Figure 7.1  Dryland windbreaks can be established in the 9-to 12-inch precipitation zones utilizing the "fabric mulch" technology. The fabric mulch is generally a woven polypropylene material which covers a strip of ground around the row of trees.
Tree Windbreaks

Tree windbreaks are probably less popular with dryland than with irrigated growers on the Columbia Plateau largely because of economic feasibility. The practice is included as a BMP option, however, because of its proven effectiveness elsewhere under relatively low rainfall conditions, and the fact that new technologies for weed control and moisture conservation provides an option for some farmers to utilize windbreaks as part of their overall wind erosion control program. Windbreaks control wind erosion by reducing wind speeds to below threshold levels on their leeward side. The zone of wind erosion reduction may extend to an outward distance of 40 to 50 times the height of the tree barrier. Thus, for 50-foot-high trees the distance would be 2000 to 2500 feet which may be sufficient to protect certain critical areas. However, to achieve complete control of wind erosion, the distances between rows of trees would have to be considerably less because the percentage reductions in wind speed gradually decrease downwind. For example, the speed of wind approaching a tree windbreak at right angles is reduced to 60 to 80 percent of the unobstructed speed near, and to a distance of 10 times the height of the tree barrier on the lee side, and to about 20 percent at a distance of 20 times the height. The reduction diminishes to near zero after a distance of about 40 to 50 times the windbreak height. On a percentage basis, these reductions remain nearly constant irrespective of unobstructed wind speeds. For most planning purposes, the distance of 10 times the barrier height has been adopted as the protected area on the leeward side of the barrier.

It should be noted that a windbreak will not provide the same degree of wind erosion control at all wind speeds. For example, the minimum speed to start soil movement on an erodible soil is 13 to 15 miles per hour. A 50-percent reduction in a 20-mile per hour wind would reduce it to 10 miles per hour which provides full control. However, a 50-percent reduction of a 50-mile per hour wind would reduce the speed to 25 miles per hour which is insufficient to stop the blowing. Thus, the fully protected zone of a tree barrier decreases as the wind speed increases. Single row plantings are most popular in field windbreaks because they occupy the least amount of land area for the amount of protection derived. Denser stands (2 to 5 rows) are more desirable for protection of farmsteads and wildlife. Tree species can have a major effect on the barrier’s effectiveness against wind erosion. The species effect may also vary with the season.

Generally tree windbreaks require a combination of other conservation practices if they are to be successful. For details on criteria on windbreak establishment and maintenance growers should consult with their local NRCS.
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field office, and/or refer to Soil Conservation Service Conservation Practice Standard Windbreak/Shelterbelt Establishment 380, and Field Windbreak 392, for windbreaks consisting of trees and shrubs.

**Dryland Windbreaks using Fabric Mulch Technology**

The NRCS, in cooperation with the Adams Conservation District in Washington state, has demonstrated that tree windbreaks can be established in the 9- to 12-inch precipitation zone without supplemental water, by using the summer fallow-mulch method. Although the emphasis here is on the dryland areas where establishment conditions are most difficult, the technology can also be used successfully with drip irrigation. The technique utilizes a continuous “fabric mulch” when establishing trees or shrubs (Figure 7.1). The fabric mulch is generally a woven polypropylene material which covers a strip of ground around the row of trees. The plastic-like cover suppresses weeds and increases effective moisture by up to 50 percent over the summer making the establishment of trees possible through efficient use of water derived solely from precipitation. The cover also saves considerable water when used in conjunction with drip irrigation.

Soil on the windbreak strip is prepared by chiseling or subsoiling if necessary to break up a tillage pan, and then tilling the surface until smooth. Residue amounts greater than 500 lb./acre may interfere with the fabric laying machine. Small trees (shorter than 12 inches) are planted first and the mulch is laid over the trees using a specialized machine which mechanically tucks the edges of the mulch into the soil. The tree location is marked with paint on the mulch as it is laid and then pulled by hand to the surface almost immediately through a cut slit. The mulch can be installed by hand but would be labor intensive.

Maintenance of the fabric mulch windbreak is minimal and mainly requires hand pulling any weeds growing adjacent to the trees about once a month during early establishment. A broad spectrum herbicide can be used to control weeds along the outside edge of the mulch. Care must be exercised to avoid spray drift. Rodent control using baits or tree protection devices may also be needed during early establishment.

Care should be taken to avoid any traffic on the fabric as this will lead to damage or pre-mature wear. If drip irrigation is used, the drip line should be placed on top of the fabric. For details on application of this practice see NRCS Fact Sheet on “Windbreaks: Dryland Windbreaks using Fabric Mulch Technology.”

The adaptability of tree windbreaks on farms for wind erosion protection, especially under dryland conditions, can vary considerably. First, they can be difficult to establish because of inability to survive in the first year or two after planting as a result of lack of water or destruction by animals and/or insects. Once established trees will compete with adjacent crops for moisture and nutrients, and in some situations even light. Windbreaks require some maintenance (e.g., protection from weeds, fertility) to ensure tree survival and health. They cost space and can sometimes harbor crop pests. Nevertheless, in spite of these potential disadvantages there are situations where windbreaks can serve as a wind erosion control strategy and the practice should be open to consideration on an individual farm basis.

**Figure 7.3** Soil binding agents can be sprayed onto highly erodible soil to form a nonerodible crust or aggregates as an emergency measure for controlling wind erosion. Limitations to its widespread use are mainly related to the cost of materials.

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Preventive Action and Emergency Measures for Controlling Wind Erosion

Preventing wind erosion from starting is usually much easier than stopping it after it begins. However, situations may arise when cropland is highly susceptible to wind erosion and unprotected areas need immediate temporary treatment until more permanent control measures can be applied. This may occur when crop residues are accidentally burned, top growth is removed for forage, or
Mulching

Once wind erosion has started it can be reduced by mulching with straw, hay, manure, municipal waste water sludges, and coarse bark dust, provided they are at adequate rates and the materials are anchored. Mulching with straw can be very effective but because of the high cost it is critical to cover a blowing area as early as possible before it gets too large. Straw mulches can be a source of weeds so as much care needs to be taken in obtaining the material as a grower would in obtaining seed. It may be best to purchase straw in the field from a grower that needs to reduce the residue level in a clean field, such as an irrigated certified seed field.

A wise approach used by some growers is to maintain a stock of baled straw for mulching. This allows them to go out and cover a “smoker” or a threatening area as soon as it appears without rushing to buy potentially contaminated straw. Straw will keep for many years. Older material is usually easier to spread and weed seed populations decrease with age. Grass straw is more difficult to spread, but stays in place very well without anchoring. Occasionally it is possible to obtain old alfalfa hay, or other suitable mulch material at a very good price. The key is to plan ahead, and not wait until the problem occurs in the field. If the straw is not used it probably can be sold to a neighbor who failed to prepare for emergency control.

To be effective, at least 0.5 to 3 tons/acre of straw or hay, or 3 to 4 tons/acre of corn residue are needed on the most vulnerable areas. The residue may be spread by hand or with a mechanical spreader (Figure 7.2). The loose residue can be anchored with a disc operated at cross wind and set straight. This will leave the straw or stover partially buried and protruding several inches from the surface. Wet manure should be applied at 15 to 20 tons per acre. Rows of unbroken straw bales placed at right angles to the wind direction can be used for emergency treatment of blowouts. The rows of bales should be no more than 15 feet apart in the direction of the wind It is important to start the rows well upwind of the blowout. Because of labor and materials costs, mulching is practical only for small critical areas. Moreover, the practice is most effective when applied before erosion starts.

Emergency Tillage/Seeding

The purpose of emergency tillage is to increase surface roughness which includes forming surface clods that are resistant to wind erosion. It can be performed with a chisel plow at right angles to erosive winds which brings stable clods up to the surface. Research in Kansas with medium and fine-textured soils shows that close spacing of tools (e.g. less than 2 feet) with any implement will create a rugged surface than wider spacing. Lower travel speeds of 2 to 3 miles per hour generally produce the largest and most resistant clods. However, speeds of 5 to 7 miles per hour produce the greatest roughness.

Emergency tillage generally works well with medium- and fine-textured soils but the Kansas research also shows that loose sandy soils, like those typical of the irrigated sandy soils when dry tends to reduce the aggregate structure to single grain particles and should be avoided.

If there is sufficient moisture, roughening the surface with tillage will reduce the erosion temporarily, from relatively light winds, as compared with no tillage. Unfortunately, most of the highly erodible soils in the Columbia Plateau are too fragile and sandy for tillage to be effective for very long, or to hold through a very severe wind event. One approach that some growers have used successfully is to roughen a blow area with narrow spaced disc drills and seed wheat at a high rate. The aim is to minimize working the soil and burying the residue while still making small soil ridges which will temporarily stop the soil from blowing and provide protection to the germinating seedlings. Narrow spacing increases the effectiveness of small ridges and minimizes the time required for the green cover to establish and protect the soil. Seeding the area twice, perpendicular to each other, is even more effective for wind erosion control because the green cover establishes much quicker and protects the soil against all wind directions.

Another approach for surface roughening is to use deep furrow hoe drills. The aim here is to create substantial clods and ridges which can...
resist the wind for longer periods. While this may work in heavier soils, it takes much longer to establish an effective green cover and may be a disadvantage for fragile soils. Another problem with this approach is that if repeated seeding is necessary, the extra cultivation resulting from this type of drill will tend to pulverize the soil and create a more erodible condition.

Emergency tillage of any kind should be used with caution on sandy soils and could even be detrimental if too much residue is buried in the process of tillage. Moreover, soils should be roughened before blowing starts since the soils could rapidly become more erodible from abrasion during the process of tilling. If this should happen it may require even more drastic measures to prevent further erosion. Before attempting emergency remedial tillage, growers who anticipate problems should consult with their local NRCS field office on the advisability of using such tillage on their fields.

Soil Binding Agents

The use of soil binding agents (also called crustants and dust control palliatives) for controlling wind erosion on agricultural land has been somewhat limited on the Columbia Plateau (Figure 7.3). Commercial applicators have used these materials successfully for dust control on roads and construction sites for several years. Even so, the cost of these materials has limited their widespread use for controlling wind erosion. In rare cases a grower may retain a small supply of a binding agent (e.g., a molasses-based crustant) for emergency or remedial wind erosion control measures. The Franklin Conservation District and NRCS have tested three types of soil binding agents including molasses-based, vegetable-based (hydrated endosperm), and bentonite clay-based materials.

Results. Three binding agents were tested at Lind, Washington in September 1996 by applying the materials to the tops of furrows while seeding winter wheat. Wind tunnel evaluations showed that there was a 50-percent reduction in erosion when about half the soil surface had been treated. If the sides of the furrows had been sprayed there likely would have been a higher degree of control. The bentonite clay-based material gave better control than the vegetable-based agents. Tests in irrigated fields in Franklin County in the fall after potato harvest showed that the use of binding agents reduced wind erosion by about 15 percent compared with an untreated check. Treatments in the spring at planting reduced erosion by 15 to 40 percent.

Product costs when the tests were conducted ranged from $30 to $35/acre for the molasses products; $30 to $100/acre for the vegetable products; and $20 to $25/acre for the bentonite clay product.

Benefits. If used on a limited basis soil binding agents may be cost-effective for emergency wind erosion control measures on soils that have little or no aggregate structure. This includes blow spots that appear in fields with low residues during dry cycles, and along field edges and old fence rows that are highly susceptible to blowing. These areas can be treated quickly and conveniently in the fall or spring with a spray application of a soil binding agent.

Disadvantages. Application of soil binding agents can cause crusting of the soil surface and poor emergence and/or injury to some crops. Tests have shown that emergence problems can be avoided by applying the binding agents to bare ground after harvest or on the tops or sides of furrows at planting. Some agents may contain chemicals that could adversely affect soil quality at high rates of application. For example, bentonite clay from Wyoming contains exchangeable sodium that may eventually degrade soil structure and create a sodic surface condition. An additional problem is that some binding agents require mechanical agitation to keep them in suspension. Consequently, large spray nozzles are needed to apply large volumes of mixed materials to achieve good control. The cost of these products also limits their use for treating field-sized areas at rates that provide effective wind erosion control.

Irrigation for Temporary Erosion Control

Sprinkler irrigation can effectively reduce wind erosion and is an option in irrigated fields, to reduce blowing of soil particles. However, sprinkling is only an emergency measure for localized areas since most sprinkler systems do not have the capacity to keep the entire surface of a field wet. Moreover, in most situations it is impractical and wasteful of water to irrigate often enough to prevent soil from blowing. Excessive watering can also leach fertilizer and may negate effectiveness of pest control chemicals applied at planting or pre-plant. Surface drying of wet, coarse-textured soils occurs very rapidly, and if the wind speeds are sufficiently high, erosion of bare soil can begin rather soon after water application. Thus, it is virtually impossible to prevent soil blowing even with the irrigation system in continuous operation. The main value of irrigation for erosion control is that it hastens the growth of vegetation, or that it allows a cloddy surface to be developed with tillage.

Sources of Information and Suggested Reading


Soil Conservation Service Conservation Practice Standard.
   a) Windbreak/shelterbelt establishment 380.
   b) Mulching. Washington State supplement to Practice Standard 484.
   c) Surface roughening. Washington State supplement to Practice Standard 609.