



## DESIGNING WINDBREAKS AND HEDGEROWS

### FOREST STEWARDSHIP MANAGEMENT NOTE #9

#### INTRODUCTION

Windbreaks and hedgerows perform more than 20 functions that are economically and ecologically significant, including prevention of soil erosion, control of snow deposition, provision of shelter for livestock, improvement of wildlife habitat, beautification of homesteads, conservation of heating energy, and many more (#3). Thus, wherever there is a substantial amount of open land, landowners should consider planting windbreaks or hedgerows.

This Note discusses general considerations for designing windbreaks and summarizes recommendations for several specific windbreak functions.

#### GENERAL CONSIDERATIONS FOR DESIGNING WINDBREAKS

1. **WINDBREAK WIDTH** - Windbreaks that are narrow (one or two rows of trees) are relatively permeable to the wind and provide less wind protection nearby, but the protection extends farther downwind. Wider windbreaks, often called shelterbelts, provide more protection nearby, but the protected zone is smaller, and a zone of greater turbulence is created downwind.
2. **ORIENTATION** - On relatively level terrain, windbreaks should be oriented approximately perpendicular to the prevailing direction of damaging winds (usually north or west in Michigan). However, on uneven terrain it may be more important to take advantage of natural features. For example, windbreaks planted on ridge crests protect much larger areas than those planted on lower slopes. On the other hand, ridgetop conditions may be too harsh for establishment, in which case planting just leeward (downwind) of the ridge is recommended.
3. **DISTANCE TO AREA TO BE PROTECTED** - Windbreaks reduce wind speeds for distances of approximately 20 times the height of the tallest trees in the windbreak, but the most effective zone of protection (50% or greater wind reduction) extends only 6-8 times the maximum tree height (#12). Wind speeds are also reduced somewhat on the windward side for a distance of 3-5 times the height of the windbreak.
4. **PROFILE (CROSS-SECTION)** - To allow wind to rise over multi-row windbreaks rather than confronting them head-on, the windward side should begin with small shrubs, followed by medium height trees, and then tall trees. If both deciduous and evergreen trees are used, place the deciduous trees to the windward side and the evergreens to the leeward side or in the central row(s). Small trees and shrubs can also be placed on the leeward side for wildlife and aesthetic benefits.
5. **PLANT SPECIES SELECTION** - The most important part of species selection is to be sure the chosen plants will thrive in the given soil and climatic conditions (FSMN #4). If soil type changes along the length of a row, change the species if necessary. Soil survey information is invaluable in this regard, as is the advice of Extension Service and Soil Conservation District personnel (FSMN #43) and the experience of neighbors. Plant hardiness information is available in Reference #4.

Evergreen species provide the greatest year-round protection. Spruces and firs provide the greatest protection because of their dense branching patterns, but pines offer quicker protection because of their relatively rapid growth. Using a mixture of species is ecologically advantageous, but each row should contain only species with similar growth rates (FSMN #8). Some exotic species, such as Norway spruce, have been widely used for windbreaks, but native species are preferable if they will serve the desired function (FSMN #37).

Guidelines for customizing windbreaks for various purposes often include tree height specifications (#6). Information on heights of various species at 20 years of age are included in the Soil Interpretations Records ("Soils 5" sheets) available for each soil type from the USDA Soil Conservation Service or county Soil Conservation District offices. Information on tree heights at maturity can be found in Reference #4.

6. TREE SPACING - In comparison to plantations grown primarily for wood products, windbreaks should generally have wider tree spacings so that lower branches will be retained longer. Unless special conditions dictate, the following specifications should be followed (#6).

Between Rows:

- Shrubs: 6-10 ft. (homestead or field);
- Conifers and small broad-leaved trees: 6-15 ft. (homestead); 6-10 ft. (field).
- Large broad-leaved trees: 8-20 ft (homestead); 8-14 ft. (field).

Within Rows:

- Shrubs: 3-10 ft. (homestead or field).
  - Conifers and small broad-leaved trees: 4-15 ft. (homestead); 6-10 ft. (field).
  - Large broad-leaved trees: 8-15 ft. (homestead); 8-14 ft. (field).
- Note: For all types, stagger spacing in adjacent rows.

7. SITE PREPARATION - It is usually best to begin site preparation for spring windbreak plantings the previous fall with mechanical or chemical weed control measures (FSMN #10).
8. PLANTING STOCK - Because windbreak trees are usually exposed to strong competition from weeds and harsh climatic conditions, medium to large size planting stock is recommended over smaller, less expensive stock. See FSMN #12 for additional information on planting stock and tree planting methods.  
  
Whatever type of planting stock you use, be sure to place your order well in advance to be sure you get what you want. For the usual spring planting period, trees should generally be ordered in the fall. Order some extra trees and plant them nearby to be used for replacements.
9. TREE PROTECTION - Depending on local conditions, tree in windbreak plantings may need protection from browsing by livestock and/or wildlife (FSMN #3,13).
10. WEED CONTROL - In addition to good weed control before planting (site preparation), successful windbreak establishment generally requires post-planting weed control for one or more years until the tree growth becomes rapid (FSMN #14).

## **RECOMMENDATIONS FOR DESIGNING SPECIFIC TYPES OF WINDBREAKS**

1. HOMESTEAD (FARMSTEAD) WINDBREAKS - L-shaped windbreaks located to the north and west of buildings are generally recommended. It is seldom necessary or desirable to plant trees on more than two sides of the area to be protected because dead air pockets tend to suck snow in, and air movement for summertime comfort will be obstructed (#8). If protection is needed from the south and/or east, use only one or two rows of shrubs or small trees.

To provide adequate protection but avoid snow accumulation problems and poor air circulation, windbreaks should generally be located 100-400 feet from, and extend 50-100 feet beyond, the area to be protected. Do not plant near above- or below-ground utility lines or other conflicting structures such as septic fields.

2. FIELD WINDBREAKS - From a crop production viewpoint, windbreaks provide several benefits, including soil erosion control, soil moisture conservation, reduction of crop damage, and yield increases (#9,10). For these purposes, relatively narrow and permeable windbreaks are generally preferable as they are better than wide, dense windbreaks at moderating wind and soil moisture conditions over large open spaces. Distances between field windbreaks should be determined by the Wind Erosion Equation (#6).

3. **LIVESTOCK PROTECTION WINDBREAKS** - An L-shaped layout provides protection from winds coming from any direction, provided the livestock can move all around the windbreak. Use at least three rows of trees, with at least two rows of dense, evergreens. Windbreaks must be fenced or the livestock will browse the trees and destroy their effectiveness. Plan location of windbreaks so meltwater from accumulated snow flows away from feedlots. Be aware that changing air flow will affect odors from feedlots.
4. **HEDGEROWS** - According to SIP guidelines, hedgerows are living fences of shrubs or trees planted in, across, or around fields to serve as fences, establish contour guidelines, provide wildlife habitat, or improve aesthetics (#6). The SIP specifications for hedgerows are similar to those for windbreaks. Thus, the term hedgerow is preferred where the primary function of the planting is not to block the wind.
5. **WILDLIFE CONSIDERATIONS** - Where winter cover for wildlife is limited, windbreaks should include two or more rows of evergreens that have dense foliage and good retention of live lower limbs, such as spruce or fir. Undulating rows provide much better cover than straight rows. A "snow catch", consisting of two or more closely planted rows of dense shrubs located about 50 feet upwind of the main windbreak, can increase the wildlife value of a windbreak by reducing snow accumulation within it (#7).

Where food for wildlife food is limited, supplement basic windbreaks with additional rows of trees and/or shrubs that will produce wildlife food (FSMN #27). Shrubs planted for food or cover will be better utilized on the protected, leeward side. Wildlife food can also be supplemented by leaving unharvested strips of crops adjacent to windbreaks and hedgerows.

Windbreaks that are composed of more plant species and that have more variation in terms of vegetation structure (e.g., tree size) will tend to attract a greater diversity of wildlife (FSMN #40,41). Wildlife will also tend to make greater use of windbreaks that are connected to other wooded areas as opposed to those that are isolated in the open (#11, FSMN #39).

6. **WOOD PRODUCTION CONSIDERATIONS** - Once windbreaks are established, it may be acceptable or even helpful to harvest trees from them for firewood or other uses. Where permeable windbreaks are desirable, selective thinning may be needed to keep windbreaks from becoming too dense. On the other hand, windbreak density can be increased by harvesting broad-leaved trees and allowing them to regenerate from stump sprouts. Cutting trees will reduce windbreak density initially, but clusters of stump-sprouts grow quickly and will be denser than the original trees. Thus, when a windbreak is being designed, consideration should be given to the types of trees that could provide useful wood products (FSMN #23).
7. **VISUAL SCREENING AND AESTHETIC CONSIDERATIONS** - Plantings designed to screen unsightly areas should be located close to the observation point, rather than close to the area to be hidden. Evergreen trees are the most effective for year-round visual screening, and a single row of these is usually sufficient if the species selected has low branching characteristics (#6).

To enhance visual quality, plant a mixture of tree and shrub species to provide a variety of form, color, and texture (FSMN #33). Randomly plant especially attractive species along the edges that are visible from houses and roads.

Windbreaks need not be planted in straight lines but may be shaped to suit the tastes of the landowner so long as they retain the basic orientation needed to block the wind.

8. **NOISE REDUCTION CONSIDERATIONS** - Tree and shrub belts should be tall, dense, and located close to the noise source, rather than close to the area to be protected (#6). Evergreen trees are the most effective for year-round noise reduction.

For moderate speed traffic, plant tree and shrub belts 20-50 feet wide, with the closest row 20-50 feet from the center of the nearest traffic lane. Shrubs 7-10 feet high, next to traffic lanes, should be backed by rows of trees that normally grow to a minimum height of 40 feet. For high speed traffic, belts should be 65-100 feet wide, with the closest row 50-80 feet from the center of the nearest traffic lane. The center row should

have the potential to grow a minimum height of 40 feet tall in 20 years

## REFERENCES

FSMN #'s refer to other Forest Stewardship Management Notes in this series.

- #1 Brandle, J.R. and J. Kort. 1994. Windbreak evaluation software available. Inside Agroforestry, Spring 1994. A free computer program that analyzes crop production benefits and economic returns of alternative windbreak designs for many common crops. Contact: Jim Brandle, Dept. Forestry, Fisheries, and Wildlife, University of Nebraska-East Campus, Lincoln, NB 68583-0814.
- #2 Brandle, J.R. et al. (eds.). 1988. Windbreak technology. Elsevier Science Publishers.
- #3 Forman, R.T.T. and J. Baudry. 1984. Hedgerows and hedgerow networks in landscape ecology. *Environmental Management* 8(6):495-510.
- #4 Henderson, C.L. 1987. Landscaping for wildlife. Minnesota Department of Natural Resources.
- #5 Hintz, D.L. and J.R. Brandle (eds.). 1987. Proceedings: International symposium on windbreak technology. Great Plains Agricultural Council Publication No. 117.
- #6 Michigan Department of Natural Resources, Forest Management Division. 1992. Stewardship Incentive Program (SIP) practice standards & specifications manual.
- #7 Norrgard, R., et al. 1989. Woody cover plantings for wildlife. Minnesota Department of Natural Resources.
- #8 Smith, M. and H. Scholten. 1980. Planting trees for farmstead shelter. University of Minnesota Agricultural Extension Service, Extension Bulletin 196.
- #9 Soil Conservation Service (USDA). 1990. Windbreaks and sustainable agriculture. Fact Sheet.
- #10 Soil Conservation Service (USDA). 1989. Windbreaks effects on filed and row crops. Fact Sheet.
- #11 Wegner, J.F. and G Merriam. 1979. Movements by birds and small mammals between a wood and adjoining farmland habitats. *Journal of Applied Ecology* 16:349-357.
- #12 Wray, P.H. 1984. Planning and management of farmstead windbreaks. Iowa State University Cooperative Extension Service Pm-543.

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