What are Windbreaks?

Windbreaks are barriers used to reduce and redirect wind.

Types of Windbreaks

- Trees and shrubs
- Crops and grasses
- Fences
- Other materials

How Windbreaks Work

As wind blows against a windbreak, air pressure builds up on the windward side (the side toward the wind), and large quantities of air move up and over the top or around the ends.

Windbreak Effectiveness

A windbreak's effectiveness is determined by:

- Height
- Width
- Density
- Species composition
- Orientation
- Length
- Continuity

For more information contact the South Dakota Division of Resource Conservation & Forestry

Division of Resource Conservation and Forestry Field Offices:

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This brochure was funded in part by a grant from USDA Forest Service Forest Stewardship Program.

Revised July 2005

How Windbreaks Work

South Dakota
Department of Agriculture and Natural Resources
Division of Resource Conservation and Forestry

Effect of Height

Windbreak height (H) is the most important factor determining the downwind protection area. This value varies from windbreak to windbreak and increases as the windbreak matures. The tallest tree row determines H for multiple row windbreaks. On the windward side of a windbreak, wind speed reduction is measurable upwind for a distance of 2 to 5 times H. See Figure 2 for leeward (side away from wind) protection zone.

Effect of Density

Windbreak density is the ratio of the solid barrier portion to the total barrier area. Wind flows through the open portion of a windbreak, thus the more solid the windbreak the less air that flows through. A low pressure area develops on the leeward side of very dense windbreaks. This low pressure area pulls air coming over the windbreak down, creating turbulence, and reducing downwind protection. As density decreases, the amount of air passing through the windbreak increases, moderating the low pressure area and increasing the downwind protection area. Conifer trees provide a denser windbreak than deciduous trees.

Effects of Orientation

Windbreaks are most effective when oriented at right angles to prevailing winds.

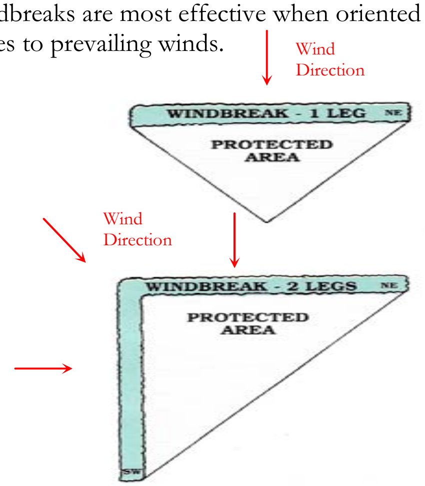

Figure 1. In areas with variable winds, multiple-leg windbreaks or windbreak systems provide greater protection to the field or farmstead than single-leg windbreaks (from University of Nebraska Extension EC-91-1763-B).

Open Wind Speed 20 mph
Deciduous 25-35% Density

Leeward distance from windbreak	5H	10H	15H	20H	30H
protected area wind speed, mph	10	13	16	17	20
% of open wind speed	50%	65%	80%	85%	100%

Open Wind Speed 20 mph
Conifer 40-60% Density

Leeward distance from windbreak	5H	10H	15H	20H	30H
protected area wind speed, mph	6	10	12	15	19
% of open wind speed	30%	50%	60%	75%	95%

Open Wind Speed 20 mph
Multi Row 60-80% Density

Leeward distance from windbreak	5H	10H	15H	20H	30H
protected area wind speed, mph	5	7	13	17	19
% of open wind speed	25%	35%	65%	85%	95%

Open Wind Speed 20 mph
Solid Fence 100% Density

Leeward distance from windbreak	5H	10H	15H	20H	30H
protected area wind speed, mph	5	14	18	19	20
% of open wind speed	25%	70%	90%	95%	100%

Figure 2. (H) is height of the tallest row in the windbreak (from University of Nebraska Extension EC-91-1763-B).

Effect of Length

The length determines the amount of area receiving protection. For maximum efficiency, the uninterrupted length should exceed the height by at least 10:1. This ratio reduces the influence of end-turbulence on the total protected area.

The continuity of a windbreak also influences its efficiency. Gaps in a windbreak become wind tunnels, creating areas on the downwind side where wind speed often exceeds open field wind speed. Lanes or field accesses through windbreaks should be located to minimize this effect or, if possible, avoided altogether.

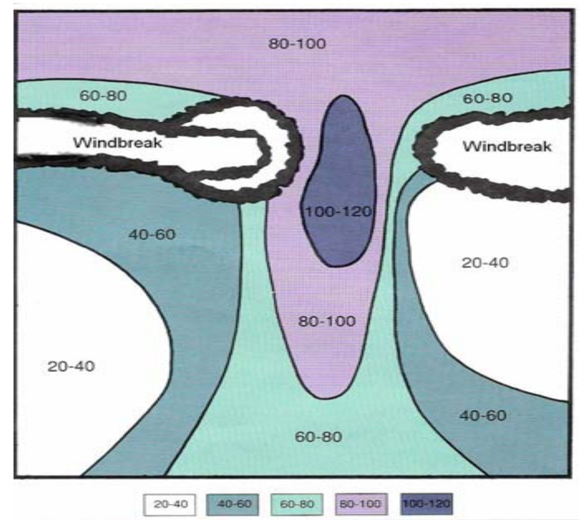

Figure 3. Wind flow increases through gaps in a windbreak decreasing the effectiveness of the windbreak. Numerical values represent the percent of open field wind speed (from University of Nebraska Extension EC-91-1763-B).

Microclimate Modification

The reduction in wind speed behind a windbreak leads to changes in the microclimate within the protection zone. Temperature and humidity usually increase, decreasing evaporation and plant water loss. Actual modification depends on windbreak height, density, orientation, and time of day.