THE YELLOW X PAPER BIRCH HYBRID--A POTENTIAL SUBSTITUTE FOR YELLOW BIRCH ON PROBLEM SITES

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ABSTRACT--Yellow x paper birch hybrids and yellow birches with common female parents were compared after 5 growing seasons in an open field. Survival of the hybrids was 91 percent compared with 64 percent for the yellow birch trees. The hybrids were from 25 to 32 percent taller than the yellow birches and had 19-40 percent greater diameter. Because this hybrid not only grows better than yellow birch but also withstands greater environmental stress, it appears suitable for planting on open or partially shaded sites where ecological conditions are less favorable for yellow birch.

Natural interspecific hybridization is common in the genus Betula but natural hybrids between yellow birch (B. alleghaniensis Britt.) and paper birch (B. papyrifera Marsh.) have only been reported from Iowa, Minnesota, Wisconsin, Michigan, and New Hampshire (Clausen 1973b, Barnes et al. 1974). However, hybridization between these species apparently does occur over much of the range of yellow birch. When we grew yellow birch seedlings for a range-wide provenance study, yellow x paper birch hybrids appeared in 32 out of 55 seed sources. The sources with hybrids came from 13 states and 4 Canadian provinces ranging from Newfoundland to Minnesota and from Quebec to Georgia (Clausen 1973b). Because the hybrid seedlings grew faster than the yellow birch seedlings in the nursery, I decided to test this hybrid against yellow birch and to try to determine its potential as a possible substitute for yellow birch on certain sites.

METHODS

In the spring of 1972, when a yellow birch progeny test was

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established near Lake Tomahawk in Oneida County, northcentral Wisconsin, a number of yellow x paper birch hybrids were included. The seedlings for the progeny test were grown in a nursery at Rhinelander, Wisconsin, as previously described (Clausen 1973a), and planted in the field when 4 years old. The test site, a former potato field and pasture on Padus sandy loam, was kept clean-cultivated through the summer of 1975 and later mowed. The plantation included 144 yellow birch families in a split-plot design with 6 or 8 replications and hybrid trees of 3 families in 1, 5, and 12 replications, respectively. All families were set out in 4-tree plots and at 8 x 8 ft. spacing. From 1 to 3 hybrid trees of 13 additional families were planted in the border rows of the plantation. Two of these families were from Canadian sources that had not produced hybrids when used in the provenance test.

Height and diameter at one-half tree height were measured after 5 growing seasons in the field. This paper is mainly concerned with those hybrid and yellow birch groups that had female parents in common and were growing together in the same replications. Because suitable yellow birch comparison plots were not available for about one-half of the hybrid plots and 13 of the hybrid families, these plots were not used in the analyses but did provide supporting information.

RESULTS

Previous publications reported the performance of the yellow birch families included in the progeny test after 4 years in the nursery (Clausen 1973a) and after 3 years in the field (Clausen 1975) but did not include any information about the performance of the hybrids. By the same token, the major portion of the 5-year yellow birch data will be presented elsewhere.

All trees in the hybrid plots with useable comparison plots were alive at the end of the fifth growing season in the field and only two comparison trees in one yellow birch family had died. Survival of all hybrids in the plantation was 91 percent compared with 64 percent for the yellow birch trees used as comparison trees or growing adjacent to the hybrids. Thus, the yellow x paper birch appears to survive better than yellow birch when planted under open field conditions.

Most hybrids followed the trend observed earlier in the nursery, and were still growing faster than yellow birch after 5 years in the field. The yellow birch comparison families averaged 174 cm in height compared with 221 cm for the hybrids (table 1). Of the individual families, hybrid group 2964-5, on the average, was 25 percent taller than its comparison group. A t-test showed that this difference was significant at the 0.5 level. The superiority in individual blocks ranged from 15 to 34 percent. Similarly, the superiority of the hybrids over the related yellow birches in family 2983-1 ranged from 8 to 60

percent and averaged 28 percent. This difference was not significant according to the t-test, probably because the differences between hybrids and yellow birch were small in 2 of the 4 blocks. The single plot of hybrid family 2983-10 was 32 percent taller than the yellow birch plot (table 1).

Table 1.--Mean height and diameter of yellow birch and yellow x paper birch hybrids after 5 years in the field

Family	Type of birch	No. of plots	Mean height	Percent superiority Mean	Percent superiority Range	Mean diameter[1/]	Percent superiority Mean	Percent superiority Range
			cm			mm		
2964-5	Yellow	4	172	--	--	13.6	--	--
	Hybrid	4	214*	25	15-34	16.1	19	4-36
2983-1	Yellow	4	176	--	--	13.1	--	--
	Hybrid	4	226	28	8-60	16.2*	24	3-31
2983-10	Yellow	1	174	--	--	11.4	--	--
	Hybrid	1	230	32	--	15.9	40	--
Means:	Yellow birch		174			13.1		
Means:	Hybrid		221			16.1		

1/ Measured at one-half tree height.
* Difference between yellow birch and hybrid is significant at .05 level (t-test).

When additional hybrid plots of families 2964-5 and 2983-1 and of 12 other families were compared with unrelated yellow birches in adjacent plots, the hybrids were taller in 18 plots, of equal size in 1 plot, and smaller than yellow birch in 5 plots. So in general, the yellow x paper birch hybrid does have faster height growth than yellow birch does.

Tree diameter followed a pattern similar to that for tree height. The yellow birch families in the 9 comparison plots averaged 13.1 mm in diameter at one-half tree height as against 16 mm for the hybrids (table 1). Hybrid group 2983-1 had a significantly greater diameter than its comparison trees with an average superiority of 24 percent and a range between blocks from 3 to 31 percent. The diameter of hybrid plot 2983-10 was 40 percent greater than that of the yellow birch comparison plot. In the comparisons between hybrid plots and unrelated yellow birches, the hybrids had greater diameter in 21 plots, were of equal size in 1

plot, and had smaller diameter than yellow birch in 2 plots. Thus, the hybrid also has better diameter growth than yellow birch in most cases.

The superiority of the hybrid over yellow birch was also evident when single trees were compared. The tallest tree in a hybrid plot (family 2964-5) was 330 cm while the tallest yellow birch in a comparison plot (family 2983-1) measured 280 cm. This is a difference of 18 percent. In addition, the tallest tree per plot exceeded 200 cm in all of the 15 surviving hybrid groups, whereas only 5 of the yellow birch families had trees 200 cm and above. Although the greatest mid-tree diameter observed, 25 mm, was the same for both the hybrid and for yellow birch, nine hybrid groups had trees with diameters 15 mm and above, while only four yellow birch families had trees in this class.

DISCUSSION

The fact that hybrid seed is produced by yellow birch parent trees over much of the range of yellow birch (Clausen 1973b), indicates that hybridization between yellow birch and paper birch can take place wherever the two species occur together. The relative scarcity of reported hybrids may mean that the hybrids have difficulty getting established under natural conditions due to lack of suitable seedbeds and to competition from other plants. The 20 hybrids located by Barnes et al. (1974) were all growing in disturbed habitats which would have had exposed mineral soil, abundant light and little competition at the time of establishment. These authors also suggested that the hybrids were most likely to be found on mesic or wet-mesic sites. This is not too surprising because most hybrids have been found growing in association with yellow birch which typically occurs on such sites. However, the results of this study show that the hybrid can survive and grow very well on a much drier site. One could, in fact, expect such a possibility because the other parent of the hybrid, paper birch, is a pioneer species capable of growing on a wide range of sites, including fairly dry ones (Fowells 1965).

Open-field sites such as the one used in this test may not provide the best conditions for the growing of yellow birch but apparently are well suited for the hybrid. On such sites, control of competing vegetation is fairly easily accomplished and undoubtedly benefits both species. The abundance of light on open field sites appears to favor the hybrid, whereas our experience indicates that yellow birch will grow better under some degree of shade. The hybrid will also withstand greater environmental stress than yellow birch. Many trees in this plantation were left in a weakened condition at the end of the 1976 growing season due to a severe drought during the summer and fall. A light snow cover over the winter followed by hot, dry weather during May 1977 lead to further tree mortality so that only 78 percent of the hybrids and 35 percent of the yellow birches used in the comparisons were alive in June of that year.

Although the natural hybrid has shown better growth than yellow birch, it may not be superior to its other parent, paper birch. There were no paper birch trees included in this plantation so a direct comparison is not possible in this case. However, hybrids from controlled crosses between the two species have been grown and compared with trees of both parent species. In those tests, the hybrids again were faster growing than yellow birches of the same age, but were either slower growing or, at best, grew as fast as paper birch (Clausen 1973b).

The superior growth of the yellow x paper birch hybrid and its greater ability to survive in the open suggests to me that this hybrid would make a good tree to plant in places where the ecological conditions are less favorable for yellow birch. In other words, the hybrid could be planted in open or partially shaded areas where it could take advantage of the high degree of insolation and still would be able to tolerate the drier site. So far we don't know what the wood characteristics of the hybrid are but assuming that they are similar to those of yellow birch, the proposed use of the hybrid would enable us to grow a tree resembling yellow birch on a wider range of sites.

How then can one obtain planting stock of this hybrid? Although it is not difficult to recognize the hybrid in nursery beds of yellow birch, this method is impractical because less than 1 percent and rarely as much as 10 percent of the seedlings are usually hybrids (Clausen 1973b). A much more efficient way is to use controlled pollination. This is most easily carried out on grafted trees in the greenhouse but can also be done in the field. Yellow birch females should be pollinated with paper birch pollen because the chance of success and the yield of good seed is poorer when the cross is made in the opposite direction (Clausen 1970). Seed yield from yellow x paper birch crosses is about as good as that of open-pollinated yellow birch where it typically ranges from 150 to 200 seeds per catkin or occasionally higher. The hybrid seed tends to be of pooer quality than that of yellow birch but usually averaged about 50 percent germination. Because even a small yellow birch graft can have 10 to 20 female catkins, it is thus possible to produce a large amount of hybrid seed with relatively little effort.

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