Summaries of Some SILVICAL CHARACTERISTICS of SEVERAL APPALACHIAN HARDWOOD TREES

by George R. Trimble, Jr.

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Common and scientific names of species referred to:

TREES

Alder, smooth	*Alnus serrulata* (Ait. Willd.)
Ash, white	*Fraxinus americana* L.
Aspen, bigtooth	*Populus grandidentata* Michx.
Basswood	*Tilia americana* L.
Beech, American	*Fagus grandifolia* Ehrh.
Birch, yellow	*Betula alleghaniensis* Britton
Birch, sweet (black)	*Betula lenta* L.
Butternut	*Juglans cinerea* L.
Chestnut, American	*Castanea dentata* (Marsh.) Borkh.
Cherry, black	*Prunus serotina* Ehrh.
Cherry, pin (fire)	*Prunus pensylvanica* L. f.
Cucumbertree	*Magnolia acuminata* L.
Dogwood, flowering	*Cornus florida* L.
Elm, slippery	*Ulmus rubra* Muhl.
Gum, black	*Nyssa sylvatica* Marsh.
Hickory	*Carya* spp.
Hophornbeam, eastern	*Ostrya virginiana* (Mill) K. Koch
Locust, black	*Robinia pseudoacacia* L.
Magnolia, Fraser	*Magnolia fraseri* Walt.
Maple, red	*Acer rubrum* L.
Maple, striped	*Acer pensylvanicum* L.
Maple, sugar	*Acer saccharum* Marsh.
Oak, black	*Quercus velutina* Lam.
Oak, chestnut	*Quercus prinus* L.
Oak, northern red	*Quercus rubra* L.
Oak, scarlet	*Quercus coccinea* Muenchh.
Oak, white	*Quercus alba* L.
Sassafras	*Sassafras albidum* (Nutt.) Nees.
Serviceberry, downy	*Amelanchier arborea* (Michx. f.) Fern.
Sourwood	*Oxydendrum arboreum* (L.) DC
Sycamore, American	*Platanus occidentalis* L.
Yellow-poplar	*Liriodendron tulipifera* L.
Walnut, black	*Juglans nigra* L.
Willow	*Salix* spp.

SHRUBS AND VINES

Hawthorn	*Crataegus* spp.
Witch hazel	*Hamamelis virginia* L.

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CONTENTS

ABSTRACT

A number of Appalachian hardwood trees are ranked according to the following silvical characteristics: shade tolerance, development of epicormic branching, susceptibility to frost damage, diameter growth rate, and seed dormancy.

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Introduction

THIS PAPER is an attempt to summarize under one cover some of the information available about several silvical characteristics of a number of hardwood species. Much of this information has been published previously piecemeal in a number of publications. Little of the material is original, but some new syntheses have been made.

Most of the tree species mentioned are common to the Central Appalachians, and much of the research on which the data were based was done in this area.

Shade Tolerance

Shade tolerance means the capacity of tree seeds to germinate and of the trees to live, develop, and grow under canopies of varying densities. No attempt is made here to explain the physiological processes involved, nor to correlate degrees of shade tolerance with percentages of full sunlight. Such discussions are beyond the scope of this paper. For a basic understanding of tolerance, the reader is referred to *Forest Ecology* by Spurr *(1964)*.

However, it is pertinent to state, following Baker *(1950)*, that the tolerance of a given species is known to vary. Young trees are more tolerant than old trees; trees growing on moist, rich soils seem to be more tolerant than the average of the species; and tolerance seems to be greater in the southern part of the range of a tree.

A number of tolerance tables have been developed by foresters for different physiographic regions. These are found in standard textbooks, bulletins, and the *Forestry Handbook (Forbes 1961)*. The considerable differences that often exist between the tables in tolerance ratings for the same species are probably largely the result of two things: (1) real differences in tolerance within species due to different environmental conditions; and (2) the fact that a standardized method for making objective ratings has never been adopted–species have generally been ranked subjectively.

In my opinion, the following table (table 1) is generally applicable to Central Appalachian conditions. It is a modified version of a table by Baker *(1950)*, and was used in *The Regeneration of Central Appalachian Hardwoods with Emphasis on the Effects of Site Quality and Harvesting Practice (Trimble 1973)*.

Epicormic Branching

Epicormic branches arise from dormant buds or sometimes from adventitious buds; or as Kormanik and Brown *(1969)* prefer to call them, inhibited and suppressed buds. For a detailed understanding of the physiology of the development of branches from these buds, the reader is referred to *Origin and Development of Epicormic Branches in Sweetgum (Kormanik and Brown 1969)*. It suffices to state here that the development of epicormic branches is generally triggered by injury to the tree itself or by exposing it to additional light by cutting surrounding stems.

Because they degrade lumber quality, epicormic branches have been much studied. Based on work done on the Fernow Experimental Forest (an outdoor laboratory of the Northeastern Forest Experiment Station, USDA Forest Service) near Parsons, West Virginia, table 2 was developed for ranking 12 hardwood species in their susceptibility to epicormic branching. The table resulted from studies by Smith *(1966)* and Trimble and Seegrist *(1973)*.

Table 1.—Tolerance ratings[a]

Species	Very tolerant	Tolerant	Intermediate	Intolerant	Very intolerant
Eastern hophornbeam	X				
American beech	X				
Sugar maple	X				
Flowering dogwood	X				
Red maple		X			
Basswood		X			
Black gum		X			
Sweet birch		X[b]			
Fraser magnolia			X[c]		
Cucumbertree			X[c]		
White ash			X		
Basswood			X[b]		
Black gum			X[b]		
Yellow birch			X		
Sweet birch			X		
White oak			X		
Northern red oak			X		
Black oak			X		
Chestnut oak			X[d]		
Slippery elm			X[b]		
Hickories			X[b]		
Downy serviceberry			X[b]		
Sourwood			X[b]		
Scarlet oak				X[d]	
Butternut				X	
Hickories				X	
Yellow-poplar				X	
Sassafras				X[c]	
Black cherry				X	
Bigtooth aspen					X
Black locust					X
Pin cherry					X[b]

[a] From Baker (*1950*) unless otherwise noted.
[b] Local observation.
[c] Great uncertainty (from *Baker*).
[d] Silvics of Forest Trees of the United States (*USDA Forest Service 1965*).

Table 2.—Susceptibility to epicormic branching by species

Number of branches	Species
Very many	White oak Northern red oak
Many	Basswood Black cherry Chestnut oak
Few	Beech Hickory Yellow-poplar Red maple Sugar maple Sweet birch
Very few	White ash

Susceptibility to Frost Damage

Differences among species in susceptibility to damage by spring frosts may have an effect on species composition of stands in certain areas. This phenomenon has been investigated and reported on by Tryon and True *(1964)*. With permission, their publication is quoted:

> Frosts may occur frequently in the Appalachian region, and spring frosts which occur after growth has started are especially damaging to forest trees. Such frosts deform stems, reduce growth rate, and may kill the smaller reproduction. . . . Trees of all sizes may be damaged, but the reproduction and saplings are usually

Table 3.—Species susceptibility to frost damage

Highly susceptible[a]	Moderately susceptible	Less susceptible	Least susceptible
Sassafras	Fraser magnolia	Smooth alder	Slippery elm[b]
American sycamore	White ash[c]	Serviceberry	Willow[b]
Black locust	American chestnut	Witch-hazel	Flowering dogwood[b]
American beech	White oak	Striped maple	Hawthorn
Cucumbertree	Scarlet oak	Fire cherry	American basswood
Yellow-poplar	Chestnut oak	Red maple	Sugar maple
Hickory spp.	Northern red oak		Black cherry
Black walnut	Yellow birch[c]		
Butternut[a]	Black birch[b]		

[a]The most susceptible species are at the top, and the least susceptible are at the bottom within each susceptibility class.
[b]Based on few observations.
[c]Considerable variation in degree of damage.

most severely injured. The period of establishment is therefore critical.

They prepared a frost-susceptibility rating tabulation based on frost damage during the springs of 1961 and 1963. They examined tree species in 12 localities in northern and east-central West Virginia and rated the degree of damage by late frosts to the newly formed leaves and shoots (table 3).

Diameter Growth

Different diameter growth rates characterize different species of trees, but the differences are not always consistent between physiographic regions, sites within the regions, tree ages, or degrees of competition (usually expressed by crown-dominance classes). And even within crown-dominance classes, basal-area density exerts an influence on growth rates. Thus to compare dbh growth rates between tree species requires careful control of many variables.

In an attempt to segregate some of the common Appalachian species by growth rates, six publications were examined that gave results of studies made in West Virginia, and two were reviewed that reported on studies made in northwest Pennsylvania. West Virginia references were: Trimble *(1960)*, Trimble *(1967)*, Trimble *(1968)*, Trimble and Mendel *(1969)*, Trimble *(1969)*, Mendel and Trimble *(1969)*. Pennsylvania references were: Grisez and Mendel *(1972)*, and Mendel, Grisez, and Trimble *(1973)*.

As a result of this review, the grouping of species was based largely on West Virginia conditions. Table 4 applies to medium-size sawtimber trees (about 15 to 20 inches dbh), and to dominant and codominant stems growing in reasonably well-stocked stands on good and better sites. Extrapolation of the tabular data beyond the specifications indicated should be done with care. For example, for saplings, black cherry has a dbh growth rate greater than either red oak or yellow-poplar growth rates. And among overtopped trees, sugar maple has a dbh growth rate greater than those of red oak, yellow-poplar, or black oak.

Table 4.—Relative dbh growth rates for 15- to 20-inch trees

Growth rate	Species
Fast	Northern red oak
	Yellow-poplar
	Black oak
Medium	Black cherry
	Sugar maple
	Red maple
	Basswood
	White ash
Slow	Chestnut oak
	White oak
	Hickories
	Sweet birch
	Beech

Seed Dormancy

Seed dormancy refers to the number of winters after falling that seed remains viable in the forest floor. In recent years, especially since the advent of extensive clearcutting, the interest in length of natural dormancy has increased greatly. Table 5 has been compiled from a number of sources.

Table 5.—Natural seed dormancy of hardwood species

Species	Number of winters seed remains viable
Ash, white	3[a,b]
Aspen	0 Germinates soon after early summer seedfall[c]
Basswood	4[d]
Beech	1[e]
Birch, sweet	1 as far as known[d]
Birch, yellow	1 or possibly 2[d]
Cherry, black	3 plus[e]
Cherry, pin	Unknown, but many years
Gum, black	1 as far as known[d]
Hackberry	3[a]
Hickories	1[d]
Locust, black	Unknown but probably several years.
Maple, red	1, but much seed germinates shortly after falling in late spring.[c]
Maple, sugar	2 possibly. Most germinates after first winter.[c]
Oak, black	1[d]
Oak, chestnut	0 probably. Germination is in fall after seed drop.[d]
Oak, Northern red	1[d]
Oak, scarlet	1[d]
Oak, white	0 Germinates in fall after dropping.[d]
Sassafras	3 plus[f]
Yellow-poplar	8[g]

[a]Clark (1962).
[b]Leak (1963).
[c]Leak, Solomon, and Filip (1969).
[d]U. S. Forest Service (1965).
[e]Wendel (1972).
[f]Unpublished information, Fernow Experimental Forest.
[g]Sander and Clark (1971).

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