Windbreaks and Living Fences in Agroforestry

Rich Straight
USDA National Agroforestry Center

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Definition

- A barrier placed on the land surface that obstructs the wind flow and alters flow patterns both up-wind (windward) and down-wind (leeward) of the barrier.

- Plantings of single or multiple rows of vegetation (trees, shrubs, grass) that are established for one or more environmental and economic purposes.
The change in wind flow affects the exchange rates between the surface of an object and the air above that object.

The vertical motion of air parcels is brought about by turbulent transfer.

As these parcels move up they carry with them the various “properties”.
Almost any measurable property of interest in the atmosphere is moved from levels of high concentration to levels of low concentration.

Properties such as:
- Water vapor
- Pollen
- Heat
- Carbon dioxide
- Ozone
- Dust
How do Windbreaks Provide These Benefits?

- Lower wind velocity causes particulate matter to be deposited
- Windbreak vegetation physically traps particulate matter
- Windbreak vegetation may absorb some of the chemicals attached to particulate matter
- Even changes in atmospheric pressure
Windbreak Purposes
Windbreak Purposes

Field Borders
Windbreak Purposes

Visual Barriers
Windbreak Purposes

Snow Control
Windbreak Purposes

Soil Erosion
Windbreak Purposes

Dust Control
Windbreak Purposes

Odor Control
Windbreak Purposes

Livestock
Windbreak Purposes

Noise Buffer
Windbreak Purposes

Pollinators
Windbreak Purposes

Soil Health
Windbreak Purposes

Organic Buffer
Windbreak Purposes

Wildlife Habitat
Windbreak Purposes

Energy Saving
Industrial Wind Barriers
Windbreak Purposes

- Field Border
- Visual Barrier
- Snow Control
- Soil Erosion
- Dust Control
- Odor Control
- Livestock
- Pollinators
- Noise
- Wildlife Habitat
- Energy Savings
- Soil Health
- Organic Buffer
- Structure Protection
Conservation Practice
Windbreak Establishment -380

- Standards define the practice and where it applies
- Specifications are detailed requirements for installing the practice
- FOTG does not address production and harvesting
One Size Does Not Fit All

- One design cannot serve all these purposes
- Producers may have more than one purpose for their windbreak
- The soil will significantly influence choice of trees and shrubs
- The local conditions may limit options
Design Elements

Windbreak function depends upon six key windbreak elements:

- Height
- Density
- Orientation
- Length
- Width
- Continuity

Criteria for elements vary by purpose
What is $H$?
At What Age?

$H = \text{Height of the Windbreak}$
Windbreak Height

The leeward distance of wind protection is directly proportional to the height of the windbreak.

Note: 4H is about the mid-point of maximum wind reduction
Windbreak density is the percentage of the solid portion of the barrier to the total area of the barrier.
Illustrations of Windbreak Density by Species and Number of Rows

- 80% Porosity
- 65% Porosity
- 25% Porosity
- 45% Porosity
Air Flow Differences

2-D fence (top view) VS 3-D barrier (top view)
Air Flow Through Buffers
Windbreak Orientation

- Orient windbreaks perpendicular to troublesome winds
- Plan multiple windbreaks for whole field protection
Working With Variable Wind Direction
Windbreak Continuity

Gaps in the windbreak can result in damage downwind
Can Windbreaks Do More?
In a world filled with Smart Phones, why do we design single purpose conservation practices?
Use Crop Producing Trees & Shrubs

Like What?

- Food
- Decorative
- Herbal / Medicinal
- Craft Materials / Specialty Wood Products
- Biomass
RESOURCES

- NRCS Windbreak Standard and supporting documents

- Wind Erosion Prediction System

- UNL Windbreak Research Bibliography
  http://trees.unl.edu/research/windbreakbiblio.asp

- Wind Rose Data
  https://www.wcc.nrcs.usda.gov/climate/windrose.html

- National Agroforestry Center
One is good

But more is better
Windbreak/Shelterbelt Establishment or Renovation

Windbreak/Shelterbelt Establishment (380),
Windbreak/Shelterbelt Renovation (650)

Initial setting: (1) Cropland, forage land; animal feeding operations; or urban area where wind erosion, snow drift, plant, animal, and human stress related to wind or temperature; energy consumption; or odor are concerns; (2) existing decadent windbreaks/shelterbelts that have reduced functionality for intended purposes

1. Wood fiber in established plants
2. Woody plant root systems, litter and soil organic matter
3. Canopy cover and vertical vegetative structure from established plants

LEGEND

Associated practice or activity

# Created by practice

Start