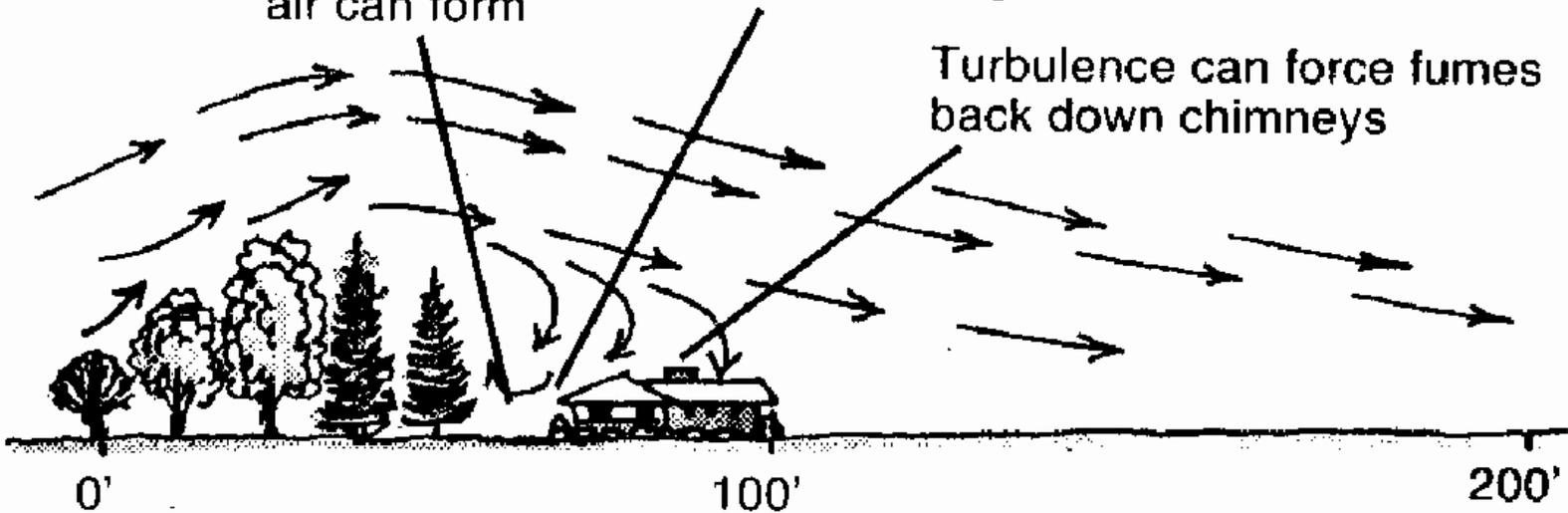


# Let windbreaks keep their distance

**Wrong:** In summer, areas of hot, stagnant air can form

Snowdrifts form on or near buildings in winter

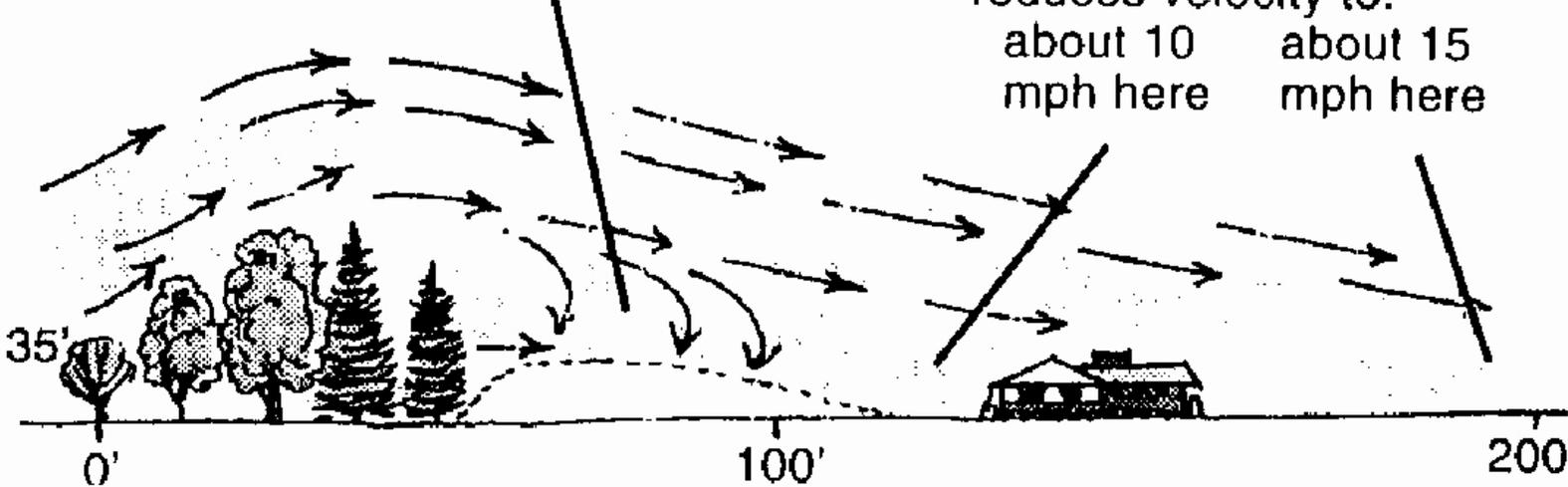
Turbulence can force fumes back down chimneys



**Better:**

Snowdrifts form away from buildings

If open wind speed is 35 mph the windbreak reduces velocity to:  
about 10 mph here      about 15 mph here





# Farmstead Windbreaks: Planning

Much of Iowa's land is relatively level to gently rolling with few trees to block the prevailing winter winds. Windbreaks—rows of trees and shrubs properly located—can slow, direct, and block these winter winds, resulting in many benefits to the landowner. A windbreak is a permanent part of the farm landscape, so think and plan carefully before planting trees or shrubs.

## Benefits of windbreaks

A good farmstead windbreak adds thousands of dollars to property values and provides many benefits. Some benefits such as energy conservation and snow control are the result of wind speed reduction. Other benefits such as wildlife habitat and aesthetic value are the result of having trees and shrubs in the landscape.

### Reduced wind speed

Windbreaks direct winds over or around protected areas. This reduction in wind speed results in many benefits. The amount of wind speed reduction and the area affected depend on the height, density, width, and shape of the windbreak. The continuity of the windbreak is important. Holes or gaps in the windbreak may result in increased wind speed and reduced protection.

Windbreak **height** (H) is the most important factor used to determine the distance downwind that is protected by a windbreak. Wind speed is reduced most nearest the windbreak; at distances of 25 to 30 times H wind speed is reduced less than 10 percent (table 1). In addition there is a small reduction in wind speed up to one to four times H on the upwind side of a windbreak (figure 1).

Table 1. Wind speed reductions on the downwind side of a moderately dense windbreak

Distance from windbreak					
5H	10H	15H	20H	25H	30H
% reduction in wind speed					
78%	66%	35%	14%	10%	4%

The taller the windbreak, the greater the zone of protection. The percent of reduction in wind speed is relatively constant and is mostly independent of wind velocity.

The **density** of a windbreak also affects the reduction of wind speed. Density is the ratio of the solid portion of a windbreak to the total area of the barrier. Very dense windbreaks reduce wind speed in the zero to 10H zone more than do less dense windbreaks. Moderately dense windbreaks reduce wind speed over a greater H number than very dense windbreaks. A windbreak density of 55 to 85 percent provides the greatest combination of benefits. For some specialty functions such as snow capture, a density of 30 to 40 percent may be ideal.

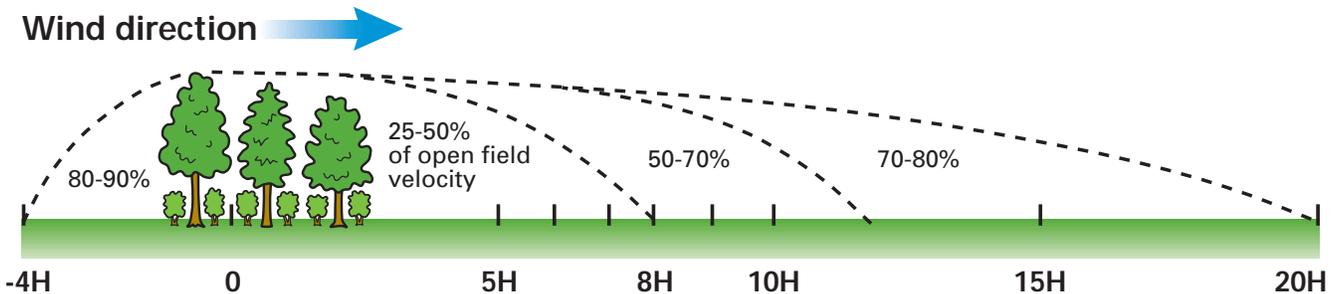
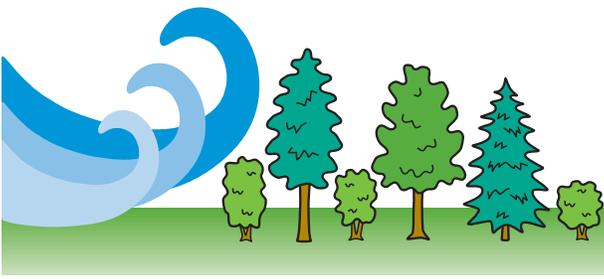


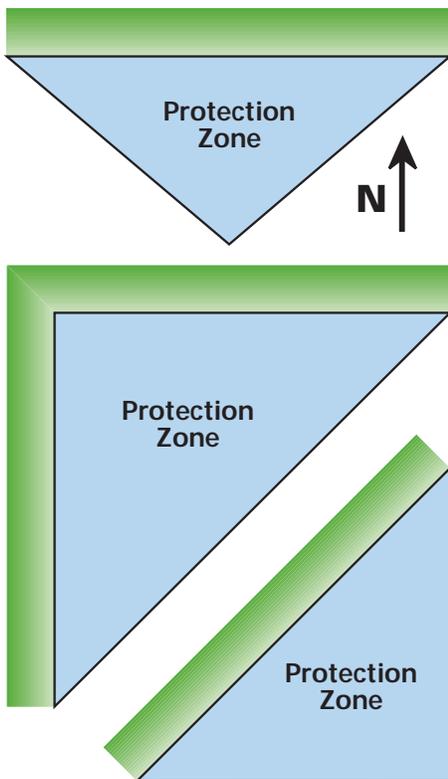
Figure 1. Zones of reduced wind velocity downwind of barrier as percentage of open field velocity. Vertical scale exaggerated.



Windbreak **width** contributes increased protection; it allows increased density by adding additional rows. Narrow windbreaks of high density may be as effective as wider windbreaks with equal density. However, narrow windbreaks provide no safety factor because a single dead tree may leave a gap in the windbreak.

Windbreak cross-sectional **shape** provides some modest difference in protection. Vertical-side windbreaks (tallest trees on the upwind side) provide a modest increase in area protected. Windbreaks arranged in a stair-step pattern (shortest tree on the upwind and tallest on the downwind) provide greater efficiency in lifting winds and less dumping and swirling in the protected zone. If beauty and aesthetics are important, establish the landowner's choice on the inside row and use the remaining rows to establish the desired shape.

A windbreak will be most effective when placed at right angles to the winds. In Iowa, winter protection from the normally prevailing northwest winds is optimal. Single



direction windbreaks provide less protection than double direction windbreaks provide (figure 2). Completely surrounding a farmstead with a dense windbreak will reduce positive effects of wind movement during the summer months.

**Figure 2. Multiple leg or extended windbreaks provide greater protection than single leg windbreaks.**

## Energy conservation

Well designed and placed windbreaks can reduce energy costs by as much as 20 to 40 percent. The type of home, energy efficiency, efficiency of home heating unit, and other factors will determine the individual savings. Any heated building or confinement space will benefit from the reduced chill factor resulting from reduced wind speeds. This represents the greatest potential for energy savings from a windbreak in Iowa.

In the summer, if the home is exposed to very hot winds, a windbreak may reduce cooling costs by reducing the infiltration of hot air. This benefit must be weighed against the positive effects of some air movement and flow through the farmstead during the warmer months.

## Snow control

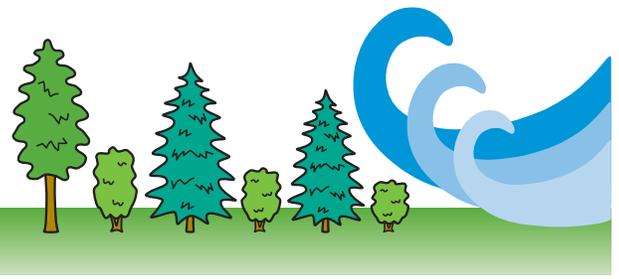
Windbreaks can be used to control or store snow, keeping it away from critical areas in the farmstead. Single rows of shrubs or trees can function as snow fences, trapping snow away from protected areas. Living snow fences should be planted 100 to 150 feet away from roads; they should be extended beyond the protected area. Windbreaks become more functional for snow stopping and storage as rows are added beyond the minimum. To trap additional snow, establish a living snow fence 50 to 150 feet away from the windbreak on the upwind side. Always check with local zoning or with the Natural Resources Conservation Service (NRCS) before establishing trees on the west or north side of roads.

## Improved working environment

Windbreaks improve the work environment of the farmstead. Wind speed reduction results in a lower wind-chill index and makes working in the outdoor environment more pleasant. Windbreaks also may reduce noise and filter dust from fields or roads.

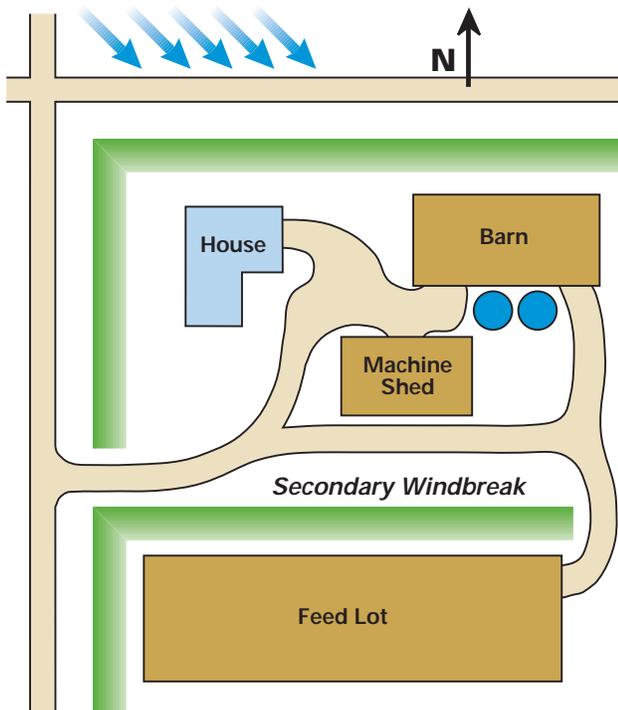
## Wildlife habitat

Windbreaks provide needed wildlife habitat in Iowa for feeding, shelter, nesting, and breeding. Windbreaks can be improved for wildlife habitat by increasing their size and selecting species most beneficial to wildlife. Contact your Iowa Department of Natural Resources wildlife biologist or Iowa State University Extension's wildlife specialist for additional assistance.



### Livestock protection

Livestock protected by a windbreak will use more of their feed for weight gain and less to maintain body heat. Windbreaks also can provide protection for feedlots, pastures, calving areas, and confinement buildings. Primary windbreaks around farmsteads with secondary windbreaks around livestock facilities may provide optimum benefits (figure 3).



**Figure 3.** Because windbreak protection is limited by tree height, secondary windbreaks may provide additional protection to large farmsteads.

### Tree products

In some cases, windbreaks may provide wood products including biomass, posts, poles, lumber, and firewood. On some sites, the production of high-value hardwoods (walnut, oak, ash, and maple) may be combined with windbreak benefits. Establishing gardens or fruit and nut trees on the downwind side of a windbreak may provide additional benefits.

### Aesthetics and property value

Windbreaks provide beauty and aesthetics to the farmstead. A well designed and maintained windbreak will greatly enhance the value of the farmstead and contribute to the pride of ownership of the property.

### Design considerations

Windbreaks for the home or farmstead should be carefully planned. The windbreak becomes an integral part of the site for at least 50 years. A well planned windbreak will enhance the property's value throughout the years. The location and layout should ensure that the windbreak is a benefit and not a hazard.

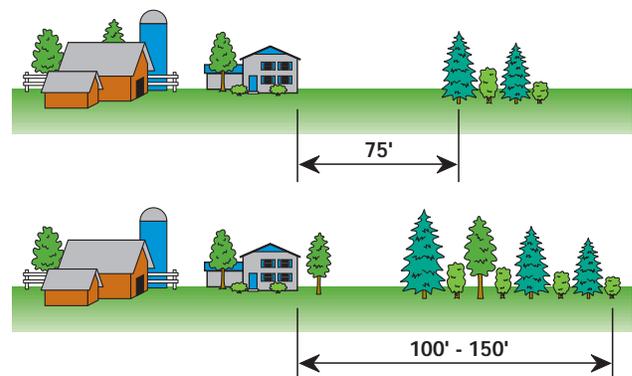
### North and west protection

For the greatest protection, locate the windbreak on the north and west sides of the farmstead. In Iowa it usually is not a good idea to totally enclose the farmstead with a windbreak because of reduced air flow during the summer months. The establishment of landscape plants on the south and east is acceptable.

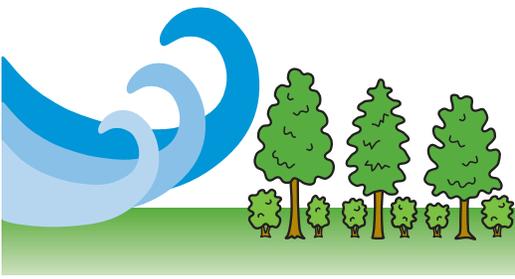
Extend the windbreak 100 feet south and east beyond the last main protected structure. This additional windbreak avoids sweeping winds on the farmstead corners. Also, snowdrifts which form around the ends of the windbreak will be beyond the farmstead corners.

### Distance to protected site

The inside row of narrow windbreaks should be at least 75 feet from buildings or structures or the outside row should be 100 to 150 feet away from the protected zone (figure 4). Significant snow drifting can occur in the first two heights of a narrow windbreak. Wider windbreaks will result in more snow accumulating inside the windbreak and less drifting through. If snow control is a critical issue, consider adding a living snow fence north and west of the windbreak or making the windbreak wider.



**Figure 4.** Narrow windbreaks must be 75' or more from protected areas. Wider windbreaks can be located closer to the protected site.



accumulation is not a problem, the distance from the windbreak to the protected site may be reduced, resulting in greater protection.

### Density

The minimum windbreak recommended in Iowa is three rows. The standard arrangement is a row of shrubs with two rows of conifers. The function, durability, and longevity of a windbreak improves with each additional row up to 10 rows. Each additional row beyond 10 contributes little to increasing the wind-slowing function of the windbreak but may enhance other values such as wildlife habitat.

Occasionally Iowa soils prohibit the use of conifers in the windbreak because of excessive wetness or high soil pH. At least five rows of deciduous trees are required to approach the effectiveness of a windbreak consisting of a row of shrubs and two rows of conifers, and up to 15 to 20 rows will improve the effectiveness of the windbreak. The original farmstead groves consisting of one to five acres of trees on the north and west side of the farmstead functioned well as windbreaks and provided wood products and wildlife habitat.

### Spacing

No single recommendation on row and tree spacing will satisfy all requirements concerning tree culture or windbreak benefits. Close spacing may provide some wind protection earlier, but wide spacing enables trees to retain lower branches longer and may result in a taller windbreak because of less competition between trees.

If possible, space all rows 20 feet apart including shrub and hardwood trees. Wide spacing will reduce competition between rows, and result in windbreaks that retain lower foliage longer. In addition, the wider spacing allows for more snow storage inside the windbreak. If space is limited, the spacing between the shrub row and conifer trees can be reduced to 16 feet. Rows of deciduous trees should not be spaced closer than 14 feet.

Within-row spacing will vary with species used and landowner objectives. Large conifers should be planted 14 to 25 feet apart; small conifers, 8 to 16 feet apart; deciduous trees, 8 to 20 feet apart; and shrubs, 3 to 13 feet apart depending on species. Narrow spacing between trees within a row will result in short-term increased density of the windbreak; the increased competition will result in self-pruning and competition, creating a less dense

windbreak. The optimum way to increase windbreak density throughout its life is by adding additional rows to the windbreak.

An alternative within-row spacing scheme is to plant trees at one-half the recommended spacing and plan to thin and remove every other tree before competition results in loss of branches.

*Farmstead Windbreaks: Establishment, Care, and Maintenance*, (Iowa State University Extension publication Pm-1717) provides information on species selection, planting, and the care and maintenance of windbreaks in Iowa. Additional technical information is available from your ISU Extension county office, or Iowa DNR district foresters or wildlife biologists. For on-site technical assistance and potential cost-share assistance, contact your county NRCS office.



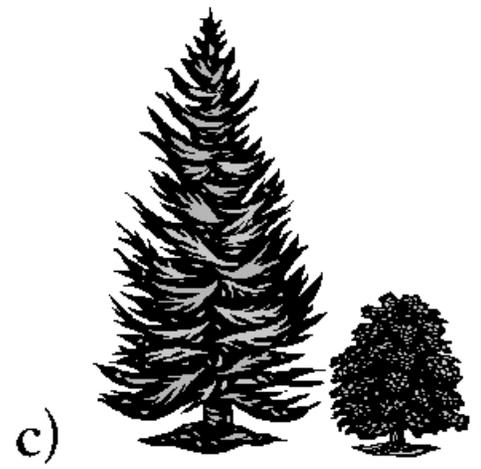
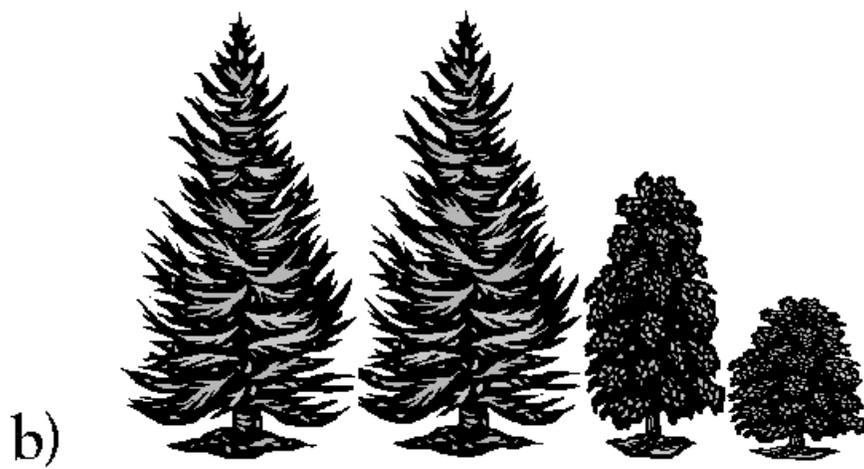
Prepared by Paul Wray, extension forester; Laura Sternweis, extension communication specialist; and Jane Lenahan, graphic designer.

### File: Forestry 5

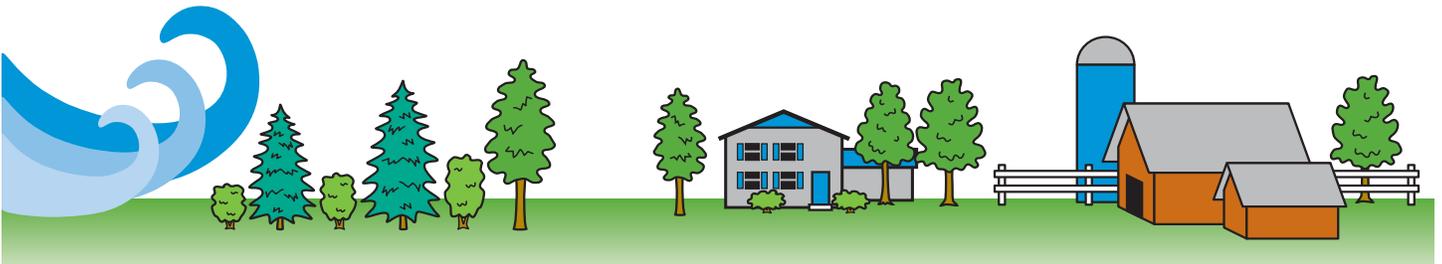
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Typical windbreak row configurations: a) 6-row, b) 4-row, c) 2-row.



# Farmstead Windbreaks: Establishment, Care, and Maintenance

Appropriate selection of species for use in the windbreak, followed by good establishment methods, care, and management, will ensure long-term wind protection in Iowa.

## Species selection

The species to select for use in the farmstead windbreak depends on soil characteristics and location in the state, as well as the personal preferences of the windbreak planner. **Never use a single species for the windbreak.** Use as diverse a mix of species as the site and conditions will allow. At the very minimum use as many different species as there are rows in the windbreak. Greater diversity can be achieved by block planting different species (figure 1). Large windbreaks and windbreaks with a greater diversity of species are better for both wind reduction and wildlife habitat

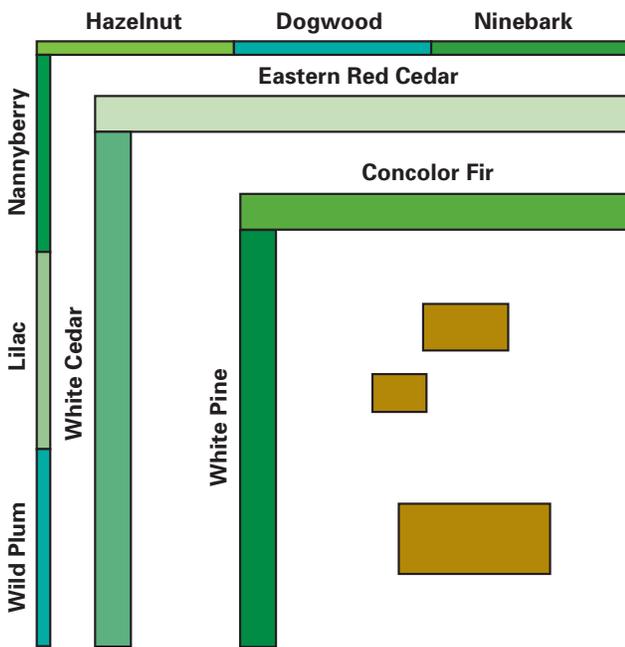


Figure 1. Species diversity makes a better windbreak.

## Conifers

If possible, use conifers in the windbreak because they retain their leaves during the winter months. However, some sites may not be suitable for conifers. Five to eight rows of deciduous trees are required to produce the same wind reduction as two rows of conifers.

Conifers are more sensitive to site and soil conditions than deciduous trees. The most limiting factors for conifers are soil moisture and soil pH. Ideal sites for conifers are soils that are acidic (pH less than 7) and well drained. As soils become less well drained and more basic, conifer growth and survival will be less likely. Do not plant conifers in soils that are poorly drained or have a pH greater than 7.6 to 8.0.

Conifers commonly used for windbreaks in Iowa are eastern red cedar, concolor fir, Douglas fir, white spruce, Black Hills spruce, Colorado spruce, Norway spruce, red pine, jack pine, white pine, ponderosa pine, and arborvitae. Due to problems with disease, Scotch pine is no longer recommended for windbreaks. Instead, use Colorado spruce or Ponderosa pine. Deciduous conifers (larch and bald cypress) contribute no more than deciduous trees to the windbreak. For more information on individual species and site adaptability, see Iowa State University Extension publications *Tree Planting: Planning* (Pm-1676) and *Community Trees: Conifer Species for Iowa* (Pm-1429g).



## Deciduous

Deciduous trees may be used as a component in a windbreak or when site conditions prohibit the use of conifers. A deciduous windbreak should include at least five rows of trees, or be established as a one- to five-acre “grove” on the north and west sides of the property. Fast-growing deciduous trees may provide some wind protection sooner when combined with conifers in the windbreak.

Deciduous trees can be matched to most sites in Iowa through species selection. Common fast-growing species used in windbreaks are hybrid poplar, cottonwood, silver maple, hackberry, green ash, and hybrid willow. Use caution when selecting both hybrid poplars and hybrid willows because of potential disease problems. Other slower growing deciduous species for windbreak use include red oak, bur oak, white oak, swamp white oak, black oak, black walnut, and white ash. Windbreak planners should not be limited by this list. Many other species may be appropriate for windbreak use. For more information see ISU Extension publication *Tree Planting: Planning* (Pm-1676).



## Shrubs

Shrubs are important to a windbreak for early snow capture and for filling in the lower portion of the windbreak as it matures. Through appropriate selection and planting, shrubs may have great benefit to wildlife because of fruit or seed production. Use several different species, planting in blocks of 10 to 50 plants (figure 1).

Shrub species commonly used for windbreaks include serviceberry, Pagoda dogwood, gray dogwood, red osier dogwood, silky dogwood, wild plum, choke cherry, sumac, Nanking cherry, hazelnut, nannyberry, black haw,

Amur maple, lilac, and ninebark. As with all woody plants, match species of shrub to the site and soil conditions. To get more information about shrub species selection, observe which species perform well locally or consult with ISU Extension or Iowa Department of Natural Resources foresters.

## Establishment

Begin planning the windbreak the fall before the anticipated spring planting. Fall is the time to prepare the site, arrange for nursery stock, and provide for weed control. Spring is the best time to plant a windbreak; however, with some nursery stock such as container-grown or balled-and-burlap stock, the season can be expanded. Obtain windbreak trees from a reliable commercial nursery. Seedlings from the state nursery cannot be used for farmstead windbreaks. For more information on tree planting see ISU Extension publications *Tree Planting: Establishment and Care* (Pm-1677) and *Tree Planting and Care Pocket Guide* (Pm-1591).

## Site preparation

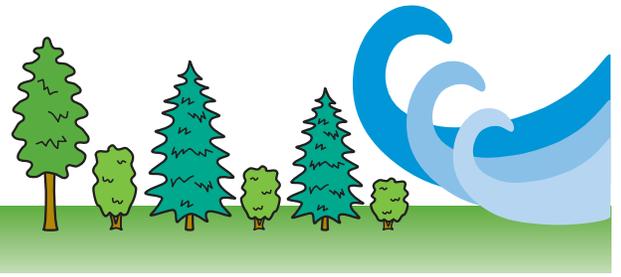
Windbreak plantings will benefit from good site preparation. Use herbicides or tillage to eliminate perennial competing vegetation where trees are to be planted. If establishing grass between rows of trees, use less competitive grass species, such as blue grass, timothy, or fine fescue; avoid brome, reed Canarygrass, and tall fescues.

## Planting stock

Several choices exist for planting stock. Bare root seedlings or transplants are appropriate for shrubs and deciduous trees. Using seedling stock for conifers may result in delays in the establishment of the windbreak. Using transplants, or potted, container-grown, or balled-and-burlap stock results in higher conifer survival and better establishment rates. Larger stock may allow the windbreak to become functional in a shorter period of time. Avoid using stock that does not have a balanced root-to-top ratio; this stock often grows poorly or does not survive. The greater the amount of roots compared to the top, the better the plants will recover from transplant shock and resume normal growth.

## Planting techniques

Use good planting techniques. Make the hole 20 to 40 percent wider than the root system to allow for root expansion and development. Avoid planting too deep. Plant at the same level or one-half inch deeper than the



plants grew in the nursery. Don't plant with parts of the root system exposed. Remove all pots, plastic, or fiber, and as much of the burlap as possible on balled-and-burlap trees.

If watering is part of the planting process, water after the soil has been replaced. For regular watering during the first year, create a basin to hold water around the tree or install an inexpensive drip irrigation system for the windbreak.

Mulching will provide many benefits to the planted windbreak stock. Four to six inches of mulch provide many benefits to the trees. Mulch conserves moisture, reduces temperature extremes around the root system, keeps lawnmowers away from the trunk, provides weed control, and provides nutrients. The best mulch materials are wood chips or bark. Other organic materials (except manure) may be used, but may not last as long.

### ***Care and maintenance***

Windbreak care and maintenance is in some cases similar to care of other trees in the landscape, but in other ways quite different. Failure to provide some minimal care may result in a windbreak that is less functional and has a shorter life span.

### **Watering**

Proper watering during the one- to two-year establishment period is critical. Water well, but don't water too frequently. Water every seven to 14 days if at least an inch of rain has not been received. When watering, make sure the entire root system is moistened, but allow enough time between waterings so the soil can dry.



### **Pruning**

Maintain a single main stem in conifers and large deciduous trees for as long as possible. Correct multiple stems as soon as they occur. Don't prune the lower branches; maintain as much foliage as possible to improve the function of the windbreak.

### **Weed control**

Continue weed control until the trees begin to control the competing vegetation. Keep the grass and weeds away from the trees and shrubs to help them maintain their lower foliage. Weed/grass competition control includes chemical control, mulches, cultivation, or barriers. Mowing is not weed control, but may be used to control grasses between rows and between trees within a row.

### **Protection**

Windbreaks are subject to damage from various agents. Keep all livestock out of windbreaks. They browse, break limbs, remove bark, or compact the soil, all of which cause serious damage to the windbreak.

Rodent damage by rabbits, mice, ground squirrels, or gophers is most severe when trees are young. Habitat elimination or reduction may be the first line of defense. For other control measures contact your ISU Extension wildlife specialist or DNR wildlife biologist.

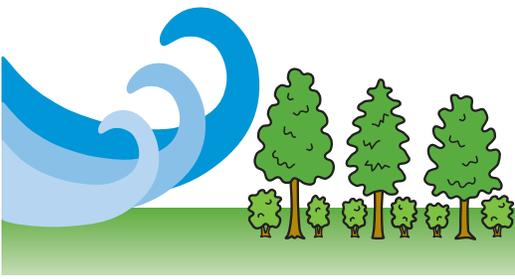
All tree plantings may be subject to insect and disease attacks. Many tree pests do little or no damage and require no control. Some damaging agents will require identification and control practices. ISU Extension Plant Pathology and Entomology can assist in pest identification and make control recommendations if necessary. Contact your ISU Extension county office.

### ***Windbreak management***

Good management of windbreaks should maintain and improve the vigor of individual trees, maintain and improve the structure and function of the windbreak, and promote the longevity of the windbreak.

### **Thinning**

Trees and shrubs that were initially planted at close spacing to become functional early may require some thinning later to maintain their effectiveness. Look for signs of deterioration in crowded windbreaks including premature loss of foliage, poor color, reduced live crown, reduced annual growth, and increased incidences of disease and insects.



Thinning may take several forms depending on the windbreak. In some cases, thinning around a tree needing more space can be accomplished on an individual tree basis. Removing every other tree in a row or eliminating an entire row may be necessary to maintain the lower crown and foliage in the windbreak. Volunteer woody vegetation may need to be controlled in windbreaks to reduce competition.

### **Sprouting**

Many deciduous trees are prolific sprouters when young; thinning or removing them may result in dense sprouting to maintain lower level density. Most shrub species maintain their ability to sprout and renew themselves even when old. For maximum sprouting, harvest during the dormant season when root food reserves are highest.

### **Natural reproduction**

Some windbreaks, usually hardwood groves as they grow older, may begin to replace themselves either with the original species or other non-planted species. These “woodlands” can, with some traditional woodland management, maintain themselves, providing both wind protection and traditional woodland crops. With management and some assistance, the landowner can control or favor the most desirable species through thinning, weed tree eradication, and crop tree selection techniques used in traditional woodland management in Iowa.

### **Windbreak replacement/rotation**

Many farmsteads can have continuous wind protection by establishing two rotating windbreaks 20 to 30 years apart on adjacent land areas. As an older windbreak begins to become less functional, establish a new windbreak adjacent to it. When the new windbreak becomes functional, rejuvenate or re-establish the older windbreak. This concept provides continuous improved protection and more benefits than the standard, minimum windbreak in Iowa.

*Farmstead Windbreaks: Planning* (Iowa State University Extension publication Pm-1716) provides information about benefits and design considerations. Additional technical information is available from your ISU Extension county office, or Iowa DNR district foresters or wildlife biologists. For on-site technical assistance and potential cost-share assistance, contact your county Natural Resources Conservation Service (NRCS) office.



Prepared by Paul Wray, extension forester; Laura Sternweis, extension communication specialist; and Jane Lenahan, graphic designer.

**File: Forestry 5**

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## PLANTING AND CARING FOR WINDBREAKS

### PLANTING

A windbreak is an important long-term investment. Careful site preparation the year before planting, the use of good planting stock and care in planting will ensure that you have an effective windbreak for a long time. For specific instructions on site preparation, the care of planting stock, planting techniques and weed control, please consult other Extension Notes in this series.

### THINNING

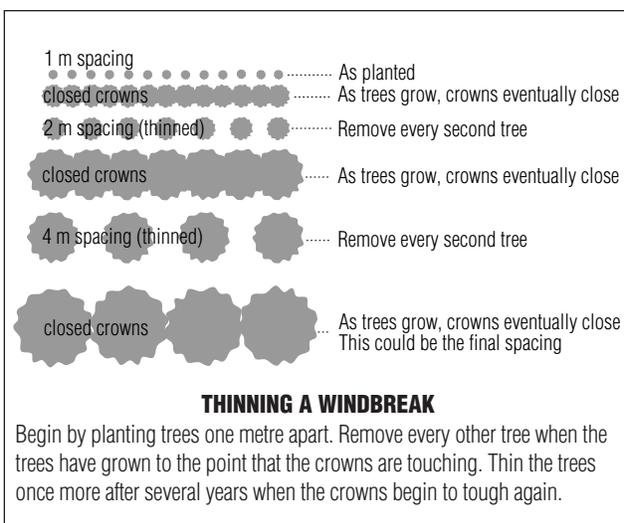
Thinning a windbreak is an essential part of its maintenance. After a number of years, the crowns of the trees will begin to touch. By removing every second tree, you'll be able to prevent the branches on the remaining trees from dying. After a number of years the crowns will again begin to touch. As before, remove every second tree, taking into consideration the trees lost through natural mortality and avoiding the creation of excessively large gaps. The key is to thin a windbreak before the lower branches on adjacent trees begin to die.

### PLANTING AND REPLACEMENT

A field windbreak has to be continuous. If there are gaps in it, weather damage to crops and soil will increase in the areas behind the gaps. Replant the gaps left by dead trees as soon as possible.

Even the healthiest windbreak will not last forever. Make plans to replace your windbreak well in advance of its decline.

For more information on designing, planting and caring for a windbreak, contact a representative of your local conservation authority, Ontario Ministry of Agriculture, Food and Rural Affairs or Ministry of Natural Resources.



The high density of white cedar makes this species ideal as a living snow fence that traps snow in a deep narrow drift close to the windbreak.