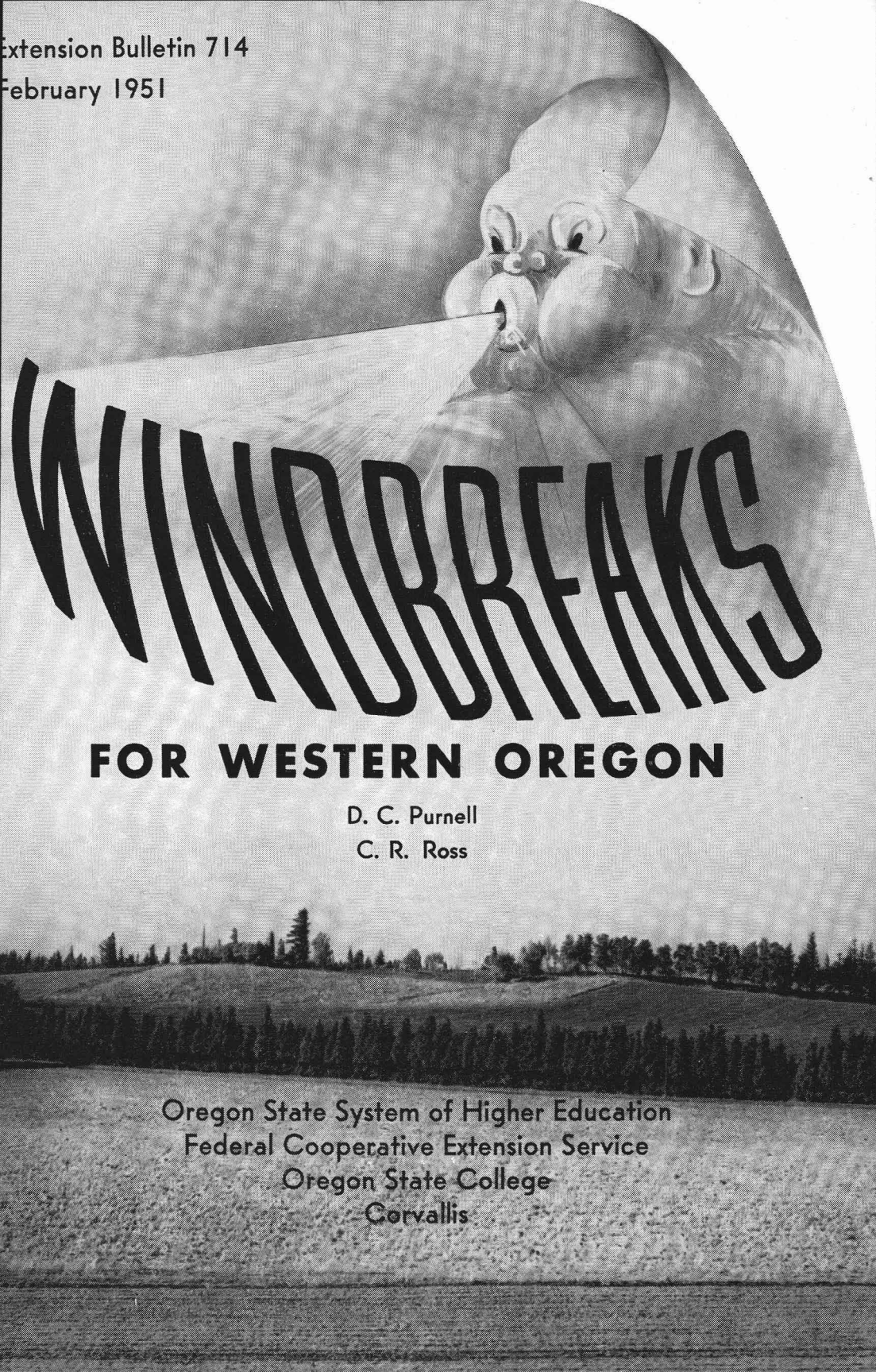


Extension Bulletin 714
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WINDBREAKS

FOR WESTERN OREGON

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Cover photo—Windbreak on the L. T. Evans farm near Corbett, Oregon. Planted in 1932, it is now more than 30 feet high. The single row of Port Orford cedars are 6 feet apart. The Douglas-fir in the background with all the limbs on one side indicates intensity of wind in this area. When natural forest cover is removed from such lands, winds become a definite soil erosion hazard, injure some crops, cause discomfort, and make the establishment of windbreaks highly desirable.

—Background photo courtesy Oregon State Forestry Department.

ACKNOWLEDGMENT: This bulletin is a compilation of information gathered from many sources—experimental and observational—and from individuals who know trees. The authors are especially indebted to W. S. Averill and N. F. Sommer, county extension agents, Multnomah County, for assistance in gathering material and many helpful suggestions in preparation of the manuscript.

PORT ORFORD CEDAR AFFECTED BY DISEASE

This bulletin recommends the Port Orford cedar very highly for windbreaks. A disease known as Phytophthora root rot is killing Port Orford cedars at a number of places, particularly in Multnomah county. Authorities of Oregon State College and the U. S. Department of Agriculture have seen enough infections to be seriously concerned. They expect the infection to spread, and recommend the use of other resistant native trees where possible. Occurrence has been noted principally in swales and poorly drained ground, but is not limited to such areas. There is apparently no way to save a tree that has become infected.

The State Forestry Department, Salem, expects to offer Incense Cedar for the 1954-55 planting season. This species has many of the good qualities of the Port Orford. Undoubtedly many people will continue to plant Port Orford cedar despite the possibility of root rot infection.

Of the trees that will be available from the Oregon Forest Nursery for the 1953-54 planting season, Douglas-fir may be the best bet. Although Douglas-fir seedlings have been killed by one species of Phytophthora in greenhouse inoculation trials, no large trees are known to have been killed by this disease. If two rows are planned, Douglas-fir and Ponderosa pine will be attractive and efficient, but preserve lower limbs by wider spacing and protection from animals.

Pages 16, 17, and 18 discuss other species that can be used for windbreaks. Private nurseries may have those not obtainable from the Oregon Forest Nursery. Incense Cedar, Norway Spruce, Big Tree Sequoia, and Western Red Cedar are believed the more desirable of these other species.

Windbreaks For Western Oregon

By D. C. PURNELL and C. R. ROSS*

Many Farms Need Protection from Wind

A special problem exists in various areas of western Oregon. One example is found in the Corbett-Troutdale area. Severe winds in this area affect crops adversely, cause discomfort in homes and around farmsteads, and hinder the growing of shrubs, flowers and other plants around the home. Reduced yields in vegetable crops are a particular factor in this area. Soil blowing may be observed on exposed fields, particularly in the spring. With the rapid development of western Oregon and consequent reduction of natural woodland, the problem has become more acute in recent years—thus further emphasizing the importance of windbreak protection.

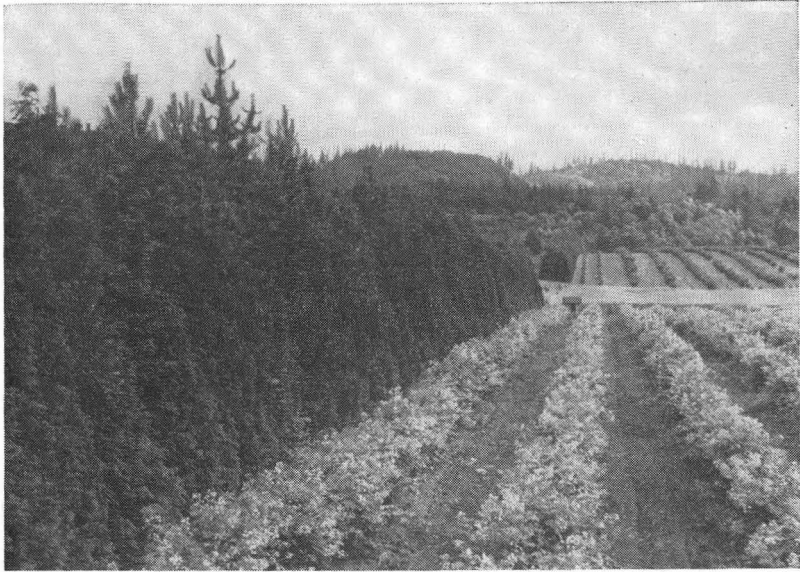
The Oregon Forest Nursery reports that more trees are used in Multnomah County for windbreak planting than in any other county of the state. Approximately 100,000 trees were set out for this purpose in the 2-year period 1948 and 1949. Farm leaders have paid increasing attention to this problem. The 1945 land use committee of the Multnomah County Rural Advisory Council stated its belief that windbreaks were a necessity for curbing the drying winds of summer. Most data in this bulletin directly concerns Multnomah County—but there are other sections of western Oregon where windbreaks will help in the same way. Troublesome winds occur on the coast, along the Columbia River, and in certain wide-open valley areas.

Benefits from Windbreaks Reported

Windbreaks improve the appearance of a farm as well as increase its market value. Windbreaks greatly increase the value of land for future subdivision, increase liveability of the home and farmstead, have a slight effect in moderating temperatures immediately adjacent to the windbreak, tend to prevent windburn on cane fruits and other fruits, and decrease the loss of fruits from wind damage.

The area mentioned has a large acreage of vegetables and the wind whipping these vegetables not only reduces the actual yield of

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—Oregon State Forestry Department

An effective field windbreak on the H. W. Strong farm near Gresham. Port Orford cedar and Ponderosa pine planted in 1931 reduce wind damage to berry field and make the field more comfortable for work.

the crop but increases harvesting expense by twisting vines and in general making harvest more difficult and expensive.

The effect of windbreaks on yields is considerable. On one farm, potatoes planted in the field to the leeward side of the windbreak showed a marked increase in yield compared to portions of the field not protected. Rows 500 feet long yielded 14 bushels where protected by a windbreak and 11 bushels where exposed to the wind.

Disadvantages to Be Considered

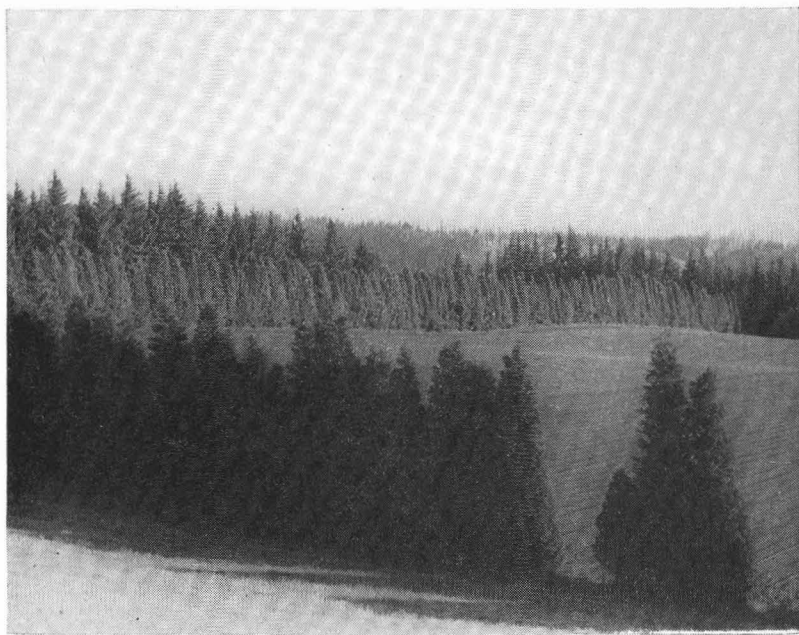
Windbreak trees will cause a reduction in yield out from the base of the windbreak to a distance equal to about two-thirds the height of the trees. Windbreaks, of course, take up land that might otherwise be used for farming. Assuming that a two-row windbreak occupies a 30-foot strip on the east side only of a 20-acre field, about one-third of one acre will be sacrificed to the windbreak, and the yield on another one-third acre will be greatly reduced.

Peter Nuffer, of the Mountain View Floral Nursery, had a very good example of the effects of a windbreak on plants nearby.

There was a definite reduction in the amount of growth of the nursery stock out to about 30 feet from the windbreak trees. Nursery stock of the same species a few feet from the edge of the windbreak trees was about 6 inches high. At 30 feet from the windbreak the stock has a height of about 18 inches. The reduction of growth next to the windbreak, however, was more than offset by increased yield in the portion of the field that received protection by the windbreak.

What Is a Windbreak?

A windbreak planting is a definite type of tree arrangement in which the branches are retained close to the ground, the trees are planted in close-order rows on the windward side or sides of the buildings or fields needing protection. Many farms do not need windbreaks; local wind conditions must be the guide in deciding whether a windbreak will return benefits commensurate with the value of the land surrendered to that purpose.



—Oregon State Forestry Department

Victor E. Ellis of Corbett planted these windbreaks in 1932 with seedlings obtained from Oregon State Nursery. They now provide excellent shelter in one of the windiest sections of western Oregon.

Effectiveness of Windbreaks in Multnomah County

While variations are to be expected, a rule of thumb is that the protected zone of a windbreak extends from 10 to 20 times the height of the trees in the windbreak. As a result of the increasing interest and of numerous questions asked each year regarding the effectiveness of windbreaks, county extension agents in Multnomah County conducted a number of tests on January 12 and January 13, 1949, both days being typical of very windy and cold days in western Oregon. Wind velocity at Gresham was recorded as 21 miles per hour; at Corbett the wind registered 37 miles per hour; while at Crown Point on more exposed bluffs of the river the wind registered more than 50 miles per hour. Results of the tests are summarized in the accompanying table.

EFFECTIVENESS OF WINDBREAKS

Location of test	Height of wind-break	Wind velocity				
		Open area	At 20 feet	At 50 feet	At 100 feet	At 150 feet
	<i>Feet</i>	<i>M.P.H.</i>	<i>M.P.H.</i>	<i>M.P.H.</i>	<i>M.P.H.</i>	<i>M.P.H.</i>
Stanley Road	80	21	6	6	6	6
L. T. Evans Farm	35	27	8	8	12	18
County Farm ¹	15	23	15	15	20	23
Schwedler Farm ² ..	80	21	14	14	12	7

¹In addition to low height, this windbreak had frequent gaps caused by death of many trees.

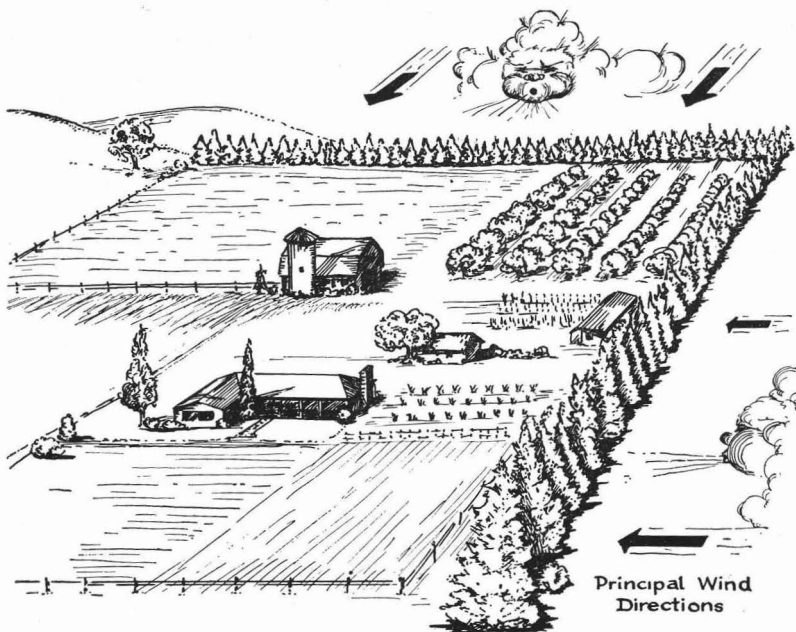
²Results here indicate effect of trimming out lower branches. Trimmed 10 feet up, this windbreak could not slow ground winds for the first 100 feet.

Top—A single row of Ponderosa pine compared to single row of Port Orford cedars. Density of windbreaks and retention of lower branches make better wind protection. Proper spacing is important.

Center—Pord Orford cedar windbreak aids in production of crops on the M. B. McKay farm. Production of potatoes protected was increased 3 bushels per 300 feet of row over the unprotected portions.

Bottom—Failure to replace dead trees destroys effectiveness of the windbreak. In the windbreak illustrated, replacements were not made.





Wind direction and velocity determine placement of the windbreak. Plant trees approximately 75 feet from the house, extend windbreak 50 feet beyond building to be protected. Enclose whole farmstead area.



Two rows of Port Orford cedar protect the Art Strebin home near Troutdale. 24-year-old trees are 6 feet apart in $2\frac{1}{2}$ -foot rows, topped to 35 feet. Break is too close for maximum drying in a wet climate.

Where to Locate the Windbreak

Farmstead and rural homes

The location of the windbreak around the farmstead or around the rural home is dependent largely on the direction of prevailing winds. There are a few simple factors that should be kept in mind. If possible the trees should be at least 50 feet from the buildings to allow fast drying in Oregon's wet climate. The best location will be from 50 to 100 feet. To protect any building the windbreak will have to extend about 50 feet beyond the building.

In areas where winds are common from more than one direction, have a windbreak on the sides of the gardens, fields and home-site from which winds commonly blow. The windbreak should always be to the windward side of the buildings and fields.

Fields

If the mature tree will be about 30 to 40 feet high then in establishing field windbreaks they should be spaced about every 250 to 300 feet across the field and on the windward side of the area to be protected.



Field windbreaks increase yields as much as 20 per cent. The effectiveness of the windbreak extends 10 to 20 times the height of the tree.

Number of Rows in Windbreak

Conifers or evergreens make a much better wall against wind than do broadleaves and they give year-round protection. Conifers sap the ground less than broadleaves and do not spread by suckers. Two rows of evergreens can make a grand windbreak. In some cases one-row windbreaks have provided excellent protection. In Multnomah County, where winter protection is essential, evergreens are a must.

Spacing

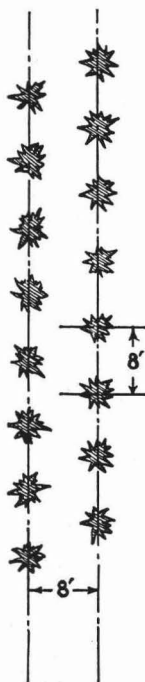
Trees in the rows should be from 4 to 9 feet apart and the rows should be 4 to 9 feet apart.

If you are to have only one row, you can plant the trees closer together.

For the one-row windbreak of Port Orford cedar, a spacing of 6 feet is suggested. No tests have been conducted to determine positively the ideal spacing between trees, but some excellent one-row windbreaks 20 to 25 years old, at a 5-foot spacing, have been observed and are very satisfactory. As they get older and the trees larger, the wisdom of a little wider spacing may be demonstrated; hence 6 feet is suggested for the one-row cedar windbreak.

If you are to have two rows then you have more trees crowding each other, so spacings should be wider. It is suggested that trees be spaced 8 or 9 feet apart in the row, and that the rows be spaced 6 to 9 feet apart.

Trees should be staggered or alternated in rows, as illustrated.



Care of the Windbreak

Much of the damage caused to windbreaks could be reduced if a mulch of sawdust, hay, straw, or leaf rakings were spread over the area immediately adjacent to the trees. This mulch should be about 2 inches thick to be of any value. The mulch would prevent the drying out of the soil in the roots of the plant, the plant will thus be able to draw water from the soil as fast as transpiration is carried on, thus preventing the burning of the leaf surface of the trees.

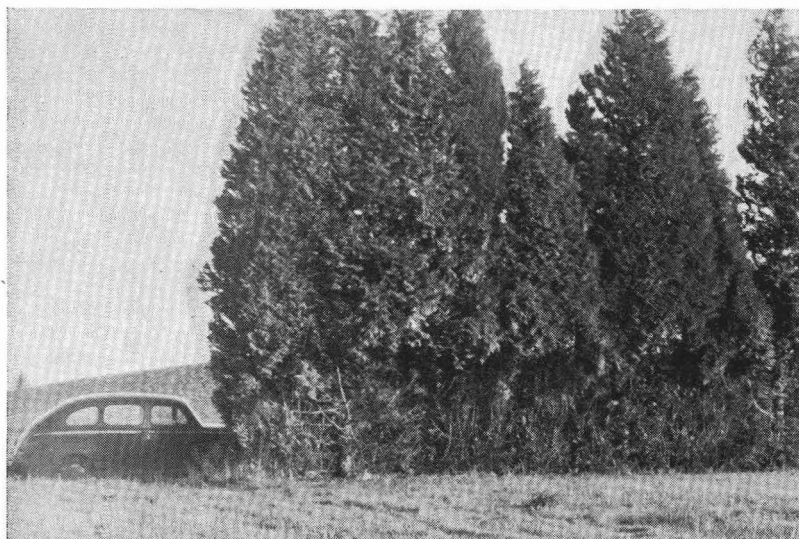
The mulch must be supplied with nitrogen for its gradual decay. Three pounds of ammonium sulphate per 1,000 square feet will supply this nitrogen without causing undesirable soft, tender growth of the trees.

It may be necessary to reset a number of the trees that fail to develop. Remember, this is a long-time plan. Order a 10 per cent excess supply of seedlings and set them out in the garden row, for replacement of failing trees.

To establish a windbreak of Port Orford cedar in the Corbett-Troutdale area or in any area of severe winds, protection of the

cedar by use of more hardy evergreen or deciduous trees on the windward side will make establishment of the windbreak easier and more certain. The "barrier" row does not necessarily have to be permanent. The Port Orford cedar becomes more resistant to cold as it gets older.

Young windbreak trees require special care the first 2 or 3 years. Cultivation or mulching to eliminate competing weed growth during this period always helps, and may be essential for success.



Mr. L. T. Evans works in comfort on windiest days behind this well-developed, one-row Port Orford cedar windbreak. This windbreak was planted in 1932. Trees are 6 feet apart and more than 30 feet high.

Source of Stock

Tree seedlings may be obtained from the State Board of Forestry, Salem, at a cost of \$6.00 to \$10.00 per thousand, plus shipping charges. It is generally required that orders reach the State Board of Forestry not later than March 15.

Trees may be ordered through the county extension agent or directly from the State Board of Forestry. Planters desiring less than 1,000 trees may order lesser amounts in bundles of 25 or more. The minimum charge for any tree order has been 75 cents; necessary to cover costs of digging and wrapping. Orders should be submitted on blanks supplied by the State Forester. Date of shipment, if desired, should be indicated on the blank.

Each fall the State Board of Forestry issues a nursery catalog describing the trees available, prices, conditions governing shipments, and other information.

Care of Seedlings

In handling tree seedlings, be sure the roots never dry out. During shipment they are packed in wet moss or similar material. There is risk in keeping the seedlings in the shipping bundle for more than a few days, because they can be destroyed through drying, heating, or moulds. Therefore, plant at once. If a short delay is necessary, place the bundle in a cool, shady place such as a cellar. Loosen the bundle and wet down the package. If a longer delay is necessary, the trees should be "heeled in" until planted, as illustrated.

Method of "Heeling in" Trees

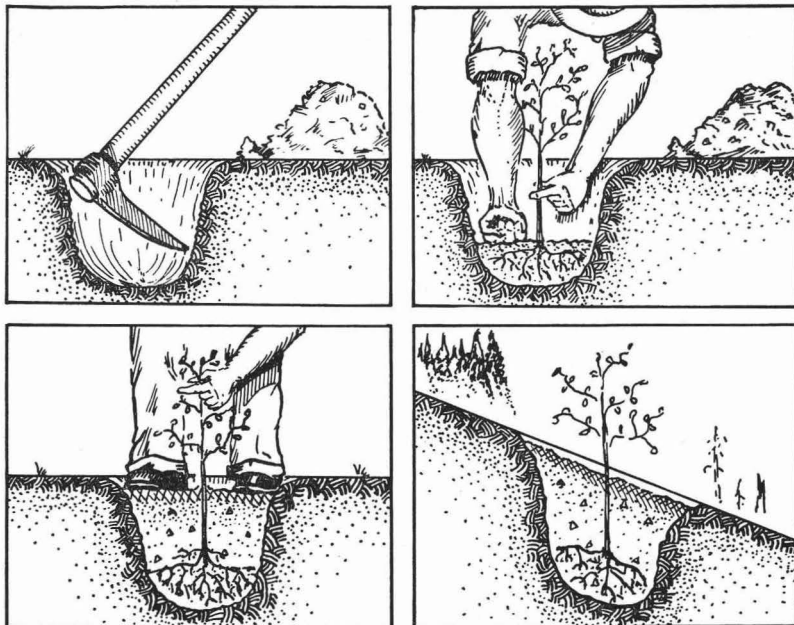


Dig trench deep enough to accommodate roots. Sloping sides allow soil to settle around the roots. Place layer of trees against slanting wall. Pack soil firmly against tree roots. Use only moist soil and wet down with water after trees and soil are in place.

Steps in Planting

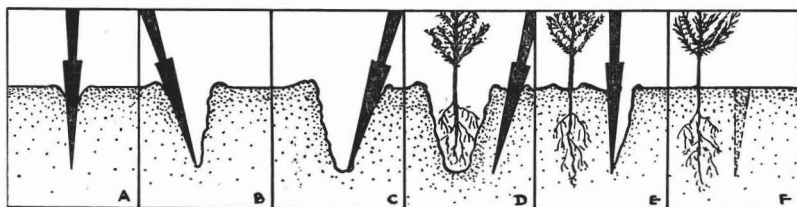
- ▶ The trees should be placed in a bucket of muddy water or keep them wrapped in wet burlap. The roots of the seedlings must not be exposed to the air for more than a few seconds.
- ▶ Use a mattock or spade to dig the hole as indicated in the illustrations.
- ▶ The trees should be planted approximately 1 inch deeper than the depth at which they grew in the nursery. Discoloration on the stem indicates the former ground line.
- ▶ The roots should be spread out; not folded under at the bottom of the hole.
- ▶ The soil should be packed firmly about the roots so that all air pockets are eliminated.
- ▶ Grass or litter may be scattered around the tree to form a mulch for conserving moisture.

Planting by the "Hole Method"



Dig a hole deep enough for the roots. Pack soil carefully around roots as the hole is filled. Finish up by packing soil with feet. Leave slight depression around trees to hold water. Illustration at lower right shows the recommended way to plant trees on a hillside.

Planting by the "Slit Method"



Use a spade, shovel, or dibble to make a vertical slit as deep as the tree roots are long. Press the handle forward and backward to enlarge the slits. Place the roots of the tree in slit and spread them out. Then insert the blade on an incline about 4 inches back of the slit. Press the dibble forward to wedge the soil tightly against the roots. Fill the last slit by kicking in damp soil. Make the soil firm around the tree by tamping with feet. Mulching will retain moisture.

Establishing the Windbreak

Proper land preparation before planting the windbreak will increase the possibility of success in windbreak establishment. Destroy all vegetative growth in the area in which windbreaks are to be planted by the use of machinery available on the farm. By the elimination of plant competition for foods and soil moisture, the windbreaks will have a better chance of survival and rapid growth. Occasional cultivation to keep down weeds during the first few years is advisable. It is not generally a good practice to use fertilizers on windbreaks as they may stimulate a tender, succulent growth which is more subject to desiccation by wind and heat. If a mulch is used, apply just sufficient nitrogen for decay requirements of the mulch.

On the higher elevations along the Columbia River in Multnomah County, a special problem in establishing a windbreak exists. Terrific winds prevent normal growth of many species of trees in these exposed areas. For example, the rate of growth of the Port Orford cedar is greatly retarded. When it does secure a fair height it is apt to be leggy and misshapen. Winter injury to this species can be expected nearly every year, and in exceptional years the damage will be quite severe. Some of the small cedars are killed outright or die from the effects of this damage, while medium or larger cedars suffer severe burning of the foliage.

As high as 25 per cent of the leaf surface has been damaged during severe winters in the Columbia River area. Farmers in nearby areas slightly less exposed to the wind, however, have had outstanding success with Port Orford cedar.

There are many excellent windbreaks of Port Orford cedar in the Troutdale-Corbett area. Due to its pleasing appearance and rapid growth, when not injured, it probably will continue to be popular in this area. Since farmers will continue to use Port Orford cedar where this damage occurs, the question arises as to what can be done to keep loss from winter injury at a minimum.

Observations made during the winter of 1949 showed that a shelter row of hardy shrubs or trees, planted to the windward side of Port Orford cedar windbreaks, allowed the cedars to winter without severe injury.

An example of the shelter-row plan was observed on the M. B. McKay farm in the Springdale area. Mr. McKay had planted a single row of cultivated spirea on the windward side of his windbreak. The trees that were protected showed little, if any, injury. It must be pointed out here, however, that to afford adequate protec-



This is the result of the third attempt to establish a windbreak in badly exposed open field. Many of the trees dead; remainder severely injured. Good protection and planning will eliminate this condition.



Protection of young cedars during early years assures survival where wind is extreme. Spirea is one of the plants that provides adequate protection for the young, tender seedlings. Note the typical, wind-caused deformity of the Douglas-fir in this severe-weather area.

tion in the shelter row the individual plants must be planted directly to the windward side of the windbreak trees.

Spirea is but one of the many hardy shrubs or low-growing trees that can be used in the shelter row. Some of these low, bushy shrubs and low-growing trees that are available from Oregon State Forest Nursery are Southernwood and Caragana, which are dense, low, deciduous shrubs. Russian Olive and Russian Mulberry are fast-growing low trees, also excellent for this purpose. Both species are offered by the Nursery.

While the seedlings are quite small, protection may be afforded by the use of slats or shakes upright in the ground directly to the windward side of the plants.

The problem of furnishing adequate protection for the young seedling trees during the period of establishment leaves an opening for the ingenuity of the individual farmer to provide such protection. The success or failure of the windbreak in this problem area is dependent upon the care and protection that the windbreak is given during its period of establishment.

Types of Trees

Probably the most extensive testing of trees in this area has been at the Wind River Arboretum. Results of these tests have been studied and are summarized here.

The Wind River Arboretum of the U. S. Forest Service is the oldest arboretum in the Pacific Northwest. Beginning in 1912 the Forest Service has made test plantings of hundreds of nonlocal trees and has made regular examinations of these trees. The arboretum is about eight airline miles north of the Columbia River Gorge, being ten miles from Carson, Washington, which lies across the river from Bonneville Lake. Its elevation is 1,150 feet and the arboretum area is surrounded by mountains rising 1,000 to 3,000 feet above the valley floor. The climate is fairly representative of a large area along the west slope of the Cascade Range.

Port Orford does well

Records at the Wind River Arboretum show that the Port Orford cedar has made excellent growth. It was first planted there in 1912; a second lot was planted in 1929. These Port Orfords have grown about one foot per year. While the survivors have done well, it is noted that nearly half of the original plantings died; although the Arboretum's records do not report the cause of the failures. It may have been severe cold at one time or another. Probably Wind River is colder than the farming areas of Multnomah

County. At Wind River the average length of season with no frost is 133 days; the coldest weather ever recorded at the Arboretum was -13° F. Sheltering mountains at the Arboretum shut off the high winds but do cause the area to be colder than would be expected from the elevation and location.

Other windbreak possibilities

The spruces have done well. Although quite healthy, Blue Spruce averaged only 13 feet in height after 30 growing seasons. Some trees, however, were 33 feet in height—which may be more indicative of the results when the trees are given some care. The trees at Wind River have not been given cultural care, since the purpose of the experiment was to see how the trees could survive under forest conditions.

Norway Spruce did especially well at Wind River. The trees averaged one foot per year growth without any care. Norway Spruce is the most popular evergreen windbreak tree used in the Middle West. It undoubtedly would be an excellent tree for windbreaks in the Corbett-Troutdale area.

Hemlock has grown very well. The Mountain Hemlock, which grows abundantly in the higher Cascades, has done well and the notation is made that "no species makes a more handsome appearance than the native Mountain Hemlock." There is no question that Mountain Hemlock is able to withstand cold winds.

There is, of course, no question concerning the ability of Douglas-fir to grow well in western Oregon. It is found abundantly in all counties, outnumbering other coniferous trees three to one. Douglas-fir is suitable for a windbreak and some people may want it. This much can be said in its favor: it is fast growing, trouble-free, and will grow in colder situations than Port Orford cedar will. Ordinarily, however, its foliage allows more penetration of the wind. Douglas-fir (like the pines) will shed its lower limbs to a greater extent than Port Orford cedar and certain other conifers that are shade-tolerant.

The balsam firs, or true firs as they are called in Oregon, have done well at Wind River. The six native Oregon species (Silver Fir, White Fir, Grand Fir, Alpine Fir, Noble Fir and Red Fir) are flourishing.

Among pines tested, the Maritime Pine sometimes offered by the Oregon Forest Nursery is rated as fair, and the note is made that it has a bushy form. It has averaged one foot of growth per year at Wind River. Lodgepole Pine has grown very fast (almost $1\frac{1}{2}$ feet per year) but the notation is that it is slender and has a thin crown. Ponderosa has grown equally well and probably shows the

usual form. One thing to be noted about these pines is that the survival was high; very few have died since the original plantings. The Lodgepole Pine survived 100 per cent from plantings first made in 1912. Open foliage probably makes pines less preferable.

The Giant Sequoia, or big tree, has averaged $1\frac{1}{2}$ feet height growth since 1912 and has shown a high survival. It is rated excellent. In this connection, Leo A. Isaac, a veteran forest service research man, suggests that Sequoia has good possibilities for a windbreak in western Oregon.

New tests started

In the spring of 1950 a trial windbreak was established on the Frank Windust Farm at Corbett.

Included in this windbreak are:

A broadleaf windward row made up of sections of Lombardy Poplar, Caragana, and Southernwood.

An evergreen row made up of Douglas-fir, Scotch Pine, Maritime Pine, Ponderosa Pine, Cluster Pine, Colorado Blue Spruce and Chinese Arborvitae.

This trial merits attention by all who are interested in establishing permanent windbreaks.

Protecting shrubs or trees

From the current information available, Southernwood appears one of the most suitable plants for a protector row. It is an erect shrub growing about 6 to 8 feet high and dying back each year—yet furnishing considerable winter protection due to the hundreds of woody stalks that are left standing. It is related to the sagebrush and has a similar odor.

Bladder Senna is another good possibility, also highly recommended as wildlife cover and food. Stock of Southernwood and Bladder Senna might possibly be obtained from the Oregon State Game Commission or the Soil Conservation Service Nurseries. The Game Commission is distributing several thousand plants of both species as part of its game habitat development program, principally for eastern and central Oregon.

Conclusions

Port Orford cedar seems to be the first choice for a windbreak tree in western Oregon because of its dense form and fine appearance. The Port Orford is injured by extreme cold and wind. If the planting site is severely exposed, protect the tree during the early years of establishment. Or, if adequate protection and care cannot be given, choose a more hardy evergreen.

Cooperative Extension Work in Agriculture and Home Economics

F. E. Price, Director

Oregon State College and United States Department of Agriculture, Cooperating
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