

VEGETATIVE WINDBREAKS MAKE EXCELLENT HOME INSULATORS



By Donald Hanley, Extension Forester, University of Idaho, Moscow, ID

A windbreak is a vegetative or mechanical barrier that is designed to reduce or eliminate undesirable effects of strong winds. Mechanical barriers, constructed of slats or narrow boards with about 50 percent density in the upper two-thirds of its height and 25 percent density in the lower third, will normally reduce open wind velocities by 40 to 60 percent on the lee side zone lying between 3 and 10 times the barrier's height.

The main advantage of mechanical barriers is that they require little space and no waiting period for protection. However, the main disadvantage to mechanical barriers is that they can not be constructed very tall. About 6-10 feet in height is the maximum practical height, especially where there are heavy snow loads. Vegetative barriers, on the other hand, often grow 60-70 feet in height depending on the species used.

Because of the severe limitation to mechanical barriers such as height, anchoring, and cost, the rest of my remarks will address vegetative barriers. Windbreaks, then, I will define as vegetative barriers.

There are two basic types of windbreaks depending on their location and what they are protecting. The first is a farmstead windbreak. A farmstead windbreak is used to protect the main farmhouse or outbuildings from winds and snow drifts. The second main type is a field windbreak designed to protect crops and livestock for increased yields and better performance.

Windbreak Benefits

Probably the single most important benefit of a farmstead windbreak is the reduction of energy required to heat a home. Recent studies (4) of windbreaks show that windbreaks can reduce winter fuel consumption by 10 to 30 percent. For example, one study in Nebraska compared the fuel requirements of identical test houses which maintained a constant inside temperature of 70°F. The house protected by a windbreak used 23 percent less fuel.

Two identical electrically heated homes in South Dakota were compared for energy usage. One was sheltered by a farmstead windbreak and the other was not. Inside temperatures were maintained at 70°F. The sheltered home used 34% less electricity—quite a sizeable savings in today's energy market.

In addition to reducing the force of the wind, windbreaks also can reduce the wind chill impact on people outside the house.

Studies of three-row windbreaks, where trees were 25 feet tall, show that wind velocities and the wind chill index were effectively reduced (Figure 1).

Energy savings can be further enhanced by the use of foundation plantings (Figure 2). Trees and shrubs planted closely to buildings reduce wind currents. These foundation plantings create a "dead air" space which slows the escape of heat from a building. Please notice that deciduous plantings are made on the south and southwest sides of the home to block the sun in the summer, but allow the warming rays in the winter to come through.

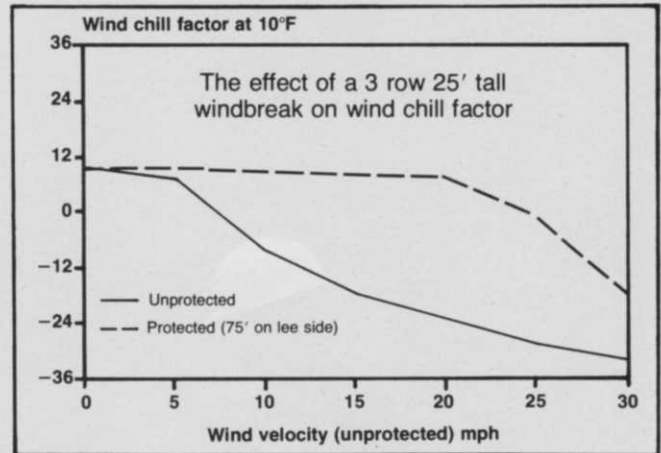


Figure 1

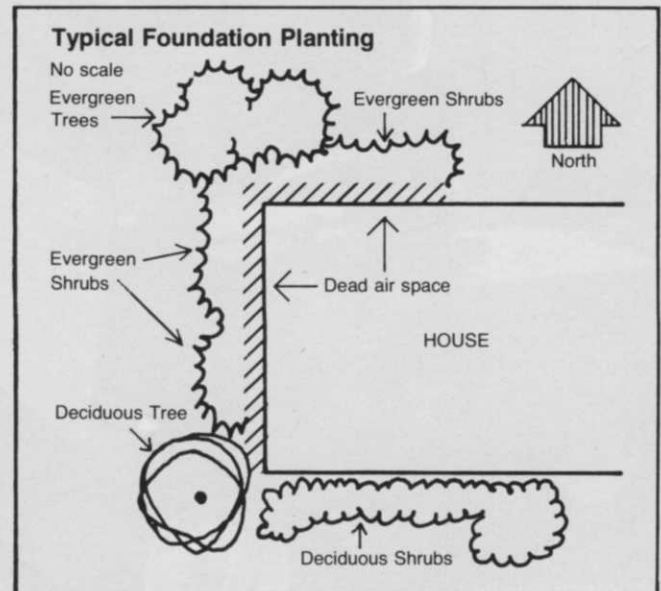


Figure 2

It has long been recognized that increased crop yields is a windbreak benefit. This data is variable, however. E. J. George (2) reports that a South Dakota study showed an increase in corn of 8-9 bushels per acre, while alfalfa increased $\frac{3}{4}$ ton per acre. In Idaho he reports potatoes increased by 80 bushels per acre. Some researchers attribute a portion of the yield increases to increased soil water penetration from snow drifts.

I have talked with numerous farmers in southern Idaho who have indicated to me that their crops "look better" in the leeward side of a windbreak. Unfortunately I know of no economic study that compares the benefits and costs of a windbreak.

Windbreaks provide improved habitat for small mammals and birds. A 1970 survey of 180 Idaho wind-

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break owners reported that over 30 percent of them were enthusiastic about the use of the trees by birds. The Idaho Fish and Game Department regularly plants windbreaks as nesting, brooding, and loafing areas for Chinese pheasants. The United States Forest Service is in the middle of a ten-year program to plant 75,000 Russian olive seedlings normally in southern Idaho on the Curlew National Grass Range for bird habitat. An excellent publication by Martel and Vohs (3), of Oregon State University, lists plants attractive to wildlife in the Pacific Northwest.

Windbreak Establishment

To survive and make satisfactory performance as a windbreak, young trees will need:

1. To be planted according to a sound plan.
2. A favorable climate and a suitable soil.
3. To be carefully handled and planted.
4. To have adequate moisture.
5. To be kept free of weeds.

6. To have protection from livestock and other damaging agents.

Windbreak planning is by far the most important step as the planning phase will determine the location, size (number of rows), tree spacing, and the tree species used.

In general, most settled areas below 5,000 feet elevation in this region have quite a favorable climate for growing windbreak trees. The lack of natural rainfall usually is not limiting because of modern irrigation practices.

However, a deep, well-drained loam soil with neutral pH and average fertility is ideal for growing a variety of trees. Species modifications will have to be made on sites with poor soils. In Idaho our major soil problems relate to iron, phosphorus, and zinc deficiencies, which are easily corrected with fertilization.

Location

Locate your windbreak at a right angle with the prevailing winds as nearly as possible. Figure 3 offers some suggestions on how windbreaks can be designed. Note how roadways cross the windbreak at non-perpendicular angles.

Place your windbreak about 100 feet from the house for maximum effectiveness. If you have considerable snow and wind in your locality, then locate your windbreak about 100-150 feet from buildings, driveways, or areas that need to stay free of drifts (Figure 4). A windbreak planted closer than 60 feet to the house or other main areas of the farmstead will be somewhat of a hindrance in snow country because of the deposition of the snow.

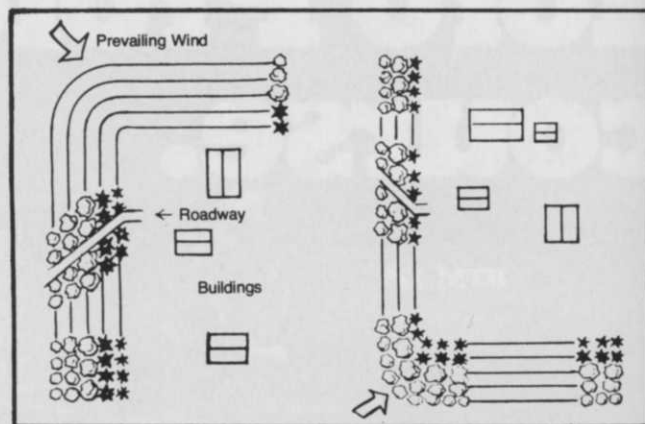


Figure 3

Extend your windbreak at each end 50 feet beyond the boundaries of the farmstead.

The location of a field windbreak will have to conform to maximum expected wind velocity, field boundaries, irrigation systems, power lines, roads, and soil type.

In this region, fields that are subject to severe wind erosion may require multiple-row planting along the windbreak border, supplemented by parallel single-row plantings at intervals of 500 feet or less (Figure 5). The usual velocity of erosive winds in your locality and the nature of your soil will determine the best intervals to use between the supplemental plantings. If the usual maximum wind velocity in your locality exceeds 30 miles per hour and you have light soils, place the supplemental windbreaks 350 feet apart. Under less severe conditions, tall trees in single-row plantings spaced 600 feet to ¼-mile apart will give adequate protection.

Windbreak size (number of rows)

My recommendation on windbreak size is to establish a five row windbreak whenever possible (Figure 6). Most owners that are contemplating the establishment of a windbreak are doing so because they have a wind problem. Five rows give the best protection.

If limited space prevents your planting a five-row windbreak, then use fewer rows rather than crowding your trees. Crowding trees in a windbreak causes a loss of vigor due to severe competition among the trees as they grow to mature size. Crowded trees slow down in growth and stagnate—reach a point where they make almost no growth—at an early age. The planting becomes more susceptible to wind whipping injuries and losses from insects, diseases, and drought. Lower limbs die out early from too much shade in an over-

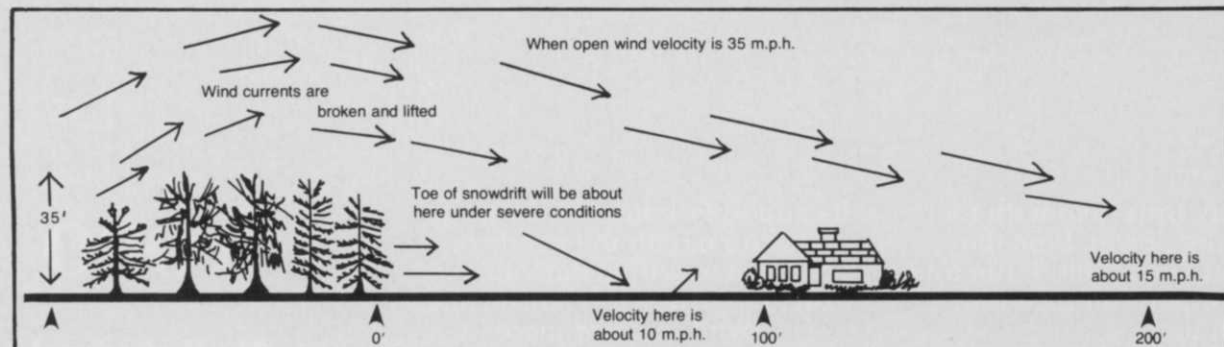


Figure 4

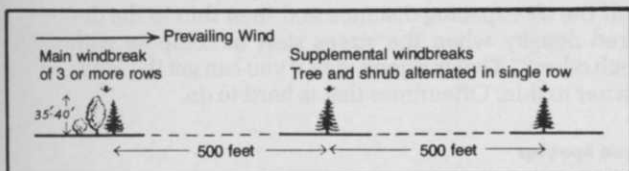


Figure 5

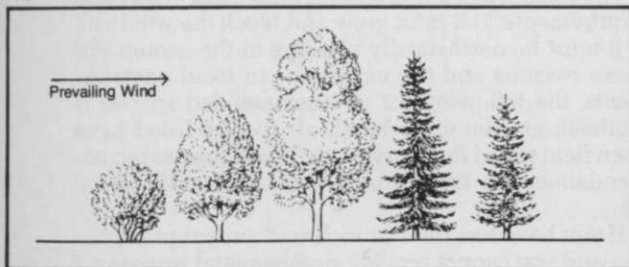


Figure 6

If you have room for only	SELECT	OR	SELECT
4 rows	Dense shrub Medium height evergreen Tall evergreen Medium height evergreen		Dense shrub Medium height deciduous Tall evergreen Medium height evergreen
3 rows	Dense shrub Tall evergreen Medium height evergreen		Dense shrub Tall deciduous Medium height evergreen
2 rows	Medium height evergreen Tall evergreen		Dense shrub Tall evergreen
1 row	Medium height evergreen		Tall evergreen

crowded planting, thus making the windbreak much less effective. Three rows with room to develop will give better results than five rows that are seriously overcrowded. A well developed single row can be more satisfactory than three rows with inadequate growing space.

If you must use fewer than five rows, select the following combinations to give the maximum year-round protection for your site:

Please notice I do not recommend a one row deciduous windbreak for year-round protection, even though we see many, many one row lombardy poplar breaks. However, sometimes a tall lombardy poplar is alternated with a dense shrub such as caragana in a single row. I would recommend this arrangement only where evergreens do poorly and protection is needed mainly in the summer.

Tree Spacing

Spacings for windbreak trees vary by the type of tree and/or shrub used because it is very desirable to give trees room to reach mature size. Table 1 gives the minimum spacings recommended for windbreak trees. Wider spacing can be used with no disadvantage ex-

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Table 1. Recommended minimum spacings for windbreak trees

Recommended minimum spacings				
Tree and Shrub types	Irrigated or dryland with 16" or more precipitation.		Dryland plantings with 16" or less precipitation.	
	Multiple-row windbreaks	Single-row windbreaks	Multiple-row windbreaks	Single-row windbreaks
All types (between rows)	(feet) 16	(feet)	(feet) 20	(feet)
Dense shrub	3	2	4	3
Medium-size deciduous	9	6	10	8
Tall deciduous	12	8	12	10
Medium evergreen	9	6	10	8
Tall evergreen	12	8	12	10

cept that it will take longer to get full protection. I believe you will find these recommended distances appear to be quite large, especially if you are planting small 2-0 or 2-1 stock. Please remember these distances will be adequate for mature trees. Additionally, the spacings recommended between rows and between trees within rows will leave adequate room for use of your tillage equipment; provide your trees with ample room for good growth; avoid wind whipping damage to trees in adjacent rows; and prevent early dieback of the lower limbs.

The question is often asked, "Why not plant at one half the tree spacing distance and then thin to the desired density when the trees start to compete with each other?" That is a good idea if you can get the landowner to thin. Oftentimes that is hard to do.

Tree species

The selection of a tree species must satisfy two basic requirements: 1) it must grow and block the wind and 2) it must be aesthetically pleasing to the owner. For these reasons and the variations in local environments, the following list of recommended species is minimal. On the other hand, all species listed have been field tested for many years. These species recommendations are taken from *Trees Against the Wind* (1).

If you have less than 16 inches of annual precipitation and you cannot provide supplemental watering, I recommend using Siberian peashrub, Russian olive, Siberian elm, black locust, ponderosa pine, and Austrian pine.

The most reliable species for high elevation plantings are Siberian peashrub, common lilac, golden willow, hybrid poplar, ponderosa pine, blue spruce, and Rocky Mountain juniper.

Evergreen trees can be called the foundation for windbreaks in all areas where they can be grown satisfactorily as they give year-round protection. They should be included in windbreaks wherever possible. In areas where they do well, evergreens may be used for the entire windbreak. However, a windbreak of mixed species gives some protection against insects or diseases damaging the entire planting.

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Table 2. Recommended windbreak species

DENSE SHRUBS					
NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
Siberian peashrub <i>Caragana arborescens</i>	(feet) 10	(feet) 10	(inches) 12	Excellent	Good
A dense, attractive, many-stemmed shrub. Makes rapid growth. Has long life, wide range of soil and elevational adaptability. Generally insect and disease free. Sprouts from crown only. Good for dryland or irrigated plantings. Reaches full size on irrigated land in 5 to 7 years, on dryland in 10 to 12 years. Can be trimmed to make an excellent protective hedge. A superior windbreak shrub adaptable to the whole region. It is weakened by repeated 2, 4-D exposures.					
Common lilac <i>Syringa vulgaris</i>	10	10	15	Good	Excellent
Very dense. Slow to medium growth rate; long lived; wide soils and elevational adaptability. Sprouts heavily, mainly at the root crown, but spreads slowly. Makes excellent hedge or shrub row in windbreak. Has high aesthetic value. Occasionally becomes infested with scale insects; extremely sensitive to 2, 4-D. Has high resistance to drought and cold.					
Tatarian honeysuckle <i>Lonicera tatarica</i>	8	7	15	Fair	Excellent
Attractive global-shaped, many stemmed shrub. Bears numerous pink or white flowers. Red fruit holds on till fall. Provides good wildlife food and cover. Not commonly subject to insect or disease problems. Does well on most soils.					
Common privet <i>Ligustrum vulgare</i>	10	8	15	Good	Good
An extremely dense, attractive shrub with medium to rapid growth. Needs well-drained soil. Sprouts only from crown. A nearly ideal plant for low single-row windbreaks, as well as the shrub row in multiple-row plantings.					
NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
Nanking cherry <i>Prunus tomentosa</i>	(feet) 6	(feet) 4	(inches) 15	Fair	Good
An attractive upright shrub with a fast growth rate. Produces abundant edible fruit that makes good jelly. Fruit is retained throughout the winter and makes good wildlife food. Some hybrid varieties grow to 10 feet tall. Has fair to good windbreak qualities. No known insect or disease problems. Nanking cherry should not be planted near cherry orchards because it is an alternate host to Western X cherry disease.					

Peking Cotoneaster
Cotoneaster acutifolia 5 4 12 Fair Good
 Similar to Nanking cherry. Will grow on severe sites. Moderate growth rate. Withstands drought well. Produces abundant fruit that is retained throughout the winter. An excellent species for adding wildlife value to a windbreak. Few insect or disease problems.

Mugo pine
Pinus mugo 8 8 20 Fair Fair
 An attractive, compact evergreen shrub with moderate growth rate. Does best on fertile, well-drained soils. Performs best as a windbreak shrub at elevations below 4,500 feet as winter burning is a problem over this elevation.

DECIDUOUS TREES

Russian-olive
Eleagnus augustifolia 30 20 12 Excellent Excellent
 A small tree with dense, attractive crown. A superior tree for windbreak, wildlife, and aesthetic values and for drought resistance. Makes a dense hedge when clipped. Its spiny-tipped twigs make a dense planting an almost impenetrable barrier. Considered to be one of the best deciduous species for dryland plantings in the region. Makes very rapid growth especially on good soil with ample moisture. It is adapted to a wide range of soils. Sprouting is negligible, but it spreads by seed where there is adequate soil moisture. More resistant to spray damage than other deciduous species, but not as resistant as evergreens.

Golden willow
Salix alba var. *vitellina* 35 30 15 Good Excellent
 A medium-size tree with good growth form for windbreak use. Bright yellow to orange colored young branches make it attractive in winter. Makes very rapid growth; has wide adaptability to soil and moisture conditions. Sprouts only from crown and does not spread from runners. Subject to severe damage from scale insects and aphids. Should be used in dryland plantings only if supplemental moisture is available. Excellent in the Palouse.

NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
Black willow <i>Salix nigra</i>	(feet) 40	(feet) 35	(inches) 20	Excellent	Excellent
Grows very rapidly under irrigation. Forms broad, global crown that is moderately dense. Usually has several stems from near ground level. Serves well as a middle row in windbreaks. Not very suitable for single row plantings because of its low wide spreading branches. Has performed well in localities with salty soils and high water tables where establishment of other species was difficult. Subject to damage by scale insects.					

Black locust
Robinia pseudoacacia 50 40 15 Fair Fair
 Has rapid growth rate. Forms moderately dense crown. Tolerates very hot climates. Adapts to a wide range of soil conditions, but does not stand waterlogging. Seldom damaged by insects or disease. Not recommended for ditch bank or fence row plantings because injured roots produce thickets of sprouts. Confine black locust between other rows of trees to prevent spreading on irrigated land. Suckering is not serious on dryland. Requires little maintenance once it is established. A well-liked and widely used tree with good shade, aesthetic, and wildlife values.

Honeylocust
Gleditsia triacanthos var. *inermis* 40 20 12 Good Fair
 Medium to tall tree. Fairly drought resistant. Withstands alkaline soils well. Attractive zigzag twigs, fine textured leaflets. Two to four inch thorns. Fruit is a large 12" (max.) pod. Winter injury on harsh sites.

Siberian elm
Ulmus pumila 50 30 12 Excellent Good
 Has moderately dense crown and attractive form. Makes rapid growth. Adapted to a wide range of conditions. Branches usually become brittle in irrigated plantings. This often results in breakage and an untidy appearance. Pruning can reduce this. Sprouting is not a problem, but thickets of seedlings often form around irrigated plantings. Severely damaged from repeated exposure to herbicides applied as crop sprays. Sudden fall freezes can cause severe damage. Susceptible to scale insects. Very drought resistant but has not stood up well in Oregon and Columbia Basin. A very acceptable dryland tree in Idaho up to 5,000 feet. (Note: Chinese elm. *U. Parvifolia* is quite similar.) Resistant to Dutch elm disease.

Hybrid poplar
Populus x spp. 50 30 15 Good Excellent
 Makes very rapid growth. Has dense crown and good form. Does best under irrigation, but performs well in dryland plantings with 15" or more annual precipitation. Provides quick protection. Suckers from injured roots. Do not plant near field drains or along irrigation ditches. A well liked tree that is growing in popularity. Susceptible to poplar and willow borer. (Note: There are many hybrid poplars. The one described here is a selection that was made from early Idaho test plantings of hybrid poplars.)

NAME	Mature Height	Crown Width	Minimum Precipitation	Saline Soil Tolerance	Winter Damage Resistance
Green ash <i>Fraxinus pennsylvanica</i> var. <i>lanceolata</i>	(feet) 60	(feet) 40	(inches) 15	Good	Good
A deep rooted, long lived tree with dense, symmetrical and attractive crown. Growth may be slow at first, but moderate to rapid after becoming established. It will become overtopped by more rapidly growing trees, such as black locust and Siberian elm, if planted too close to them. Sprouting is negligible. An excellent tree for ditch bank and fence row plantings. It is more winter hardy and salt tolerant than black locust. It is damaged by herbicide sprays, but is more resistant than Siberian elm. Subject to damage by scale insects and aphids.					

Lombardy poplar

<i>Populus nigra</i> var. <i>italica</i>	70	15	20	Good	Excellent
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Grows very rapidly, reaching 40 feet in 12 years under favorable conditions. Has very narrow, though fairly dense, crown. Makes good middle row where fast growth and extra windbreak height are desired. Subject to some canker diseases and heart rot, especially if trees have been damaged by topping, fire, or other causes. Windfirm unless diseased. Susceptible to poplar and willow borer. Competes with nearby crops for soil moisture and nutrients. Short lived.

EVERGREENS

Rocky Mountain juniper

<i>Juniperus scopulorum</i>	20	15	12	Excellent	Excellent
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Makes medium to rapid growth. Forms very dense, symmetrical crown. Adapted to wide soil variations. Tolerates high water table. A superior small windbreak tree for this region. Bare-rooted planting stock is difficult to establish on dryland, but does well once established. Subject to damage by spider mites and is sometimes a host to cedar-apple rust.

Eastern redcedar or Virginia juniper

<i>Juniperus virginiana</i>	25	15	15	Good	Good
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Has moderate to fast growth rate. Similar in appearance to Rocky Mountain Juniper and generally as adaptable. It is easily established except on very dry sites and at high elevations. Well liked for single row screens. Subject to attack by cedar-apple rust. Should not be planted near apple orchards.

Northern white cedar

<i>Thuja occidentalis</i>	35	20	20	Good	Good
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Moderate growth rate. Forms very dense, attractive crown. Holds lower branches well. Makes a dense single-row windbreak or leeward row in a multiple-row planting. Survives well under irrigation where soils are not highly saline. No known insect or disease problems. Has not been widely used, but existing plantings indicate it is a good tree for many localities. It is well liked in Oregon for single-row screens and windbreaks.

NAME	Mature Height (feet)	Crown Width (feet)	Minimum Precipitation (inches)	Saline Soil Tolerance	Winter Damage Resistance
Austrian pine <i>Pinus nigra</i>	40	30	20	Fair	Good

Has medium growth rate. Develops symmetrical crown that is very dense for a pine. Some maintain the density of one row of Austrian pine is equivalent to that of two rows of ponderosa pine. Holds lower branches well. An excellent tree under irrigation, but has failed in some dryland plantings with low rainfall after 10 to 12 years. If planted without supplemental watering in localities with less than 20-inch annual precipitation, it needs a deep, fertile soil with good moisture holding capacity. Austrian pine is considered an excellent species

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for the Columbia Basin. Ponderosa pine is preferred in Wasco, Gilliam, Sherman, and Morrow counties, Oregon. Usually remains free of insect and disease problems. Susceptible to iron chlorosis.

Scotch pine

Pinus sylvestris 40 20 15 Fair Good

Has rapid growth rate. Crown density is usually medium. Lower branches shade out and die if they do not get full sunlight. Adapts to a wide variety of soil conditions. Will withstand permanently moist soil conditions better than ponderosa. Generally easy to establish. A widely used tree for windbreaks. There are many strains of Scotch pine. Some have poor form. Spanish burgo variety does well in Idaho.

Blue spruce

Picea pungens var. *glauca* 40 25 20 Good Excellent

Growth rate is unusually slow for first 5 years after planting but has medium growth rate after that. Crown is very dense with attractive pyramidal form. Makes an excellent windbreak species in most of the region. Color varies from green to blue. Sometimes it is difficult to establish. Subject to damage by spider mites, scale insects, and spruce gall aphid.

Norway spruce

Picea abies var. *bavaria* 60 25 16 Fair Fair

Makes rapid growth. Develops a very dense crown that extends to the ground unless the base of the crown is in heavy shade. Moisture and soil fertility requirements are higher than for the pines. Does fairly well in dryland plantings if soil is deep and fertile. Subject to spider mite and spruce bud scale damage. Sometimes becomes stunted in growth due to zinc deficiency.

Ponderosa pine

Pinus ponderosa 60 30 15 Fair Good

Has moderate growth rate. Crown is symmetrical and fairly dense. Needs full sunlight for best development so lower branches shade out and die under close spacing. Adapts well to a variety of soil conditions but must have good drainage. Withstands hot, dry sites well. Can be damaged or killed by too much irrigation. Generally free of insect and disease problems. Considered by many to be the most reliable evergreen for windbreaks. Highly preferred in Oregon and in much of the Columbia Basin.

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