristic of many German inland continental types., as well, of course as of the far north.

Littlefield Do you have any Latvian or Estonian that are blue?

Baldwin I don't recall whether we had any Latvian or Esthonian that were blue.

Kriebel Latvian trees would presumably include the so-called "Riga" strain; this very definitely turns yellow, at least in Ohio.

Pelt I believe the differentiation in winter coloration, especially the yellowing or distinct green color of certain strains, has been found to show up better or be more pronounced in 2- to 5-year-old seedling or transplant stock.

Baldwin I think Eliason has some remarks about that too. We did observe when these trees were in the seed beds the yellow trees were more purple. Yellow and golden color was observed casually all the time the plantations were growing and I don't notice a great deal of difference in winter color as the trees get older. The differences are very prominent now, and they were ten years ago.

Kennedy T have noticed for the past several years that Scotch pine trees have a more pronounced color on the south side than the north; that is during the late fall when coloring occurs. This would indicate that the sun has something to do with this coloring effect. Does anyone know what actually causes coloring on the pines in the late fall?

Simonds The Pennsylvania Christmas Tree Growers Association has been coming to a classification system for Christmas trees. I've just got down here some of the points that they're interested in for getting what you might term more ideal types of Christmas trees. One thing of course is color, whether it is gray blue or just a plain green is not as important as the fact that it should not be yellowish or brown in the fall. They'd like to get away from that. Another very important thing is the density of the foliage, whether i is a tree that you can see through, that's open, or whether it's a tree with foliage so dense you can't see the stems. Bigness is of minor importance. The length of the needle is an important thing. They don't want needles too long or too short.

Another very important thing is the angle of branching. Trees with branch angles near 90° look more open than a tree which has branch angles between 60° and 45°. In that way it closes up and you have a tree with a longer intermode to give you a better tree than one with a 90° angle and the same amount of foliage. Of course they want a tree that has wide adaptability to climate, soil and so forth.

It would also be desirable to have trees that bear cones fairly early. Some of the Christmas tree growers are collecting cones from young trees for seed and planting them. It would also be important to have local seed sources where we can find some of these better strains. Some of our Christmas tree growers are actually growing some of their own seed but we need larger sources.