Silvical Characteristics of Sweet Birch

(Betula lenta)

by William B. Leak

STATION PAPER NO. 116 / NORTHEASTERN FOREST EXPERIMENT STATION
U.S. FOREST SERVICE / U.S. DEPARTMENT OF AGRICULTURE
RALPH W. MARQUIS, DIRECTOR

Preface

MUCH of the silvical information on our forest trees is widely scattered and sometimes difficult to find. To make this material more readily available, the Forest Service is assembling information on the silvical characteristics of all the important native forest tree species of the United States. It is expected that this information will be published as a comprehensive silvics manual.

This report presents the silvical characteristics of one species. It contains the essential information that will appear in the general manual but has been written with particular reference to the species in the Northeast. Similar reports on other species are being prepared by this Experiment Station, and by several of the other regional forest experiment stations.

Silvical Characteristics of Sweet Birch

by William B. Leak

●

About the Author ...

WILLIAM B. LEAK *received his Bachelor's degree in general forestry at the State University of New York College of Forestry, at Syracuse, in 1953 and his Master's degree at the same institution in 1956. He joined the Northeastern Forest Experiment Station in 1956 as a research forester, and served a year and a half in hardwood nursery and planting research at Burlington, Vermont, before taking up his current work in northern hardwood silviculture at the Experiment Station's research center at Laconia, New Hampshire.*

Contents

Commercial Importance

SWEET birch *(Betula lenta)* is also known as black birch and cherry birch *(27)*. It is commercially less important than the two principal members of the genus, yellow birch *(Betula alleghaniensis)* and paper birch *(Betula papyrifera)*.

Although the wood of sweet birch is slightly heavier and harder than that of yellow birch *(2, 9)*, the two species are sometimes accepted together for such common uses as furniture, flooring, containers, woodenware, and interior finish, as well as for hardwood distillation and fuel *(32, 46)*. Utilization statistics usually lump both species together under the common name, "birch", but sweet birch accounts for only a very small part of the total "birch" production.

Thirty or forty years ago, sweet birch was used in making imitation mahogany furniture *(22)*. The common local name of "mahogany" or "mountain mahogany" probably originated from this practice. Occasionally, sweet birch has also served as a substitute for cherry and hickory.

The presence of a spicy oil in the inner bark was the basis for another early industry--the extraction of birch oil as a substitute for oil of wintergreen. This substance is also found in yellow birch but in smaller quantities *(4, 17)*. In the southern Appalachians, extraction was done with crude stills, often as a family enterprise *(34)*. Distillation operations were also conducted on a few state forests in northern Pennsylvania *(22)*. Today, synthetics have replaced the natural product.

Formerly, birch beer was made by fermenting the sap of sweet birch *(4, 29)*. Today, this process, never widespread, is seldom practiced and little-known.

Habitat Conditions

EDAPHIC

Sweet birch occurs primarily on three of the major soil groups: podzol, brown podzolic, and gray-brown podzolic. The species grows best on moist well-drained gray-brown podzolic soils, but also occurs on a wide variety of less favorable sites with rocky, coarse-textured, or shallow soils *(4, 8, 14, 15, 17, 22, 43)*. Due to its occasional abundance on rocky mountains in Pennsylvania, it has been suggested that sweet birch may be valuable for soil protection *(22)*. On other poor soils, however, such as the excessively dry portions of the Harvard Forest, sweet birch is partially or completely replaced by oaks and conifers *(41)*.

PHYSIOGRAPHIC

Sweet birch occurs over a wide range of altitude from near sea level along the New England coast *(4)* to an upper extreme of 4,000 *(35)* to 4,500 *(23)* feet in the southern Appalachian Mountains (fig. 1). In New England, the species is fairly common in southern Maine, the highlands of southern New Hampshire, western Vermont, the highlands of Massachusetts and Rhode Island, and throughout Connecticut *(4)*. In the southern Appalachians, where sweet birch grows best, the optimum elevation is in the range from 2,000 to 4,500 feet *(23)*.

Moist, protected northerly or easterly slopes are considered most favorable for sweet birch in both northern *(28)* and southern *(15)* portions of its range.

BIOTIC

Sweet birch is found in eleven of the cover types recognized by the Society of American Foresters *(37)*:

Type 20--White pine-northern red oak-white ash

Type 21--White pine

Type 22--White pine-hemlock

Type 23--Hemlock

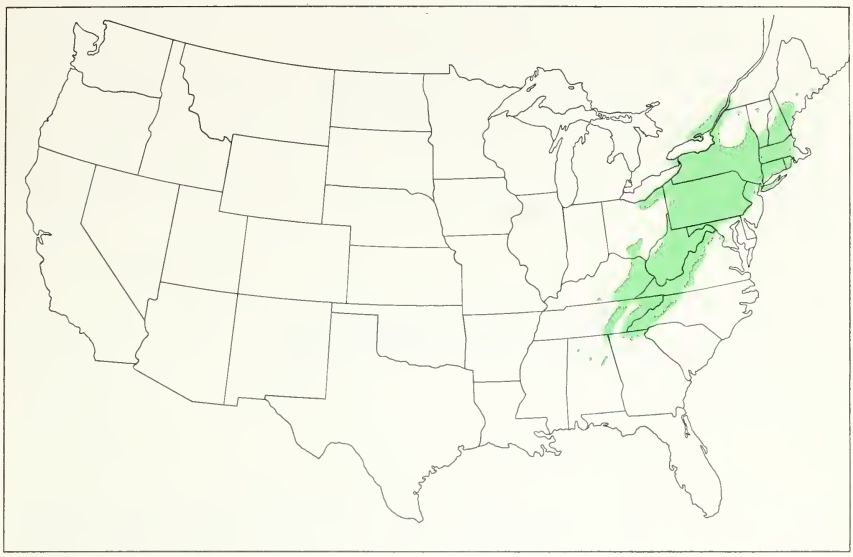

Figure 1.--*The natural range of sweet birch.*

Type 25--Sugar maple-beech-yellow birch

Type 27--Sugar maple

Type 29--Black cherry

Type 46--Eastern red cedar

Type 54--Northern red oak-basswood-white ash

Type 57--Yellow poplar

Type 60--Beech-sugar maple

In the southern Appalachian region, sweet birch reaches its best development in Types 21, 22, 25, 54, and 57 *(23)*. In addition to the various tree species found in the above eleven types, the plant associates of sweet birch include a wide variety of fern, shrub, and herbaceous species.

Sweet birch provides limited amounts of cover and food in the form of browse, buds, and seeds as contributions to the welfare of its animal associates, which include deer, rabbits, mice, ruffed grouse, and songbirds. Data on the seasonal preferences of white-tailed deer in central Pennsylvania reveal that sweet birch may be important as deer food only during the winter, and even in this season it is not heavily browsed *(6)*.

When woods are pastured, and if herbaceous forage is scarce, sweet birch may be heavily browsed by cattle. In a study made in western North Carolina, it ranked fifth in palatability among 16 associated tree species *(3)*.

Life History

SEEDING HABITS

Sweet birch, in common with the other members of the genus *Betula,* is monoecious. The staminate catkins develop in late summer and autumn to a length of about 3/4 inch; the pistillate catkins, however, remain enclosed in the buds until spring. The flowers open in April through mid-May, at about the time the leaves are unfolding. The seeds ripen during the following autumn from mid-August to mid-September and are disseminated by wind from September through November *(45)*.

Seed production begins when the trees are about 40 years old, and good seed crops occur every 1 or 2 years *(45)*.

Seed may be stored under conditions of good ventilation at room temperature for at least 1 year without serious reduction in viability. During such storage, moisture content of seeds should not exceed about 8 percent. In tests at the Boyce Thompson Institute, seeds having a moisture content of 11.8 percent deteriorated at room temperature but retained viability fairly well for a year at 8° C. At 17.6 percent moisture they lost their viability even at the lower temperature *(26)*.

VEGETATIVE REPRODUCTION

Sweet birch reproduces vegetatively by sprouting from small stumps *(14)*, but seems to be less prolific in this respect than many of its associates--red maple, sugar maple, beech, and some of the oaks *(48)*.

SEEDLING DEVELOPMENT

The germinative capacity of sweet birch seed is extremely variable, ranging from 5 percent to 87 percent with an average of 43 percent. In nursery sowings, delayed germination is frequently due to embryo dormancy; stratification in cool, moist sand or peat for 42 to 70 days is recommended *(45)*.

The optimum constant temperature for the germination of air-dried seeds is about 32° C., and the minimum temperature is about 30° C. However, after 5 to 6 months of cold, moist stratification, germination may take place at temperatures as low as 0° C. *(26)*.

Under forest conditions, germination normally occurs during the spring following seed dispersal. Nursery experience indicates that it may extend over a period of 4 to 6 weeks *(26, 45)*. Moist mineral soil, rotten logs, and humus serve as suitable germination media, although possibly not equally favorable to subsequent development.

Sweet birch seedlings start and develop best during their early years when protected by side shade or light overhead shade *(14, 45)*. Scattered individuals frequently occur as advance reproduction in openings in mature stands or under younger stands of light to moderate crown density. On the Harvard Forest, sweet birch is sometimes present in the advance hardwood growth under old-field white pine about 50 to 70 years old. On fairly cool moist sites--sheltered ravines, north to east aspects, or moderately heavy soils--heavy or clear-cutting of these stands generally results in a higher proportion of sweet birch in the succeeding reproduction than was present in the advance growth *(7, 20, 28, 43)*. On the other hand, as shown by studies in northwestern Pennsylvania *(33)*, clear-cutting of immature second-growth northern hardwood stands, before an understory has developed, is followed by an abundance of intolerant species with only a poor representation of sweet birch and tolerant hardwoods.

SAPLING STAGE TO MATURITY

The average growth rate of sweet birch saplings has been described as moderate *(14)* to relatively rapid *(43)*.

According to a study in virgin hemlock-hardwood stands in northwestern Pennsylvania, sweet birch saplings in the understory grow about twice as fast as hemlock, beech, sugar maple, and red maple, slightly faster than yellow birch, and at about the same rate as black cherry. In this instance, the sweet birch required an average of 12 years to reach a height of 6 feet *(19)*. With more light and less root competition, growth would, of course, be much faster.

Data from plots located on apparently average sites in Delaware County, New York, and Forest and Potter Counties, Pennsylvania, show that sweet birch can attain a diam-

Figure 2.--*Characteristic bark of mature sweet birch.*

Figure 3.--*Young sweet birch, of good form, growing under fairly dense conditions.*

eter at breast height of about 4 inches in 20 years, 7 inches in 40 years, and 10 inches in 80 years *(14)*. Figures for the Anthracite Region of Pennsylvania indicate slightly faster growth rates. In unmanaged stands of this region, sweet birch reaches 14 inches d.b.h. in 85 years on Site I and 12 inches in 80 years on Site II. For managed stands, it is estimated the same sizes would be reached in 10 to 15 years less time *(13)*.

On the very best sites, sweet birch reaches a height of 70 to 80 feet and a d.b.h. of 24 to 60 inches *(35)*. In most areas, however, it is a tree of medium size, 50 to 60 feet tall, and 24 inches or less in diameter *(17)*.

Sweet birch generally is rated as a short-lived tree *(38)*. In the Pennsylvania Anthracite Region, 10-year cubic volume production begins to decline when the trees are 14 to 16 inches d.b.h. *(13)*, that is, at about 100 years of age. Still, older trees are common and two individuals of 192 and 265 years of age have been found in Pennsylvania *(20)*.

Sweet birch has been rated by some authorities as intolerant *(38, 43)* and by others as intermediate *(1, 17, 42)*. Typically, it is a minor component of the sub-climax or climax forest throughout its range *(7, 14, 17, 37)*.

Where the stand is sufficiently dense, a long and fairly clean bole is developed *(17)* (fig. 3); but low, thick branches are produced on open-grown trees. Although exposure by cutting surrounding trees may result in epicormic branching *(18, 24)*, observations on the Allegheny National Forest indicate that sweet birch does not produce such branches as profusely as yellow birch and some of its other common associates *(18)*.

In northwestern Pennsylvania, glaze storms have caused appreciable damage to the crowns of sweet birch trees. Available data indicate, however that this species rates as intermediate *(12)* to fairly resistant *(21)* to glaze in comparison with other northern hardwoods and common associates. In addition to the primary effects of ice damage in directly reducing crown volume, glaze storms may contribute to the decline and subsequent death of both yellow and sweet birches by affording an opportunity for the entrance of wood decay organisms or, possibly, by causing crown deterioration through sudden excessive exposure *(10)*. No specific information is available on the damage resulting from glaze storms outside Pennsylvania, but this hazard probably exists in many parts of southern New England, the Middle Atlantic States, and the higher elevations of the southern Appalachian Mountains.

Sweet birch does not seem to be very susceptible to winter-killing. As a result of the severe winter of 1942-43,

partial or complete killing of many species occurred in Maine, but sweet birch appeared to be uninjured *(31)*.

A study of the effects of the 1930 drought on oak forests near Pennsylvania State College indicated that sweet birch is intermediate in drought resistance. Percentage reduction of basal area from drought mortality was 36 percent for sweet birch, 11 percent for sugar maple, 50 percent for red maple, and 15 percent for white ash. Other common associates were about equally distributed above and below sweet birch in the proportion of basal area lost *(30)*.

Several infectious diseases attack living sweet birch trees, and stems frequently become highly defective at an early age. Data from the Anthracite Region of Pennsylvania show that cull normally exceeds 10 percent of the total cubic-foot volume when the trees are 9 inches in diameter on Site I and 5 inches on Site II *(13)*. The most important pathogens are *Fomes igniarius* (white trunk rot), *Pholiota adiposa* (yellow cap fungus), and *Nectria galligena* (Nectria canker) *(5)*. Throughout its entire botanical range, sweet birch is affected by this last disease, Nectria canker, and available information indicates that this tree is one of the most susceptible species *(5, 16, 36, 39, 47)*. Cankers on the bole are more serious than branch cankers since the former reduce merchantable volume and increase susceptibility to stem breakage.

Sweet birch is easily damaged by ground fires because it has extremely thin bark. Direct mortality may result from severe burns, but even light scorching at the base of the tree will lower its resistance to the attacks of various diseases or insects such as *Xyloterinus politus* (ambrosia beetle) *(40)*.

Several leaf-feeding insects occasionally infest sweet birch. The most prevalent ones are *Acrobasis betulella, Bucculatrix canadensisella* (birch skeletonizer), *Cnidocampa flavescens* (oriental moth), *Porthetria dispar* (gypsy moth), and *Croesus latitarsus* (dusky birch sawfly). Wooden articles manufactured from sweet birch are sometimes damaged by *Lyctus* spp. (powder-post beetles) *(11)*.

Special Features

The most distinctive characteristic of sweet birch is the presence of birch oil in the inner bark of stems, branches, and roots. As previously mentioned, this was formerly used as a substitute for oil of wintergreen.

Sweet birch is sometimes found as a stilt-rooted tree --a feature commonly observed in yellow birch *(17)*. This happens when the tree grows on top of a stump or fallen tree trunk which eventually decays, leaving the tree supported above the surface of the ground by its roots alone.

Races and Hybrids

A low growing birch tree with unusually small leaves was found in Wythe County, Virginia, and named *Betula lenta* var. *uber*. Unsuccessful attempts to discover similar individuals indicate that this variety is not even locally abundant *(25)*.

A natural hybrid of *Betula lenta* and *Betula pumila*, which occurred at the Arnold Arboretum, was designated *Betula jackii (35)*.

Literature Cited

(1) Baker, F. S.
1949. A revised tolerance table. Jour. Forestry 47: 179-181.

(2) Betts, H. S.
1929. The strength of North American woods. U. S. Dept. Agr. Misc. Pub. 46. 18 pp.

(3) Biswell, H. H., and Hoover, M. D.
1945. Appalachian hardwood trees browsed by cattle. Jour. Forestry 43: 675-676.

(4) Blakeslee, A. F. and Jarvis, C. D.
1911. New England trees in winter. Storrs Agr. Expt. Sta. Bul. No. 69. 574 pp.

(5) Boyce, J. S.
1948. Forest pathology. Ed. 2, 550 pp., New York.

(6) Bramble, W. C., and Goddard, M. K.
1953. Seasonal browsing of woody plants by white-tailed deer in the ridge and valley section of central Pennsylvania. Jour. Forestry 51: 815-818.

(7) Bromley, S. W.
1935. The original forest types of southern New England. Ecol. Monog. 5: 61-89.

(8) Brooks, A. B.
1920. West Virginia trees. W. Va. Agr. Expt. Sta. Bul. 175. 242 pp.

(9) Brown, H. P., Panshin, A. J., and Forsaith, C. C.
1949. Textbook of wood technology. 652 pp., New York.

(10) Campbell, W. A.
1937. Decay hazard resulting from ice damage to northern hardwoods. Jour. Forestry 35: 1156-1158.

(11) Craighead, F. C.
1950. Insect enemies of eastern forests. U. S. Dept. Agr. Misc. Pub. 657. 679 pp., illus.

(12) Downs, A. A.
1938. Glaze damage in the birch-beech-maple-hemlock type of Pennsylvania and New York. Jour. Forestry 36: 63-70.

(13) Ferree, M. J.
1948. Growth, cull, and mortality as factors in managing timber in the Anthracite Region. U. S. Forest Serv. Northeast. Forest Expt. Sta., Sta. Paper 15. 21 pp.

(14) Frothingham, E. H.
1915. The northern hardwood forest: Its composition, growth, and management. U. S. Dept. Agr. Bul. 285. 80 pp.

(15) ----------
1931. Timber growing and logging practice in the southern Appalachian region. U. S. Dept. Agr. Tech. Bul. 250. 93 pp.

(16) Grant, T. J., and Childs, T. W.
1940. Nectria canker of northeastern hardwoods in relation to stand improvement. Jour. Forestry 38: 797-802.

(17) Harlow, W. M., and Harrar, E. S.
1950. Textbook of dendrology. Ed. 3, 550 pp. New York.

(18) Hough, A. F.
1936. Epicormic branching of Allegheny hardwoods. U. S. Forest Serv. Allegheny Forest Expt. Sta. Tech. Note 10. 2 pp.

(19) ----------
1936. Height growth of hemlock and hardwood seedlings in a virgin stand on East Tionesta Creek. U. S. Forest Serv. Allegheny Forest Expt. Sta. Tech. Note 12. 2 pp.

(20) ---------- and Forbes, R. D.
1943. The ecology and silvics of forests in the high plateaus of Pennsylvania. Ecol. Monog. 13: 299-320.

(21) ---------- and Taylor, R. F.
1946. Response of Allegheny northern hardwoods to partial cutting. Jour. Forestry 44: 30-38.

(22) Illick, J. S.
1923. Pennsylvania trees. Pa. Dept. Forestry Bul. 11. Ed. 4, 238 pp.

(23) Jemison, G. M., and Hepting, G. H.
1949. Timber stand improvement in the southern Appalachian region. U. S. Dept. Agr. Misc. Pub. 693. 80 pp.

(24) ---------- and Schumacher, F. X.
1948. Epicormic branching in old-growth Appalachian hardwoods. Jour. Forestry 46: 252-255.

(25) Johnson, A. G.
1954. Betula lenta var. uber Ashe. Rhodora 56: 129-131.

(26) Joseph, H. C.
1929. Germination and vitality of birch seeds. Bot. Gaz. 87: 127-151.

(27) Little, E. L., Jr.
1953. Check list of native and naturalized trees of the United States (including Alaska). U.S. Dept. Agr. Handbook 41. 472 pp.

(28) Lutz, R. J., and Cline, A. C.
1947. Results of the first thirty years of experimentation in silviculture in the Harvard Forest, 1908-1938. Part I. The conversion of stands of old field origin by various methods of cutting and subsequent cultural treatments. Harvard Forest Bul. 23. 182 pp.

(29) Mathews, F. S.
1915. Field book of American trees and shrubs. 465 pp. New York and London.

(30) McIntyre, A. C., and Schnur, G. L.
1936. Effects of drought on oak forests. Pa. State Coll. School Agr. and Expt. Sta. Bul. 325. 43 pp.

(31) Nash, R. W.
1943. Winter killing of hardwoods. Jour. Forestry 41. 841-842

(32) Neubrech, W. L.
1938. American hardwood flooring and its uses. U.S. Dept. Comm. Trade Promotion Series 186. 35 pp.

(33) Ostrom, C. E.
1938. Clear cutting of young northern hardwood stands. Jour. Forestry 36: 44-49.

(34) Ritter, E.
1940. The distillation of birch oil. Jour. Forestry 38: 517-518.

(35) Sargent, C. S.
1933. Manual of the trees of North America. 910 pp. New York and Boston.

(36) Society of American Foresters.
1935. Forest disease control in New England. Jour. Forestry 33: 469-473.

(37) ----------
1954. Forest cover types of North America (exclusive of Mexico). 67 pp. Washington, D.C.

(38) ----------
1955. Forestry handbook. 1212 pp. New York.

(39) Spaulding, P., Grant, T. J., and Ayers, T. T.
1936. Investigations of Nectria diseases in hardwoods of New England. Jour. Forestry 34: 169-179.

(40) Stickel, P. W.
1934. Forest fire damage studies in the Northeast, I. Bark-beetles and fire-damaged hardwoods. Jour. Forestry 32: 701-703.

(41) Stout, B. B.
1952. Species distribution and soils in the Harvard Forest. Harvard Forest Bul. 24. 29 pp.

(42) Toumey, J. W., and Korstian, C. F.
1947. Foundations of silviculture. Ed. 2, 468 pp. New York and London.

(43) Tryon, H. H.
1943. Practical forestry in the Hudson highlands. Black Rock Forest Bul. 12. 50 pp.

(44) United States Department of Agriculture.
1941. Climate and man. U.S. Dept. Agr. Yearbook 1941. 1,248 pp.

(45) United States Forest Service.
1948. Woody plant seed manual. U. S. Dept. Agr. Misc. Pub. 654. 416 pp.

(46) ----------
1955. Wood handbook. U. S. Dept. Agr. Handbook 72. 528 pp.

(47) Welch, D. S.
1934. The range and importance of Nectria canker on hardwoods in the Northeast. Jour. Forestry 32: 997-1001.

(48) Westveld, R. H.
1949. Applied silviculture in the United States. Ed. 2, 590 pp. New York.

AGRICULTURE-FOREST SERVICE-UPPER DARBY

These Silvical Papers...

This is one of a series of 15 silvical papers to be published by the Northeastern Forest Experiment Station. The series will include papers on the following species:

Green ash
White ash
Beech
Paper birch
*Sweet birch
Yellow birch
Black cherry
Red maple
Balsam fir
Red spruce
Eastern hemlock
Eastern white pine
Pitch pine
Virginia pine
Atlantic white-cedar

*Already published.


FOREST SERVICE
US
DEPARTMENT OF AGRICULTURE