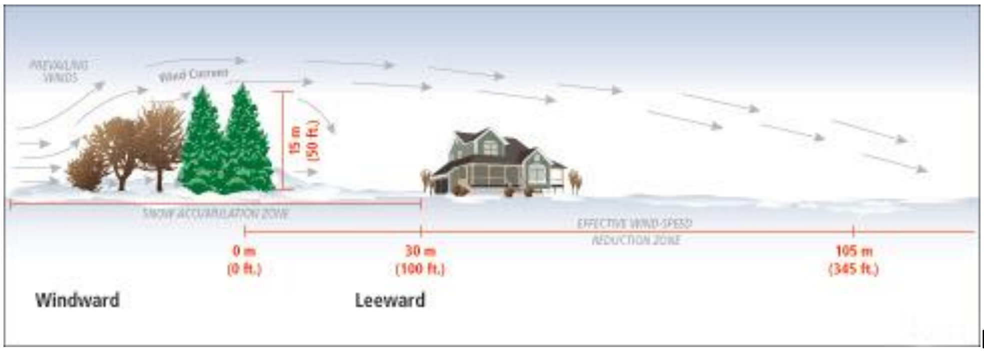
Shelterbelts Characteristics

Effect of Height

Shelterbelt height is the determining factor for the area of the protected downwind zone. This is controlled by the tallest tree or shrub row in the shelterbelt. This varies from shelterbelt to shelterbelt, and increases as the shelterbelt matures.

On the windward side of a shelterbelt, wind speed reductions are measurable upwind for a distance of two to five times the height of the shelterbelt. On the leeward side, wind speed reductions occur up to a distance of 20 times the height of the shelterbelt.



Description - Figure 1

Effect of Density

A dense shelterbelt will have less wind passing through it. Air pressure is reduced on the leeward side of dense shelterbelts. This low pressure area pulls air coming over the shelterbelt downward, creating turbulence. The zone of protection is somewhat smaller behind dense shelterbelts.

For less dense shelterbelts, more air passes through the shelterbelt, resulting in reduced turbulence, and greater length of the downwind protected area. While this protected area is larger, the wind speed reductions are not as great. By adjusting shelterbelt density, different flow patterns and areas of protection are established.

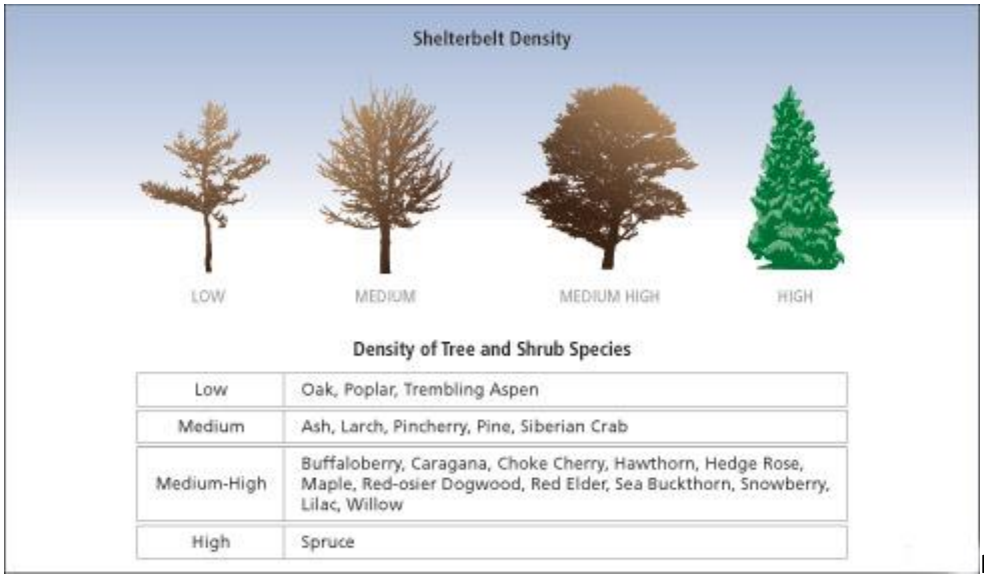
The number of rows, the distance between trees, and species composition are factors controlling shelterbelt density. Increasing the number of shelterbelt rows or decreasing the distance between the trees increases density and provides a more solid barrier to the wind. The species chosen for the shelterbelt will determine height as well as density, and will influence the length of the sheltered area.

Shelterbelts can be located around farmyards, adjacent to roadsides, on the boundaries, within fields or around livestock facilities.

Shelterbelt density plays an important role. If the shelterbelt has a low density, wind can pass through open areas causing less downward turbulence on the leeward side and increasing the length of the protected area. Even though this protected area is larger, the wind speed reductions are not as great.

A shelterbelt design with low density would be favourable for field shelterbelts where soil erosion and even distribution of snow is required. Whereas with high density, less wind passes through the shelterbelt and a low pressure area is created on the leeward side. This pulls air downward causing turbulence which reduces protection downwind and increases wind reductions closer to the shelterbelt.

In short, as density decreases, the amount of wind passing through the shelterbelt increases and the downwind protected area increases.



Description - Figure 2

Density of Tree and Shrub Species

Density of Tree and Shrub Species

Low	Oak, Poplar, Trembling Aspen
Medium	Ash, Larch, Pincherry, Pine, Siberian Crab
Medium-High	Buffaloberry, Caragana, Choke Cherry, Hawthorn, Hedge Rose Maple, Red-osier Dogwood, Red Elder, Sea Buckthorn, Snowberry, Lilac, Willow
High	Spruce

Effect of Orientation

Shelterbelts are most effective when orientated at right angles to prevailing winds. The orientation of shelterbelts depends on the design objectives. Farmyards and feedlots usually need protection from cold winds and blowing snow or dust. Field crops usually need protection from hot, dry summer winds, abrasive wind-blown soil particles, or both.

Orienting shelterbelts perpendicular to the prevailing wind direction provides the most protection. As the wind changes direction and no longer blows directly against the shelterbelt, the protected area decreases. Although the wind may blow predominantly from one direction, it rarely blows exclusively from that direction.

For this reason, shelterbelts for feedlots or farmyards should protect from more than one direction.

Effect of Length

Shelterbelt height determines the extent of the protected area downwind. Shelterbelt length determines the amount protected area. For maximum efficiency, the uninterrupted length of a shelterbelt should exceed the height by a minimum factor of 10 to one. This ratio reduces the influence of end-turbulence on the total protected area.

Continuity of a shelterbelt is important because gaps can become funnels that concentrate wind flow so that wind speed is accelerated. Since gaps reduce the effectiveness of the shelterbelt, lanes or field access through shelterbelts should be located to avoid this effect.

Microclimate Modifications

Reduced wind velocity behind a shelterbelt changes the microclimate within the protected zone. Temperature and humidity levels usually increase. The result is decreased soil moisture evaporation and plant water loss. Actual temperature modifications depend on shelterbelt height, density, orientation, length and time of day. At a distance within 10 times the height of the shelterbelt, the leeward side daily air temperature is generally several degrees higher than the temperature in the open.

At a distance beyond 10 times the shelterbelt height, air temperature near the ground tends to be cooler during the day.

At night, temperature near the ground in sheltered areas is slightly higher than in the open. However, on calm nights sheltered areas may be several degrees cooler than in the open.

Summer soil temperatures in sheltered areas are usually higher than in unsheltered areas. Warmer temperatures may allow earlier crop planting and accelerate germination in areas with short growing seasons. In the area next to an east-west shelterbelt, soil temperature is higher on the south side due to heat reflected by the shelterbelt. On the north side of an east-west shelterbelt, soil temperatures close to the shelterbelt may be lower, especially in the early spring, due to shading. These cooler temperatures may reduce the rate of snow melt, and cause problems with access to fields in the early spring.

Relative humidity in sheltered areas is often higher than in open areas, depending on shelterbelt density. Higher humidity decreases the rate of plant water use, so crops more efficiently use water than in unsheltered areas.

However, enhanced humidity levels may, in some cases, increase diseases such as mildew.

Heat loss due to wind chill is reduced on the leeward side of a shelterbelt. Moderation of the wind chill factor is most significant with farmyard and livestock shelterbelts where people, animals, and buildings benefit from increased energy efficiency. A good shelterbelt can reduce the use of home-heating fuel by as much as 25 per cent.

Most shelterbelt benefits are indirect because of changes in the microclimate of the sheltered zone. One exception is the direct benefit of reducing wind speed to control soil erosion. A shelterbelt can reduce soil erosion on the leeward side to near zero within 10 times the height of the leeward side of the tree row.

Shelterbelts reduce wind speed on both the leeward and windward sides. The resulting reductions in wind speed lead to moderation of the microclimate in these protected zones. With careful planning, microclimate modifications can create desirable environments for growing crops, raising livestock, and protecting living and working areas.