RESEARCH NOTE NC-75

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE
Folwell Avenue, St. Paul, Minnesota 55101

Bark Characteristics Indicate Age and Growth Rate of Yellow Birch

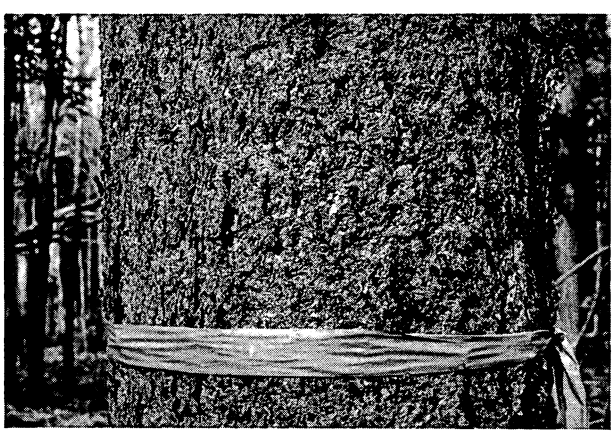
ABSTRACT. — Yellow birch trees with peeling or smooth bark tend to be younger and faster growing than rough-barked trees of similar diameters and should be selected as crop trees or superior tree candidates.

OXFORD: 811.79:523.9:559:815.2:176.1 *Betula alleghaniensis*

Published marking guides for oaks and yellow-poplar and northern hardwoods show bark characteristics to be reliable indicators of tree vigor (Burkle and Guttenberg 1952, Arbogast 1957). Kennedy and Wilson (1954) have also shown that there is a strong relationship between bark type and age in subalpine fir with the cork-barked trees being consistently older than trees with smooth bark. In a recent publication we suggested that smooth-barked yellow birches 12 inches d.b.h. and larger tend to be faster growing than rough-barked trees (Clausen and Godman 1967). We now have data showing that this difference is apparent even in smaller trees and that smooth-barked yellow birches also are younger than rough-barked trees of similar diameter.

In the bark type called smooth or peeling in this paper, the outer layers of the bark usually separate into thin, papery curls (fig. 1). These layers often slough off with age leaving an essentially smooth bark. The rough type of bark does not exfoliate or peel in younger trees but breaks up into plates in older trees (fig. 2). Large, smooth-barked trees may have a small amount of rough bark near the ground line while rough-barked trees have this type of bark extending high up on the stem. Rough bark appears to be less common than the smooth type and may not occur in all stands.

F-519217
Figure 1. — Peeling bark of tree 15.2 inches in diameter at breast height (ribbon).



F-519218
Figure 2. — Rough bark of tree 14.8 inches in diameter at breast height (ribbon).

Methods

Pairs of yellow birches, one smooth-barked and one rough-barked, were selected in northern hardwood stands on the Argonne Experimental Forest in northern Wisconsin. To be included, members of each pair had to: (1) have breast height diameters differing 1 inch or less from each other, (2) be of the same crown class, and (3) be located within 150 feet of each other. The trees making up the nine pairs ranged from 3 to 15 inches d.b.h. and were all strong codominants (table 1). Members of most pairs were less than 100 feet apart.

The trees were felled and a stem section was taken at breast height from each tree. Annual rings were counted in order to determine the number of years each tree required to reach 4 inches in diameter at breast height and tree age at this height. Diameter growth for each 10-year period from the bark toward the center was measured to the nearest 0.01 inch along four radii, two on the largest diameter and two at right angles to it. Bark thickness was measured to the nearest 0.01 inch on the same four radii and on four additional radii midway between the other measurements.

Results

The most striking result of this study was the difference in age between the members of each pair. All the rough-barked trees were older than their smooth-barked counterparts, ranging as high as 3.7 times as old (table 1). The rough-barked trees on the average took twice as long to reach 4 inches in diameter at breast height as did trees with smooth or peeling bark (56.8 years versus 28.0 years). Although the rough-barked trees tended to be slow starters, partly because they were established before the stands were cut 60 to 65 years ago, the smooth-barked member of pair No. 4 was as slow as the rough-barked trees in pairs 3 and 5.

The average annual diameter growth of the smooth-barked trees was 0.172 inch compared with 0.092 inch for the rough-barked trees, and all the smooth-barked trees were faster growing than their rough-barked counterparts (table 1). Although diameter growth in the last decade in general was less than expected from the average annual diameter growth, the smooth-barked trees with an average of 1.29 inch were still growing more than twice as fast as the rough-barked trees with 0.59 inch. Most of the

Table 1. — *Average age at 4 inches d.b.h., bark thickness, and growth of nine pairs of yellow birch*

Pair number	Bark type	D.b.h.	Age at breast height	Age at 4 inches d.b.h.	Bark thickness	Diam. growth/year	Diam. growth last 10 yrs.
		Inches	Years	Years	Inches	Inches	Inches
1	Smooth	15.2	78	26.2	0.259	0.195	1.08
	Rough	14.8	162	77.0	.491	.091	.72
2	Smooth	13.6	55	17.9	.234	.247	1.48
	Rough	14.3	136	55.1	.356	.105	.56
3	Smooth	11.6	56	21.9	.269	.207	1.30
	Rough	11.8	206	37.2	.584	.057	.56
4	Smooth	10.6	83	40.2	.250	.128	.68
	Rough	9.6	192	85.4	.609	.050	.17
5	Smooth	9.5	53	24.0	.194	.179	1.30
	Rough	10.0	77	38.9	.272	.130	.47
6	Smooth	8.0	52	30.0	.188	.154	1.42
	Rough	7.8	80	48.1	.166	.098	.48
7	Smooth	6.8	50	27.1	.125	.136	.71
	Rough	7.1	93	56.4	.172	.076	.30
8	Peeling	5.5	43	36.5	.072	.128	1.91
	Nonpeeling	5.5	66	55.9	.172	.083	.84
9	Peeling	3.3	19	1/ 14.2	.075	.174	1.76
	Nonpeeling	3.1	23	1/ 15.1	.090	.135	1.19

1/ Years to reach 2 inches d.b.h.

trees had grown considerably faster at some earlier period of their lives. The best diameter growth in any decade for the smooth-barked trees ranged from 1.65 to 3.04 inches and averaged 2.22 inches; corresponding values for the rough-barked trees were 0.59 to 2.35 inches and 1.42 inch. One rough-barked tree grew faster than its smooth-barked counterpart in its best decade and thus had the potential for good diameter growth but had become a very slow-growing tree in the most recent decade.

With the exception of pair No. 6, the rough-barked trees all had thicker bark than their smooth-barked counterparts (table 1). Although bark thickness, as expected, increased with diameter, the regression equations for smooth- and rough-barked trees were not significantly different from each other. Since bark thickness is closely related to age ($r = 0.948^{**}$) the rough-barked trees had thicker bark primarily because they were so much older than smooth-barked trees of similar diameters.

The smooth bark averaged 4.0 percent of the d.b.h. The rough bark, on the other hand, averaged 7.3 percent. Using the conversion factor given by Gevorkiantz and Olsen (1955), we found average bark volume to be 8.0 percent for the smooth-barked trees and 14.6 percent for the rough-barked trees. The latter figure agrees well with the 14 percent listed by Gevorkiantz and Olsen (1955) for yellow birch of these sizes. Adjustment for individual trees is, therefore, important when using these volume tables since the smooth-barked trees all had less than 14 percent bark while rough-barked trees had as much as 25 percent bark. Unless adjustments are made for excessive bark thickness in tree volume calculations, the buyer of standing timber may be paying for a lot of useless bark.

Bark thickness also affects basal area calculations since these usually are based on diameter outside bark. The area of the stem sections occupied by bark averaged 7.2 percent in the smooth-barked trees and 12.7 percent in the rough-barked trees. The bark area did not exceed 10 percent in any smooth-barked tree but was as high as 23.4 percent in rough-barked trees. Thus, when stand volume computations include basal area there will be a serious overestimate if many of the yellow birches have thick bark.

Implications

The results of this study demonstrate that external bark characteristics indicate age and growth rate in yellow birch as well as the volume of wood that can be expected for trees of a given size. Trees with peeling or smooth bark tend to be younger and faster growing — possibly due to genetic traits — normally have had a shorter period of suppression during their establishment period, and should yield more wood for a given stem size than rough-barked trees. Smooth-barked trees, therefore, should be favored as crop trees wherever possible and should be selected as superior tree candidates. Obviously, we do not want to select a tree that has taken 200 years to reach 12 inches d.b.h. when another tree has done it in 50 to 60 years.

Literature Cited

Arbogast, C., Jr. 1957. Marking guides for northern hardwoods under the selection system. U.S.D.A. Forest Serv. Lake States Forest Exp. Sta., Sta. Pap. 56, 20 p., illus.

Burkle, J. L., and Guttenberg, S. 1952. Marking guides for oaks and yellow-poplar in the southern uplands. U.S.D.A. Forest Serv. Southern Forest Exp. Sta., Occas. Pap. 125, 27 p., illus.

Clausen, K. E., and Godman, R. M. 1967. Selecting superior yellow birch trees — a preliminary guide. U.S.D.A. Forest Serv. Res. Pap. NC-20, 10 p., illus. N. Cent. Forest Exp. Sta., St. Paul, Minn.

Gevorkiantz, S. R., and Olsen, L. P. 1955. Composite volume tables for timber and their application in the Lake States. U.S. Dep. Agr. Tech. Bull. 1104, 51 p.

Kennedy, R. W., and Wilson, J. W. 1954. Studies on smooth and cork-bark *Abies lasiocarpa*: I. Fiber length comparisons. Pulp Pap. Mag. Can. 55: 130-132.

KNUD E. CLAUSEN
Plant Geneticist
Institute of Forest Genetics
RICHARD M. GODMAN
Silviculturist
Northern Hardwoods Laboratory
Rhinelander, Wisconsin

1969