



Windbreaks for Kansas



- Reduce Home Heating Costs
- Reduce Exterior Building Maintenance
- Beautify Farmsteads and Protect Ornamentals
- Create a More Pleasant Environment
- Control Drifting Snow
- Reduce Livestock Feeding Costs and Stock Losses
- Reduce Wind Chill Index
- Reduce Blowing Soil
- Provide Food and Cover for Wildlife
- Reduce Crop Damage and Increase Yields
- Improve Efficiency of Irrigation Systems
- Protect Gardens and Orchards
- Provide Noise and Visual Screen

How Windbreaks Function

Windbreaks are a valuable asset on farms, ranches, and homesites. The many benefits of windbreaks, as listed on the front of this publication, are a direct result of tree and shrub plantings designed to reduce wind speed. Their worth has been demonstrated on many farms and through university research in the Great Plains.

The effectiveness of a windbreak to reduce wind speed depends on its height and density. Windbreaks can reduce wind velocity on the leeward (protected) side of the windbreak to a distance equal to 30 times the height (H) of the tallest trees. However, the degree of protection gradually decreases with distance from the windbreak (Figure 1). The most effective area of protection extends to about 10 times the height of the trees. For example, if the windbreak is 30 feet tall, good protection can be expected within an area 300 feet downwind from the windbreak.

Windbreak density affects the pattern of air movement around the windbreak. Wind velocity is reduced as the density is increased, and the area protected tends to be decreased. The density of windbreaks protecting homes and livestock areas needs to be greater than the density of windbreaks designed to protect fields from soil erosion. Density depends upon the type of trees and shrubs and the number of rows planted. Density within a windbreak can be increased by planting multiple rows of evergreen trees.

Planning Your Windbreak

Windbreaks are a long-term investment. They need to be carefully designed to ensure that the desired benefits are obtained. Homes, livestock, and fields are the most common areas needing protection. Once it is decided what needs protection, prepare a sketch of the area. Include buildings, roads, gardens, corrals, fields, and above-and below-ground utilities. Use the following principles to design the planting.

Wind eddies will form around the ends of a windbreak. Therefore, windbreaks should extend at least 100 feet beyond the area to be protected. Any gaps will funnel the wind, eliminating much of the windbreak's effectiveness. As a result, driveways should be located around the ends of the windbreak. If a driveway must go through the windbreak, angle it so that the gap will be perpendicular to the prevailing wind as shown in Figure 2 where the prevailing wind is from the northwest.

Windbreaks are more attractive if they follow the natural contour of the land. They do not have to be planted in straight east-west or north-south rows. However, they should be generally perpendicular to the prevailing winds.

Do not plant a windbreak where it will block a drivers' vision at road intersections. Avoid planting a windbreak closer than 200 feet north or west and 80 feet south or east of the centerline of a road to preclude creating snow drifts across the road.

Avoid planting in old feedlots or barnyard drainage areas. Many tree and shrub species will not grow in these areas due to excessive nutrients in the soil.

It is wise not to use the same type of trees and shrubs in every windbreak row. Diversity in the planting will increase insect and disease resistance and increase wildlife habitat. It is also a good rule not to mix plant varieties within a row. One variety or another will usually grow faster and eventually suppress the growth of the slower growing plants. An exception to this rule is when shrubs with comparable growth rates and form are mixed within the row to provide diverse wildlife habitat.

Winter Protection for Home Sites

Reducing wind velocity has an immediate effect on our outdoor comfort (Table 1). Windbreaks slow winter winds and reduce heating costs in homes, barns, and other buildings. Heat loss through walls, floors, ceilings, and windows is reduced because calm air is a better insulator than moving air. Actual fuel savings from windbreak protection can range from 15 to 25 percent.

Windbreaks also are effective in controlling drifting snow around homes, farmsteads, livestock areas, and roads. Properly designed windbreaks will accumulate the snow within and adjacent to the windbreak and prevent it from drifting into protected areas. For winter protection, windbreaks should be located on the north and west side of the area to be protected. The greatest wind protection occurs

Table 1. Wind Chill Indexes with the Air Temperature at 10°F

Wind velocities (mph)	5	15	25
Wind chill index without windbreak	6°	-18°	-29°
Wind chill 75 feet in lee of windbreak	9°	7°	2°

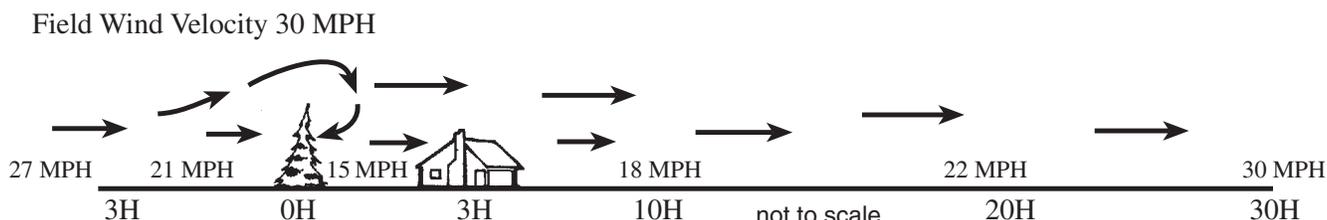


Figure 1. The degree of protection gradually decreases as one moves away from the windbreak.

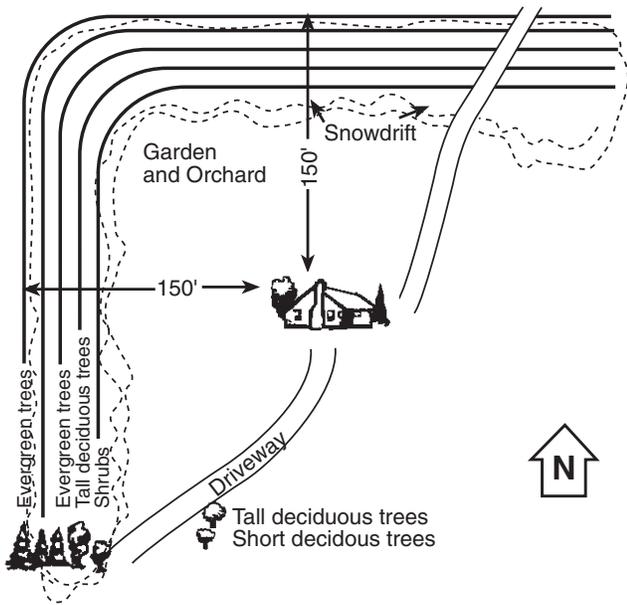


Figure 2. Typical farmstead windbreak for all year protection.

on the leeward side of the windbreak within 3H of the windbreak. However, this is also the area of greatest snow accumulation. To obtain the greatest wind protection and eliminate snow accumulation in the protected area locate the primary windbreak 3H from the area to be protected and plant a single row 100 to 150 feet to the windward to serve as a snow trap (Figure 3).

An option to this design is to locate the north row of the primary windbreak 150 feet from the protected area. This will provide an area for snow accumulation and provide adequate wind protection.

To provide adequate density and add height to the windbreak, five rows of trees and shrubs make an effective home or farmstead windbreak. Space limitations, however, may dictate planting fewer rows. Three to four rows are often a reasonable compromise. Since evergreens retain their foliage in the winter, they are considered the foundation of all winter windbreaks. Windbreaks should have at

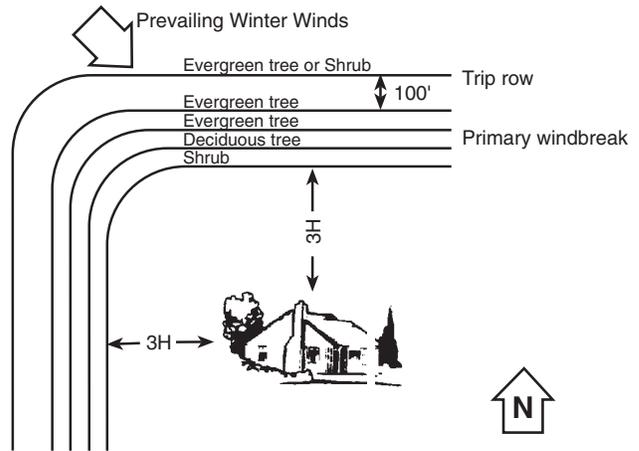


Figure 3. Home site windbreak with trip row.

least two rows of evergreen trees, and three rows are preferred. One- or two-row windbreaks are less dependable. The death of only a few trees could create gaps resulting in wind funnels. Typical three- and five-row windbreaks are shown in Figures 4 and 5.

The north and west rows should be either a dense shrub or evergreen tree. Second and third rows should be evergreen trees. Additional rows can be deciduous trees to provide faster growth and greater height, or shrubs to provide better ground level wind protection and enhanced wildlife habitat.

Summer Protection for Home Sites

Windbreaks also can modify the summer environment. A well-designed summer windbreak will reduce wind velocity, but it will allow a breeze for ventilation. Windbreaks trap blowing dust and add comfort to the home.

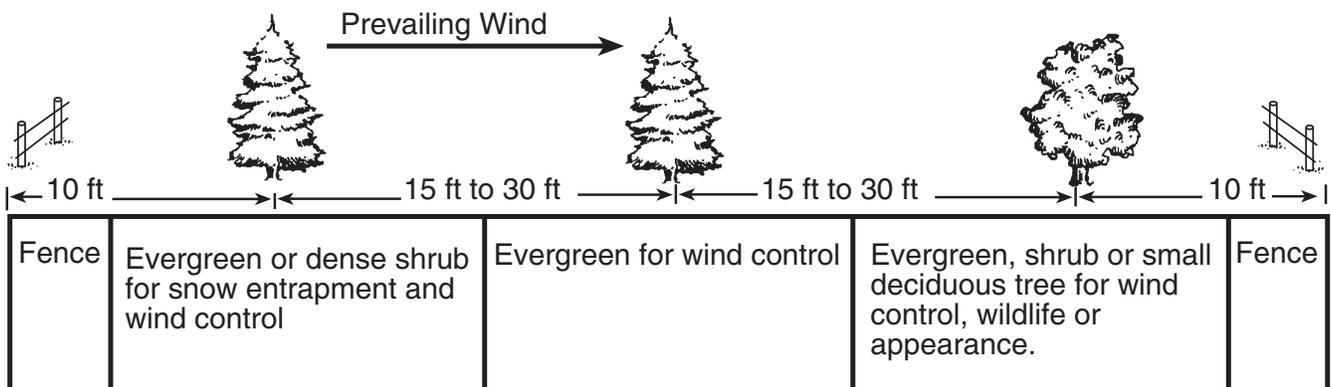


Figure 4. A typical three row windbreak for winter protection.

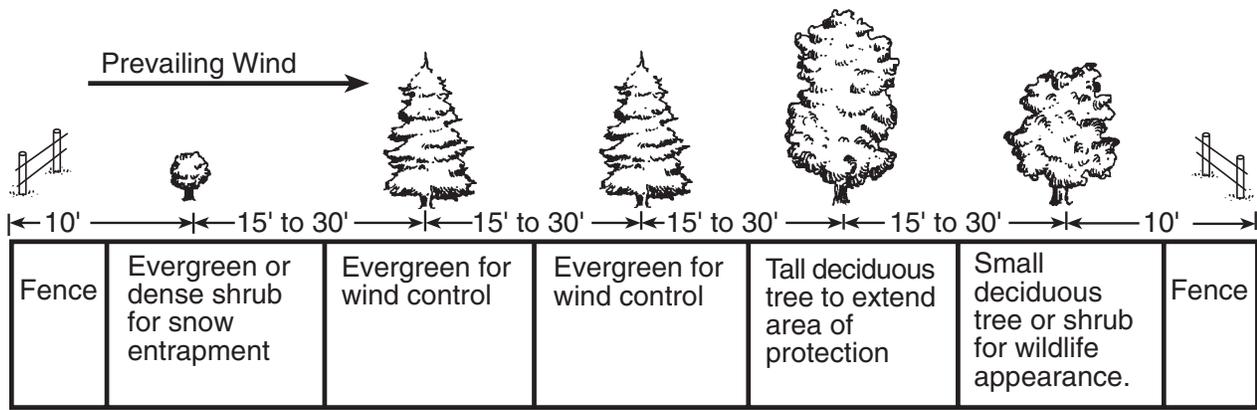


Figure 5. A typical five row windbreak for winter protection.

Summer windbreaks usually consist of one or two rows of plants located south of the area to be protected. A one-row windbreak may be either evergreen trees, deciduous trees, or shrubs. The south row of two-row windbreaks usually consist of deciduous shrubs or small deciduous trees while the north row consists of moderate to tall deciduous trees. The summer windbreak should be located five times the mature height of the trees south of the area to be protected. Dense windbreaks located closer will do a better job of reducing wind speed, but they may cause an increase in mid-day air temperature.

Winter Livestock Protection

Windbreaks reduce winter stress on livestock. All livestock have critical minimum temperatures that must be maintained. When animals are subjected to air temperatures below this critical temperature, they require more food to offset the increase in energy lost to maintain themselves. By reducing wind velocity, windbreaks significantly lower stress on animals and reduce feed energy requirements. This results in better animal health, lower

feed costs, and greater financial gain. On open grassland, windbreaks are especially valuable during the calving season when protection from late winter and early spring storms is most critical.

Confined livestock will benefit from winter and summer protection by windbreaks designed with the same principles as described for home and farmstead windbreaks. However, drainage from melting snow trapped in the windbreak needs to be considered (Figure 6). Also, drainage from the feedlot should not be allowed to flow into the windbreak.

Livestock in open grassland receive good winter protection from windbreaks consisting of three to ten rows of evergreen trees. Windbreaks shaped like the letters “L” or “U,” with the open ends facing southeast will provide the most protection. Locate these “living barns” in the southeast corner of the range since livestock tend to drift with the wind. The snow drift area should be fenced so that livestock will not be covered and smothered by snow. The fence should enclose the entire windbreak and an area 50 to 75 feet south and east to include the snow drift area.

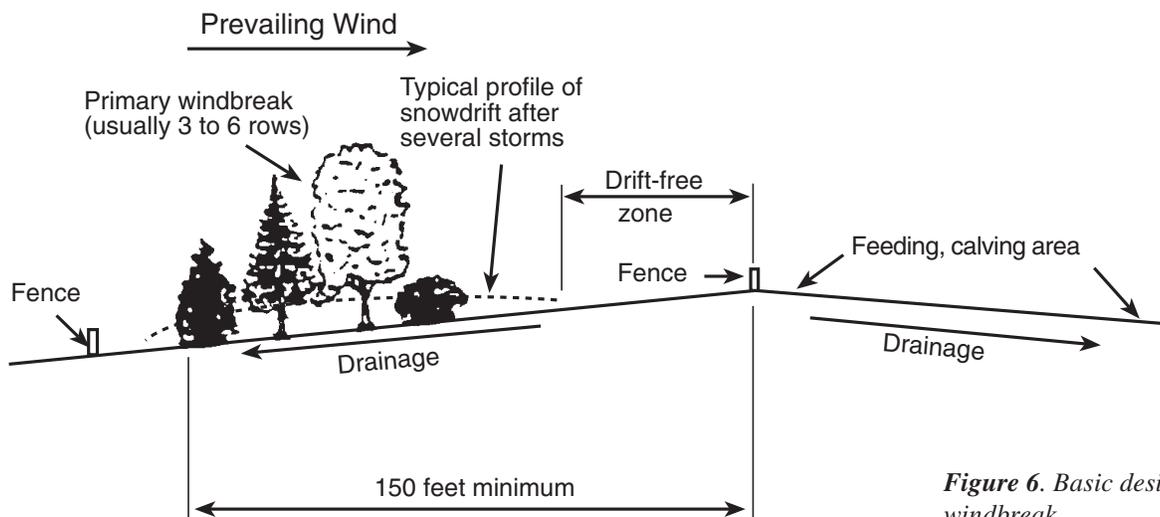


Figure 6. Basic design for livestock windbreak.

Protection for Crop Fields

Field windbreaks are valuable resources that offer protection to crops and soil from harsh winds. They increase crop yields by creating conditions that are more conducive to plant growth. Crops responses to wind protection may be classified as low, moderate, or high. Low-response crops include the small grain crops. Corn, grain sorghum, and forage crops are considered moderate-response crops. Vegetable crops and fruit orchards are high-response crops.

Wind erosion occurs when wind velocity exceeds 12 mph and the soil is loose, dry, and finely granulated; the surface is smooth; and the vegetative cover is sparse or absent. Blowing soil can cause significant damage to growing crops and eventually lead to decreased soil productivity. Windbreaks along with other conservation practices will provide maximum protection to our valuable topsoil.

A series of windbreaks spaced at $\frac{1}{8}$ mile intervals, as shown in Figure 7, will provide good protection from wind erosion and, in most conditions, will provide increased crop yields. For maximum protection on highly erodible soils, reduce the interval between windbreaks to a distance of 10 to 15 times the mature height of the tallest trees. To be most effective, the windbreaks should be oriented in an east-west direction.

Although older field windbreaks usually consisted of five to ten rows of trees, the modern field windbreak will only have one or two rows of trees and will take considerably less cropland out of production. Evergreen trees should be used in these windbreaks.

Field windbreaks also can be designed around center-pivot irrigation systems (Figure 8). The odd corners located between the center-pivots are ideally suited for tree planting. Windbreaks are effective and economical shelters when designed for these areas. They provide crop and soil protection and also afford shelter for livestock grazing stubble on the irrigated fields or for confined livestock in the non-irrigated corners. Wildlife use these corners for shelter, loafing, nesting, and feeding areas.

Enhancing Wildlife Habitat in Windbreaks

A windbreak designed to protect a home site, livestock, or a crop field will attract wildlife. However, a windbreak designed with wildlife needs in mind will provide better wildlife habitat.

Wildlife have three essential needs for survival: food, water, and cover. Cover is necessary for nesting, loafing, escape, and protection from the elements. Well-designed windbreaks provide all types of cover as well as food. Windbreaks can serve as “travel lanes” for wildlife as they move from one area to another. In conjunction with a nearby pond or other water source, they provide permanent homes for a variety of wildlife.

The design of the windbreak depends primarily on the species of wildlife to be attracted to an area. If a variety of wildlife is desired, a large and diverse planting is needed.

A multi-row planting consisting of evergreen trees, shrubs, and tall deciduous trees will provide homes for many species of wildlife.

If upland game birds are the desired species, a windbreak consisting of two or more shrub rows will provide adequate habitat, with more shrub rows being better.

Snow accumulation in narrower plantings is a major concern. Severe blizzards can completely fill narrow windbreaks with snow and kill upland game birds that have concentrated in the windbreak for protection. A row of shrubs or dense conifers (snow trip row) planted 100 to 150 feet on the windward side of a narrow windbreak will help prevent this. The trip row also will help prevent snow from breaking up the trees in the windbreak. The area between the trip row and the primary windbreak can be planted to native grass or annual food plots.

Best wildlife benefits are realized when windbreaks are planted in an east-west direction. During winter months, direct sunlight is available on southern rows during the day, where wind protection is greatest. The opportunity to “sun” in a protected site lowers metabolic rates for birds and animals. Food-bearing shrubs along the southern rows create an excellent zone for feeding and protection. Further habitat enhancement can be achieved by planting a strip of native grass, annual food plots, or a green strip (clover or alfalfa) adjacent to the windbreak or between the windbreak and the snow trip row.

Spacing of Trees

Many of the problems that occur in old windbreaks are directly related to the trees being planted too close to one another. Crowding results in reduced vigor and greater susceptibility to insects and diseases, due to competition for sunlight, moisture, and nutrients.

Between-row spacing will vary with the section of the state, number of rows in the windbreak, soil type, kind of trees, and the size of cultivation equipment. Use wider spacing in western Kansas to compensate for lower precipitation. Row spacing should be at least 4 feet wider than the cultivation equipment. Closer spacing will result in mechanical injuries to the plants. A minimum spac-

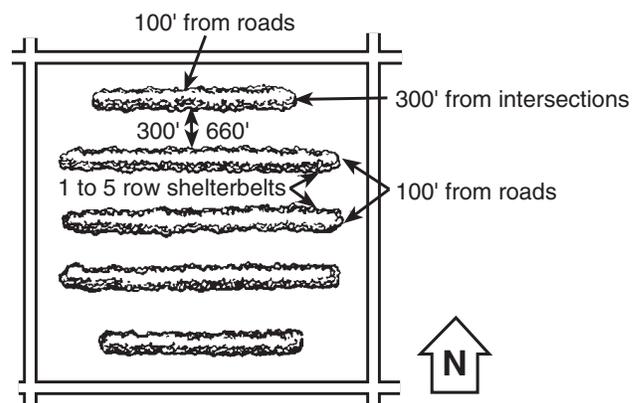


Figure 7. A typical system of field windbreaks.

ing of 8 to 30 feet (use wide spacing on dry sites) usually is adequate to prevent stunting or overtopping. Large deciduous trees should be at least 25 feet from shrubs and evergreen trees.

In-row spacing will vary with the type of plants and the number of rows in the windbreak.

Shrubs	3' - 6'
Redcedar	6' - 10'
Rocky Mountain juniper	6' - 10'
Pine species	8' - 16'
Short deciduous trees	6' - 12'
Tall deciduous trees	8' - 18'

Use close spacings in the windward row and in windbreaks with two rows. Wider spacings are best in the interior and lee rows of multi-row windbreaks.

Selecting the Best Kind of Plant

A list of trees and shrubs suitable for windbreaks is given in Table 2. These plants are provided at low cost by Kansas Forest Service. Order forms are available from county extension offices, conservation district offices, district wildlife biologists, and district foresters.

These plants are selected to serve various functions in windbreaks. They are not all adapted for statewide use. Table 2 indicates their general adaptability. A plant should be selected for its adaptability to your area, mature size, and function within the windbreak.

The soil at the planting site may limit the kinds of plants to use. A county soil survey will provide information to help select the plants for your windbreak. Depth, texture, fertility, acidity, and moisture relations are all important factors in tree survival and growth. All of the plants listed in Table 2 will grow in deep, moist, fertile soils. Relatively few plants, however, can tolerate shallow, droughty, impermeable, alkaline soils. The choice of plants becomes increasingly limited as soil conditions become more adverse. Eastern redcedar, Rocky Mountain juniper, ponderosa pine, and honeylocust can make moderate growth on

relatively shallow and dry sites. On sandy upland soils, the better species are ponderosa pine, Austrian pine, eastern redcedar, Rocky Mountain juniper, and American plum. You can expect considerably slower height growth from plants growing on adverse sites.

Windbreak Establishment and Management

Windbreaks are a long-term valuable investment. Careful planning and management are needed to have a successful windbreak.

The first step in successful windbreak establishment is proper site preparation. Site preparation will provide a desirable seed bed for planting the trees, build up soil moisture, and help control perennial weeds and grasses. On sod sites, the sod should be killed or removed and the site fallowed for one year prior to tree planting. Site preparation in cultivated fields consists of deep chiseling in the fall and disking prior to tree planting in the spring.

Weed control is a critical factor to tree survival and growth. Weeds, especially perennials and warm season annuals, compete for moisture, nutrients, and sunlight. Weeds also provide habitat for tree-injuring pests and fuel for wildfires. The success of windbreaks is often directly related to the degree of weed control. On dry, shallow sites, weed control may be necessary throughout the life of the windbreak.

There are three basic methods for weed control: mulching, cultivation, and herbicides. Mulch serves to reduce weed competition, conserve moisture, and reduce soil temperature. Weed barrier fabric, a man-made polypropylene fabric, does an excellent job of controlling vegetation and conserving soil moisture. Suitable organic mulches include wood chips, old straw or hay, and well-leached, dried ensilage. Organic mulches should be applied 2 to 4 inches deep around individual trees.

For most people, a combination of mulching and cultivation may be the most effective method of weed control. Shallow cultivation, not more than 3 to 4 inches deep, effectively controls weeds and avoids injury to tree roots. Sweeps, disks, spring-tooth cultivators, or rotary cultivators do a good job, but care must be taken to avoid hitting the young tree seedlings.

Herbicides can be useful in controlling weeds in tree and shrub plantings. However, if improperly applied, they may injure or kill the trees and shrubs. Most common agricultural herbicides are not labeled for use on windbreaks. Be sure to follow all label directions when using herbicides for controlling weeds in tree plantings.

Adequate soil moisture is needed at the time of planting. If soil moisture is lacking, irrigate immediately after planting and then as necessary during the first three growing seasons. Soak the soil thoroughly and then allow it to partially dry before irrigating again. Irrigating just before the soil freezes in the fall is very helpful for all trees, especially evergreens.

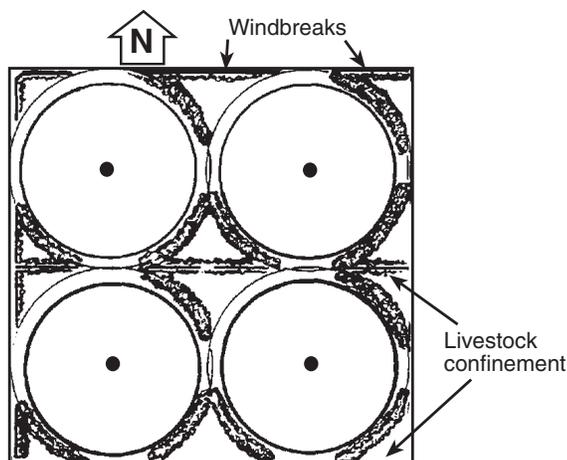


Figure 8. Center pivot irrigation systems showing placement of windbreaks for crop, soil, and livestock protection.

Protect windbreaks, regardless of age, from livestock and wildfire. Livestock trample and compact the soil, break or eat small trees, and damage the bark and lower limbs of larger trees. Young trees are very susceptible to damage caused by fire. A well-maintained fire break around a windbreak offers good protection from wildfire.

Mice, rats, gophers, rabbits, and deer are common pests. Damage can be prevented through the use of wire screens, wraps, traps, repellents, and weed control.

Inspect windbreaks frequently for insect or disease problems. Contact your local extension office or district forester for control measures.

Avoid pruning trees in the windbreak except to remove dead, diseased, or broken branches. Additional pruning reduces the density and therefore lowers the capacity to control wind and snow. To maintain viability and effectiveness as they age, windbreaks may require thinning and/or replanting.

Help Is Available

For recommendations on designing, planting, or managing your windbreak, contact district foresters through your county extension office, district conservationist at the USDA Natural Resources Conservation Service Office, or district wildlife biologist.

Related Publications

Tree Planting Guide, L-596

Windbreak Management, MF-815

Living Snowfences in Kansas, L-744

Conservation Tree Planting Schedule, L-871

Windbreaks for Wildlife, MF-805

Weed Control Options in Tree Plantings, L-848

Chemical Weed Control in Tree

and Shrub Plantings, MF-656

Kansas Foresters Serving Your Needs, L-847

Weed Barrier Fabric Mulch for Tree

and Shrub Plantings, MF-2216

Table 2. Windbreak Trees and Shrubs For Kansas

Plant Name	Range¹	Height (feet)	Growth Rate	Wildlife Benefit	Comments
Small Deciduous Trees					
Mulberry, Russian	W,C,E	15-20	Fast	Excellent wildlife cover and summer food	Very hardy and drought tolerant. Provides excellent wildlife habitat in windbreaks.
Redbud	C,E	10-20	Moderate	Little	Very attractive with flat spreading top and colorful pink bloom. Often used to add color to the windbreak.
Large Deciduous Trees					
Ash, Green	W,C,E	35-80	Moderate	Perch, roost, and nest sites for many birds	Adapted to many sites, but is very susceptible to borers on droughty sites. Grows well on very wet sites.
Cottonwood	C,E	70-90	Fast	Perch, roost, and nest sites for many birds	Needs abundant moisture throughout the growing season. May be used on wet sites. Borers are a severe problem on drier sites. Good for quick protection.
Elm, Lacebark	W,C,E	35-40	Moderate	Perch, roost, and nest sites for many birds.	Resistant to Dutch elm disease and elm leaf beetle. Winter injury may be a problem in northern Kansas.
Hackberry	W,C,E	35-70	Moderate	Berries eaten by birds and squirrels	Commonly used to provide height. Drought tolerant, but slow growing on such sites.
Honeylocust	W,C,E	30-50	Moderate	Perch, roost, and nest sites for many birds	Commonly used to provide height. Drought tolerant. Moderate to fast growth except on very shallow soils.
Maple, Silver	C,E	70-80	Fast	Perch, roost, and nest sites for many birds	Commonly used to provide height. Brittle. Plant only on moist bottomlands.
Oak, Bur	W,C,E	60-100	Slow to Moderate	Acorns used by squirrels, deer, and some birds	Long-lived and very strong. Commonly used to provide height.
Oak, Northern Red	C,E	50-75	Moderate	Acorns used by squirrels, deer, and turkeys	Grows best on deep fertile soils. Provides height in windbreaks.
Oak, Sawtooth	C,E	50-60	Moderate to Fast	Perch, roost, acorns used by squirrels, deer and some birds	Grows best on deep fertile soils. Provides Height in windbreaks.

¹ W, C, and E, indicate Western, Central, and Eastern

Plant Name	Range	Height (feet)	Growth Rate	Wildlife Benefit	Comments
Evergreen Trees					
Arborvitae, Oriental	W,C,E	30-35	Moderate	Winter protection	Desirable tree for windbreaks. Low branching habit provides good ground cover for wildlife. May experience winter injury in northern Kansas.
Juniper, Rocky Mountain	W	15-25	Moderate 12"-18"/yr	Excellent winter protection	Similar to eastern redcedar. Retains green color in winter, more resistant to limb breakage and tends to be slower growing than eastern redcedar. Subject to Cercospora blight in eastern and central Kansas.
Pine, Austrian	W,C,E	30-50	Moderate 12"-18"/yr	Winter protection	An excellent windbreak tree for state-wide use. Pyramidal in form with moderate length needles.
Pine, Eastern White	E	50-60	Moderate	Winter protection to Fast	Least drought tolerant of the pine species.
Pine, Southwestern White	E	35-50	Moderate	Winter protection	Similar to eastern white pine
Pine, Ponderosa	W,C,E	40-50	Moderate 12"-18"/yr	Winter protection	A drought hardy pine. Long, stiff needles. Purchase only tip moth resistant varieties.
Redcedar, Eastern	W,C,E	20-40	Moderate 12"-18"/yr	Excellent winter protection and emergency food for many wildlife species	The "backbone" of a good winter windbreak. Forms a dense windbreak. Very hardy and drought resistant. Maintains its lower branches much longer than the pines.
Shrubs					
Caragana	W,C,E	7-12	Moderate	Cover and nesting	Drought tolerant. Can grow on a wide range of soils.
Cherry, Choke	W,C,E	6-10	Fast	Excellent cover and summer food.	Used for ground-level protection. Forms dense thickets that increase in size by suckering.
Cotoneaster, Peking	W,C,E	5-7	Moderate	Cover and emergency winter food	Used for ground-level protection. Attractive foliage and berries.
Currant, Golden	W,C,E	3-5	Moderate	Cover and summer food	Drought tolerant. Often forms loose, open thickets. Edible fruit.
Lilac	W,C,E	8-12	Slow	Little	Used for ground level protection. Large purple flowers provide spring color. Long-lived and drought tolerant.
Plum, American	W,C,E	6-12	Fast	Excellent wildlife cover and summer food	Used for ground level protection. Forms dense thickets that increase in size by suckering. Edible fruit.
Plum, Sandhill	W,C,E	3-4	Fast	Excellent wildlife cover and summer food	Very similar to American plum.
Sumac, Fragrant	W,C,E	3-6	Moderate	Cover and emergency food	Drought tolerant. Scarlet berries through winter.

James H. Strine
Kansas Forest Service
2610 Claflin Road
Manhattan, KS 66502-2798
(785) 532-3300
www.kansasforests.org

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