# Shelterbelts for control of wind erosion

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## INTRODUCTION

Shelterbelts offer many benefits to land managers, including a reduction in soil erosion caused by wind.

Australian soils are old, weathered and often depleted of valuable nutrients. Soil erosion can further reduce the productivity of land by removing valuable topsoil and nutrients.

The productivity of land for agriculture is dependent on the characteristics of soil. Most soils within Australia have low levels of nutrients and topsoils are very thin.

Topsoils take a very long time to form. Over a one-hundred-year period only a couple of millimetres of soil may be formed. This soil can then be quickly eroded by even modest winds.

Victoria regularly experienced dust storms during the 1950s due to wind erosion. In February 1983, following the 1982 drought, a large cloud of dust estimated to carry 250,000 tonnes of dust passed over Melbourne. Another large wind erosion event occurred in autumn 2003. These events demonstrate the vulnerability of our soils to wind erosion.

Shelterbelts can decrease windspeed within the sheltered zone to a level below the threshold for soil movement.

## IMPACTS OF WIND EROSION

The erodibility of soils depends on surface texture, tilth, wetness and vegetative cover (Cremer, 1990). Wind erosion can begin at relatively low wind speeds. At 30 km/hour sand grains can be dislodged and suspended in air movement.

Wind can move soil particles and nutrients resulting in nutrient depleted soils and productivity losses. An example includes a site where crop yields in the year following a major erosion event were estimated to be reduced by 25%.

Nutrients lost due to soil erosion need to be purchased and replaced or productivity will be reduced. It is difficult to replace organic matter lost due to wind erosion.

Wind erosion can have a direct impact on crops in several ways. Soil particles carried by wind can physically damage crop plants. Crops can also be damaged by roots being exposed due to soil loss, being buried by moving soils and plants being blown out of the ground.

## SOIL CHARACTERISTICS

Australia's weathered, nutrient deprived soils are susceptible to erosion largely due to broadscale clearing of vegetation. The removal of vegetation has resulted in large areas of land that are traversed by strong winds. This land has little to protect its soils from being dislodged and moved over very large distances.

Most soil nutrients are held in the organic matter of plants and in the top layer of soils. This top layer of soils often contains fine silt or clay particles that hold valuable nutrients.

These fine particles of soil and nutrients are the first to move during a wind event. The fine nature of these particles means that once they have been dislodged, they can be carried over large distances while suspended by wind.

Soils are most vulnerable if they have been heavily grazed or cultivated. Large-scale erosion of soils by wind often occurs during dry or drought conditions. It is during dry conditions that vegetative cover is low due to slow growth and overstocking.

Re-establishment of vegetation and in particular shelterbelts can protect soils from the impacts of erosion. Establishment of vegetation reduces the vulnerability of soils in a number of ways.

The leaves and vegetative matter within and dropped by vegetation intercept raindrops and prevent the pounding of soil and dislodgment of soil particles.

The litter dropped by vegetation increases the organic matter within soils increasing the ability of soils to absorb and hold water and to reduce run-off. The roots of plants bind and hold the soil.

## SHELTERBELTS REDUCE THE IMPACT OF WIND EROSION

Shelterbelts can reduce and in some cases prevent wind erosion by intercepting wind and consequently reducing wind speed as wind passes through or over the shelterbelt. Even narrow or open shelterbelts can reduce wind speed for a distance many times the height of the shelterbelt and therefore have a considerable impact on wind erosion.

Moderate wind speeds can begin the process of soil erosion. Once soils are suspended the quantity of soil carried increases in proportion to the wind velocity cubed. Therefore a modest reduction in wind speed can result in a significant reduction in soil erosion. Reducing wind speed by half can reduce the rate of erosion by up to eight times. Even wind approaching shelterbelts on angles that are almost parallel to the shelterbelt can decrease wind speed. Although the area over which shelter is provided will be reduced.

This means that even sparse shelterbelts can provide considerable reductions in soil erosion. An example is where windspeed at 0.5 metres above the ground, at a distance of 12 times the height (12H) of a shelterbelt was measured at a modest 60% of the open windspeed. The erosive force of the wind there was estimated to be reduced to 25% of that in open areas (Bird et al. 1992).

## SHELTERBELT DESIGN FOR REDUCING WIND EROSION

The location, density, height and length of a shelterbelt will determine its effectiveness in reducing wind erosion.

A grid of shelterbelts positioned at appropriate distances apart provides the maximum level of shelter for a property as shelter will be provided from all wind directions.

Shelterbelts provide the highest level of protection when they are located at right angles to erosive winds (figure 1). Good protection from wind erosion can be maintained for up to 30H of a shelterbelt if wind is approaching the shelterbelt at right angles. Therefore consideration should be given to the direction of winds protection is required from when planning a shelterbelt network.

Although maximum protection from erosive winds is achieved by placing shelterbelts at right angles to the wind direction, soil erosion can still be substantially reduced if wind is coming from other directions. However, the area protected by a shelterbelt will be reduced during events of higher wind speeds.

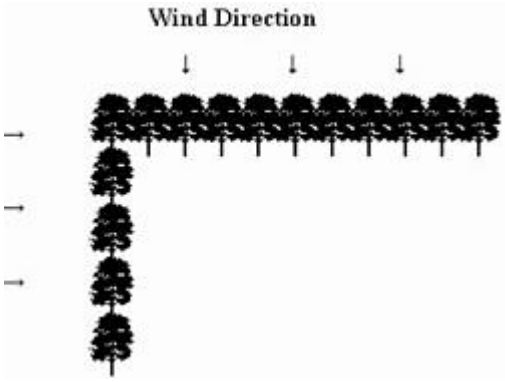


Figure 1. Joining shelterbelts can provide protection from a range of wind directions and reduce the impact of accelerated wind speed around the ends of shelterbelts.

Dense shelterbelts provide a high level of protection but over a reduced area when compared to less dense shelterbelts.

Moderately dense shelterbelts (~40% density) will provide a considerable reduction in wind speed to a distance of at least 20H. Dense shelterbelts generally provide good shelter to a distance of at least 15H.

To control wind erosion over a large area the height of a shelterbelt needs to be maximised. Therefore, it is wise to incorporate at least one row of tall species within the shelterbelt.

It is important to incorporate shrubs into a shelterbelt where an even density is required from the ground to the top of the shelterbelt. It is also advisable to fence out a shelterbelt to prevent livestock grazing on the lower limbs of vegetation and creating gaps. If gaps occur within a shelterbelt wind will tunnel through the gaps at an accelerated rate. This can result in blowouts near the gaps and also be detrimental to livestock and crops.

Wind speed accelerates around the ends of shelterbelts. This impact is reduced by increasing the length of the shelterbelts or joining them to other shelterbelts. Shelterbelts can be joined where they can form a right angle for protection from a range of wind directions (see Figure 1). Livestock should not be able to graze below or at the ends of a shelterbelt as these areas are susceptible to erosion. The more effective a shelterbelt is in reducing wind erosion the more eroded the sites at the end of the shelterbelt can be, unless the ground surface is protected.

## CONCLUSION

Wind erosion can cause large quantities of topsoil to be lost in a very short period of time. This topsoil is almost irreplaceable as it can take hundreds of years to restore soils that can be removed in a matter of hours during erosive wind events.

Shelterbelts can provide a relatively cheap and long-term option for reducing wind erosion on farms. The decrease in wind speed due to shelterbelts can result in a considerable reduction in the removal of fertile soil from agricultural land.

The design and location of shelterbelts should take into consideration other benefits that can be achieved through establishing shelter. Shelterbelts offer a range of benefits such as improved livestock productivity, protection for horticultural and cropping enterprises, reduced salinity impacts, wildlife habitat, fire protection and improved aesthetics.

Careful consideration needs to be given to the location, height, density and composition of a shelterbelt. These factors are best considered as part of a Whole Farm Planning process.

## FURTHER READING

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Shelterbelt design: https://agriculture.vic.gov.au/farm-management/soil/erosion/effective-shelterbelt-design

Shelterbelt Management: https://agriculture.vic.gov.au/farm-management/soil/erosion/shelterbelt-maintenance-and-management

Shelterbelts and Wildlife: https://agriculture.vic.gov.au/farm-management/soil/erosion/shelterbelts-to-protect-wildlife

## FURTHER INFORMATION

For more information contact your local Agriculture Services Extension Officer or call the customer service centre on 136 186.

## ACKNOWLEDGEMENTS

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