



# MINNESOTA FORESTRY NOTES

COPY 2

No. 163

April 15, 1965

DWARF SEEDLINGS FROM WITCHES' BROOMS IN JACK PINE II. 1/

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In a recent publication (Minn. For. Notes No. 158, January 15, 1965) we reported evidence that a normal-dwarf ratio of 1 : 1 characterizes the segregation ratio of plants grown from open pollinated witches' broom seed of jack pine (Pinus banksiana Lambert). In the absence of any evidence that the five witches' brooms tested were due to a pathogen, the conclusion was made that the observed segregation was genetically determined since such a 1 : 1 segregation ratio was that to be expected from a simple Mendelian dominant gene for dwarfism when fertilization is accomplished by normal pollen. This hypothesis is further supported by the observed total absence of male strobili on the brooms studied. In a comparable series of tests with progenies grown from seed produced in witches' brooms of white pine (P. strobus L.) and sand pine (P. clausa Sarg.) similar 1 : 1 ratios were observed. These data have not yet been fully analyzed statistically, but do not appear to differ from those observed in jack pine.

In all segregating populations the distinction between normal and dwarfed trees was sufficiently clear to permit classification during the first season of growth. In a few cases some suppressed normal seedlings were classified as dwarfs, but these totalled only 8 in the 1411 dwarf jack pine seedlings tallied, an error of less than .6 percent.

Aside from the gross differences characterizing dwarf and normal seedlings there were distinct differences between the progeny of different brooms. These differences, reflected chiefly in the height and crown density of the seedlings, appeared quite uniform within progenies.

With the objective of providing adequate data for an analysis of height growth and other differences among the normal and dwarf segregates of the five broom progenies studied, a 5-replicate randomized complete block nursery planting was made at the University of Minnesota's North Central Experiment Station nursery on May 4, 1962. The seed was sown in 4-ft. rows at the rate of 50 seeds/row. Each plot consisted of two rows, i.e., 100 seeds. Spacing between rows was 12 inches. Survival and segregation counts were made at the end of the first growing season. During the second growing season some normal plants were removed from all plots to provide release for overtopped dwarf plants. Survival in the thinned plots at the end of the first growing season ranged from 51 to 68 percent. Mean heights of dwarf and normal trees were determined for each plot in April, 1964 (Table 1).

1/ Establishment and maintenance support for this study was provided in part by the Charles K. Blandin Foundation, Grand Rapids, Minn.

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Table 1. Mean height of dwarf (D) and normal (N) 2-0 seedling progenies, April, 1964.

Progeny No.- dwarf (D); normal (N)	Replicate					Mean
	1	2	3	4	5	
	----Mean Height in cm----					
1-D	17	17	18	19	19	18.0
1-N	38	44	36	49	46	42.6
2-D	28	29	33	28	34	30.4
2-N	42	48	39	38	42	51.8
3-D	25	23	23	25	30	25.2
3-N	58	36	40	30	40	40.8
4-D	25	30	31	21	29	28.4
4-N	50	62	44	42	42	58.0
5-D	17	18	18	18	18	17.8
5-N	38	52	40	47	47	44.8

The magnitude and uniformity of differences in height between dwarf and normal progenies in all replicates is apparent in Table 1. Analysis of variance of the five dwarf progenies indicated a highly significant (.01 level) difference in height means. Analysis of the normal progeny height means also indicated a statistical difference (.05 level). Dwarf and normal progeny height means were also analyzed by Duncan's Multiple Range Test. The results are summarized in Table 2.

Table 2. Multiple range test: mean heights of dwarf and normal 2-0 seedlings. Values not included in the same bracket are significantly different at the indicated probability level.

Dwarf Segregates		Normal Segregates	
Progeny No.	Mean Ht. cm	Progeny No.	Mean Ht. cm
2	30.4	4	58.0
4	28.4	2	51.8
	P = .01		P = .05
3	25.2	5	44.8
1	18.0	1	42.6
5	17.8	3	40.8

Conspicuous needle-length differences characterized normal and dwarf segregates of the five broom-derived progenies studied. The average needle length of the normal progenies (6.36 cm) was almost twice that of the dwarfs (3.38 cm). Similar differences in needle length characterize the brooms and non-broomed portions of the crowns of parental trees. Analysis of variance of needle length means of the dwarf progenies indicated no statistically significant differences.

There is some evidence of similarity in shape and density between the parental brooms and the dwarf progenies derived from them. With increasing age of the dwarf plants some meaningful correlations may be detectable. If dwarf seedlings are to be grown for ornamental purposes, the choice of parental seed should be based on suitable progeny tests.

