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Evergreens



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On the Cover—Mass plantings of evergreens are adaptable to large grounds.

Evergreens

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David W. French

EVERGREENS are widely used in landscape and shelterbelt plantings. Although they are greatly appreciated, their identity and cultural requirements are unfamiliar to most individuals. This bulletin, therefore, was prepared to enable people to become better acquainted with evergreens and the problems connected with their culture.

No attempt is made in this bulletin to give a botanical description of species and varieties of evergreens or to provide an identification key. A brief general description of the tree and its uses, however, will be helpful.

Evergreens are distinguished from deciduous trees and shrubs by the green leaves that persist over winter. For the most part the evergreens which grow in Minnesota have leaf-like needles or scales. A few of the broad-leaved evergreens, such as the Oregon grape, bearberry, and wintergreen, also occur in Minnesota, but these are not considered in this bulletin.

Major Groups of Evergreens

THE MAJOR GROUPS of evergreens are the pines, spruces, arborvitae, junipers, yews, hemlock, firs, and Douglas fir. The tamarack and European larch drop their needles in the fall but are closely related to the narrow-leaved evergreens.

All evergreens do shed needles, for the individual leaf or needle does not remain on the tree throughout its life span. The losing of the needles is a slow, gradual process. This is generally from the interior part of the tree. Some needles, such as on the arborvitae, persist for two years, whereas in spruce the needles live for 3 to 10 years if they are healthy. Any excessive browning and dropping of needles, especially from the branch tips, could mean insect damage, diseases, or other injury.

Each of the evergreen groups has certain characteristics that make identi-

fication easy. The pines have long, slender needles that are borne in clusters of from two to five. The spruces, firs, Douglas fir, yews, and hemlock have needle-shaped leaves that are scattered along the stem. The spruces have sharp, pointed needles that are square in cross section. When the needles drop, the leaf base persists. In the true firs the needles are blunt, and when they fall they leave a smooth, circular scar on the twig. The Douglas fir needles resemble those of the fir, but the sharp, pointed buds and three-lobed bracts that come out from between the cone scales are characteristics that readily distinguish this tree. The yews have dark green needles and green twigs. The fruit on the female tree resembles a fleshy, red berry, making the yew easy to distinguish when in fruit. The hemlock is the only conifer that bears

its needles on petioles. The linear needles are flat, pointed, and generally $\frac{1}{4}$ to $\frac{2}{3}$ inch long. When they drop every third year, they leave a prominent leaf scar on the twig. The leaves are whitish underneath.

The arborvitae and the juniper have scale or awl-shaped leaves. In the arborvitae these scale-like leaves are borne in pairs, closely crowded on flattened twigs. The fruits of the arborvitae are small, dry cones. In the junipers the leaves are either small and scale-like or short and pointed. The characteristic arrangement of these leaves is in whorls of three. The juniper berries are hard, round, and usually bluish-green.

The Firs (*Abies* spp.)

The firs are among the most beautiful of our evergreens. Most of the fir species are native in the mountainous regions of the West and hence are not adapted to Minnesota conditions. Only two species will be considered.

Balsam Fir (*Abies balsamea*). The balsam fir can be distinguished by the short, blunt, flat, and flexible needles $\frac{1}{2}$ to 1 inch long, and the blunt buds that are always covered with a heavy layer of sticky pitch. The smooth, gray bark is covered with many small blisters containing pitch. The tree is native in northern and eastern Minnesota. Balsam fir is not especially drought-hardy. Planting results have been disappointing on sandy soils where dry periods are frequent during the summer. Its use should therefore be limited to the northern, forested sections and to the parts of southeastern Minnesota with fine textured soil and ample rainfall. The chief uses for the balsam fir are for Christmas trees, decorations, and paper pulp.

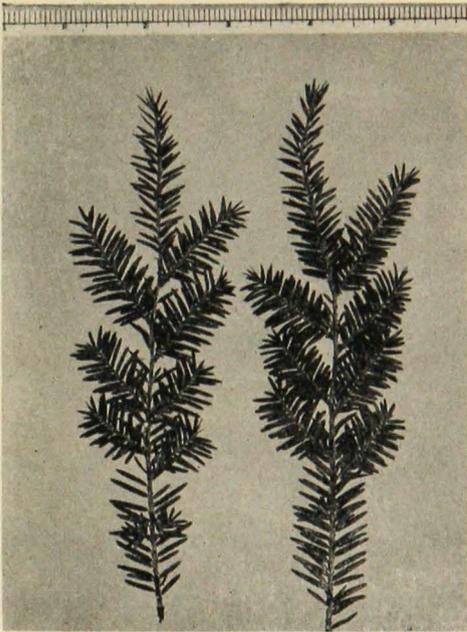
White Fir (*Abies concolor*). The white fir is the best fir to plant in Minnesota. The 2- to 3-inch long leaves are flat and curl upward. Their color varies from light green to a deep bluish-green.

When young, the tree is wide and pyramidal, the lower branches touching the ground. As it grows older, the plant grows mostly upward and becomes a narrow, pyramidal, beautiful tree 50 or more feet tall. To retard the growth of white fir, thus having a tree which is useful for more years, remove the central bud early in June or cut the new growth in half with a shears. Do not cut into hard wood for this will cause permanent injury and new leaves will not develop. By annual pruning a more dwarfed and compact specimen can be obtained. The white fir is a good specimen tree for parks and large home grounds, blending well with other evergreens in group plantings. They should be limited to the southern part of the state.

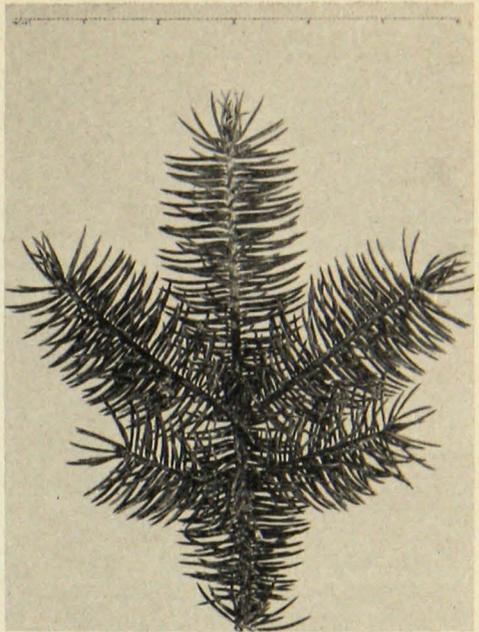
Douglas Fir (*Pseudotsuga menziesii glauca*). The Douglas fir is a beautiful evergreen and deserves to be more widely grown than it is. The species ranges throughout the Rocky Mountains and Pacific Coast area. Only plants grown from seeds from the northern Rocky Mountains should be planted here, since strains from the West Coast are not hardy in this area. The tree is difficult to shape in the nursery, but as it gets older it forms a symmetrical, pyramidal tree bearing its branches well down to the ground when grown in the open. The normally dark green needles are flattened like those of the true fir. Bluish forms are known. The peculiar three-lobed appendages that grow out between the cone scales and the long, pointed red buds make the Douglas fir easy to recognize. The Douglas fir, when grown from hardy seed stocks, grows well in most sections of Minnesota. It is good for specimen and group plantings. If the seed source is carefully selected, it could prove valuable for windbreak and Christmas tree purposes.

The Junipers (*Juniperus* spp.)

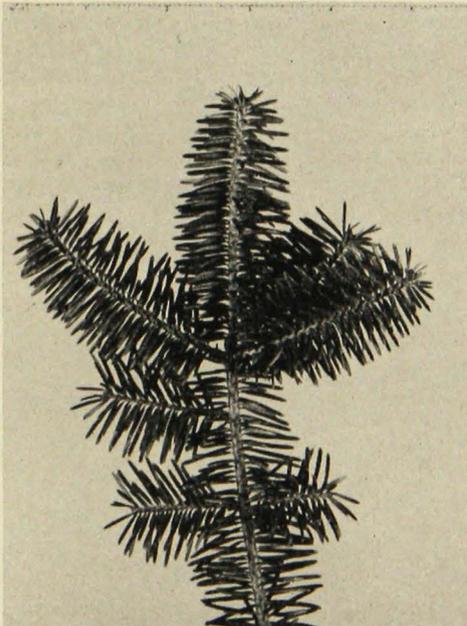
The junipers are a very large group and contain some of our very best ever-



Eastern Hemlock



Colorado Spruce



Balsam Fir



Douglas Fir

FIG. 1. Size, shape, and arrangement of the evergreens' leaves are their most important identifying characteristics.

greens for landscape purposes. The forms vary from low, creeping types to tall, upright trees. Because of this diversity of form, junipers can be selected for almost any landscape use.

Chinese Juniper (*Juniperus chinensis*). The Chinese juniper varies greatly in form and size. The typical form of the species is pyramidal in shape and grows about 12 feet high. The leaves are awl-shaped, at least $\frac{1}{2}$ inch long and very sharp. They have two indistinct white lines on the upper surface that give the plant a bluish appearance.

The tree is not too hardy, frequently losing many of its needles by browning during the winter. If used, plant in a protected spot, preferably on the east side of the house. The following varieties are used far more commonly than the species.

Variety *sargentii* (Sargent's Juniper). This is a low, wide-spreading shrub with bluish-green needles. It seldom grows very tall, so it makes an excellent groundcover or plant for beneath low windows.

Variety *pfitzeriana* (Pfitzer Juniper). This is one of the hardiest and most widely used of the low, semi-erect evergreens throughout the entire state. An untrained specimen is quite low and spreading, seldom exceeding 3 feet in height. The practice of staking the



FIG. 2. A Pfitzer Juniper

young plants in the nursery results in a taller, spreading shrub that may reach a height of 5 feet. This variety is commonly used under windows in the foundation planting and in the shrub border.

Variety *pfitzeriana aurea* (Golden Pfitzer Juniper). This resembles the Pfitzer except that the new growth is golden yellow. It is not as popular as the common Pfitzer.

Variety *pfitzeriana hetzi*. The Hetzi Blue Pfitzer juniper resembles the common Pfitzer in appearance and growth habit. It has much waxy bloom on its foliage which gives it an aqua color. It is very popular in foundation plantings, grows quite rapidly, and stands shearing well. It grows about 4 to 5 feet tall and 6 to 8 feet wide.

Variety 'Maney' (*Juniperus chinensis maneyi*). This is a low, spreading evergreen and is more dwarfed than other varieties. Its foliage has a bluish cast. Plant this variety in a semi-shady location.

Common Juniper (*Juniperus communis*). The common juniper is quite variable in form, ranging from a tree 20 to 30 feet high to a low, prostrate shrub. The following varieties are grown in Minnesota.

Variety *depressa* (Prostrate or Old-field Common Juniper). This prostrate juniper is native in the timbered sections of northeastern and eastern Minnesota and is suitable for planting in all parts of the state. The distinguishing features of this evergreen are the numerous buds that occur in the axils of the leaves and the white line down the upper side of the leaves. The plant grows to a height of about 3 feet and has a spreading habit of growth. This evergreen is very good where a low, irregular mass of foliage is desired. It does well on sandy soil.

Variety *J. communis depressa aurea* (Golden Prostrate Juniper). This variety is similar to the one above but

possesses golden yellow needles on the growing tips.

Creeping Juniper (*Juniperus horizontalis*). The creeping juniper spreads close to the ground and gives an attractive appearance when used for covering sandy banks and slopes, or in the rock garden. It is native in northern and southeastern Minnesota and is adapted to most of the state. The following varieties have been selected because of their color variations or form.

Variety douglasi (Waukegan Juniper). This variety has soft bluish-green foliage in summer that turns a reddish-purple in winter. It is used mostly in rock gardens and foundation plantings. Its branches will take root so one plant may cover a large area.

Variety plumosa (Andorra Juniper). This variety is not quite as spreading as the creeping juniper but forms a compact mound a foot or so high and about 3 feet in diameter. It can be included in an evergreen grouping as the lowest plant or planted in the rock garden or alongside the steps of a terrace. The summer color is bluish-green, the winter color purple.

Savin Juniper (*Juniperus sabina*). This is one of the best of the low evergreens for foundation plantings or at the edge of evergreen groups. The form is graceful with slender, arching branches that rise 3 or more feet. The needles are short and soft, giving the shrub a fine texture.

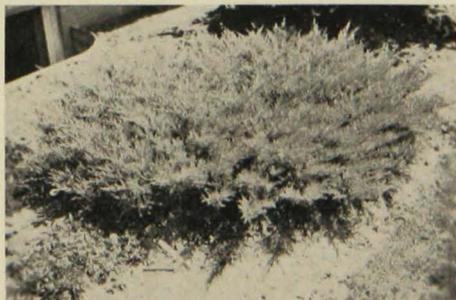


FIG. 3. An Andorra Juniper

Variety tamariscifolia (Tamarisk Juniper). This beautiful evergreen is more of a low, spreading shrub than the Savin juniper. The general effect is that of a feathery mound, 12 to 15 inches in height and 3 or more feet in diameter. The color is an attractive bluish-green. This shrub is especially good in the rock garden or as a low element in an evergreen grouping. Though apparently hardy in a protected spot, it suffers from drought in a dry location.

Rocky Mountain Juniper (*Juniperus scopulorum*). The Rocky Mountain juniper is very similar to the eastern red cedar in general appearance, differing chiefly in the fact that it requires two years to mature its seeds while the eastern red cedar requires one. It is used extensively in farmstead shelterbelts and field windbreak plantings. The following horticultural varieties are used more commonly in landscaping than are the species.

Variety 'Welch.' Welch has a narrow pyramidal habit and bluish-green foliage. It tends to be quite narrow.

Variety 'Moffet.' Moffet is similar to Welch but has a more compact habit of growth. The branches are closer together, giving the tree a symmetrical shape. It is bluish-green and requires minimum shearing. It fruits more than does Welch.

Variety Pathfinder. Pathfinder is considered to be the best variety in this species. It is the bluest, hardiest, and most drought resistant. It has a tendency to have more than one leader. It does not bear fruits.

Eastern Red Cedar (*Juniperus virginiana*). The eastern red cedar is native in practically every state east of the Rocky Mountains. Over this wide range, the numerous forms include plants tall and narrow, low and bushy, and all shapes and sizes in between. In Minnesota, the typical form is upright with a broad, conical top. The color, which is typically green, usually

turns a reddish-brown in the fall, blending with the autumn landscape. Bluish-green forms are common also, and some of the green forms have been selected that hold their color all winter. Because of the extreme variability of this species, it is only natural that numerous named varieties should have been selected and propagated.

The eastern red cedar is the alternate host for the cedar-apple rust and should not be planted within a half mile of apple or crab apple trees. It should not be planted in areas where apple production is important.

The eastern red cedar is used widely for windbreak, shelterbelt, and wildlife plantings. The species is also used for hedges and foundation plantings. For most landscape purposes, however, one of the following grafted varieties is more often used.

Variety pyramidiformia hillii (Hill Dundee Juniper). This is a slender, compact, pyramidal form that is bluish-green in the spring and summer and turns to a purplish-plum color in the fall and winter. It is useful for foundation plantings where upright specimens are desired.

Variety glauca (Silver Red Cedar). The silver red cedar is fast growing and, unless sheared regularly, forms a rather loose, pyramidal tree. Its outstanding feature is its attractive silver-blue color, which is brightest in the spring.

Variety canaerti (Canaert Red Cedar). This is a popular dark green form with short needles and rather slender twigs. The habit of growth is pyramidal, and if properly sheared it makes an attractive upright specimen in the foundation planting. The contrasting steel blue berries make this evergreen more attractive. This variety tends to be broader at the base.

The Larches (*Larix* spp.)

The larches, although they shed their needles in the fall, are generally classi-

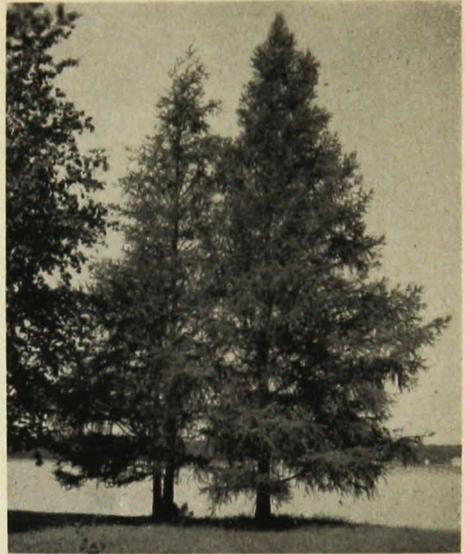


FIG. 4. A Tamarack

fied among the evergreens because of their needle-shaped leaves and cones. The leaves are soft to the touch and clustered on short, spur-like branches. Only two species will be considered, the European larch (*Larix decidua*) and the Eastern larch or tamarack (*Larix laricina*).

European Larch (*Larix decidua*). The European larch seems to be well adapted for planting in most sections of Minnesota. The mature tree reaches a height of 60 or more feet and has wide-spreading branches. One old specimen in Goodhue County has a branch spread of over 50 feet. The needle-shaped leaves are borne in whorls and are bright green in color. The chief attraction of the larch is the delicate beauty of the new spring growth and the yellow color of the needles just before they drop in the fall. It is used chiefly for planting in parks and as lawn specimens on large home grounds. It is possible that this species may have a place in shelterbelt plantings.

Eastern Larch or Tamarack. (*Larix laricina*). The eastern tamarack is na-

tive in swampy areas over much of the state. In the spring of the year when the new growth comes out, the native tamarack is a tree of great beauty. When it is planted on upland soils, tamarack grows more rapidly than it does in swamps or bogs.

The Spruces (*Picea* spp.)

The spruces are one of the most important evergreen groups for windbreak and ornamental plantings in Minnesota, having been found useful in all parts of the state. The distinguishing characteristics of the spruces are their sharp, pointed needles that are squarish in cross section. When the needles drop, they leave a jagged leaf base. This characteristic helps to distinguish the spruces from the firs.

Norway Spruce (*Picea abies*). The Norway spruce and its numerous varieties have been extensively planted in the eastern United States. In Minnesota this species seems to be adapted to only a limited area in the southeastern part where it is grown chiefly for shelterbelt and ornamental purposes. In the East, the species is planted to supply the Christmas tree market. If northern Scandinavian seed sources were selected more carefully, the Norway spruce could be planted in more northern areas of Minnesota. It could then be placed on the Christmas tree market.

The tree grows rapidly when young and eventually reaches a height of 70 or more feet. The main branches are more or less horizontal with the tips turning slightly down-ward, but the secondary branches and twigs tend to droop as the tree gets older. Except in favored sites the needles shed prematurely, giving the mature trees a bare, shaggy appearance.

White Spruce (*Picea glauca*). This tree, native to northern Minnesota, grows rapidly to form a fairly compact, spire-shaped tree 50 or more feet tall. The needles are not quite so long nor as sharp-pointed as those of the Colo-

rado spruce. The color varies from green to bluish-green. The cones are about 2 inches long.

The white spruce is used for windbreak and shelterbelt plantings and for specimen and background plantings in all parts of the state except in the dry high-lime soils of western Minnesota. It is not a popular species for Christmas tree plantings because of its poor needle retention and the disagreeable odor of the needles. The tree does best in rich, moist soil.

Variety *densata* (Black Hills Spruce). The Black Hills spruce is a geographical variety of the native white spruce, differing from the species in its more compact habit and slower growth. Like the species, the color ranges from green to bluish-green. It is excellent as a lawn specimen and, since it is more drought resistant than the native form, it is especially useful in windbreak and shelterbelt plantings in western Minnesota.

Variety *conica* (Dwarf Alberta Spruce). This is a dwarf form of white spruce that grows only about ½ inch in height each year. A mature specimen does not exceed 6 feet in height, while a 10-year-old specimen may not be over about 2 feet tall. The form is compact and upright. Because of its dwarf nature, this evergreen is useful in rock gardens and for accent in the formal garden. It must be grown in a protected place or winter burn might occur.

Colorado Spruce (*Picea pungens*). The Colorado Spruce is one of the most widely grown evergreens. It thrives on most soil types and withstands drought better than many of the other spruces. The tree is striking in appearance—it has a nearly perfect pyramidal outline with horizontally spreading branches that occur in close whorls, giving the tree a layered appearance. Its color varies from green to bluish-green in seedling lots. The bluish forms are generally sold as Colorado blue spruce, while the green forms are sold as Colo-



FIG. 5. A Colorado Spruce

rado spruce. The needles are stiff and very sharp, coming out at right angles to the stem. The year-old twigs are a bright brown color and the cones are 3 to 5 inches long.

The Colorado spruce and its selected forms are very valuable for lawn specimens and group plantings, and for windbreaks and shelterbelts. Although frequently used in foundation plantings, its use for this purpose should be discouraged because of its large size at maturity. Colorado spruce is not native to this state and may be more subject to diseases than the native white spruce. A shortcoming of Colorado spruce is its susceptibility to a fungus canker disease (see number 3 in table 1, page 26). For this reason it may be relatively short-lived. It also seems to be more subject to browning of the needles following a severe winter than the native white spruce or Black Hills spruce.

Variety kosteri (Koster Blue Spruce). This is a grafted form with an intense bluish-green color. The form is narrow and upright, with rather irregular and pendulous branches.

The Pines (*Pinus* spp.)

The pines are readily distinguished from other evergreens by the long needle-shaped leaves that are always borne in bundles of from two to five bound together at the base by a light brown membranous sheath. In varying degrees the pines are susceptible to winter injury, with the needles showing browning following a severe winter. The following species are commonly planted in Minnesota.

Jack Pine (*Pinus banksiana*). The jack pine is native in northern Minnesota. The tree is characterized by its short needles that are dark, shiny green, 1 to 2 inches long, and in bundles of two. The small, recurved cones remain on the tree for several years, thus distinguishing this species from other pines that shed their cones as soon as they are ripe.

Jack pine is somewhat irregular in habit of growth and is not too attractive as a specimen. Because of its rapid growth and ability to grow on poor, sandy soils, this tree is best adapted for field windbreaks and farm shelterbelt plantings in sandy areas of northern Minnesota.

Swiss Mountain Pine (*Pinus mugho*).

The Swiss mountain pine is native in the mountainous regions of northern Europe and shows many variations in size and form, from a low, spreading shrub to an upright tree 20 or more feet high. The typical form is a large, pyramidal bush nearly as broad as it is high. The needles are borne two in a cluster and are 2 to 3 inches long. The species is used for specimen plantings on the lawn or for group plantings in parks and around public buildings. The following variety is widely used in foundation plantings and in formal gardens.

Variety mugho (Dwarf Mugho Pine). This mugho pine is a compact, dwarf variety that is widely grown for use in foundation plantings and for accents in formal gardens. By pinching

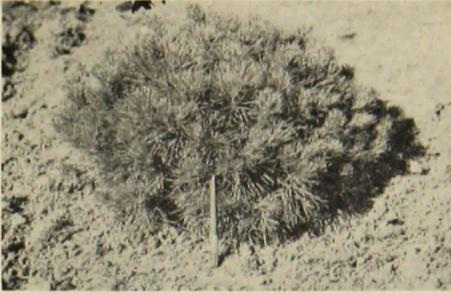


FIG. 6. A Dwarf Mugho Pine

back the new growth in the spring, this plant can be shaped to almost any form desired. It is one of the best dwarf evergreens.

Austrian Pine (*Pinus nigra*). The Austrian pine is one of the two-needled pines with needles 3 to 5 inches long, very stiff and sharp, and of a dark green color that gives the entire tree a dark appearance. Aside from the mugho, the Austrian pine is the most symmetrical of the pines, forming a broad pyramidal tree of slow growth that may ultimately reach a height of 50 feet or more.

The Austrian pine is used for lawn specimens on large grounds and for background groupings. It might also be used in windbreak and shelterbelt plantings. Only the northern variety, native of Austria, is hardy in the state.

Rocky Mountain Ponderosa Pine (*Pinus ponderosa scopulorum*). The Ponderosa pine is native from the Missouri River westward to the Pacific Coast. The variety *scopulorum* from the Black Hills of South Dakota and northern Rocky Mountain regions seems to be best adapted to Minnesota conditions.

The tree is fast-growing and ultimately reaches a height of 50 feet or more. The needles are 4 to 6 inches long, are rather coarse and twisted, and occur in bundles of two or three on the same tree, thus making this pine easy to distinguish from other pines.

Because of its large size, this variety of Ponderosa pine should not be used

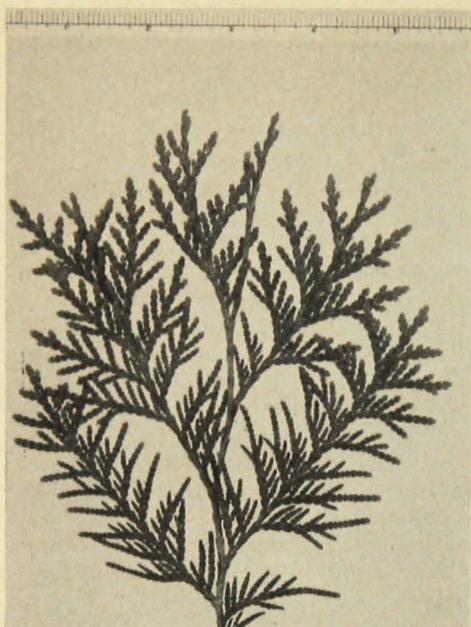
for landscaping except on large grounds or in parks where large background groups are desired. In western Minnesota, it is one of the best pines for windbreaks and shelterbelts.

Norway or Red Pine (*Pinus resinosa*). The red pine is native and occurs commonly in northern Minnesota. It is widely known in the Lake States as Norway pine. In 1953, the Minnesota legislature accorded it recognition as the state tree. It grows rapidly as a young tree and attains considerable size when mature. It can be distinguished from other two-needled pines by the 4- to 6-inch long needles that are soft and dark green. The bark is reddish colored, having broad, flat scales on older branches and the trunk.

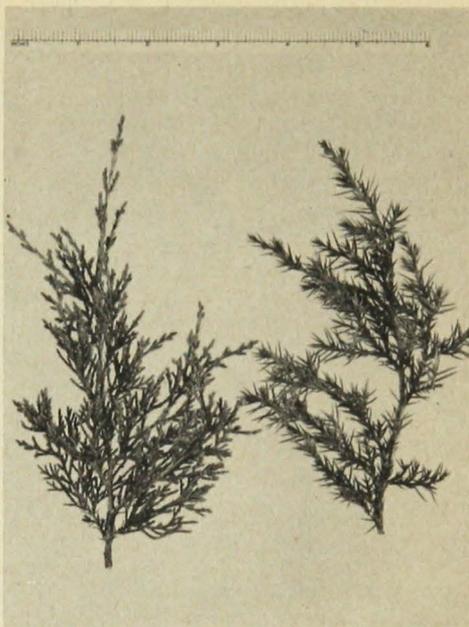
Because of its rapid growth and large size, red pine is not desirable for landscape purposes on small grounds. It is, however, very useful for windbreak,



FIG. 7. A Norway Pine



American Arborvitae



Eastern Red Cedar



Eastern White Pine



Japanese Yew

FIG. 8. Further help in identifying evergreens.

shelterbelt, and Christmas tree purposes in southeastern and northern counties. It is also valuable for park and roadside plantings. In other parts of the state, Norway pine is often the victim of "winter drying" or "winter injury." This disease usually deforms the tree and frequently kills it.

Eastern White Pine (*Pinus strobus*).

The eastern white pine is native in northern, eastern, and scattered points in southeastern Minnesota. The needles are bluish-green, soft in texture, 3 to 5 inches long, and occur in bundles of five. When young, the trees are pyramidal in form, but they become more or less open and picturesque as they grow older.

Because of its rapid growth, the white pine is not recommended for use as lawn specimens on small grounds. It is especially recommended for the wind-break and shelterbelt planting in those sections of Minnesota where this species thrives. White pine is susceptible to the blister rust disease. Remove the alternate hosts, currants and gooseberries, to protect the tree from this disease. For best development, the species requires an acid, moist soil and protection from dry winds. For this reason the white pine is not recommended for western Minnesota.

Scotch Pine (*Pinus sylvestris*).

The Scotch pine, a native of Europe, is fast growing and forms a pyramidal tree when young, but it becomes open and rather picturesque as it matures. The needles are in bundles of two, bluish-green in color, 2 to 3 inches long, and twisted. The bark on the older branches is quite smooth and cinnamon brown or reddish.

Because of its rapid growth it is best used where large mass plantings or specimen trees in parks or large grounds are desired. Because of its shallow root system, this pine cannot endure long dry periods and is not well suited for planting in western Minnesota. Only northern seed sources such

as the Riga strain exhibit satisfactory form at maturity. Certain other strains from Central Europe may be used in Christmas tree production.

The Yews (*Taxus spp.*)

The yews differ from all other evergreens in their method of seed production. The male flowers are produced on one tree while the female flowers are produced on another. The fruits form a soft, pulpy, red, cup-shaped berry. Other distinguishing features of the yew are the dark bright green color of the flat needles and the green color of the young twigs. They will tolerate considerable pruning, thus they can be kept in bounds almost indefinitely in the foundation planting. Shearing regularly about twice per season will give a more dwarfed, compact specimen.

Canada Yew (*Taxus canadensis*). The Canada yew is native in moist, shaded spots in Minnesota. It is a low, spreading plant, often rooting where the branches touch the ground. It can be grown best where it is moist and protected, since it will not endure overexposure to the winter sun.

Japanese Yew (*Taxus cuspidata*). The Japanese yew is far better than the na-



FIG. 9. A Dwarf Japanese Yew

tive form for landscape purposes. When grown from seed, the typical form is a small, upright tree. Spreading forms are propagated from cuttings. It is useful in the foundation planting on the north or east sides of the house and in semi-shade elsewhere in the yard. When it is grown in the open, protection from the sun should be provided in late winter.

Variety nana (Dwarf Japanese Yew). This is a dwarf form which, with a little shearing, can be trained into a globe and kept under 3 feet for years. It endures more sun than the species.

Variety capitata (Upright Japanese Yew). This upright variety tends to be broad at the base and rapidly tapering to a point. Regular pruning will assure a more compact pyramidal specimen. Prune to a single leader. This type is produced from seeds or tip cuttings from upright shoots.

Variety browni (Brown's). This vase shaped upright form has dense, waxy, dark green foliage. It has a graceful, attractive growth habit.

Anglojap Yew (*Taxus media*). Several named varieties have been selected by Eastern nurserymen. These varieties have not been sufficiently tested here. These forms are thought to be hybrids resulting from a cross of *T. baccata* and *T. cuspidata*.

Arborvitae (*Thuja* spp.)

Eastern or American Arborvitae (*Thuja occidentalis*). The arborvitae are characterized by the flattened branches and twigs that resemble the fronds of certain types of ferns. The frond-like twigs are made up of small, scale-like, flattened leaves that are attached closely in pairs. In the common forms these branches are arranged horizontally, while in some globe and pyramidal forms the arrangement is nearly vertical. They have very small cones.

Although native in northern and eastern Minnesota, the arborvitae have



FIG. 10. A Globe Arborvitae

a tendency to brown during the winter-time and during dry summers, especially when planted in light soils or in exposed sites. For this reason the arborvitae should be used sparingly out of its natural range except in protected spots, such as the north or east sides of the house. Avoid planting the arborvitae in light soils unless the rainfall is ample or additional water can be supplied. It is widely used for hedges, screens, and foundation plantings. The following varieties are commonly grown.

Variety pyramidalis (Pyramidal Arborvitae). This pyramidal arborvitae is of columnar habit with dark green foliage which reaches a height of 15 to 20 feet. It is useful for foundation plantings where an upright specimen is needed.

Variety Douglasi pyramidalis (Douglas Pyramidal Arborvitae). This is a narrow form which slowly reaches a height of 20 feet. The foliage is dense with small fronds that are a dark, glossy green.

Variety Douglasi aurea (Douglas Golden Arborvitae). This is a bushy

pyramidal tree with bronzy-yellow foliage in the spring.

Variety wareana (Ware or Siberian Arborvitae). One of the hardiest of all the arborvitae, this form is typically pyramidal and compact, although it can be pruned into a globe. It has dark green foliage.

Variety Woodwardi (Woodward Globe Arborvitae). The branches of the globe arborvitae tend to grow upward, producing a well rounded form rather than an upright tree. Of all the globe forms, the Woodward Globe is one of the best for Minnesota conditions. It seldom grows over 3 feet tall.

The *Jewell Globe* and the *Dark Green* are other varieties of arborvitae often planted in Minnesota.

Hemlock (*Tsuga spp.*)

Northern Hemlock (*Tsuga canadensis*). This is one of the most beautiful of all evergreens of upright habit. The leaves are narrow, flat, and about $\frac{3}{4}$ of an inch long, with a white line on the undersurface. The tips of the branches are drooping and very graceful. Unfortunately, the hemlock, whose natural range just touches the state near Duluth, is not too hardy in most parts of the state except in protected and shaded locations. Since it will tolerate more shade than most evergreens, it can be grown on the north side of the house where an upright specimen is desired. When grown under these conditions, trimming is necessary. This tree is worth growing where conditions are favorable.

Uses for Evergreens

Evergreens lend themselves to landscape planting because of their interesting forms and year-round color. Perhaps the most universal use for evergreens is in foundation plantings. Here selections may be used alone or in combination with deciduous shrubs. It is recommended that a combination of deciduous and evergreen specimens be used to take advantage of seasonal effects. Narrow or broad pyramidal forms may be chosen for corner groupings or to frame the doorway. Global forms may be selected for planting under the windows or in front of the upright specimens. If less formal specimens are desired, the half erect or creeping forms can be used.

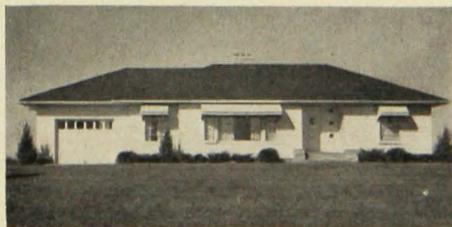


FIG. 11. An all-evergreen foundation planting



FIG. 12. Pines used in a screen planting

Evergreens may also be used for background plantings to help enclose the outdoor living room or to screen some unsightly view. Groups of the taller forms should be used in back, with lower forms in front. Evergreens make excellent backgrounds for flower borders.

On large grounds or in parks, the taller evergreens, such as the Colorado

blue spruce, white fir, and pines, are excellent. Always locate these trees where they will have ample room to develop naturally. It is best not to plant specimen trees in front of the house but rather out at an angle from the front corners so that they will frame the house as they grow up.

Some of the evergreens make very compact and beautiful hedges when kept regularly sheared. The arborvitae and red cedars are especially good for this purpose. For a compact hedge, plant evergreens about 18 inches apart and shear each year to keep the hedge dense from the ground up.

Evergreens are being used more and more for field windbreaks and farmstead shelterbelts in all parts of Minnesota. In addition to adding beauty, they add year around wind protection for the farmstead and field. Use them in

combination with deciduous trees and shrubs. At least two rows of evergreens are needed. Colorado, white, and Black Hills spruce, Ponderosa and red pine, and red cedar are recommended species for shelterbelt and windbreak plantings in those sections of Minnesota where they are adapted. (See Ext. Bul. 196 *Planting the Farmstead Shelterbelt*.)

Not too long ago, almost all of the evergreens cut for Christmas trees were taken from wild forests. Today, however, thousands of landowners are systematically planting, managing, and harvesting pine, spruce, and fir for the Christmas tree market. In many cases, these manmade forests were established on idle land or land unsuitable for agriculture. Evergreens prefer coarse textured soils, sandy loam in nature, to the finer silt and clay soils.

Planting and Care

Soil and Moisture Requirements

Evergreens, for the most part, are not particular about the soil type on which they are grown. A rich, sandy loam is best for most varieties. However, evergreens can be grown successfully on sandy or clayey soils if organic matter is incorporated with the soil.

Except for the arborvitae and native tamarack, most of our commonly grown conifers need a well drained soil. Even the arborvitae and tamarack, which are found native in poorly drained soils, grow much better on well drained sites if rainfall is sufficient.

Perhaps the greatest difficulty comes from planting the evergreens in foundation plantings where the subsoil from the basement and building refuse has been filled in around the house. Under such conditions, success can be achieved only by digging a sufficiently large hole and refilling with good soil.

It is well to remember that many of the evergreens grown for landscape purposes are native in other regions and that they are being planted under unnatural conditions. Under such situations they are apt to be short-lived and will therefore need to be replaced occasionally.

Shade Tolerance

Evergreens vary in their tolerance of shade. Some kinds, when planted under large deciduous trees, fail to develop in an acceptable manner. They are apt to be deformed and stunted in appearance. This is especially true of the pines, cedars, and spruces. The arborvitae will tolerate some shade, and the yews and hemlocks seem to do better in shade than in full sunlight. The differences in shade tolerance make it very necessary to select evergreens for each shade condition when they are being used for foundation plantings.

Planting Evergreens

Except when planting evergreen seedlings and transplants, it is necessary to plant them with a ball of dirt attached. When the evergreen arrives from the nursery a strip of burlap will be tightly fastened around the ball of dirt to hold it in place. Dig a hole slightly larger than the ball of dirt and place the tree carefully in the hole so that the tree will be an inch deeper than it was in the nursery. Fill in around the base of the ball with good soil. Tamp the soil around the base of the ball to firm the soil and prevent undue settling of the plant. Repeat until the hole is a little more than half full. Loosen the burlap from around the top of the ball and fold back. Next, fill the hole with water and allow time for water and soil to settle. Finish filling the hole with loose soil and leave a depression around the base of the tree to facilitate later watering. Keep the ground soaked periodically during dry periods for the first season. This is especially advisable if trees are planted near the house foundation where the soil frequently becomes very dry. Larger trees should be temporarily staked

to prevent tipping while the ground is wet.

Small evergreens, either seedlings or transplants, are generally planted bare-rooted during the spring before new growth has begun. Seedlings which have remained in the seedbed for two years are designated as 2-0 stock, while transplants which were grown for two years in the seedbed and one or two years in the transplant bed are known as 2-1 or 2-2 transplants. When the trees are out of the ground and until they are planted, it is very important that the roots be kept moist at all times; exposure to the drying effects of the atmosphere will cause their death.

One successful method of planting seedlings or transplants is the hole method. The hole should be dug large enough to permit placing the tree roots in their natural position without crowding. Good soil should be worked around the roots a little at a time and firmed with the hand. It is very important that the root collar or dirt line be right at the surface of the soil when the hole is completely filled. Planting small evergreens too shallow or too deep will often result in retarded

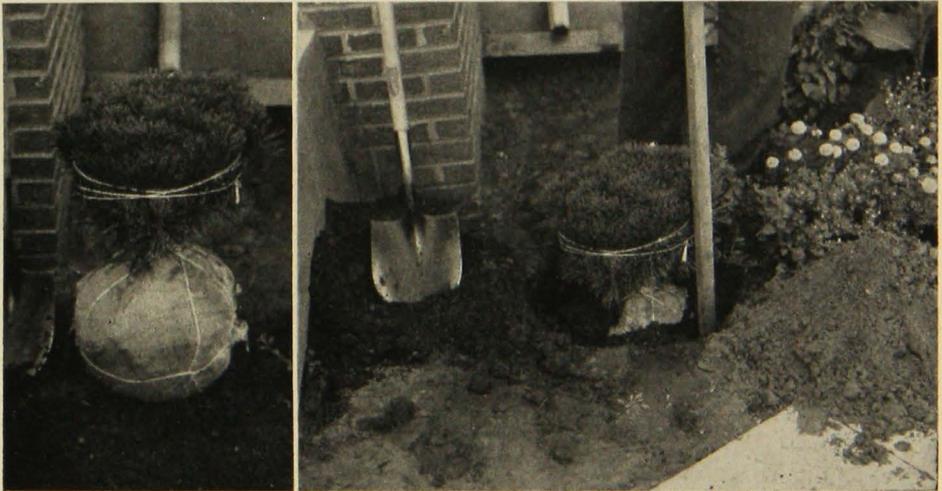


FIG. 13. Steps to follow in planting balled evergreens: (1) Balled Mugho Pine as received from the nursery. (2) Hole dug amply large, tree in place, and top soil being tamped around the roots. (Steps 3 and 4 follow on page 18.)

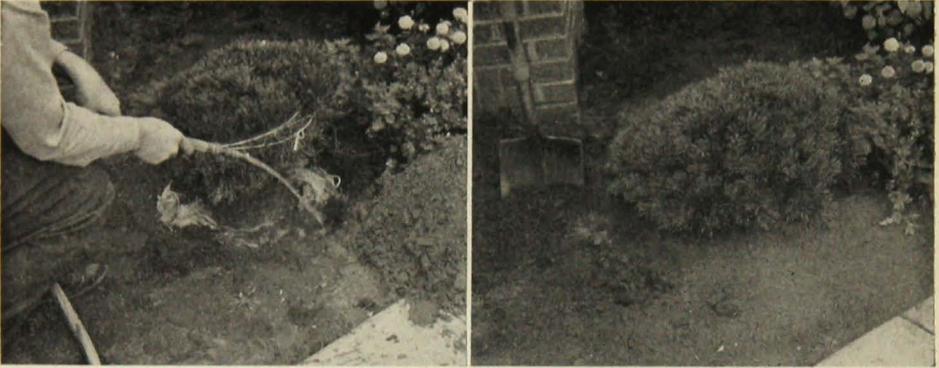


FIG. 14. Steps in planting balled evergreens (cont.). (3) Burlap folded back and water being applied to settle soil. (4) Loose soil added to fill hole and surface evened, leaving a shallow depression for watering.

growth or death. After the hole is filled the soil should be tamped. Another method that has proved successful on light soils is the slit method. A slit is opened with a spade, the seedling is inserted in the slit, and the spade removed. The soil is then firmed by tamping.

Mechanical planting with specially designed tree planting equipment is recommended when large numbers of trees are involved.

Never mix fertilizer with the soil that is put around the evergreen roots when planting, since evergreen roots are sensitive to contact with commercial fertilizers.

Instead of using fertilizer, plant new trees in a good grade of topsoil containing plenty of organic matter. After the tree has exhausted this supply of food, it may be necessary to use fertilizer.

Cultivation

Evergreens should be kept cultivated for several years until they have become well established. This is as true for shelterbelts and windbreaks as for ornamental plantings. For individual trees, it will be necessary to keep the soil cultivated about a foot beyond the spread of the branches. In the foundation planting the entire area should

be cultivated from the house foundation out to the edge of the lawn. Cultivation should be shallow to prevent injury to the roots.

Remember, you have a large investment in your plantings and they demand the best of care.

Fertilizers for Evergreens

Evergreens, like other green plants, remove nutrients from the soil. Evergreens, unlike other green plants, are not especially demanding on the mineral elements necessary for growth. In the forest, needles and twigs accumulate on the ground and return fertilizing elements to the soil. Under cultivation, however, evergreens usually do not get this repeated source of plant nutrients because the needle and twig litter is raked and burned. Moreover, grass clippings are removed which further impoverishes the soil. Under these unnatural conditions, it sometimes becomes necessary to fertilize.

The tree itself will indicate when a fertilizer is needed. If the rate of growth and the color of the needles are normal for a particular variety, then it is not necessary to add fertilizer. On the other hand, if the growth is sharply reduced and the color is not a bright, healthy green, it is best to add fertilizer.

Of the 12 or more elements necessary for plant growth, only 3 are apt to be lacking in most soils. These are nitrogen, phosphorus, and potassium.

A complete fertilizer relatively high in nitrogen, such as 10-8-6, is suggested. This formula may be varied slightly but, in general, the nitrogen content (the first figure in the formula) should be higher than the phosphorus and potassium (the last two figures in the formula).

Fertilizer may be applied from early spring until mid-summer. Applications beyond this period are apt to stimulate growth late in the season. This does not allow sufficient time for plant tissue to harden up to withstand the early frosts and winter cold.

The amount and method of application of fertilizer are important. As a general rule, one-half pound of a 10-8-6 or similar fertilizer for each foot in height of the tree is recommended. In foundation plantings and places where the soil around the tree is cultivated, apply the fertilizer in a shallow trench in a circle under the tips of the outer branches. Scatter the fertilizer in the bottom of this trench and cover with soil. Rain or artificial watering will carry the fertilizer down to the feeding roots.

When large lawn trees seem to be growing poorly, apply fertilizer by placing it in ground holes, made with a crowbar or soil auger. Make the holes 6 to 18 inches deep and 2 feet apart under the outer branches of the tree. Soak the soil around the tree thoroughly the day before fertilizing. This makes it easier to drive an iron rod or other 1-1½-inch punch far enough into the ground. Place a handful of fertilizer in each hole and add water to help dissolve it. It is not necessary to plug the holes afterwards—in fact, leaving them open will help get air and water to the tree roots.

Well rotted manure is an excellent fertilizer for evergreens. Annual applications provide a good mulch which

helps conserve moisture and furnish the necessary nutrients. Apply manure in a layer 2-3 inches thick over an area equal to its branch spread. If a summer mulch is not wanted, use the recommended amount and dig it into the soil to a depth of a few inches in late summer. Manure and compost, in addition to supplying needed minerals, improve the physical texture and water-holding capacity of the soil.

Watering Evergreens

Evergreens growing in our native forests reach enormous sizes with only the moisture they receive from natural rainfall. From this we might conclude that evergreens need no additional water. This, however, is not the case. If we were to examine the soil under evergreens in a natural forest, we would find an accumulation of leaves and leaf mold to a depth of several inches. This keeps the ground cool and moist and reduces evaporation from the forest floor. Contrast this with the conditions that exist in the average yard. Here the ground has no natural mulch to protect it from drying out. Trees are often planted under the eaves where they get little rainfall and often the young trees must compete with garden flowers and the adjoining lawn. For the first few years, the roots will not extend much beyond the original ball of dirt so the feeding area for each tree is limited. For these reasons, it is advisable to water regularly for the first few years at least, until the tree has become well established.

In watering, it is best to remove the hose nozzle and let the water soak into the soil until the soil will absorb no more water. After soaking, work the surface of the soil to form a dust mulch. During dry weather one thorough watering every 10 days or 2 weeks should be sufficient. A light sprinkling at frequent intervals often does more harm than good, since the water does not reach the main mass of roots and shallow surface roots are encouraged.

Pruning Evergreens

There are three reasons for pruning an evergreen. These are:

1. To keep the tree within certain limits of size and form.
2. To remove any diseased or injured part of the tree.
3. To train the tree into some special shape.

Evergreens may be divided into two groups. The first group is the evergreens that open their dormant buds and make their annual growth within a few weeks in the spring. This group includes the pines, firs, spruces, and Douglas fir. In the second group the growth is not limited to early spring but is more or less continuous throughout the growing season. This includes the junipers, arborvitae, yews, and hemlock.

Pruning of the first group of evergreens is generally limited to the removal of dead or injured branches. These should be removed close to the main trunk or just beyond a strong lateral branch. Occasionally it may be desirable to shape one of these evergreens for a particular purpose. This is true of the mugho pine when a globe-shaped specimen is desired in the foundation planting. It is also true when these evergreens are grown for clipped hedges. In pruning evergreens of this group to obtain a desired form, the pruning must be done annually in the spring just as the buds are opening and before the new needles unfold. The pruning is merely cutting off the tips of the new growth. This can be done either with a sharp knife or with a pair of hedge shears. The rate of annual growth can be regulated by the amount of new growth removed. Wherever the cut is made, several adventitious buds develop and consequently the tree becomes compact and dense.

Since trees of this class are most attractive when allowed to grow naturally, they should not be planted where their growth must be restricted by

heavy pruning. Pruning heavily into hard wood makes an unsightly specimen and new shoots will not develop to cover the large stubs. The natural growth should not be destroyed by pruning. For this reason we would not advise the planting of spruces and pines (except dwarf mugho) in the foundation planting, but rather use them for lawn specimens or background groups where they can develop naturally.

The pruning of junipers, arborvitae, etc. is quite different. These evergreens are commonly used where their growth must be limited, as in foundation plantings, rock gardens, formal gardens, and hedges. Corrective pruning generally starts in the nursery, and by the time the specimens are purchased they are well shaped according to the natural form. After they are planted in their permanent locations, this pruning will need to be continued annually if their compact form is to be retained.

The pruning can be done at any time during the late spring or early part of the summer. A pair of hedge shears might be used, but a sharp knife will give a more natural appearance to the pruned specimens. The tips of the new growth are cut back with a sharp pruning knife, using an upward, freehand movement. This annual pruning will keep the tree compact and restrict the rate of growth, and it will greatly increase the time that these evergreens can be left in the foundation planting.

For low-growing or spreading specimens, little pruning will be necessary. If the specimens spread too widely, some of the outer branches can be removed by cutting back to a vigorous side shoot.

Evergreens which grow with a single stem are sometimes injured by the breaking or loss of the leader. Frost and insect damage as well as mechanical injuries may result in this loss. To correct this condition, one of the side branches in the upper whorl should be tied up and securely fastened to a stake anchored below to the main trunk. The

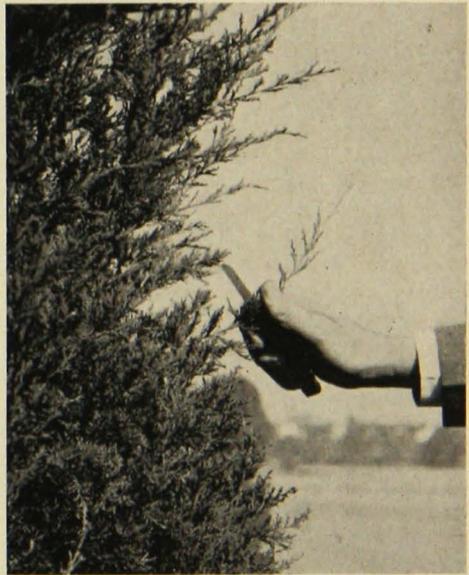


FIG. 15. Upper left: A Colorado Spruce that has developed a double leader. Upper right: One leader removed and the other tied in an upright position. Lower left: Pruning shears can be used in maintaining the formal ball shape of a Muhgo Pine. Lower right: The most natural shape of an upright Red Cedar or Juniper can be kept with a sharp, short-bladed knife.

side branch thus trained to grow upward will soon replace the lost leader. Unless this is done, the tree will either grow up without a top or several of the side branches will grow up to form a tree with several leaders.

Winter Protection

Many newly planted evergreens suffer from winter drought. This is especially true if the ground is dry when it freezes. To overcome this difficulty, soak the ground thoroughly and mulch heavily, using leaves or peat moss, just before the ground freezes. This will reduce the depth of freezing and help to conserve moisture. Since evergreens retain their leaves, they use some water

all winter, and unless this water is available the trees will suffer.

Some evergreens, such as the yews and arborvitae, will brown or show burning during late February or March from too much sun. Where these evergreens are grown in full sun, it may be necessary to shade them during this period by placing a burlap shade mounted between upright stakes on the south and west sides of the specimens.

Evergreen branches may be broken by heavy snows and ice storms. It is desirable to shake the snow from the branches after each heavy snowfall. After an ice storm, branches which are not broken may be saved by placing props under them.

Health of Evergreens

THE COMMON and injurious insects and diseases of ornamental evergreens are described in tables 1, 2, and 3. Factors other than specific insects, diseases, and bird or animal injury may influence the appearance, vigor, and length of life of these trees.

Individual trees of spruce, fir, pine, or other evergreens will vary greatly in size, vigor, growth habit, and length of life. One individual tree may be broad and squat and another of the same species narrow and high. One individual pine may grow at only half the rate of another. There are, occasionally, some that never do well. Because this variability among individuals is inherent and unavoidable, every one of the trees you buy will not equal the choicest individuals in quality.

Evergreen leaves, although green throughout the year, do not live forever. Each year a healthy, vigorous evergreen puts out a new crop of twigs and leaves at the outer ends of the twigs only. This means that needles destroyed by insect defoliation, fire, dogs, etc. are not replaced. Each year leaves will die, turn brown, and drop. Thus it

is natural for the older parts of all the twigs to be bare of foliage. Furthermore, the lower branches, shaded by those above, may have leaves only at the outer ends.

Most of the evergreens planted as ornamentals in this region have a life expectancy of 50 to 60 years at most, and often they will begin to deteriorate when only 25 to 40 years of age. A tree 4 feet high may be as much as 10 years old, and if trees this age and size are planted they can be expected to remain attractive for an additional 15 to 30 years.

Even with the best of care and the most expert workmanship there is some risk involved in transplanting ever-



FIG. 16. Pine Needle Scale



FIG. 17. White Pine Blister Rust

greens. The older and larger the tree, the greater the risk. Because of the inevitable loss of some of the root system in transplanting, some of the transplanted trees will fail to survive even when the roots are balled and burlapped. With trees only a foot high, this loss may be only 5 to 10 percent, but with trees 3 to 4 feet high the loss may be up to 20 percent. That is, of trees more than 3 feet high when transplanted, one out of every five or ten will normally die within the next year or two, and of those that survive the majority may be stunted for a year or two. Heavy watering after transplanting helps reduce this injury.

Specimens from unhealthy trees may be sent to the University for examination. Be sure to include the following:

1. As large a sample as possible, preferably several branches from the tree or trees affected. These should include some in which the symptoms are just beginning to appear, because little information is obtainable from

material that has been dead for some time.

2. Information on when the trouble first appeared and the course which it has taken.
3. The number and kind of trees affected.
4. Age and size of trees affected and their location as to kind of soil, exposure, slope, shape, etc.
5. The previous history of the trees insofar as this is known: when transplanted, whether sprayed or given other treatments.
6. Specimens of insects should be placed in a small box or mailing tube with some of the foliage on which they are found feeding. Do not send softbodied insects in an envelope. Such specimens should be sent to the Agricultural Extension Service, University of Minnesota, Institute of Agriculture, St. Paul 1, Minnesota.

The tables referred to in this section follow on pages 26 through 28.



FIG. 18. Cedar Apple Gall Rust

Uses for Evergreens

See general description for adaptability in your area and special requirements

Evergreens for Shelterbelts

Rocky Mountain Juniper
 Eastern Red Cedar
 European Larch
 Tamarack
 Norway Spruce
 White Spruce
 Black Hills Spruce
 Colorado Spruce
 Jack Pine
 Ponderosa Pine
 Red Pine
 White Pine
 Arborvitae

Evergreens for Foundation Plantings

Pfitzer Juniper
 Common Juniper
 Creeping Juniper and varieties
 Savin Juniper
 Rocky Mountain Juniper and varieties
 Eastern Red Cedar and varieties
 Mugho Pine
 Japanese Yew
 Arborvitae and varieties

Evergreens for Lawn Specimens

White Fir
 Balsam Fir
 European Larch
 Tamarack
 Norway Spruce

White Spruce
 Black Hills Spruce
 Colorado Blue Spruce
 Austrian Pine
 Red Pine
 White Pine
 Scotch Pine
 Douglas Fir

Evergreens for Hedges

Rocky Mountain Juniper and varieties
 Eastern Red Cedar and varieties
 Arborvitae
 White Pine
 White Spruce
 Black Hills Spruce
 Colorado Spruce

Evergreens for Screens

Concolor Fir
 Rocky Mountain Juniper and varieties
 Eastern Red Cedar and varieties
 Norway Spruce
 White Spruce
 Black Hills Spruce
 Colorado Spruce
 Ponderosa Pine
 Red Pine
 White Pine
 Scotch Pine
 Douglas Fir
 Arborvitae

List of Evergreens

Name	Size at maturity	Form	Site preference
Balsam fir	Very tall tree	Pyramidal	Moist deep soil
White fir	Very tall tree	Narrow pyramidal	Moist deep soil
Douglas fir	Very tall tree	Dense pyramidal	Moist to wet soil, needs some shade
Chinese juniper	Tall tree	Variable, but mostly upright; broad conical to pyramidal	Sandy soil, good drainage
Sargent's juniper	Low shrub	Spreading, irregular mass	Sandy soil
Pfitzer juniper*	Low shrub	Broad irregular; spreading to half erect	Sandy soil, tolerates some shade
Common juniper	Low medium shrub to small tree	Mostly upright; quite variable; often pyramidal	Dry, sandy soil, well drained
Oldfield or Prostrate juniper	Low shrub	Spreading, irregular mass	Most soils, prefers sandy
Maney juniper	Low shrub	Somewhat prostrate	Most soils, prefers sandy

* Golden and Hetzi Pitzers are similar in size, form, and site preference, but differ in color of foliage.

List of Evergreens (continued)

Name	Size at maturity	Form	Site preference
Creeping juniper	Very low shrub	Low; creeping	Most soils, prefers sandy
Waukegan juniper	Very low shrub	Low; trailing, upright tips	Most soils, prefers sandy
Andorra juniper	Very low shrub	Compact mound	Most soils, prefers sandy
Savin juniper	Low shrub	Semi erect; spreading	Most soils, good drainage
Tamarisk juniper	Very low shrub	Low; spreading; with erect branches	Most soils, good drainage
Rocky Mountain juniper	Medium tree	Narrow; upright; pyramidal to conical	Sandy, dry, high land
Eastern red cedar	Medium tree	Narrow; upright; pyramidal to conical	Sandy, dry, high land
European larch	Tall tree	Open, broad pyramidal; loses needles annually	Moist soil
Tamarack	Tall tree	Open, broad pyramidal; loses needles annually	Moist soil
Norway spruce	Tall tree	Pyramidal; pendulous branches; top is open and than at maturity	Rich, deep, moist soil; high land
White Spruce	Tall tree	Thick pyramidal	Rich, deep, moist soil; high land
Black Hills spruce	Medium tree	Dense pyramidal; symmetrical	Most soils; deep, good soil best
Dwarf Alberta spruce	Dwarf tree	Very dense, compact, broad pyramidal	Moist, deep soil, needs protection from winter sun
Colorado spruce	Medium tree	Dense pyramidal	Most soils, best on deep, moist soil
Jack pine	Tall tree	Open; broad; irregular	Dry, sandy soil
Swiss Mountain pine	Tall shrub to small tree	Globe-like to broad, irregular mass	Most light soils
Dwarf Mugho pine	Dwarf shrub	Round, globe-like; compact if pruned regularly	Most light soils
Austrian pine	Tall tree	Broad pyramidal; wide spreading, rounded top	Most light soils
Ponderosa pine	Very tall tree	Broad, open pyramidal; coarse needles	Most light soils, high land
Norway or Red pine ..	Tall tree	Dense, broad pyramidal; finer textured needles	Most light soils
Eastern White pine	Tall tree	Upright, open pyramidal to rounded top; fine textured needles	Most soils
Scotch pine	Tall tree	Open, broad pyramidal to irregular	Most light soils
Canada yew	Very low shrub	Low, irregular mass to upright	Most soils; shade
Spreading Japanese yew	Low to medium shrub	Variable, but generally vase-shaped	Most soils; protected shady site on north or east side
Dwarf Japanese yew	Low to medium shrub	Upright irregular form	Most soils; protected shady site on north or east side
Upright Japanese yew	Low to medium shrub	Upright pyramidal, broad base, grows slowly	Most soils; protected shady site on north or east side
Brown's Japanese yew	Low to medium shrub	Dense conical to columnar form	Most soils; protected shady site on north or east side
Eastern or American arborvitae	Medium tree	Narrow pyramidal to columnar	Heavy, moist soil; protected from winter sun and winds
Pyramidal arborvitae	Medium tree	Pyramidal	Heavy, moist soil; protected from winter sun and winds
Douglas arborvitae	Small to medium tree	Dense, broad, columnar	Heavy, moist soil; protected from winter sun and winds
Golden arborvitae	Small tree	Bushy pyramidal, yellowish tips on branches	Heavy, moist soil; protected from winter sun and winds
Ware or Siberian arborvitae	Medium shrub	Compact pyramidal, prunes easily to globe	Heavy, moist soil; protected from winter sun and winds
Woodward arborvitae	Small to medium shrub	Globe shaped; branches tend to grow upward	Heavy, moist soil; protected from winter sun and winds
Northern hemlock	Large tree	Graceful, pendulous branches; pyramidal, fine textured	Moist, deep soil; protected shady site

Table 1. Injuries Caused by Diseases

Description	Cause	Treatment	Remarks
1. <i>Red cedar turns brown</i> in mid-summer. Browning may affect twigs or branches, gradually spreads to kill tree in year or two.	Twig blight, a fungus disease.	Cut off and burn dead branches promptly; spray tree with Bordeaux mixture every 10 days during growing season.	These controls are not very effective but none better are known at present.
2. <i>Brown galls</i> up to inch in diameter on twigs of Eastern red cedar; in rainy weather orange colored gelatinous tendrils protrude from galls.	Cedar apple rust, a fungus disease which spends part of its life on apple trees.	State laws specify that Eastern red cedar trees constituting a menace to nearby apple orchards may be eradicated.	Eastern red cedars are not injured enough to justify protection, but there may be heavy loss of nearby apple crop.
3. <i>Branches die</i> on Colorado blue spruce, usually beginning at base of tree and progressing upward. As branches die, resin is exuded from bark, hardens in white masses, and drips.	Blue spruce trees deteriorate at an early age in Minnesota. Weakened trees may become infected with a canker-causing fungus.	No effective control is known at present. Cutting out infected branches and fertilizing trees to improve vigor has been recommended.	Value doubtful of cutting out infected branches and fertilizing trees.
4. <i>Yellow blisters</i> about ¼ inch across erupt from outer bark of stems and branches of white pine in April or May; part above cankered area dies.	White pine blister rust which spends part of its life on currants.	Eradication of all wild and cultivated currant bushes (except Alpine currant) from vicinity of white pine plantings.	Does not spread from one pine to another; only to currants and gooseberries, then back to pines.
5. <i>Small yellow blisters</i> on old needles of pine during April or May, on new needles of spruce in July and August. Infected needles may turn brown and fall off.	Leaf rust, caused by fungi which spend only part of their life on pines and spruces.	Pine leaf rust can be controlled only by eradicating goldenrod in vicinity; spruce needle rust only by eradicating leatherleaf.	Damage too slight to justify expense of control.

Table 2. Injuries Caused by Insects

Description	Cause	Treatment	Remarks
1. Needles eaten by greenish, yellowish, varicolored, or spotted worms, usually feeding in clusters.	Larvae of several species of sawflies.	Spray with lead arsenate, 3 tablespoons to gallon water, or 2 tablespoons of 50 percent wettable DDT to gallon water.	Trees should be observed periodically because control measures are most effective when applied while larvae are small.
2. Buds of spruce destroyed by reddish-brown larvae in webs formed among new needles.	Spruce budworm.	Use materials given in No. 1. Apply with strong spray just as buds break and again about 10 days later.	Injury to the buds usually precedes foliage feeding.
3. Ugly nests formed of needles and excrement webbed together, usually on inner branches.	Spruce tortrix.	Use materials in No. 1. Apply with strong spray in the spring and again after the first of August. Nests may be removed and burned.	Loss of old needles will seldom cause serious injury unless repeated often.
4. Small, white cottony masses on trunk and branches of white pine, occasionally other pines.	White pine aphid.	Spray thoroughly in late May with malathion applied at the rate of 2 teaspoons to 1 gallon of water.	Trees weakened by winter injury or excessive shade are most seriously affected.
5. Foliage off color, dull grayish or turning brown, particularly on lower branches; very fine webbing on twigs and needles.	Spruce spider mite (to see mites, strike branch sharply over white paper).	Spray with ovex, chlorobenzilate, kelthane, or aramite.	Spruce and junipers are most commonly attacked.
6. White objects on needles, small, elongated, particularly on spruce and white and Mugho pine.	Pine-needle scale.	Spray with malathion, 2 teaspoons to 1 gallon of water, in late May when purple young scales appear.	Hatching usually occurs about the time that lilacs are coming into full bloom.
7. Cone-like galls at base of terminal growth of spruce, green when fresh, brown when old, twigs often dying beyond galls.	Spruce gall aphid.	Spray in late April or May when the terminal buds are beginning to swell. Use malathion at the rate of 2 teaspoons to 1 gallon of water.	Galls can be removed from ornamental trees and destroyed.
8. Dying young conifers show on examination that small roots have been eaten.	White grubs or strawberry root weevil.	Treat soil with chlordane, 10 pounds of actual chlordane per acre.	Avoid planting conifers in sod land infested with white grubs.
9. Fine brown dust or shredded wood particles forced from holes in bark. Tree appears to be dying.	Bark beetles or wood borers.	None.	These insects usually attack dead or dying trees. Cut and burn.

Table 3. Injuries from Other Causes

Description	Cause	Treatment	Remarks
1. Trees turn brown in May or early June. Often leaves die on part exposed to winter sun; sometimes whole tree dies.	Winter injury caused by warm weather, especially on warm, sunny days in January, March.	None. Trees will recover from moderate injury.	White and red cedars, western yellow pine, Austrian, Scotch, and white pines are most affected, spruces occasionally.
2. New growth dies or curls downward in late spring after cold spell.	Heavy frost in late spring.	None. Unless injury is very severe, trees will recover.	
3. Stunting of needles or gradual death occurs within year or two after transplanting. Sometimes older needles fall off.	Transplanting injury.	Trees should be transplanted as small as practicable and watered heavily at transplanting and at frequent intervals for a year or two.	If trees have been planted in summer or fall, injury is most likely to show up after new growth appears in the spring.
4. Lower branches die, foliage becomes thin, and growth rate declines from year to year.	Old age or poor vigor in trees not native to this region.	Remove trees when they become unsightly and replace with younger and more vigorous stock.	Many evergreens that are not native decline in vigor after 20 or 30 years.
5. Fall yellowing of older needles occurs back from growing tips, especially apparent in white pine in late autumn.	Perfectly natural; pine needles live only 1½ years, spruce needles 3 to 5 years.	None.	It is natural for older branches to be bare of needles except at their growing tips.
6. Patches die on trees and shrubs near ground, usually during early spring. Injury is most common on exposed outer parts.	Urine from dogs.	Protect trees with fencing.	
7. Nearly square holes occur evenly spaced in horizontal rows in bark.	A bird—yellow-bellied sapsucker.	There is no practical control other than driving birds away.	Smearing bark with tanglefoot has been suggested.
8. Needles turn brown beginning with new growth. Tree dies and may bend over.	Pocket gophers eat off the roots.	Poison bait.	Damage generally occurs in sandy soils where gophers are prevalent.