


**Windbreaks Make Dollars and Sense**



The Fundamentals of Windbreak Design and Protection

*John G. DuPlessis  
Tri-State Forest Stewardship Conference  
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**The Fundamentals...**

- Windbreak for rural living and related costs and benefits.
- How Windbreaks Work
- Windbreak Design Considerations



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**Windbreak systems Can Help Increase Farm Profitability**

- Higher productivity of existing crops and livestock.
  - Plantings of trees and shrubs provide cover and protection from wind and sun, and can help manage soil moisture by trapping snow.
  - This can mean higher crop values, increased crop yields, and better livestock production and survival.

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## Windbreak Systems Can Help Increase Farm Profitability

- Reduced costs.
  - Providing wind protection can also have money-saving results, such as
    - Reduced ditch cleaning and snow removal costs,
    - Reduced farmstead heating and cooling bills,
    - Reduced irrigation and energy costs

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## Field Windbreaks

- Field windbreaks are used to protect row crops and livestock from damaging wind and to control wind erosion.
- They can also function as living snow fences to disperse snow more evenly across cropland, increase soil moisture in dry areas, and prevent drifting over roads and driveways.



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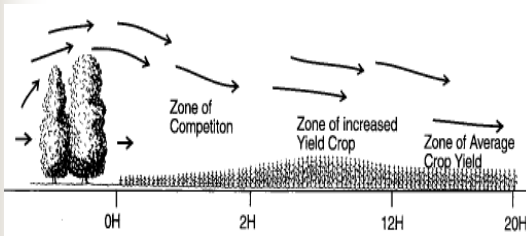
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Often crop yields are lowest next to a windbreak...



the greatest gains are out a few more rods

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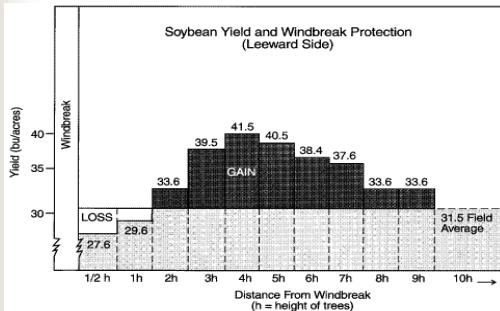
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For example...




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Average, Net Yield Increases of Common Grain and Oilseed Crops in Response to Shelter

Crop	Yield Increase (%)
Spring Wheat	6% to 10%
Winter Wheat	20% to 25%
Barley	23% to 25%
Oats	5% to 7%
Rye	18% to 20%
Millet	40% to 45%
Corn	10% to 15%
Soybeans	12% to 17%

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Production increases and energy costs decrease...

	% Change	Notes
Crop Production (yield)	+6% to +44%	
Wind Erosion (tons/ac/year soil loss)	-50% to -100%	Wind velocity dependent
Snow Distribution (cm dph w/in 20H)	>+50%	Highly variable
Irrigation (in or mm/day or gr. sea.)	-3% to -22%	Based on sprinkler drop size

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## Shelterbelts

- Farmstead shelterbelts protect homes from wind. They can help save household heating energy, manage snow drifts, and create a more pleasant place to live.




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## Some of the benefits of planting shelterbelts...

- Increased property values
- Lower farmstead heating and cooling bills
- Less blowing snow, dust, and odors, and reduction in noise
- Protects yards, machinery, etc.
- Protects buildings during high winds
- Enhances accessibility by control of snow/ice

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## Shelterbelts by the numbers

	% Change	Notes
Energy Consumption (e.g., kWh)	-10% to -40%	Variable by Region
Snow Removal (\$ of labor)	-?	Variable by Individual
Working Conditions (\$ of labor)	-?	Variable by Individual
Equipment Maintenance/Replacement (\$)	-?	Variable by Operation
Structure Maintenance (\$)	-?	Variable by Operation
Road Dust (\$ - Accident Frequency)	-?	Variable by Locality
Property Value (\$)	+6% to +12%	Variable by Region
Noise Level (decibels, dBA)	-10% to -20%	Dependent on Barrier

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## Windbreaks for snow management...

- Windbreaks can reduce the amount of effort spent on snow management.
- They can be designed to spread snow across a large area or to confine it to a relatively small storage area.



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## Living snowfences

- Where the goal of snow management is to confine the snow to a limited area, a dense windbreak of trees and shrubs can be a cost-effective method of controlling blowing snow.



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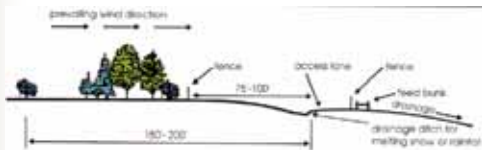
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## Snow traps...



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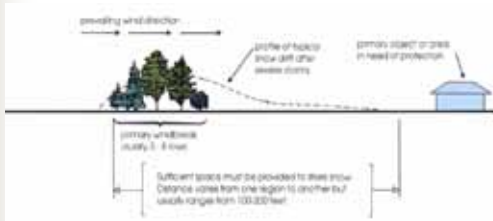
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Remember to think about where all that snow will go...



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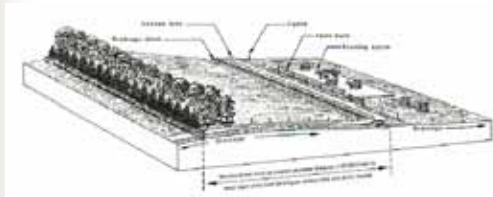
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Plan ahead - you want to be careful about where the water drains



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Windbreaks for Livestock operations...

- Windbreaks play an important role in the protection of livestock.
- Reducing wind speed in winter lowers animal stress, improves animal health, and increases feeding efficiency.



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## Livestock - Benefits

- Better livestock protection, production, and survival
- Feed savings
- Increased weight gain
- Feed is not blown away
- Decreased problems with flies

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## Livestock – Estimated “Change”

	% Change	Notes
Feed – Feedlot and Open Range (\$)	-10% to -30%	Variable by Climate
Livestock Mortality (Number of Animals)	-?	Variable by Operation

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Field windbreaks perform double-duty when grazing cattle on stalks



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## Riparian Buffers

- Riparian buffers are strips of perennial vegetation (trees/shrubs/grass) planted between cropland or pastures and streams, lakes, wetlands, ponds, or drainage ditches.
- Buffer strips can be planted with trees, shrubs, grass and herbaceous plants that produce harvestable products such as pulpwood, fruits, nuts, seed, or floral products.



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## How windbreaks work...

- Windbreaks are barriers used to reduce and redirect wind.
- The reduction in wind velocity behind a windbreak leads to a change in the microclimate within the protected zone.



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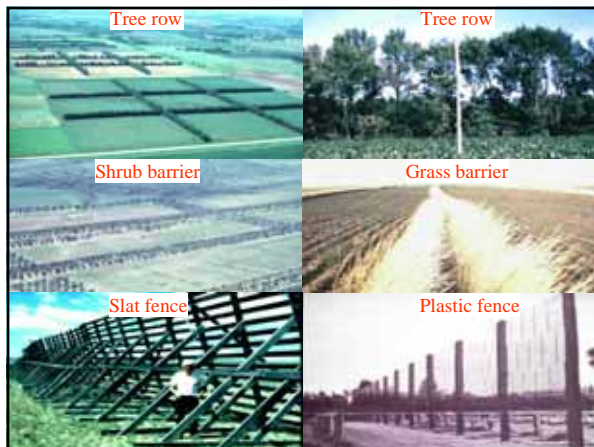
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## Windbreak Design Options...

- Density (Porosity)
  - Species selection
  - Number of rows
  - Row – to – row and plant – to – plant spacing
- Length
- Height
- Orientation
- Placement

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## Density or Porosity? letting the wind pass through...



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## Density...

- Windbreak density is the ratio of the solid portion of the barrier to the total area of the barrier.
- Wind flows through the open portions of a windbreak, thus the more solid a windbreak, the less wind passes through.



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### How dense does it really need to be?

- To get an even distribution of snow across a field, densities of 25 to 35 percent are most effective, but may not provide sufficient control of soil erosion.

**Open Wind Speed 20 mph  
Deciduous 25-35% Density**

Distance from windbreak	25'	100'	150'	200'	300'
inches per hour	10	13	16	17	20
% of open field speed	30%	32%	34%	35%	40%

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### Highly variable wind protection...




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### How dense does it really need to be?

- A windbreak density of 40 to 60 percent provides the greatest downwind area of protection and provides excellent soil erosion control.

**Open Wind Speed 20 mph  
Conifer 40-60% Density**

Distance from windbreak	25'	100'	150'	200'	300'
inches per hour	6	10	12	15	19
% of open field speed	30%	30%	40%	35%	45%

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## Excellent crop protection...



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## How dense does it really need to be?

- Windbreaks designed to catch and store snow in a confined area usually have several rows, and densities in the range of 60 to 80 percent.

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

# Windbreak Rows	5ft	10ft	15ft	20ft	30ft
rows per foot	5	7	13	17	19
% of open field speed	25%	33%	43%	50%	60%

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## Let it snow...



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## How dense does it really need to be?

- Solid barriers actually make for very poor windbreaks...




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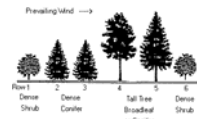
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## How many rows in a windbreak...

- The typical windbreak has several components:
  - Dense conifer trees to reduce wind velocity
  - Tall broadleaf or conifer trees to extend the area of protection
  - Low shrubs to trip snow, provide wildlife habitat and/or provide aesthetic value.




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## Spacing and density...

Windbreak Position	Windbreak Component	Spacing (ft.) Between Trees in the Row	Spacing (ft.) Between Tree Rows
Windward Rows (Rows 1 or 2)	Dense Conifer	6-12	12-20
Leeward Rows (Rows 3+)	Dense Conifer	8-12	14-20
Leeward Rows (Rows 3+) Broadleaf / Conifer	Medium Height Trees	10-18	14-20
Leeward Rows (Rows 3+)	Tall Trees	12-20	20-25
Windward or Leeward Rows	Shrubs	4-6	8-10

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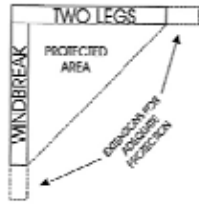
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### The effect of length...

- Although the height of a windbreak determines the extent of the protected area downwind, the length of a windbreak determines the amount of total area receiving protection.



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### Getting the most from your windbreak...

- Protection is not equal for all areas on the leeward side of a windbreak.
- As the wind changes direction and is no longer blowing directly against the windbreak, the protected area decreases.
- The use of multiple-leg windbreaks provides a larger protected area than a single windbreak.



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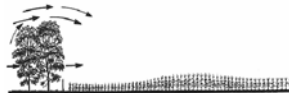
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### The effect of height...

- Windbreak height (H) is the most important factor determining the downwind area protected by a windbreak.



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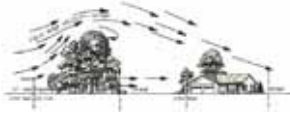
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## Its not all just one way...

- On the windward side of a windbreak, wind speed reductions are measurable upwind for a distance of 2 to 5 times the height of the windbreak
- On the leeward side (the side away from the wind), wind speed reductions occur up to 30 times the height downwind of the barrier.



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## Orientation

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



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## Placement

- Location of a windbreak is determined by its purpose and the agricultural system it is serving.



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How much protection do you really need?



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Questions...



"Notice all the corporations, theoretical scribbles, and lab equipment. None... 'Yes, certainly killed these cars!"

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The material in this presentation was collected from numerous sources, including

- Windbreaks for Conservation
  - USDA Agriculture Information Bulletin 339
- How Windbreaks Work
  - University of Nebraska Extension EC 91-1763B
- Windbreak Design
  - University of Nebraska Extension G96-1304-A



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