

# AGRICULTURAL GUIDE

Published by the University of Missouri-Columbia Extension Division

JUN 15 1983  
energy  
information

## Planning tree windbreaks in Missouri

John P. Slusher, School of Forestry, Fisheries  
and Wildlife

Jim Robinson, Soil Conservation Service, USDA  
Clell Solomon, Missouri Department of Conservation

Your need for a windbreak is measured by the benefits you can receive from one. Windbreak research has indicated that up to 40 percent heat energy savings are possible when you use windbreaks. Most of these savings result from reduced wind velocity and, therefore, in reduced air infiltration in homes downwind from the windbreak. (See Figure 1.) The properly placed windbreak also serves as an effective snow barrier and can improve the working conditions in farmstead areas where you perform winter chores.

Crops protected from wind use moisture and nutrients more efficiently. Windbreaks reduce burning and wilting of crops often resulting from strong winds, high air temperatures and deficient moisture. However, because of tree root competition, crop yields will be less than normal in a strip about equal to the height of the trees. You can plant grass or legumes in these areas as roadways or turning areas. Crop yields generally decrease at distances about two to 10 times the tree height. In seasons of abundant moisture, cool temperatures and little wind, the windbreak is not likely to increase crop yields.

Windbreaks improve feed efficiency and reduce death losses of cattle fed in open lots. This protection has reduced weight losses in cattle by as much as 50 percent. Studies over a five-year period in Iowa showed that sheltered cattle gained 80 pounds more per year and consumed 129 pounds less feed per hundred weight of gain than those not sheltered.

A windbreak can contribute food and a secure habitat for a diverse wildlife community, including game and other birds and animals. Choices of trees and shrubs can influence the types of birds and animals living there. Where wildlife values are of importance, two or more rows of evergreens with dense foliage characteristics and live limbs close to the ground are recommended for winter cover. You can then add additional rows of trees and shrubs that will produce wildlife food, such as autumn olive, or wild plum, to the protective rows of evergreens.

Plantings for beautification should contain flowering trees or trees with other colorful characteristics to complement the basic windbreak species.

Studies show windbreaks to be effective as noise barriers where busy highways or noisy industrial plants are nearby. They also provide visual screening. Tree and shrub belts 65 to 100 feet wide are effective in reducing the level of noise from *high speed* traffic. Tree belts 20 to 25 feet wide are effective in reducing noise from *moderate speed* car traffic. For maximum effectiveness, tree and shrub belts should be tall, dense, and located close to the noise source, rather than close to the area protected. Evergreen trees and shrubs are most effective where you desire year-round screening from noise.

### Planning your windbreak

Planning your windbreak well in advance is necessary. Make decisions about the types of plant materials needed which will grow well in your location and soil type. Also, consider the windbreak design needed for the purpose and the available area. The design must take into consideration the equipment available for preparing the planting area, planting and maintenance. Order trees in the fall before planting to ensure the availability of desired species of trees. Many of the plant species mentioned in this publication are discussed in more detail in UMC Guide 5006, "Before You Order Seedling Trees," and other publications avail-

Figure 1. Wind velocity.

Measured wind velocities in miles per hour—	5	10	15	20	25	30
Wind chill index at 10°F—	7°	-9°	-18°	-24°	-29°	-33°
Velocities mph 75 feet in lee of windbreak—	0.5	2	3	5	8	15
Percent decrease in wind velocity—	90%	80%	80%	75%	68%	50%



able at University of Missouri Extension Centers, the Soil Conservation Service, and the Missouri Department of Conservation District Forestry Offices. On-the-ground technical assistance in soils, plant selection, and windbreak design is also available at those same offices.

### Considerations

- Locate the windbreak where it will be most effective.
- Design the windbreak to fit the available space and to meet the purpose of the planting. The design must allow for proper spacing for tree growth and the use of appropriate cultivation equipment.
- Select tree and shrub species that are well adapted to your soil and climatic conditions. Order trees early.
- Prepare the planting site properly and fence areas accessible to livestock.
- Arrange for proper planting labor and equipment.
- Arrange for proper storage of seedling trees in case planting is delayed by weather.
- Provide care and protection for young seedlings.
- Provide proper management practices after windbreak establishment.

## Location and shape of windbreaks

The prevailing winds in winter are north and northwest in Missouri, so protective windbreaks should be located along the north and west sides of your farmstead. The most effective zone of influence includes the distance from the windbreak out to six times the height of the trees. Drifting snow varies with the direction and velocity of the wind, the type of snow, and the composition of the windbreak but often piles up behind the windbreak at distances of one to three times the height of trees.

Windbreaks placed too close to houses and other buildings results in snow drifting in the very areas that should be free of snow. Therefore, you should plant windbreaks for winter protection at least 100 feet from farm buildings and feed lots on level land.

If the land slopes steeply to the north or west, you'll have to plant the trees closer to the farmstead, but never closer than 60 feet from main buildings or drives, if snow drifting is a concern. If your farmstead is close to the south or east side of a public road, where the plantings may necessarily be located across the road from buildings, recognize the possibility of the road being blocked by a drifting snow.

Most winter windbreaks are **U**, **L**, or **E** shaped. Because wind and snow whip around the ends of a wind barrier, the ends of the windbreak should be extended approximately 50 feet beyond each corner of the area to be protected. Reinforce corners with extra shrubs and conifers if you desire. Windbreaks do not have to be laid out in hard, straight lines. A curved windbreak on the contour line around the north and

west sides of your farmstead is a little more difficult to fence, but it will look more pleasing and be easier to cultivate.

Don't plant across old feedlots, near manure piles, or across barnyard drainage ways. Trees, particularly evergreens, survive and grow poorly in such locations. When soils or drainage conditions change drastically, it may be necessary to correct the drainage or to change the species of trees and shrubs in the windbreak to match the conditions. If it's necessary to cross field roads, driveways, or large ditches with a windbreak, try to make the crossings at an angle to avoid creating direct wind tunnels through the planting.

**Don't plant windbreaks where they might create visibility hazards at road intersections.**

## Windbreak design

Ordinarily, windbreaks require several kinds of trees with different growth characteristics to provide foliage density at various heights over a period of years. (See Figure 2.) As trees grow older, their form and crown characteristics change. The ability of a tree planting to furnish protection depends on the sum total of all tree and shrub foliage making up windbreak height, density, and longevity.

- **Height** influences the extent of the protected area. The taller the windbreak the greater the area protected and the less land required by the trees. For a quick effect, fast-growing trees that reach maximum height in a short time are the first choice. Because fast growers are usually short-lived, also plant slower-growing tall trees that mature later but remain effective for a long time.

- **Density** influences the extent of downwind protection. Most evergreens have fairly dense, compact tops that retain foliage throughout the year. In contrast, the broadleaf trees and shrubs lose foliage in the fall and cause windbreaks to have different densities in summer and winter. Density depends on the width of the windbreak, arrangement and spacing of species, and the crown height of the different species at various ages.

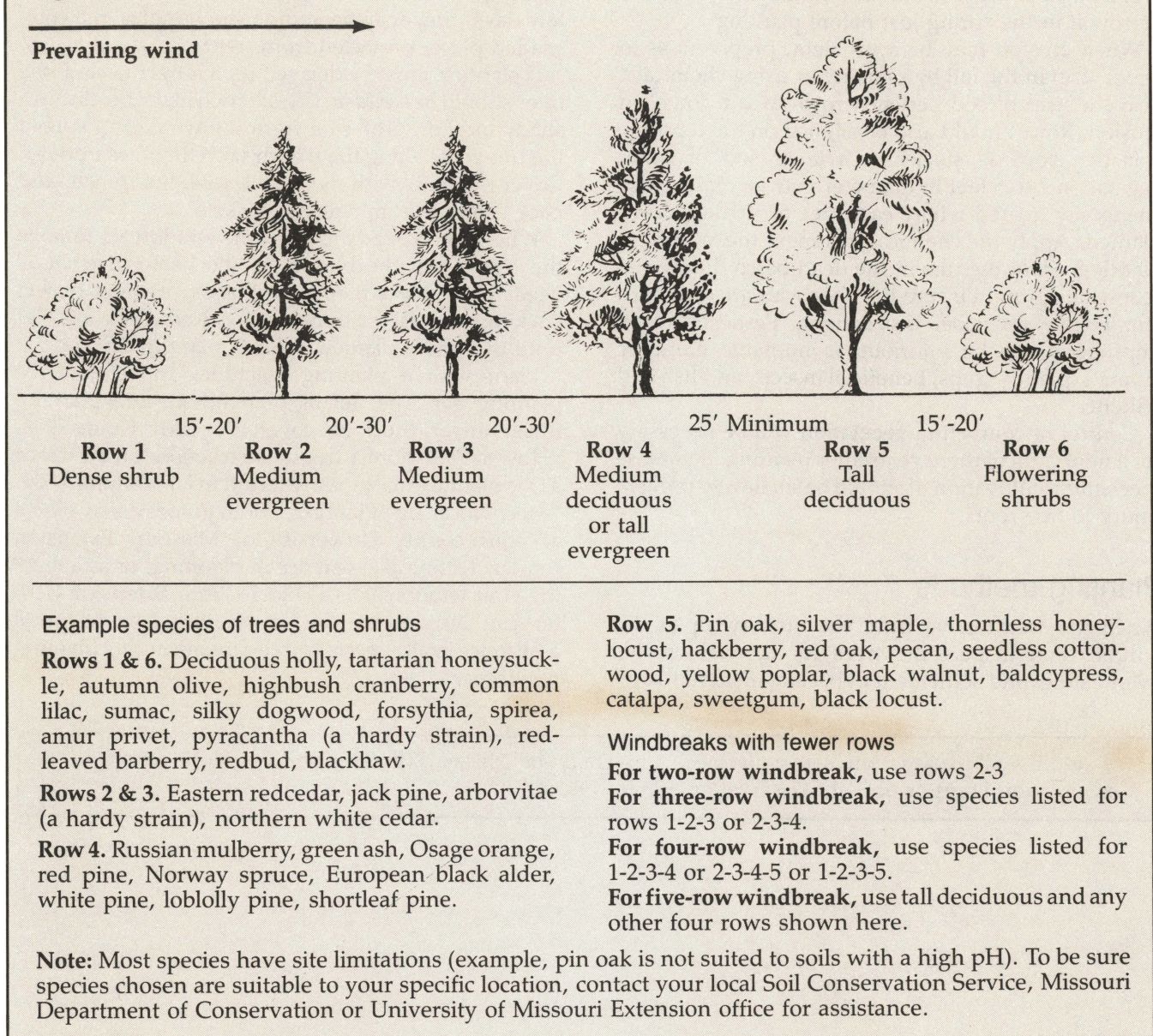
Foliage density of the middle level of shelterbelts will be provided by the fast growing broadleaf trees for the first 15 years. After that, evergreens will provide it.

Young trees provide a lower level of density, but after 20 to 30 years, you'll have to rely on thickly growing shrub species for foliage density near the ground.

For winter protection, the main evergreen planting should always be north and west of the taller broadleaf trees for best control of drifting snow. Evergreens provide maximum winter protection and help trap snow. Shrubs also trap snow and reduce wind near the ground.



Figure 2. Windbreak design.



Mixtures of species offer more insurance against a plantation being damaged by disease, insects or climatic factors.

Plantations with both deciduous and evergreen species *must have adequate space*. For example, if evergreen and deciduous trees are planted as close as 6 to 8 feet apart, the deciduous trees will soon over-top the evergreens. When this happens, the evergreens will suffer from shading, their form will be ruined, their growth stunted, and their effectiveness greatly reduced. There must be **at least 20 feet** of space between rows of evergreen and deciduous species.

A five-row plantation makes an efficient windbreak. If limited space prevents planting five rows, it is better to use fewer rows than to crowd the trees. Three rows, with room to grow, will give better long-range results than five crowded rows. Where there isn't sufficient area for even three rows, a

narrow windbreak of two rows of dense evergreens gives the most practical protection under the circumstances. Staggering the trees in an alternate pattern, so they are not directly behind the tree in the next row, will allow you to space them a little more closely.

Windbreaks can also modify the summer environment. A well designed summer windbreak reduces wind velocity but will still allow a breeze for ventilation. Summer windbreaks usually consist of one or two rows of plants located to the south and west of the area to be protected. A one-row windbreak may be either evergreen or deciduous trees. The south row of a two-row summer windbreak usually consists of deciduous shrubs or small deciduous trees, and the row to the north, of moderate to tall deciduous trees.

Locate the summer windbreak about five times the mature height of the trees from the area to be protected. Dense windbreaks, located more closely,



reduce windspeed more but may cause an increase in midday air temperature and reduce or eliminate ventilation.

## Spacing and arranging trees in windbreaks

Plan spacing on the probable size of the crowns after the trees reach 20 to 30 years of age. It takes longer for trees to form an effective wind barrier at wider spacing, but you can overcome this by staggering the trees in adjacent rows. The delay in effectiveness will be more than offset by the increased growth and vigor of the trees which have adequate growing space. Such trees live longer, retain their lower limbs better, and produce more foliage.

### Spacing

Spacing between rows ranges from 15 to 30 feet,

depending on the types of trees or shrubs in the adjacent row.

- ✓ Space 15 to 20 feet between shrub and tree rows.
- ✓ Space 20 to 30 feet between medium-sized tree rows.
- ✓ Space 20 to 30 feet between medium and tall tree rows.
- ✓ Space 20 to 30 feet between tall evergreen rows.
- ✓ Space a minimum of 25 feet between tall evergreen and tall deciduous tree rows.

Spacing must always allow for proper use of suitable maintenance equipment.

### Between trees in a row:

- ✓ Allow 4 to 6 feet for deciduous shrubs.
- ✓ Allow 10 to 20 feet between medium-sized evergreens.
- ✓ Allow 12 to 20 feet between medium-sized deciduous trees.
- ✓ Allow 14 to 20 feet between tall conifer trees.
- ✓ Allow 16 to 24 feet between tall deciduous trees.

## Trees and shrubs used in Missouri windbreaks.

### Key

#### Soil tolerances

- 1 = Deep or moderately deep, well-drained or moderately well-drained soils.
- 2 = Shallow, dry soils.
- 3 = Poorly to very-poorly drained wet sites.
- All = All of the above.

### Planting zones

- N = Northern Missouri
- C = Central Missouri
- S = Southern Missouri
- All = All areas

### Symbol for heights

- < = less than
- > = more than

Species	Soil tolerances	Estimated height (in feet) after 20 years	Planting zones
American holly	1,3	<26	S
American plum	all	8-15	all
American sycamore	all	26-35	all
Amur honeysuckle	all	8-15	all
Amur maple	1,2	<16	all
Amur privet	all	>10	all
Autumn olive	1,2	<16	all
Bald cypress	1,3	16-25	all
Basswood	1	>26	all
Black cherry	1	16-25	all
Blackhaw	1,2	<16	all
Black locust	1,2	26-35	all
Black walnut	1	26-35	all
Black willow	1,3	>25	all
Bur oak	all	16-25	all
Catalpa	1	26-35	all
Chinkapin oak	1,2	16-25	all
Common lilac	all	<16	all
Cutleaf staghorn sumac	1,2	<8	all
Eastern cottonwood	all	>35	all
Eastern red cedar	all	16-25	all
Eastern white pine	1	26-35	all
European alder	1,3	>26	all
Flowering dogwood	1,2	<26	C,S



## Trees and shrubs used in Missouri windbreaks.

Species	Soil tolerances	Estimated height (in feet) after 20 years	Planting zones
Forsythia	all	<16	all
Green ash	all	26-35	all
Hackberry	all	16-25	all
Highbush cranberry	1,3	<10	all
Jack pine	1,2	16-25	all
Kentucky coffee tree	all	16-25	all
Loblolly pine	1,3	26-35	C,S
Medium purple willow	1,3	8-15	all
Northern red oak	1	26-35	all
Northern white cedar	1,3	16-25	N,C
Norway spruce	all	26-35	all
Osage orange	all	16-26	all
Pecan	1,3	26-35	all
Persimmon	all	<26	all
Pin oak	1,3	26-35	all
Pyracantha (hardy variety)	1,2	<12	all
Redbud	1,2	<16	all
Red maple	all	>35	all
Red mulberry	all	<26	all
Red pine	1	26-35	N,C
River birch	1,3	26-35	all
Russian olive	all	16-25	all
Sassafras	1	>26	C,S
Shagbark hickory	1,2	>16	all
Shingle oak	all	26-35	all
Shortleaf pine	1,2	26-35	C,S
Siberian elm	1,2	26-35	all
Silky dogwood	all	<8	all
Silver maple	1,3	>35	all
Smooth sumac	all	<8	all
Spirea	all	>8	all
Sweetgum	1,3	26-35	all
Tartarian honeysuckle	all	8-15	all
Thornless honeylocust	all	26-35	all
White oak	1,2	16-25	all
Yellow poplar	1	>35	all

## Selecting of trees and shrubs for windbreaks

You can get planting stock from commercial nurseries or from the Department of Conservation's State Nursery at Licking, Mo. Application blanks for trees from the state nursery are available from University of Missouri Extension Centers in every county, Soil Conservation Service offices, or Missouri Department of Conservation District Forestry Offices.

A partial list of private nurseries carrying seedling trees is available by writing: Extension Forester, School of Forestry, Fisheries and Wildlife, 1-34 Agriculture Building, UMC, Columbia, Mo. 65211.

Seedling trees will be relatively small and will require good care from their arrival to planting time

but are the most commonly used size because of their low cost. Medium- and larger-sized, bare-rooted stock, balled and burlapped stock, and container-grown trees and shrubs will usually produce an effective windbreak two to three years sooner than seedling trees. However, they greatly increase the cost of planting.

## Preparing the area for planting

Proper preparation of the planting site is important for good tree survival and growth. Except on light, sandy soils where weeds and sod are not a problem, begin control of competing vegetation during the fall before spring planting. Control all competing vegetation including sod, weeds, and brush.



Where the ground is level and erosion is not a problem, plow the entire area in the fall, then disk and harrow it in the spring just before planting.

When erosion may be a problem, prepare a 4- to 6-foot strip in the fall by plowing or using chemicals. Leave a strip of sod between rows to cut down on erosion. Rows should also be aligned on the contour.

If the slope is steep, a circle of sod or other vegetation 2 to 6 feet in diameter may be removed or chemically treated where each tree or shrub is to be planted. Apply the chemical treatment the fall before planting. Plant the tree in the dead patch during the following spring. Be sure the chemicals are appropriate. Follow the label instructions. Pesticides used improperly can be injurious to humans, domestic animals, plants, crops, beneficial insects, and fish and wildlife.

Control of competing vegetation will be necessary for a minimum of three years after planting. If you use mechanical cultivation, it should be shallow to prevent injury to tree roots.

## Planting methods

When the trees arrive from the nursery, open the bundles and inspect the trees for damage, mold, overheating, and settlement of packing material away

from the tree roots. Repack the roots and moisten the packing if needed. If the trees will be planted within a few days, they may be kept in the bundles in a cool, shaded place, protected from freezing.

If planting must be delayed for a longer period, the trees should be *heeled in*. Dig a trench in the ground in a shady location protected from the wind, and spread the tree roots along the trench with the trees upright. Cover the roots with moist soil, refill the trench, and pack firmly to eliminate air pockets.

When you're ready to plant the windbreak, remove the trees from the bundle or the heel-in trench as needed and place them in a bucket of water or wet packing material for transporting. Keep the roots wet until the tree is planted. Do not plant in dry soil.

Plant with a planting machine, shovel, or tree planting bar. The details of handling and planting forest nursery stock are covered in UMC Guide 5008, "How to Plant Forest Trees." Instructions on the use of a tree planting machine are found in UMC Guide 5009, "Mechanical Tree Planting." Both guides are available at your county University of Missouri Extension Center. Technical assistance in planning, or establishing your windbreak is available. Your Extension Center can also assist you in locating free technical assistance in all aspects of tree care, including planting windbreaks.

For additional information see your local University of Missouri Extension Center, Department of Conservation Forester or Soil Conservation Service Office.