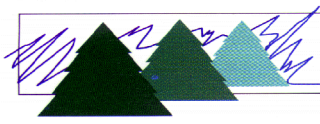


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In areas of high winds and blowing snow, windbreaks can reduce the amount of effort spent on snow management. They can be designed to spread snow across a large area or to confine it to a relatively small storage area. The design of your windbreak will depend on your objective. Field windbreaks designed to distribute snow evenly across a field should be tall and porous. In contrast, windbreaks designed to capture snow and control drifting should have multiple rows with high density. There is no one set design, number of rows, or width of planting that is ideal for every circumstance. The design of your tree planting should be done with your needs and winter conditions in mind. In some cases, landowners may choose to relocate fences, driveways, or feedlots in order to take full advantage of their windbreak. Remember, a tree planting is a long-term investment and it pays to consider all alternative designs before installation.



A windbreak across a large field distributes snow throughout the field, providing winter protection and moisture for crop production.



Benefits of Snow Management

In areas of high winds and blowing snow, windbreaks serve the dual purposes of modifying climatic factors and providing methods for managing snow. In open areas, wind lifts, carries, and deposits snowflakes just as it does soil particles. By modifying wind flow, blowing snow can be distributed over a field or deposited within a given area.

Effective snow management can yield a variety of results. A low density field windbreak will spread snow across the protected area, provide additional moisture for crop fields and rangelands, and increase productivity and economic return. Field and rangeland windbreaks reduce spring runoff partly through the physical retarding action of snowdrifts on water flow and partly through the presence of unfrozen soil under the snow cover.

A dense multiple row windbreak or living snow fence will pile snow in a restricted area, reducing the need to plow highways and driveways. Dense windbreaks on rangelands provide protection for spring calving and lambing areas and reduce mortality of new born livestock. Living snow fences located to the windward side of stock ponds deposit snow in the pond area and can provide significant amounts of water for summer use by livestock. Controlling blowing snow with windbreaks can prevent large drifts in the living and working areas of farmsteads and feedlots and reduce the labor and energy needed for snow removal.

Snow Control on Fields and Pastures

In areas where snow provides a critical source of soil moisture for crop and forage production during the next growing season, windbreaks help capture the moisture available in snow by keeping it on the fields. In northern prairie areas, croplands protected by field windbreaks trap blowing snow on the fields resulting in improved crop yields. On average, yields of winter wheat are increased by 15 to 20 percent. These increases are a result of increased moisture due to snow capture and to the protection of the wheat crop from winter desiccation.

Design and Location

Field windbreaks designed exclusively for the uniform distribution of snow across the field should have a density of no more than 40 percent. Planting a single row of a tall, deciduous tree species on a wide spacing (15 to 20 feet between trees) in a location perpendicular to the prevailing winter wind will provide good snow distribution across a field to a distance of 10 to 15 times the height of the trees. Snow blowing over the tops of the trees falls out of the air-stream on the relatively still, leeward side of the windbreak. Wind passing through a porous windbreak will distribute the snow evenly across the field. The uniformly distributed snow cover provides the opportunity for maximum water infiltration into the soil.

Field windbreaks that are too dense will cause the snow to collect in narrow, deep drifts near the tree row. In more northern areas these deep drifts may cause excessive moisture in the area adjacent to the windbreak, prevent uniform and early surface drying of the land, and delay field operations. In more southerly areas, the spring thaw usually occurs early enough so that field operations can be carried out in a timely manner.

In those cases where an established windbreak is too dense for effective snow distribution (60 percent density or more), removing selected trees or pruning the lower tree branches up to a height of four feet will allow more wind to pass through the windbreak and will result in a more even distribution of snow across the field. Unfor-

unately, pruning of deciduous trees may cause an increase in sprouting from the base of the tree, increasing windbreak density. Pruning also allows more light to reach the area around the base of the trees causing an increase in understory vegetation, and again leads to deeper snow drifts on the leeward side of the windbreak. Once pruning has been started it must be continued for the life of the planting. Remember, you are working with living plant material which may respond differently to your site conditions or actions and it is best to seek advice from your local forester before you thin or prune your windbreak.



Areas or fields vulnerable to wind erosion during the winter offer additional challenges since field windbreaks with a density below 40 percent provide little protection for the soil resource. If the field is covered with snow the soil resource is protected, however, many areas where snow is an important source of water do not have continuous winter snow cover and therefore additional protective measures must be used. If the windbreak density is increased to provide erosion control then snow distribution is reduced, resulting in larger drifts. One solution to the problem is to use a combination of conservation practices. For example, by using a system of porous field windbreaks and conservation tillage a landowner will get both good snow distribution and good erosion control. The important aspect to remember is that any conservation practice must be designed for your conditions and farm operation.

Living snow fences located along the north side of a highway will reduce time and energy costs associated with snow removal and improve winter driving conditions.

Living Snow Fences

In those situations 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. Living snow fences planted along highways, county or private roads, driveways, irrigation ditches, and fence lines provide economic advantages over slat-fence barriers and provide additional benefits to the landowner. Living snow fences have greater snow storage capacity, require less maintenance once they are established, have a longer life span, and provide multiple benefits such as livestock protection, crop protection, soil erosion control, wildlife habitat, and aesthetic value.

Design and Location

In major storms, short (3-4 feet), vertical slat fences reach their snow-storing capacity quickly. Wind-driven snow then sweeps across the saturated barrier causing drifting in the roadway and reducing visibility. In open, windy areas blowing snow often continues long after the actual snowfall has stopped. If the snow fence is already full, snow drifts may continue to develop and repeated drift removal may be necessary. Taller (12 feet) wooden barriers with horizontal boards are very efficient and store considerably more snow, but at a much higher cost. In contrast a three-row living snow fence (20 feet tall) will store the same amount of snow but at a fraction of the cost.

A living snow fence achieves optimum snow storage capacity when winter density of the individual rows is about 50 to 60 percent. As density increases, drifts become deeper and shorter. Windbreaks with very close

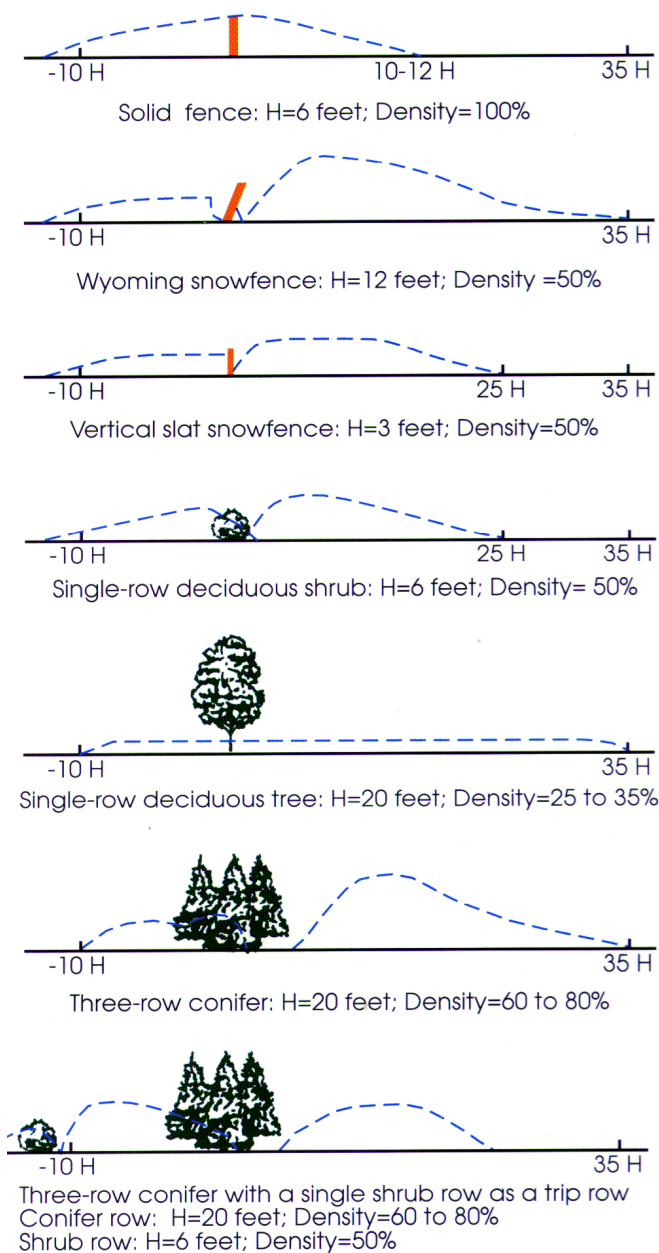


Figure: The height and density of the snowfence or windbreak will determine how much snow can be stored in the system

In some areas snowdrifts may accumulate on the steep, leeward slopes of readouts and cause serious soil erosion when the snow melts. This problem may be reduced by planting the living snow fence parallel to the ridge line about 100 feet to the windward side of the crest. The windbreak will then collect snow on the more gentle slope on the windward side of the hill, and reduce the impact of runoff caused by melting snow.

Snow Control for Farmsteads and Feedlots

The main objectives of farmstead or feedlot windbreaks are to reduce the force of the winter wind on the activities within the sheltered zone and to enhance the microclimate on the leeward side of the windbreak. An additional benefit of these windbreaks can be the management of blowing and drifting snow.

spacings, both within the row and between the rows (densities greater than 60 percent) may be damaged by deep, heavy snow drifts. Remember that density will vary with the number and spacing of the tree rows, the species chosen (evergreen vs. deciduous) and the distance between trees within the row. The height of the trees is also important since snow storage capacity increases more than four times when the height doubles. For example, a three-row, mature, living snow fence with a height of 20 feet will store over 16 times more snow than a single-row slat-fence (height = 3 to 4 feet).

Species will vary depending on climate, soil, and available space and should be chosen based on local growing conditions and the objectives of the landowner. By careful design and selection the windbreak can serve additional functions, such as erosion control, wildlife habitat, and livestock protection.

A living snow fence should be located perpendicular to prevailing winter winds and be placed so that the highway or area to be protected is located on the leeward side of the windbreak. In most areas, winter winds come from the northwest, north, or northeast and living snow fences should be located on the north side of east-west roads, or on the west side of north-south roads. Allow plenty of room for the leeward drift by locating the windward row of your windbreak 200 to 300 feet from the center of the road. Trees should be planted no closer than 200 feet from corners or intersections in order to allow for traffic visibility. Local ordinances may restrict the location of windbreaks for snow control, so be sure to check with the local authorities on regulations in your area.



In areas where trees and shrubs are difficult to grow, tall grass barriers can be used for distributing snow and controlling erosion.

With no windbreak protection, farm houses and other buildings act as solid barriers to the wind, resulting in swirling wind currents around corners or structures. Driveways and work areas may be subject to snow drifting, become inaccessible, and require additional hours of labor to remove the snow. A properly designed windbreak can catch and store most of the snow, reducing the need for snow removal.

One purpose of feedlot and livestock windbreaks is to maintain an area relatively free from deep snow where hay and other feed are stored. These windbreaks provide a haven where livestock can get out of strong winds and driving snow. This reduces animal stress and decreases feeding requirements, resulting in better animal health, lower death losses, and lower feed costs.

Design and Location

Farmstead or feedlot windbreaks should be located so that the windward row of trees is at least 150 feet (300 feet in northern areas with large amounts of snow) from buildings, driveways, and feedbunks in order to provide adequate room for the leeward snow drift. This distance should allow between 75 and 100 feet from the leeward side of the windbreak and the areas needing protection. On the windward side of the windbreak, there should be at least 50 feet between the windbreak and roads or other features that might be within the zone of the windward drift. The ends of the windbreak should extend at least 100 feet beyond the farmstead or feedlot to prevent the drift which forms at the end of a windbreak from interfering with farm operations.

For any windbreak designed to capture snow in high use areas, allowances must be made for controlling the runoff from melting snow. Proper drainage is critical since excess water from melting snow will result in muddy conditions which are inconvenient to the landowner and cause serious problems for livestock in feedlot operations. In the case of feedlot windbreaks, runoff from the feedlot also must be controlled and not allowed to damage the windbreak.

One method of controlling snow when space is limited is to establish a single or double row of dense shrubs located parallel to the main windbreak and 50 to 100 feet to the windward side. This will provide a trap row for blowing snow, reduce the size of the snow drift in the main windbreak, and reduce potential damage to the main windbreak caused by heavy snow loads. The area between the shrub row and the main windbreak can be cropped and may be an ideal site for wind sensitive crops such as vegetables. Again, be sure to provide for the runoff from melting snow.

Typical windbreaks for snow control around farms, ranches, or feedlots consist of four to six rows (a row of shrubs, two or three rows of conifers and one or two rows of tall deciduous trees). In northerly areas additional rows may need to be incorporated in order to provide adequate protection from cold winds and heavy snow. The specific designs for these types of windbreaks must be developed for individual locations and circumstances. For more information on these two types of windbreaks ask your district forester, extension specialists or conservationist for copies of the farmstead and livestock publications in this windbreak series.

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