FEMALE STROBILI ON 12-MONTH-OLD JACK PINE

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Jack pine from four separate progeny groups grown under near optimum conditions in a greenhouse for 10 weeks and transplanted to the nursery in early July had female strobili on 1 percent of the trees the following spring.

Forest geneticists and tree breeders are continuously searching for ways to reduce the age at which flowering begins. Jack pine *(Pinus banksiana* Lamb.) is among the youngest of the pines to flower *(4)*.At wide spacing in the nursery, Wright *(8)* noted flowering at 3 years of age. However, in standard nursery beds in lower Michigan, only 0.3 percent of 3year-old seedlings produced female strobili and only a small percentage of these bore male strobili *(5)*.

When seedlings were grown under near optimum conditions in the greenhouse and nursery, two separate studies showed that from 16 to 23 percent of 17month-old seedlings produced female strobili, 62 percent flowered at 23 months, and 71 percent at four years *(3, 5)*. Practically no male strobili were produced on these plants in the first 3 years.

In this paper I report the production of female strobili on jack pine seedlings about 12 months old.

Materials and Methods

The study trees include four types of progenies: (1) open-pollinated progenies from the original parent or S_O trees, (2) S_1 X S_1 trees or progenies from selfed trees (S_1) control pollinated with pollen from other selfed trees, (3) open-pollinated progenies from the S_1 trees, and (4) S_2 progenies or trees from self-pollinations of the S_1 trees.

The origin of the seed for the S. trees was the Chippewa National Forest in Minnesota and the original seedlings were started in the nursery in 1951 *(5)*. Self-pollinations to produce the S, generation were made in 1962 and 1963 and those for the S_2 generation and cross-pollinations of the S_1 X S_1 trees were made in 1974 on 10-year old S_1 trees *(6)*. Seventy-one progenies, including various numbers of each of the four types mentioned above, were available.

The seed from each lot was placed on moist filter paper in petri-dishes for germination at room temperature on April 16, 1976. When the seed germinated and before the seedcoats were shed, the seedlings were planted into "Jiffy 7" peat pellets in a greenhouse in a replicated design *(6)*. Greenhouse temperatures were usually 22° C during the day and 17° C at night but daytime temperatures occasionally reached 30° C on warm sunny days. The seedlings were fertilized with water-soluble 20-10-10 fertilizer as needed to maintain vigorous growth. A 20-hour photoperiod was provided and a 50-percent shade screen covered the greenhouse.

Seedling height was measured at 10 weeks of age and the seedlings were transplanted into nursery beds at the Hugo Sauer Nursery near Rhinelander, Wis. in late June and early July, 1976. Spacing between plants was 25 by 25 cm in four tree plots. A 50 percent shade screen was kept over the seedlings for 3 weeks. Height growth during the remainder of the season was undoubtedly influenced by the late transplanting date because little additional shoot elongation was noted. Foliage elongation and bud development continued later into the season. Tree height was measured again at the end of the 1976 and 1977 growing seasons. Flowering was scored in early May 1977.

Results and Discussion

Twenty-one (1 percent) of 2,106 surviving seedlings had female strobili in May 1977 or at about 12 months of age (table 1). This is the youngest flowering age thus far reported for jack pine. Because female strobili at this location are differentiated in August *(1)*, differentiation in this study occurred when the seedlings were about 4 months old.

All of the female strobili were borne on the terminal shoot of the main stem. Only one of the 21 trees bore two strobili; the others had one. No male strobili were produced at this age.

Average height of the flowering trees was significantly greater than that of the nonflowering trees at the end of the greenhouse phase

and continued so at the end of the first and second growing seasons in the nursery (table 1). The trees were all of the same age, suggesting that tree size attained by a given age is an important factor in early flowering. However, some nonflowering trees were taller than flowering trees within progenies in the same plot, indicating that factors other than tree size, also affect early flowering.

An additional phenomenon observed while scoring the flowering was the presence of single vegetative buds in positions on the terminal shoots where female strobili would normally be found. These buds were smaller than normal lateral branch buds on the same tree and had the same characteristic, more pointed shape of female strobili buds. Until resumption of vegetative growth in the spring, they could readily have been mistaken for female strobili buds. During the growing season they produced a very short, weak lateral shoot. These observations suggest that the female-like buds may have begun differentiation as female strobili buds the previous season and at some point during differentiation reverted to a vegetative type. This possibility is further supported by the fact that female strobili are modified long shoots (2). Such reversion of male strobili buds to vegetative buds has been noted in Douglas-fir (7).

Table 1.—*Comparison of tree heights of flowering trees with means of three other trees within four-tree plots (in millimeters)*

	Tree height-- 10 weeks[1]		Tree height-- 1 year[2]		Tree height-- 2 years[2]	
Tree number	Flowering trees	Other trees in plot	Flowering trees	Other trees in plot	Flowering trees	Other trees in plot
S-91, OPA-3	165	158	130	125	477	489
N-53, OPVL-1	165	176	109	130	296	414
N-23, OPA-2	202	169	190	134	601	450
N-23, OPA-4	183	175	155	146	484	489
N-2, S_1XS_1-2	171	174	130	144	497	392
N-46-2, S_2-1	203	203	165	178	377	402
P-88-2, OPVL-1	220	192	170	160	465	416
P-49, OPVL-4	220	211	140	152	465	506
P-88-2, S_1XS_1-2	207	182	127	148	509	497
S-91, OPVL-1	197	191	190	160	602	561
N-23, OPA-1	152	124	140	93	547	349
N-12, OPVL-3	222	190	180	161	538	457
N-12, S_2-1	188	177	150	138	514	393
N-82, OPA-2	223	214	170	170	507	485
N-2, OPA-2	176	191	140	165	539	580
N-53, OPVL-3	195	164	160	135	510	372
P-88-1, OPVL-3	195	140	150	113	523	424
N-53, OPA-2	161	133	144	100	481	275
P-87, S1XS$_1$-1	152	134	132	98	429	333
N-36, S_1XS_1-2	201	194	176	145	539	467
P-14, OPA-4	172	148	140	126	473	481
Mean	189.0	173.3	151.8	139.1	494.0	439.6
Std. Dev.	23.0	25.9	21.9	23.8	68.4	74.3
"t"	4.29[3]		2.40[4]		2.97[3]	

[1] Measured to tip of vertically extended foliage.
[2] Measured to tip of terminal shoot bud.
[3] Significant at 1 percent level.
[4] Significant at 5 percent level.

Noteworthy also is the distribution of the flowering trees among the four types of progenies. Of the 21 flowering trees, eight were in open-pollinated progenies of the S_O trees, seven in open-pollinated progenies of S_1 trees, four in S_1 X S_1 cross-pollinated progenies, and two in S_2 progenies. The number of trees available in the progeny groups varies. Therefore, the frequency of flowering trees translates to 1.23, 1.18, 0.77 and 0.55 percent for the