Acer saccharinum L. Silver Maple

Aceraceae Maple family

William J. Gabriel

Silver maple *(Acer saccharinum)* is a medium-sized tree of short bole and quickly branching crown common in the Eastern United States where it is also called soft maple, river maple, silverleaf maple, swamp maple, water maple, and white maple. It is found on stream banks, flood plains, and lake edges where it grows best on better-drained, moist alluvial soils. Growth is rapid in both pure and mixed stands and the tree may live 130 years or more. Silver maple is cut and sold with red maple ***(A. rubrum)*** as soft maple lumber. The winged seeds are the largest of any of the native maple. They are produced in great abundance annually, providing many birds and small mammals with food. An attractive tree with delicate and graceful foliage, silver maple is often planted as an ornamental.

Habitat

Native Range

The natural range of silver maple (figs. 1, 2) extends from New Brunswick, central Maine, and southern Quebec, west in southeastern Ontario and northern Michigan to southwestern Ontario; south in Minnesota to southeastern South Dakota, eastern Nebraska, Kansas, and Oklahoma; and east in Arkansas, Louisiana, Mississippi, and Alabama to northwestern Florida and central Georgia (22). The species is absent at higher elevations in the Appalachians.

Silver maple has been introduced to areas of the Black Sea coast of the Soviet Union, where it has adapted to the growing conditions there and is reproducing naturally in small stands (24).

Climate

The important climatic factors within the area of the natural distribution of silver maple vary as follows: normal annual total precipitation, 810 to 1520 mm (32 to 60 in); growing season precipitation (May, June, July, and August), 200 to 810 mm (8 to 32 in); mean annual snowfall, 0 to 254 cm (0 to 100 in); mean length of frost-free period, 120 to 240 days (42).

There is no information on specific climatic factors that may influence the natural range of silver maple. It is not found in the colder climate of high mountainous areas, and in the drier parts of its range it grows only along streams where ample moisture is available. Its ability to withstand temporary flooding better than other species gives it an advantage in competing for growing space. When planted as ornamentals, trees grow vigorously under a variety of climatic factors from coast to coast.

Soils and Topography

Within the range of silver maple the forest soils are predominantly brown and gray-brown podzols (orders Spodosols and Inceptisols) but the species is found most often on alluvial soils in the orders Inceptisols and Mollisols. Its best growth is in better-drained moist areas *(11)*. On occasions silver maple may occupy low pH (2.2 to 3.3) muck or shallow peat soils (order Histosols), but is not generally found in soils where acidity is below 4.0 (26).

In descriptions of forest vegetation, silver maple appears as a dominant species only in streamside communities or on the fringes of lakes or backwaters of streams. Occasionally it is found in swamps, gullies, and small depressions of slow drainage. Though it generally cannot compete with other species in upland environments, silver maple seedlings are adapted to survive long periods of inundation in bottom lands, where flooding is one of the factors that determine the makeup of individual stands ***(11,231.***

Associated Forest Cover

In the Central Forest Region, Silver Maple–American Elm (Society of American Foresters Type 62) is a major eastern forest cover type (7). In addition to American elm ***(Ulmus americana),*** other major associates of silver maple are sweetgum *(Liquidambar styraciflua),* pin oak ***(Quercus palustris),*** swamp white oak ***(Q. bicolor),*** eastern cottonwood *(Populus deltoides),* sycamore ***(Platanus occidentalis),*** and green ash ***(Fraxinus pennsylvanica).***

Understory species commonly found with silver maple in the Central Forest Region are willow ***(Salix*** spp.), redberry elder *(Sambucus pubens),* red-osier dogwood *(Cornus* ***stolonifera),*** and greenbriar *(Smilax* spp.). Associated herbaceous species are wood-nettle ***(Laportea canadensis),*** jewelweed *(Impatiens* spp.), poison-ivy ***(Toxicodendron*** *radicans),* cardinal flower ***(Lobelia cardinalis),*** Joe-pye-weed

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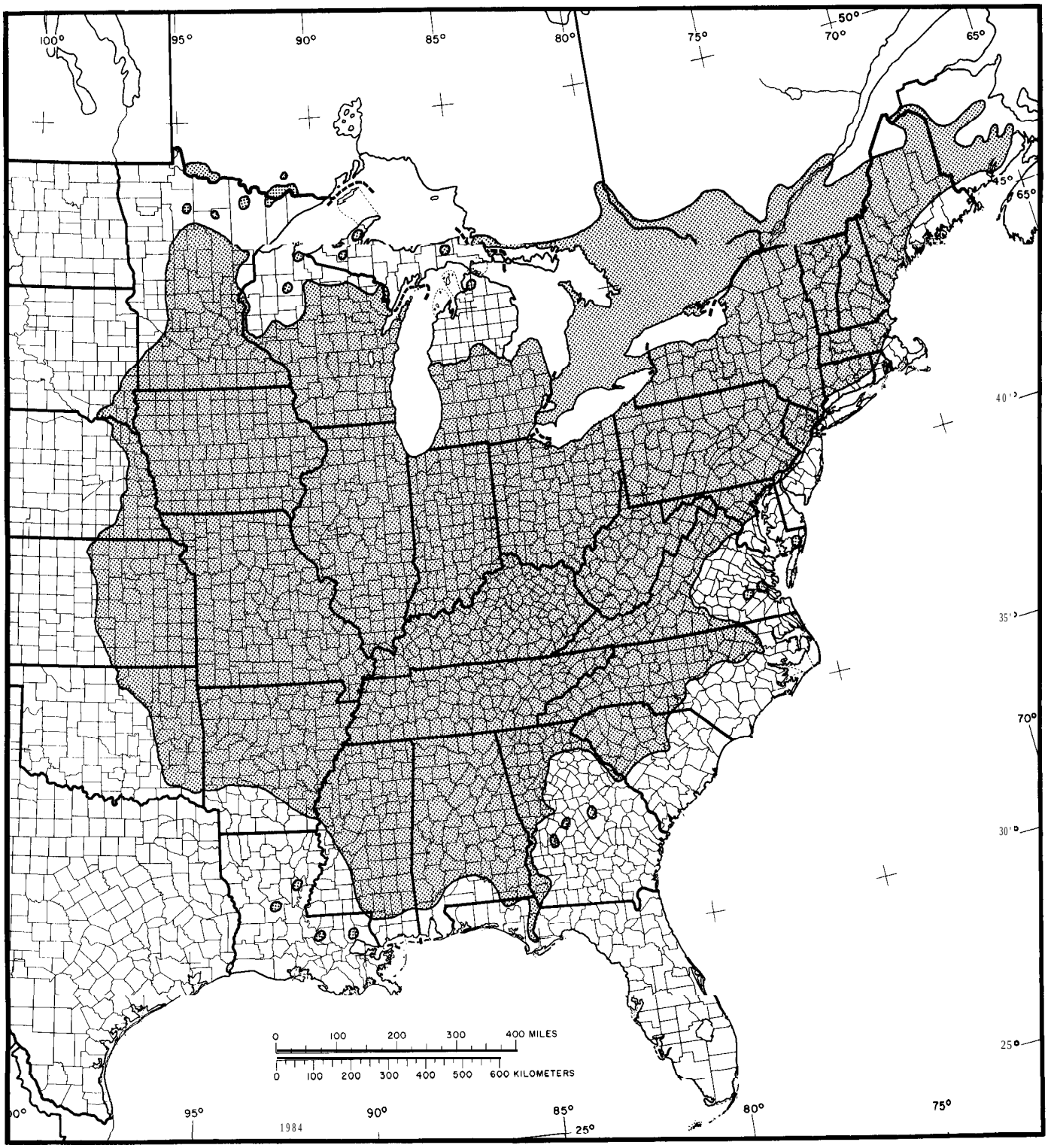

Figure *l-The native range of silver maple.*

Figure *Z-Ornamental planting of silver maple.*

(Eupatorium spp.), swamp milkweed *(Asclepias incarnata),* and boneset *(Eupatorium perfoliatum).*

In the Northern Forest Region, silver maple in northern Ohio and Indiana is associated with swamp white oak, sycamore, pin oak, black tupelo *(Nyssa sylvatica),* and eastern cottonwood; in New England and eastern Canada with sweet birch *(Betula lenta),* paper birch *(B. papyrifera),* and gray birch *(B. populifolia);* in New York with white ash *(Fraxinus americana),* slippery elm *(Ulmus rubra),* rock elm (U. *thomasii),* yellow birch *(Betula alleghaniensis),* black tupelo, sycamore, eastern hemlock *(Tsuga canadensis),* bur oak *(Quercus macrocarpa),* and swamp white oak.

Life History

Reproduction and Early Growth

Flowering and Fruiting-Silver maple is the first of the maples to bloom in North America, beginning as early as February and extending into May (38). Flowers are greenish yellow and bloom long before the leaves appear. They are borne on short pedicels in sessile, axillary fascicles on shoots of the previous year, or on short, spurlike branchlets developed the year before. Separate clusters of female and male flowers appear on the same tree or on different trees *(19,371.*

Four types of trees, with respect to sex expression, have been observed: all male flowers; all female flowers but with rudimentary pistils; mostly male with a few females; and mostly male with a few females and a scattering of hermaphroditic flowers *(19).*

Silver maples growing in Holland showed a tendency for the same tree to produce female flowers one year and both female and male flowers the next year. Trees that produced all male flowers did not show this type of change (6).

Fruits and seeds of silver maple develop rapidly. Within 24 hours after pollination flower parts become withered and ovaries begin to swell. Fruits are about 6 mm (0.25 in) long 1 week after pollination. At the end of 3 weeks, when they become mature samaras, the fruits are about 5 cm (2 in) long. Fruit pedicels are short, ranging in length from 2.5 cm (1 in) to nearly 9 cm (3.5 in) *(19).*

Ripening fruits change from a green or rose color to yellowish or reddish brown. Seeds to be placed in storage should be picked when their moisture content is more than 30 percent and should be maintained at this level. Seeds with less than 30 percent moisture content lose their viability quickly.

Seed Production and Dissemination-Seed ripening and dispersal over the range of the species begins in April and ends in June. The number of seed-filled fruits per kilogram ranges from 1,980 to 7,050 (900 to 3,200/lb), with an average of 3,920 (1,780/lb), making these the largest seeds of any maple species in the United States (38). Dissemination is mainly by wind and occasionally by water. The minimum seed-bearing age of trees is 11 years.

Seedling Development-Silver maple seeds require no stratification or pretreatment. They are capable of germinating immediately at maturity. When seeds are covered, germination is hypogeal, the cotyledons remaining below ground. This is contrary to evidence reported previously which states that germination of all maples is epigeal *(38),* i.e., where the cotyledons are borne above the surface of the soil. When seeds germinate on bare soil, there is little development of the hypocotyl; the cotyledons

shed their fruit coat and spread apart as in epigeal germination *(6)*.

Natural regeneration of young seedlings is most successful on seedbeds of moist, mineral soils with considerable organic matter (48). Seedlings that are established on bottomland sites are often stunted if the soil becomes saturated with water but generally recover when soil moisture drops. When growing in potassium-deficient soils, plants are stunted; young leaves are chlorotic and older leaves are necrotic *(30)*. Initial growth of seedlings may be rapid, ranging from 30 to 90 cm (12 to 36 in) in the first year, but as they cannot compete with overtopping vegetation, first-year mortality is high if they are not released.

Seedlings of silver maple require 2,000 to 2,500 hours of chilling to break dormancy. No differences were found in the time of first budbreak between cold-stored and nursery-lifted stock; there is a strong correlation between time of first budburst and root regeneration after the seedlings are transformed to environmental conditions suitable for growth. Maximum root regeneration takes place after 3,500 hours of chilling, but new roots can develop from November to May (47).

The preferred size of seedlings for establishing plantations of silver maple in Ontario is 30 cm (12 in) in height and 6 mm (0.25 in) in root-collar diameter (43).

Vegetative Reproduction-Silver maple can be propagated vegetatively. Softwood cuttings taken in July and again in October rooted 100 percent and 92 percent,, respectively (34). Hardwood cuttings taken in early winter and stored in a cool place for 2 months rooted 84 percent when planted in moist sand ***(13)***. The treatment of silver maple cuttings with rooting hormones may be important to rooting success *(18)*. Cuttings taken from young trees (5 years of age) root easily, but cuttings from mature trees (80 years old) root very poorly.

Success in bud grafting is mixed. Graft-takes among clones may range from 0 to 40 percent when the branches from which bud sticks are collected have lateral, epicormic, and coppice origins. A high degree of success was recorded for bud grafts of the hybrid red maple x silver maple made on 4-month-old silver maple seedlings (48).

Layering has been used successfully to propagate the species. Horizontally oriented stems have greater rooting success than vertical stems. Although layering occurs without hormone treatment, maximum results are obtained from treated stems. Prolific sprouting from the root collars and lower stems of living trees is characteristic of the species. Sprouts appear readily from stumps that are 30 cm (12 in) or less in diameter.

Sapling and Pole Stages to Maturity

Growth and Yield-Growth of young trees is seriously affected by competition from other vegetation. Height growth averaged 3.8 m (12.5 ft) after five growing seasons under plantation conditions where site preparation was intense and weed control was complete (44). With no site preparation, the average height of trees of the same age was only 0.5 m (1.6 ft). Seedling growth is increased by the application of 56 g (2 oz) in slow release packets of 19-5-17 (N-P-K) fertilizer at the time of planting *(1)*.

Growth in d.b.h. of pole-size trees increased from 6 mm (0.25 in) to 13 mm (0.5 in) following a stand thinning to a 5.2 m (17 ft) spacing. Basal area of the crop trees nearly doubled and wood volume tripled during a lo-year period following thinning. Unthinned stands had only one-third of the basal area and two-thirds of the volume of thinned stands during the period ***(18)***.

Silver maple grows rapidly in both pure and mixed stands, some trees growing from 13 mm (0.5 in) to nearly 25 mm (1 in) in d.b.h. each year ***(18)***. Plantation silver maples (fig. 3) in southern Ontario averaged 25 m (81 ft) in height and 29.7 cm (11.7 in) in d.b.h. at 43 years of age (45). One tree in Vermont consistently grew 5 cm (2 in) in diameter each year. Mature trees have reached a height of 26 to 37 m (90 to 120 ft) with a trunk diameter of 91 to 122 m (36 to 48 in) (37).

Since the species is usually found in mixed hardwood stands, data on yields for silver maple alone are not available.

Rooting Habit-The species has a shallow, fibrous root system. Survival would be enhanced by this system rather than one that is deep and taprooted, since silver maple is primarily found on the more protected floodplain and bottom-land sites. Its prolific root system is notorious for invading and clogging underground drainage and water lines that are not tightly constructed.

Reaction to Competition-The tolerance to shade of silver maple ranges from moderately tolerant to very intolerant, depending on site quality and location. In general, it is considered tolerant on good sites and almost intolerant on poor sites (48). Foresters, in general, class silver maple as tolerant of shade *(2)*, but the species has been rated very intolerant on bottom-land sites in the South (48). Seedlings are intermediate in tolerance to water-

saturated soils (12) but can tolerate prolonged periods of inundation. On upland soils silver maple grows well but is highly intolerant of competing vegetation.

Figure 3—*43-year-old silver* maple *plantation in southern Ontario. (Courtesy of F. W. von Althen,* Canadian *Forestry Service).*

Damaging Agents-A number of diseases, insects, and other damaging agents attack the species. Their effect ranges from an unsightly appearance to the weakening and death of the tree.

Chief among the foliage diseases on silver maple are gray-mold spot *(Cristulariella depraedens);* bull's *eye* spot *(C. pyramidalis),* which can cause severe defoliation of nursery stock; anthracnose *(Gloeosporium apocryptum* and *G. saccharinurn);* tar spots *(Phyllosticta minima, Rhytisma acerinum,* and *R. punctatum);* leaf blister *(Septoria aceris* and *Taphrina carveri);* and the powdery mildew fungi *(Phyllactinia guttata* and *Uncinula circinata).* Of less importance are the common spot fungi *Venturia acerina* and *Cladosporium humile (10).*

Probably the most important stem disease in silver maple is Verticillium wilt *(Verticillium albo-atrum),* which can cause sudden death. Other diseases of the stem that have either a secondary or parasitic effect are the target canker *(Nectria galligena* and N. *cinnabarina),* the common mistletoe *(Phoradendron serotinum),* crown gall *(Agrobacterium tumefaciens),* and two that produce the brown felty covering over scale insects *(Septobasidium burtii* and *S. pseudopedicellatum) (10).* The Eutypella canker *(Eutypella parasitica),* formerly thought to attack only sugar and red maple, has been found on silver maple (9).

A host of root and trunk rots attack silver maple. Seedlings are killed by *Rhizoctonia solani* and the imperfect stage of the charcoal root rot *(Macrophomina phaseoli).* Shoestring root rot *(Armillaria mellea)* is common on the species and kills trees that are already in a weakened state. A similar root rot *(Armillaria tabescens)* attacks silver maple in the South. A number of other decay fungi act on heartwood and inner sapwood. These are primarily in the *Fomes* and *Hydnum* genera. Flowers and seeds of the species are lost through the discomycete *Ci boria acerina (10).*

There are no serious insect pests of silver maple, but the species is attacked by borers, leaf feeders, and scale insects. Among the borers are the Columbian timber beetle *(Corthylus columbianus);* the flatheaded appletree borer *(Chrysobothris femorata);* the maple callus borer *(Synanthedon acerni);* and the pinhole borer *(Xyloterinus politus).* Leaf feeders are the fruittree leaf roller *(Archips argyrospila);* the cecropia moth *(Hyalophora cecropia);* and the white-marked tussock moth *(Orgyia Zeucostigma).* Bladder gall mites found on the species are *Vasates quadripedes* and *V. aceris-crummena (3,4,46).* An outbreak of the cottony maple scale *(Pulvinaria innumerabilis)* was controlled by treatment with large numbers of the coccinelid *Hyperaspis signata* (25). Gypsy moth *(Lymantria dispar)* is not a significant pest of silver maple; the young larvae cannot become established on the species (27).

Silver maple, because of its brittle wood properties, is highly susceptible to ice damage (5); when planted as an ornamental along streets it can be seriously affected by illuminating gas leakage from underground mains. It is known to react unfavorably to certain other air pollutants *(14,15,16,17,41).*

Special Uses

The buds of silver maple provide a vital link in the food chain of squirrel populations (33). The early

swelling and budburst characteristics of the species come during the critical late winter-spring period when stored food supplies of squirrels are exhausted.

Local studies conducted on floodplains in the province of New Brunswick show that the species ranks far above other dominants on wet, mesic sites as nesting trees for wood ducks and goldeneye ducks *(31)*.

Silver maple ranks high as a food source for beavers in southeastern Ohio (29). According to availability, it is exceeded only by common alder in importance.

The species is heavily planted as an ornamental in the urban areas of this country. Its widespread popularity is due to its early rapid growth and its pleasing appearance. Five ornamental subdivisions or forms are recognized in silver maple on the basis of leaf structure, coloration, and habit: (1) ***Acer saccharinum Zaciniatum-leaves*** are deeply cleft with leaf lobes that are dissected and narrow; (2) ***A. s. tripartitum-leaf*** lobes are divided almost to the base of the leaf; (3) ***A.*** s. Zutescens-when the leaves unfold they are yellow-bronze; (4) ***A.*** s. pendulum-branches are pendulous, hanging or droopy in appearance; and (5) ***A.*** s. pyramidale-branches are acutely angled from the tree trunk, upright in habit, forming a crown that is narrow and pyramidal in shape *(32,37)*. The U.S. National Arboretum published a checklist of cultivars of silver maple based on the International Code of Nomenclature for Cultivated Plants (36) and included 58 names. In the fall of the year the leaves of silver maple change to a soft yellow.

Silver maple has been planted as a farmstead windbreak in several locations in Minnesota. Its survival over a period of 38 years averaged 70 percent. Its height and diameter growth during the period averaged 11.6 m (38 ft) and 17.8 cm (7 in), respectively (39).

In Ontario, tests of five maple species indicated that the quality of syrup from silver maple sap is satisfactory. Sugar content of silver maple sap ranked lowest of the five species tested *(21)*.

There have been no studies of population differences and racial variation in silver maple, possibly because of higher priorities currently given to other, more commercially important hardwoods.

Genetics

A program for the genetic improvement of the species for timber production is in progress in Ontario. Phenotypes with superior form, growth rate, and wood quality have been selected and are being evaluated *(18)*. There are obvious differences in branchiness in seedlings from different silver maple trees within the same stand. These and other observations indicate that sometimes there is enough genetic variability to warrant selection *(49)*.

Because the blooming periods of silver and red maple overlap, there is a possibility of natural hybridization between them. Under controlled artificial conditions, the two species hybridize easily, producing prolific seed sets (8). The hybrids are intermediate between their parents in leaf characters. Their growth was much faster than that of red maple seedlings but did not equal that of silver maple. Hybrids first flowered at 6 years of age, but of several thousand flowers, only a few dozen fruit were produced, indicating incompatibilty between hybrid females and existing pollen sources.

Silver maple crosses readily with red maple when the latter is used as a female parent. But the reciprocal cross gives mixed results: some female silver maples set very few seeds when crossed to red maple while others apparently do very well *(20,28)*. The species also is capable of setting viable seed to self-pollination.

The basic chromosome count in silver maple is n = 26. Meiosis takes place in the fall, in contrast to other local maple species whose pollen matures in the spring *(35,40)*. No serious abnormalities of meiosis resulting from hybridity between red and silver maple were reported, except in one cross where 2n = 71 and 72 instead of 2n = 78.

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