

Trees on farms

Trees for shelter

Grazing livestock are generally well-adapted to the New Zealand climate, but there are times in the production cycle when even well-fed animals are vulnerable to cold, wet and windy weather. Carefully designed shelter plantings have the potential to provide many benefits to farms. They:

- improve livestock welfare and productivity including young stock survival and growth
- increase pasture productivity
- improve irrigation efficiency from reduced evaporation
- reduce wind erosion of topsoil
- provide habitat for wildlife
- create a more diverse, pleasant working and living environment.

MPI Code of Welfare 2014: Minimum standard No. 6 – Shelter

(a) All classes of dairy cattle must be provided with the means to minimise the effects of adverse weather

(b) Newborn calves that have been removed from their mothers must be provided with shelter from conditions that are likely to adversely affect their welfare

(c) Sick animals and calves that are not suckling their mother must have access to shelter from adverse weather.

Recommended Best Practice:

Shelter (e.g. windbreaks or natural topography) should be provided to protect animals from adverse weather, especially cows when they are close to calving.

First check that your trees are not toxic to animals

Many trees available and for sale in New Zealand could be harmful to companion animals and livestock. Some of the tree species mentioned on the website below could, in some cases, cause issues in some animals. Before planting, make sure that you have selected the right trees. Check with your vet for advice or visit this site for a general list of toxic plants: taruavets.co.nz

Why do animals need shelter?

All animals want to be thermally comfortable – neither too hot, nor too cold. Grazing animals gain heat from external factors including solar radiation, and internally through their metabolism. They lose heat through convective and evaporative losses; also radiative losses, which are greatest on cold, clear nights.

Below certain critical temperatures, animals become thermally stressed, and will metabolise their body resources in an attempt to stay warm. Newborn calves are highly vulnerable while still wet and unsuckled because they have no internal resources; heavily pregnant animals and shorn sheep can also rapidly become stressed if temperatures fall below critical limits.

Even if not at critical temperatures, animals will alter their behaviour in cold wet weather. For example, cows may huddle together or lie down and refuse to graze; cows calving in large herds have been known to abandon newborn calves in adverse weather.

The rate of convective heat loss depends on air temperature and wind chill significantly reduces the feel of the air temperature. Shelter trees reduce wind speed and alleviate wind chill. In addition, trees can provide protection from rain and snow.

Improving the survival chances of newborn animals

Newborn calves can only survive for a very short time in normal New Zealand conditions unless they are dried and suckled by their mothers. The colder the air temperature when they are born, the faster they will succumb. By reducing wind chill, shelter buys more time for newborn livestock to be mothered up. Once dry and suckled, calves can survive comfortably at temperatures down to 0°C, and for short periods at temperatures below this.

Effect of wind speed on temperature

Wind speed			Actual thermometer reading 0C			
			10	5	0	-5
Km/hr	m/s	Beaufort scale and observed effects	Equivalent temperature with windchill 0C			
10	3	Force 2 Gentle breeze – leaves move	8	2	-3	-9
20	6	Force 4 Medium breeze – small branches move	3	-3	-9	-16
40	11	Force 6 Strong breeze – large branches move	-1	-8	-16	-23
60	17	Force 8 Gale – twigs break	-3	-11	-19	-26

Key point: dense shelter can reduce wind speed by up to 90%, resulting in a 13-16 degree difference in temperature felt

Planning shelter plantings: how do shelter trees function?

The two most important characteristics of shelter plantings are height and porosity.

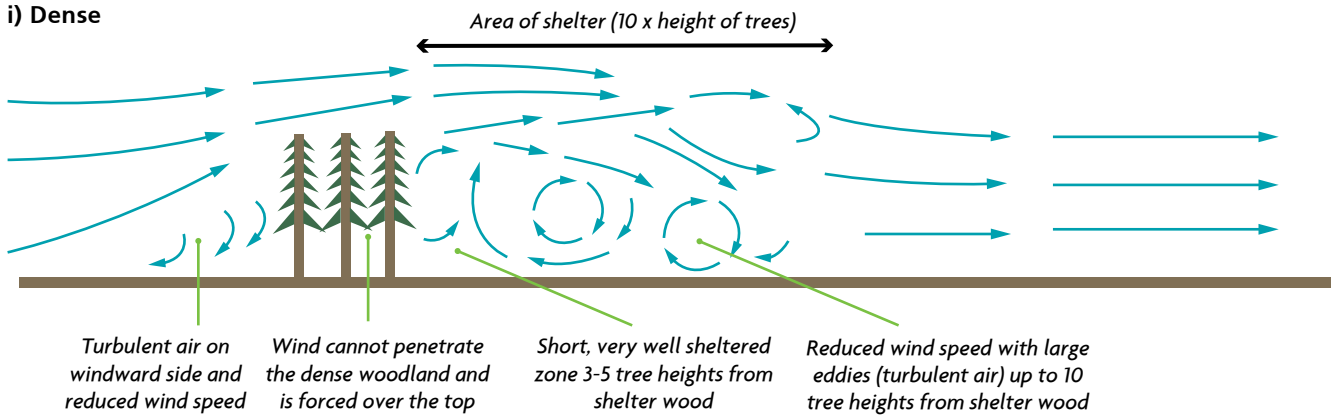
(i) Height: the taller the trees, the larger the area of shelter created. Tree height depends mainly on the species planted and their age. Nursery catalogues provide information on the mature height of trees. Fast-growing trees create more shelter more quickly.

(ii) Porosity: this is a measure of how open the shelter planting is, and how easily wind can flow through it. Porosity is determined by the species used and the width of the planting; also the time of year and the age of the shelterbelt. It is difficult to manipulate porosity in an older, narrow shelterbelt, so the more thought you put in at the design stage, the better.

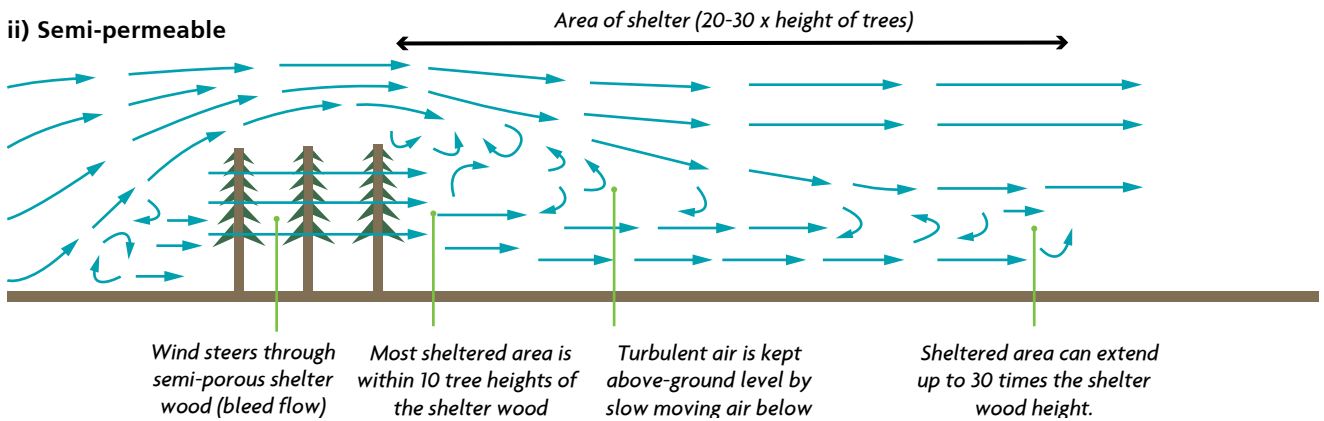
The diagrams below show how the wind behaves around three different types of shelterbelt:

(i) dense (ii) semi-permeable and (iii) a hybrid design.

i) Dense



ii) Semi-permeable



iii) Hybrid design

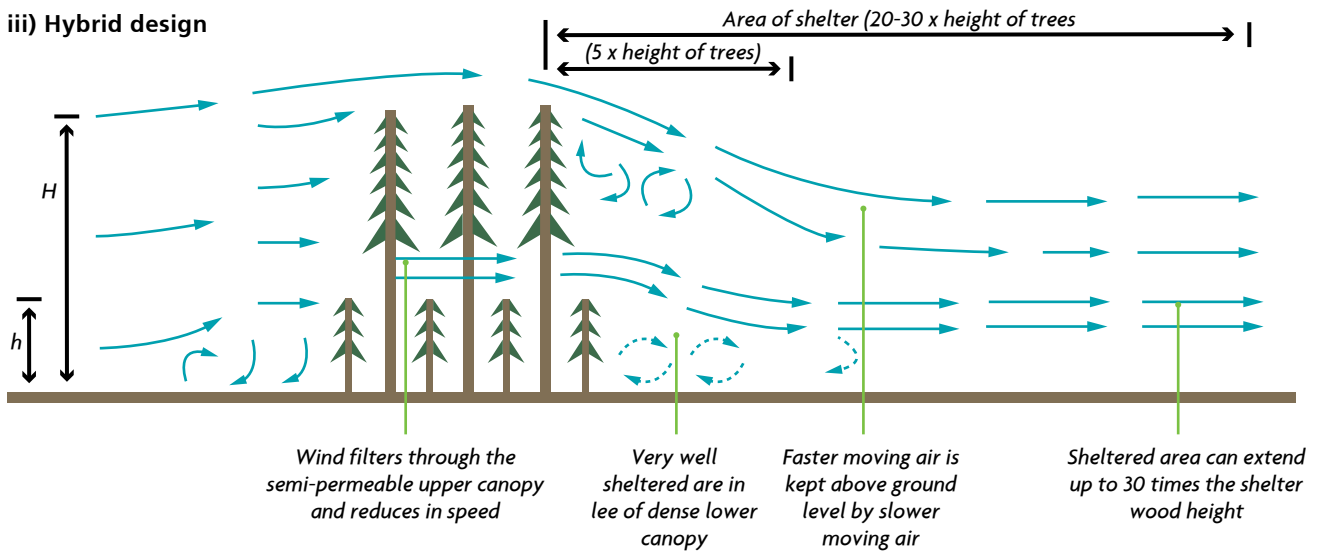


Figure 1: Flow of wind across shelterbelts of different porosity.

Shelterbelt design	Porosity	Length of wind speed reduction	Reduction of wind speed
Dense	<40%	Up to 10 x height of trees (max shelter at 3-5 x the height)	Up to 90%
Medium density	40-60%	20-30 x the height of the trees	20-70%
Hybrid	<40% lower storey	5 x height of lower storey	Up to 90%
	40-60% upper storey	20-30 x height of upper storey	20-70%

Where do I start?

It is important to take a whole-farm approach. Think about how you would like the farm to look in future, and consider how the plantings could be designed to bring other benefits, such as shade, soil conservation or amenity benefits to the farm. Also consider any infrastructure, especially irrigation. Increasingly, farmers on irrigated properties are finding ways to combine shelter plantings and irrigation infrastructure.

Shelter can alter the microclimate significantly, so you may be able to increase land-use flexibility by creating more sheltered areas. Areas used (or with potential) for calving might be the first places to plant shelter trees.

Shelter design features

Orientation

Ideally, shelter plantings will be at right angles to the winds you are trying to shelter livestock from, whether these are the prevailing winds or 'problem' winds such as cold southerlies or easterlies which may be more damaging e.g. at calving time.

Shelterbelts running north-south create little shade; shelterbelts running east-west create significant shade on their eastern side. In east-west plantings, deciduous species reduce winter shading; even in winter without their leaves, deciduous belts of trees can markedly reduce wind flow.

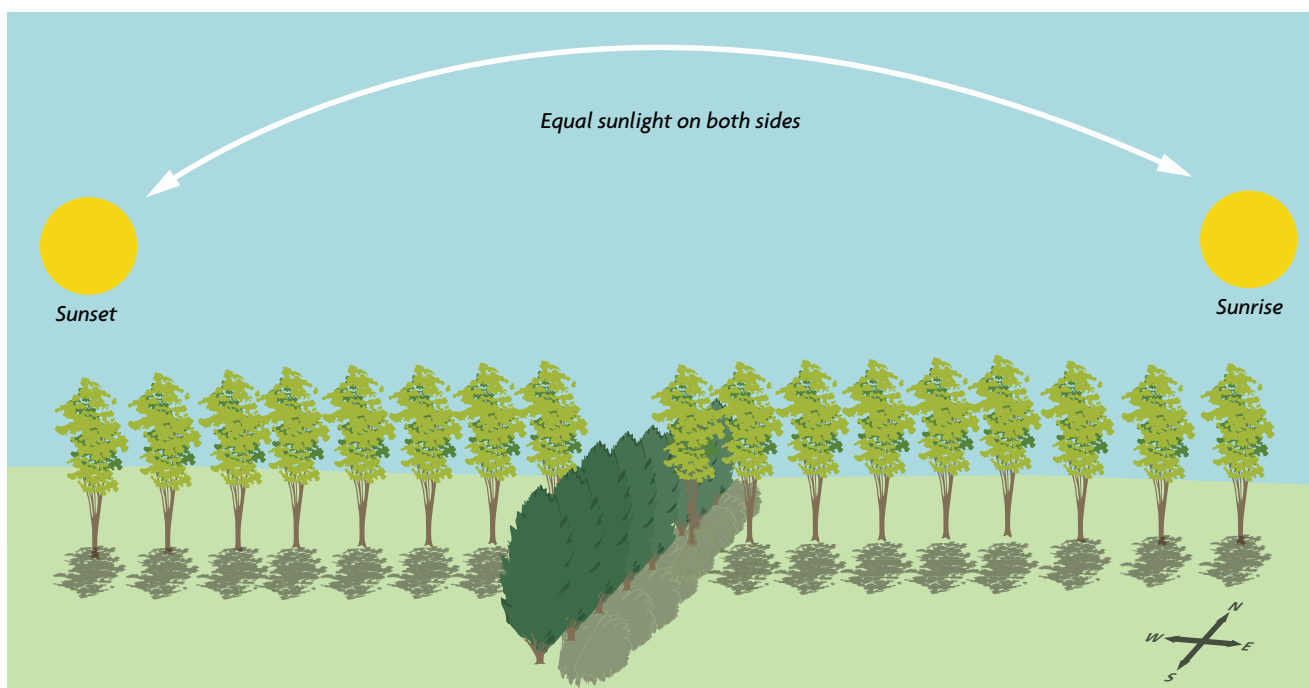


Figure 2. How shelterbelt design and orientation affects shading.

Continuity/gaps

Any gap in a shelter planting – for example a gate, or where a tree has been lost in a single row belt - will create a funnelling effect, with wind speeding up as it is forced through the gap. Wind also speeds up around the end of shelterbelts, and through belts that are open at the bottom.

Length

Ideally shelter plantings will be longer than the area they are intended to shelter, because the sheltered zone in their lee is triangular, narrowing as distance from the trees increases.

Topographic position

Shelterbelts on ridges are less effective; trees are better planted below the ridgeline for both shelter and landscape benefits. Planting low down on slopes may create frost pockets if air drainage is impeded.

Width

Width of planting is much less important than porosity in terms shelter created. Single or double row belts create good shelter in all but the most exposed locations. Wider plantings can provide extra benefits – for example, animals can be sheltered inside the planting once the trees are big enough not be browsed; timber production becomes more viable; and options increase for more tree and shrub species and hence richer wildlife and amenity values.

Planting in challenging conditions

Species choice needs to take account of the site and the type of shelter you want. By their very nature, shelterbelts are likely to be planted in exposed locations. Sites may be dry, stony, frost-prone, and compacted, and pests such as rabbits, hares, deer and possums may threaten young trees. All these factors add up to the fact that shelter plantings are often done in challenging environments.



Establishing shelter in challenging conditions: the cypresses in this very exposed location provide an environment for other species to survive.

Take advice and look at local plantings; talk to farmers about designs and establishment techniques. A golden rule is to only plant an area that you can manage. Shelter plantings often require significant maintenance in their early years if they are to establish successfully.

Establishment

As with all types of tree-planting, good site preparation is essential. Ripping may be needed on compacted sites. Livestock must be fenced out – dairy farmers using electric fencing can keep belts narrow and lift the bottom wire of the fence once the trees are established to allow grazing underneath. Pre-planting spraying of existing vegetation makes establishment easier.

Make sure trees are well-planted; use individual shelters if pests like rabbits and hares are a threat. Maintenance, including release spraying and replacing dead trees, is needed, sometimes for several years.



A shelterbelt established using biodegradable mats to prevent weed competition.



Cheap and cheerful – a shelter planting protected from grazing livestock by a single hot wire; the tyres will prevent hare, rabbit and spray damage to the young trees but need to be removed after a few years. Note the good weed control.

Options for planting

Shelterbelt plantings come in many different forms. Density (or porosity/permeability) is the key characteristic determining the type of shelter created; tree height also determines the size of the sheltered area.

Dense shelter: ideal for calving or hospital paddocks, buildings and yards, protection from cold southerlies for short periods, and under pivots.



A dense shelterbelt of predominantly native species, providing excellent, close shelter plus biodiversity benefits.



A dense cypress shelterbelt creating excellent close shelter. Cypress belts can be side-trimmed to keep them narrow but beware! Some cypress species can cause abortion in cattle.



Dense native plantings under pivots provide a short zone of good local shelter plus biodiversity benefits.



A wide shelter and amenity planting located outside the pivot circle which will provide a dense, short shelter zone once established.

Porous/semi-permeable shelter: ideal for sheltering grazing pastures; also cultivated paddocks where topsoil is at risk from wind erosion.



A semi-permeable poplar shelterbelt, which will provide shelter up to 20-30 times its height and occupies only a one metre-wide strip. Trimming can provide fodder when grass is in short supply. Refer to Fodder technote for more information.



If this shelter belt is 10m high, it will provide 200-300m of shelter by reducing wind speed.

Hybrid shelter: a combination of low, dense shelter and taller, porous shelter – a good compromise design



A hybrid design: native species provide dense lower shelter and taller eucalypts provide a longer sheltered zone.



A hybrid design: a semi-permeable poplar upper storey and dense eucalypt lower storey.

Overhead canopy shelter: prevents radiative losses; valuable for any vulnerable livestock on cold, clear nights as well as shade on hot summer days



Canopy shelter provided by open-spaced trees will significantly reduce night-time radiative heat loss.

Indicative costs:

Cost item	How much	Other considerations
Fencing	Electric fencing \$5-\$8/m Post and batten fencing \$13-\$17/m	Allow at least one metre between standard fences and trees to prevent browsing damage.
Plants	Exotic species - \$1-\$4/plant Native species - \$2-\$7/plant	Plant quality is more important than plant size. Larger plants need less future maintenance. For single row, large-stature species, plant 1 tree every 2-3m. For wider belts add smaller species/shrubs at 1 plant every 1-2m.
Planting	40-70c/tree (contractor rates for bare-rooted trees).	Planting costs increase with bigger plants.
Weed control	25-30c/tree (contractor rates including herbicide)	May need several repeat applications. 1.4m ² spot recommended.
Shelters	\$1-\$3 each Some designs include a mat (to prevent weeds growing within the shelter).	Protect from rabbits, hares, and spray damage.

Further information

NZ Farm Forestry Association including Trees on Farm videos. Visit nzffa.org.nz

Trees on Farms: A guide with local experience of growing trees in the Waikato Region (2002) Environment Waikato/Waikato Regional Council. Visit waikatoregion.govt.nz

The Principles of Using Woods for Shelter. Forestry Information Note 81, UK Forestry Commission, Edinburgh, Scotland (2006) visit forestry.gov.uk

Regional councils often have a range of useful publications. Check out your regional council's website.