Acer rubrum L. Red Maple

Aceraceae Maple family

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Red maple *(Acer rubrum)* is also known as scarlet maple, swamp maple, soft maple, Carolina red maple, Drummond red maple, and water maple (33). Many foresters consider the tree inferior and un-

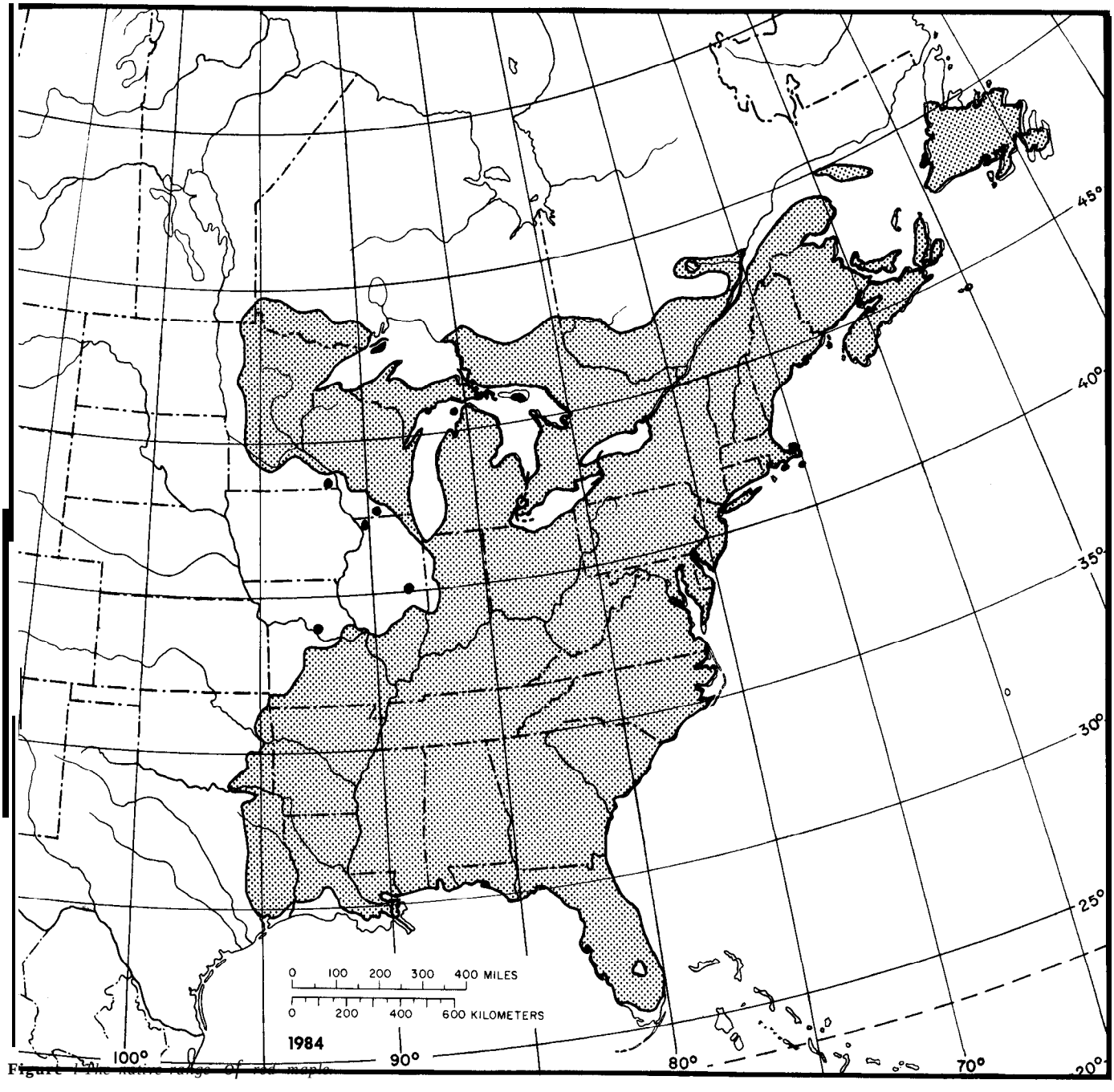

Figure 1. The native range of red maple.

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desirable because it is often poorly formed and defective, especially on poor sites. On good sites, however, it may grow fast with good form and quality for saw logs. Red maple is a subclimax species that can occupy overstory space but is usually replaced by other species. It is classed as shade tolerant and as a prolific sprouter. It has great ecological amplitude from sea level to about 900 m (3,000 ft) and grows over a wide range of microhabitat sites. It ranks high as a shade tree for landscapes.

Habitat

Native Range

Red maple (figs. 1, 2) is one of the most abundant and widespread trees in eastern North America (26). It grows from southern Newfoundland, Nova Scotia, and southern Quebec to southern and southwestern Ontario, extreme southeastern Manitoba, and northern Minnesota; south to Wisconsin, Illinois, Missouri, eastern Oklahoma, and eastern Texas; and east to Florida (33). It has the greatest continuous range along the Atlantic Coast of any tree found in Florida-an extent of 2575 km (1,600 mi) *(32)*. The species is native to all regions of the United States east of the 95th meridian, with three exceptions: Prairie Peninsula proper of the Midwest, the coastal prairie of southern Louisiana and southeastern Texas, and the swamp prairie of the Florida Everglades. The most notable exception is the Prairie Peninsula, where red maple is absent from the bottom land forests of the Corn Belt, though it grows abundantly in similar situations and species associations both to the north and south of the Peninsula *(54)*.

Figure 2—*Mature red maple.*

Climate

The northern extent of the red maple range coincides with the -40" C (-40" F) mean minimum isotherm in southeastern Canada *(11)*. The western range is limited by the dry climate of the Prairie States. Of all the maples, it has the widest tolerance to climatic conditions. The absence of red maple in the Prairie Peninsula does not seem to be related to precipitation amount because the tree grows elsewhere with similar or less annual precipitation.

Soils and Topography

Red maple can probably thrive on a wider range of soil types, textures, moisture, pH, and elevation than any other forest species in North America (18). Its range covers soils of the following orders: Entisols, Inceptisols, Ultisols, Alfisols, Spodosols, and Histosols. It grows on both glaciated and nonglaciated soils derived from granite, gneisses, schists, sandstone, shales, slates, conglomerates, quartzites, and limestone (26).

Red maple grows on diverse sites, from dry ridges and southwest slopes to peat bogs and swamps. It commonly grows under the more extreme soil-moisture conditions-either very wet or quite dry. The species does not show a strong affinity for either a north or a south aspect (48). Although it develops best on moderately well-drained, moist sites at low to intermediate elevations, it is common in mountainous country on the drier ridges and on south and west exposures of upper slopes. It is also common, however, in swampy areas, on slow-draining flats and depressions, and along small sluggish streams (26). In upper Michigan and New England, red maple grows on ridge tops and dry sandy or rocky upland soils and in almost pure stands on moist soils and swamp borders *(13,40)*. In the extreme south, red maple is almost exclusively a swamp species.

Associated Forest Cover

Red maple is a major or an associated species in 56 of the 88 nontropical forest cover types recognized for the eastern United States *(13)*. Red maple forms a pure cover type (Society of American Foresters Type 108) because it makes up at least 80 percent of the stand basal area. The species is also at least 20 percent of Gray Birch-Red Maple (Type 19), White Pine-Northern Red Oak-Red Maple (Type 20), Black Cherry-Maple (Type 28), and Black Ash-American Elm-Red Maple (Type 39).

The red maple is most common in New England, Middle Atlantic States, upper Michigan, and northeast Wisconsin. It is rare farther west and south. Recognition of red maple as a separate cover type generally is attributed to disturbances that allowed red maple residuals to respond rapidly. The elimination of elm *(Ulmus* ***americana*** and *U.* ***thomasii)*** by Dutch elm disease and of the American chestnut ***(Castanea dentata)*** by the blight, and selective removal of yellow birch ***(Betula alleghaniensis)*** and sugar maple *(Acer saccharum)* have contributed to increasing the proportion of red maple stocking in many stands *(13,40,48)*.

Throughout its range, red maple is associated with more than 70 different commercial tree species *(26)*. Its more common associates from the north to the south include red spruce *(Picea rubens)*, balsam fir ***(Abies balsamea),*** white pine *(Pinus strobus)*, sugar maple, beech *(Fagus* ***grandifolia),*** yellow birch, paper birch *(Betula* ***papyrifera),*** gray birch ***(B. populifolia),*** sweet birch ***(B.*** *lenta)*, eastern hemlock ***(Tsuga canadensis),*** eastern hophornbeam ***(Ostrya*** *virginiana),* striped maple *(Acer pensylvanicum)*, northern white-cedar ***(Thuja occidentalis),*** aspen ***(Populus grandidentata*** and ***P. tremuloides),*** black ash ***(Fraxinus*** *nigra)*, pin cherry ***(Prunus*** *pensylvanica)*, black cherry *(P.* ***serotina),*** northern red oak ***(Quercus*** *rubra)*, American elm, chestnut oak ***(Q.*** *prinus)*, Virginia pine *(Pinus* ***virginiana),*** yellow-poplar ***(Liriodendron tulipifera),*** silver maple *(Acer saccharinum),* black gum ***(Nyssa sylvatica),*** swamp white oak ***(Quercus*** *bicolor)*, and loblolly pine *(Pinus* ***taeda) (13).***

Life History

Reproduction and Early Growth

Flowering and Fruiting-Red maple is one of the first trees to flower in the spring, generally several weeks before vegetative bud break. The flowers are small, with slender stalks, red or rarely yellowish, with petals; they appear from March to May depending upon elevation and latitude. Trees can flower and bear seed at an early age; 4-year-old trees have produced seed. Flowering occurs on all branches in the well-lit upper portion of the crown. Characteristically, the nonflowering branches are slow growing and lack vigor.

Red maple flowers are structurally perfect. The species is polygamo-dioecious. Thus, some trees are entirely male, producing no seeds; some are entirely female; and some are monoecious, bearing both male and female flowers. On monoecious trees, functioning male and female flowers usually are separated on different branches. Sex of the flower is not a function of tree vigor. The species shows a tendency toward dioeciousness rather than toward dichogamy *(59,64,67)*.

Seed Production and Dissemination-A seed crop occurs almost every year, and on an average, a good to bumper crop occurs once in every 2 years (14). Red maple is generally very fruitful. Trees 5 to 20 cm in d.b.h. (2 to 8 in) can yield seed crops of 12,000 to 91,000 seeds. A 30-cm (12-in) tree yielded nearly a million seeds ***(1).*** It is possible to stimulate red maple seed production through fertilization. The stimulation often lasts 2 years and may yield up to 10 times more seeds than an unfertilized stand *(4)*.

The fruit, a double samara, ripens from April to June before leaf development is complete. After ripening, seeds are dispersed for a 1- to %-week period during April through July. The seed does not require pregermination treatment and can germinate immediately after ripening. The fruits are among the lightest of the maple fruits, averaging about 51,000 cleaned seeds per kilogram (23,000/lb). In general, fruits are heavier in northern latitudes. Red maple fruit from Canada, Wisconsin, and Michigan, where the normal growing season is 80 to 150 days, averaged 23 gr (1.5 g)/100 fruits. On the other hand, in Rhode Island, Kentucky, and South Carolina, with a frost-free period of 180 to 240 days, the weight averaged 17 gr (1.1 g)/100 fruits. Because the fruits are small and winged, they disperse efficiently in the wind. Germination may be 75 to 80 percent in 2 to 6 days. Total germination is often 85 to 91 percent *(59,66)*.

Seedling Development-Red maple has few germination requirements. The seed can germinate with very little light *(26)*, given proper temperature and some moisture. Most seeds generally germinate in the early summer soon after dispersal. Shading by a dense overstory canopy can depress first-year germination; then second-year germination is common (36). Germination is epigeal (59).

Moist mineral soil seems the best seedbed for red maple, and a thin layer of hardwood leaf litter does not hinder germination and early survival. Many red maple seeds germinate each year in abandoned old fields, in cutover areas and burns, and in the forest. Reproduction has also been observed on strip-mine spoil banks in Pennsylvania, West Virginia, and Ohio (26). Not many new seedlings can survive under a closed forest canopy, but enough do survive to perpetuate the species in abundance.

Presently, red maple is important in many stands where it was formerly a limited associate; it is enabled to increase by disturbances such as disease, windthrow, fire, and harvesting *(5,15,19,37,40)*. In southeastern Ohio, 6 years after clearcutting a 3.4 ha (8.5 acre) mature oak-hickory stand, the new stand contained more than 2,200 red maple seedlings per hectare (900/acre) taller than 1.4 m (4.5 ft), together with many yellow-poplar and oak seedlings (Unpub. data, Vinton Furnace Experimental Forest, McArthur, OH). The original stand on the plot contained no red maple. There were occasional red maples in nearby stands. Red maple does not show a strong affinity for either northern or southern exposures *(48)*, but its best growth form is often found on northeast slopes *(40)*. The young seedlings are shade tolerant, and abundant 1- to 4-year-old seedlings are often found under the canopy of older stands. Many of these seedlings die each year if they are not released by opening of the main crown canopy, but new ones replace them. Thus, a reservoir of seedlings and ungerminated seed is available to respond to increased sunlight resulting from disturbance. Pre-existing red maples in a cut stand add greatly to the new stand stocking through stump sprouts ***(21)***. In some species, disturbances of small areas often restrict development of new age classes because the canopy over small areas closes in from the side too quickly. Red maple, however, is sufficiently shade tolerant to respond and may increase in prominence after small disturbances *(20,37)*.

Red maple shows an early tendency to develop root system characteristics according to soil conditions, enabling it to grow on greatly different sites ranging from swamp to dry upland (62). On wet sites, red maple seedlings produce short taproots with long, well-developed laterals. On dry sites, they develop long taproots with much shorter laterals (26). Red maple seedlings are classified as moderately tolerant of soil saturation. In one study, their growth was only slightly retarded after 60 days in saturated soils (24). Red maple seedlings were very tolerant of flooding, showing no sign of stem or leaf damage after 60 days of flooding (7). This capacity to withstand conditions of wetness or dryness enables survival and growth on a wide variety of site conditions where red maple grows naturally.

Throughout the northern portion of its range, with respect to shade, red maple seedlings are rated moderately tolerant to tolerant and are often abundant in the understory advance reproduction. In the Piedmont, red maple seedlings were found to be shade intolerant however; and, in the lower Mississippi Basin, red maple seedlings grow well only in openings. The species was found to be more shade tolerant on good sites than on poor sites. Overall, it ranks more shade tolerant than yellow birch or white ash ***(Fruxinus** americana)* but less so than sugar maple, American beech, or eastern hophornbeam *(26)*.

Sugar maple is one of the first species to start stem elongation in the spring, and red maple starts only a few days later. In one study, red maple stem elongation was one-half completed in 1 week. Growth then slowed and was 90 percent completed in 54 days (27). Under favorable light and moisture, red maple seedlings can grow 0.3 m (1 ft) the first year and as much as 0.6 m (2 ft) each year for the next few years. Some sprouts can grow 0.9 m (3 ft) or more the first year *(26)*, but they soon slow to about the same rate as seedlings.

Although red maple naturally germinates and becomes established on many types of seedbeds, direct seeding in an old field failed. Survival was only 37 percent after the first year (2). Planting of seedlings has not succeeded on strip-mine spoil banks (26) or old fields (45). First year survival generally is low and survivors may show poor growth rate and form. Planted red maple infected with mycorrhizae may grow somewhat better, especially on strip-mine spoil banks *(10)*. In the nursery, red maple seedling growth was increased when 4 hours of supplemental light and an aluminum foil soil mulch were provided, and when the soil was treated with the insecticide Disulfoton. In 1 year, these seedlings compared favorably with 2- to 3-year-old seedlings grown by conventional methods (8). If planting of red maple is desired, container-grown stock seems to offer some promise. Ninety-eight percent of the red maple tubelings planted in a New Hampshire forest clearcutting during August survived. The stock had been grown for 8 weeks in containers. Two container sizes-41 cm^3 (2.5 in^3) and 125 cm^3 (7.6 in^3)—were compared, with no difference in results ***(17)***.

Red maple is a common associate in second-growth cherry-maple Allegheny hardwood stands. But after clearcutting, red maple seedlings often grow poorly, whereas the black cherry seedlings do well. A chemical from black cherry, perhaps benzoic acid, may interfere with red maple development (22). Black cher-

Figure 3-Clump *of red maple stump sprouts.*

ry leaves have been identified as a source of benzoic acid and as a potential allelopathic inhibitor of red maple (23).

Vegetative Reproduction-Red maple stumps sprout vigorously (figs. 3, 4). Inhibited, dormant buds are always present at the base of red maple stems. Within 2 to 6 weeks after the stem is cut, these inhibited buds begin to extend (65). Fire can also stimulate these buds. The number of sprouts per

Figure *4-Red* **maple** *sprouts at base of tree 30 cm (1.2 in) in d. b. h. 2 months after a prescribed burn.*

stump increases with stump diameter to a maximum of 23 to 30 cm (9 to 12 in), and then decreases among larger trees. Stumps of younger trees tend to produce taller sprouts *(39,47).* Sprouts grow faster than seedlings, and leaf and internode size is greater. As competition increases, growth rates slow (65). Many of the sprouts have rot and poor form (58). Also, the attachment of a sprout to the stump is often weak because the base of the sprout grows over the stump bark and the vascular connection between them is constricted (65). Regeneration by seedling sprout may be especially successful *(19).* Generally, the species' great sprouting capacity makes it suitable for coppicing and accounts for its tendency to be found in sprout clumps.

Red maple is difficult to propagate from cuttings and success varies considerably. Some rooting has been obtained by treating cuttings with a concentration of 200 mg per liter (200 p/m> of indolebutyric acid for 3 hours. Cuttings collected in June seem to root better than those taken later in the growing season. Cuttings from the lower part of the crown root better than those from the upper part, and cuttings from male clones or female clones, which fruit sparingly, root better. Successful bud grafting on an experimental basis has been reported with red maple and with sugar maple on red maple stocks, and layering has been observed in central Pennsylvania. For the most part, however, the species is difficult to propagate vegetatively, except by means of stump sprouts (26).

Sapling and Pole Stages to Maturity

Growth and Yield-Red maple is a short- to medium-lived tree and seldom lives longer than 150 years. It reaches maturity in 70 to 80 years. Average mature trees are 18 to 27 m (60 to 90 ft) in height and 46 to 76 cm (18 to 30 in) in diameter (26). The largest registered living red maple is growing near Armada, MI. It is 38.1 m (125 ft) tall and has a bole circumference, at breast height, of 4.95 m (16.25 ft) *(38)*.

Although red maple height growth starts relatively early in the spring, radial growth starts late in the season. Radial growth then proceeds rapidly, becoming half complete in 50 to 59 days and fully complete in 70 to 79 days. In a New York study, red maple total height growth was somewhat better than that of the other species studied (26).

Growth during early life is rapid but slows after trees pass the pole stage. Red maple responds well to thinning. In upper Michigan, thinning was more effective than fertilization for stimulating red maple growth (49). In the Canadian Maritimes, a 35-year-old coppice red maple stand was thinned by reducing each sprout clump to one of the better stems. The number of red maple stems was reduced from 2,610 to 560ka (1,057 to 227/acre). Ten years later, these residual trees had more than doubled their volume to 63.8 m^3/ha (911 $ft^3/acre$). In another study, a partial cutting was made on a 40-year-old stand of Allegheny northern hardwoods. Of all the species, red maple grew best. In the lo-year period after cutting, dominant red maple trees grew an average of 5.7 cm (2.25 in) in diameter. In the north, the young red maple trees grow faster than sugar maple, beech, or yellow birch, but slower than aspen, paper birch, or white ash. In southern bottom lands, the growth rate of red maple compares favorably with that of other hardwood species. An average diameter growth of 7.5 to 9 cm (3.0 to 3.5 in) in 10 years is possible (26).

Early crop tree release of red maple seedlings and sprouts is feasible in young, even-aged stands. It should be done when the new stand has crown closure and crown dominance is being expressed. This occurred on 9- to 12-year-old trees in West Virginia *(56,57)*. Only 10 percent of red maple sprout clumps did not have a sprout of potential crop tree quality (29). Released red maple trees have a low susceptibility to epicormic sprouting (46).

Rooting Habit—Red maple trees grow well and are generally capable of growing as well as or better than their associates on sites with less than optimum moisture conditions, either too wet or too dry. In Michigan, red maple sprouts grew about twice as fast on wet organic soils as on mineral soils or drier organic soils (26). Roots of maple seedlings are capable of developing differently in response to various environments, so that the seedlings can survive in situations ranging from swamp to dry upland. This characteristic root system adaptability is maintained as the trees grow older. Under flood conditions, many adventitious roots develop, but the root systems recover quickly upon drainage (24). Red maples seem to tolerate drought through their readiness to stop growing under dry conditions (52) and by producing a second growth flush when conditions improve again, even after growth has stopped for 2 weeks (27).

Red maple roots are primarily horizontal and form in the upper 25 cm (10 in) of soil. After germination, a taproot develops until it is about 2 to 5 cm (1 to 2 in) long, then it turns and grows horizontally As the woody roots extend sideways, nonwoody fans of feeder roots extend upward, mostly within the upper 8 cm (3 in) of mineral soil. The woody roots may be 25 m (80 ft) long (34). Although red maple trees and seedlings tolerate flooding, they can be damaged if silt and sand layers 7.6 cm (3 in) or more are deposited over their roots (6).

Reaction to Competition-Red maple is a pioneer or subclimax species that is more shade tolerant and longer lived than the usual early successional species, such as poplar (aspen) and pin cherry It compares in shade tolerance with sycamore *(Platanus **occidentalis**),* silver maple, American basswood *(Tilia **americana**),* common persimmon *(Diospyros **virginiana**),* black gum, and rock elm *(Ulmus thomasii)*. It is not as tolerant as sugar maple, American beech, eastern hophornbeam, and flowering dogwood *(Cornus florida)* (26). Red maple can most accurately be classed as tolerant of shade. Seedlings are more shade tolerant than larger trees and can exist in the understory for several years. They respond rapidly to release and can occupy overstory space. Disturbances such as fire, disease, hurricanes, and harvesting have caused red maple to increase in stocking where it previously occurred as only scattered trees *(19,31,35,40,48,55)*. As these stands mature and the canopy closes, red maple growth slows due to competition for light *(9)*.

Following a hurricane in central New England, the site was soon dominated by pin cherry, with red maple, northern red oak, paper birch, and a few eastern white pine. After 10 years, the pin cherry was giving way to dominance by red maple. After 40 years, however, northern red oak and paper birch had assumed dominance over the the now codominant red maple ***(19)***. In northern hardwood

types, red maple begins to give way to sugar maple and more tolerant hardwoods after about 80 years *(26)*, but on certain wet sites, red maple can probably maintain itself indefinitely as an edaphic climax *(13)*.

Red maple is generally very resistant to herbicides *(28)*. Also, diffuse porous species such as red maple are difficult to kill by girdling. For example, 3 years after treatment, 70 percent of the girdled trees had live crowns *(63)*. Stem injection, using cacodylic acid *(12)* and picloram *(61)*, did successfully control red maple as did glyphosate applied by hydraulic sprayer, but not when applied by a mist blower *(16)*. Generally, if treatment of red maple is planned, it is wise to consult current labels or experts in the field of chemical control to determine the latest allowable chemicals and the best methods of application.

Damaging Agents-Red maple is generally considered very susceptible to defect. Especially on poor sites, red maple often has poor form and considerable internal defect. Discoloration and decay advance much faster in red maple than in sugar maple (43). In northeastern Pennyslvania, average cull ranged from 13 percent in 30 cm (12 in) diameter red maple trees to 46 percent in 61 cm (24 in) diameter trees. Only associated beech and black birch were more defective (26).

Sprout clumps present some serious problems. More defects originate from branch stubs on the sprout stems than from the parent stump (43). *Inonotus glomercztus* can infect branch stubs and wounds above the butt in red maple. Nevertheless, a red maple sprout with only a slightly defective base and small and well-healed branch stubs has a potential for high future value. Criteria for selecting red maple sprouts for thinning are (1) select only stems with small, well-healed branch stubs, (2) reject sprout clumps with defective bases, and (3) cut all but one or two of the best dominant stem sprouts *(50)*.

Many trunk rot fungi and stem diseases attack red maple. *Inonotus glomeratus* infects branch stubs and wounds on the stem and is most important. Second in importance is *Oxyporus populinus,* which forms a small, white fruit body that often has moss growing on top. *Phellinus igniarius* is another leading heart rot of red maple. Red maple may also be cankered by species of *Nectria, Eutypella, Hypoxylon, Schizoxylon, Strumella,* and others *(18)*.

Red maple is susceptible to many leaf diseases, generally of minor importance. It is seldom or seriously damaged by root diseases, although *Armillaria mellea* can enter through root or butt wounds. However, *A. mellea* kills only trees already weakened from other causes *(18)*.

Mechanical injury is a common source of defect in hardwoods, and red maple is especially sensitive to wounding. Often, large areas of cambium surrounding the wound will die back. In shade tree maintenance, wound dressings have not proven effective in stimulating wound closure or internal compartmentalization of the damaged area *(44)*. Increment boring causes discoloration and may lead to decay in red maple. Callus growth, when established, is reasonably rapid, but an extra year or two often is needed if cambial dieback has been extensive around the wound *(26)*. Red maple was rated intermediate with respect to amount of damage after a severe glaze storm in Pennsylvania. In one study, major damage was sustained by 41 percent of the black cherry, 16 percent of the red maple, and 5 percent of the hemlock *(18)*.

Many different insects feed on red maple, but probably none of them kill healthy trees. They do reduce vigor and growth leaving the tree more susceptible to attack from fungi. Insect feeding also may hasten the death of weakened trees. Susceptibility to insect attack is illustrated by a study in the Piedmont. Of 40 species investigated, red maple had the highest percentage (79 percent) of insect attacks. Among the more important borers attacking red maple were the gallmaking maple borer *(Xylotrechus aceris)*, the maple callus borer *(Synanthedon acerni)*, and the Columbian timber beetle *(Corthylus columbianus)*. The common scale insects included the cottony maple scale *(Pulvinaria vitis)*, the maple leaf scale *(P. acericola)*, and the oystershell scale *(Lepidosaphes ulmi)*. The common leaf feeding moths were the gypsy moth *(Lymantria dispar)*, the linden looper *(Erannis tiliaria)*, the elm spanworm *(Ennomos subsignaria)*, and the red maple spanworm *(Itame pustularia)*. The forest tent caterpillar *(Malacosoma disstria)* avoids red maple, however *(26)*.

Red maple is very sensitive to fire injury, and even large trees can be killed by a fire of moderate intensity. The fire-killed trees sprout vigorously, however, and red maple may become a more important stand component after a fire than before one (26).

Red maple is a desirable deer food and reproduction may be almost completely suppressed in areas of excessive deer populations. Snowshoe hares may also reduce the amount of red maple reproduction *(26)*.

If sapsuckers attack red maple, ringshake may develop (42). Sapsucker damage may also result in mortality. Healthy as well as unhealthy trees are attacked and nearly 40 percent of the trees attacked may be killed *(41)*.

Special Uses

Red maple is known in the lumber industry as soft maple. The wood is close grained and resembles sugar maple but is softer in texture, not as heavy, lacks the figure, and has somewhat poorer machining qualities. Red maple in the better grades is substituted for hard maple, particularly for furniture. Red maple lumber shrinkage from green to oven-dry moisture content is slightly more than shrinkage for hard maple in radial, tangential, and volumetric measurements *(60)*.

Brilliant fall coloring is one of the outstanding features of red maple. In the northern forest, its bright red foliage is a striking contrast against the dark green conifers and the white bark and yellow foliage of the paper birches. Red maple is widely used as a landscape tree.

Although the hard maples-sugar and black maple *(Acer nigrum)*—are principally used for syrup production, red maple is also suitable. When sap and syrup from sugar maple were compared with those of red and silver maple, boxelder *(A. negundo),* and Norway maple *(A. platanoides),* they were found to be equal in sweetness, flavor, and quality (30). The buds of red and silver maple and boxelder break dormancy much earlier in the spring than sugar maple, however, and the chemical content of the sap changes, imparting an undesirable flavor to the syrup. Consequently, the tapping season for red and silver maple is shorter than that for sugar maple.

Red maple is a highly desirable wildlife browse food. Elk and white-tailed deer especially use the current season's growth of red maple and aspen as an important source of winter food (25). Timber harvesting slash can provide an important source of browse to help sustain the animals. Red maple, sugar maple, and paper birch trees cut any time after leaf fall provide browse as nutritious as, and more acceptable than, trees cut immediately before leaf fall (3).

Genetics

As might be expected from its wide range, red maple shows great variation in height, cold hardiness, straightness, time of flushing, onset of dormancy, and other traits. In general, red maples in the north show the most reddish autumn color, earliest flushing and bud set, and least winter injury. Seeds from the north-central and east-central range produce the tallest seedlings. Genetic potential has been found for breeding and selecting red maple against three major urban stresses: verticillium wilt, air pollution, and drought *(52,53)*. Red maple fruits also exhibit geographical variation. The more northerly sources, from locations with short frost-free periods, produced samaras that are shorter but heavier than those from southern sources *(51,66)*.

Experimental crosses of red and silver maple have been made (26). Also, red maple is known to hybridize naturally with silver maple (33).

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