

Trees on farms

Trees for shade

All regions of New Zealand experience summer temperatures and humidity that, at times, are likely to cause heat stress in livestock. Climate change forecasts indicate that summers will become longer, hotter and drier in some parts of the country. Providing shade for grazing livestock is one obvious way to prevent heat stress and to contribute positively to animal welfare.

The right trees planted in the right place will provide excellent shade for livestock.

Well-designed plantings can also offer other benefits on the farm, including:

- soil conservation and slope stabilisation
- habitat for wildlife, especially birds and bees
- fodder in times of drought (check suitability of species before planting)
- more amenable summer working conditions.

Premium meat markets now insist that livestock have access to shade in summer. The MPI Dairy Cattle Code of Welfare 2014 also includes a provision for shade among its 'best practice' guidelines for New Zealand milk suppliers.

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: tararuvets.co.nz

Cool ideas: Where to plant for shade

Available site for shade planting	Shade species and planting design
Around paddock boundaries	Single row spaced poplars (one tree every 10-15m) or a dual-purpose shade/shelter belt (one tree every 2-5m).
Around paddock boundaries, corners outside irrigator pivots	Wider plantings of spaced poplars or eucalypts interspersed with small-stature natives (flax, cabbage trees, pittosporums).
Irregular and sharp paddock corners or riparian strips	A few large-stature natives (totara, kahikatea, rimu) interspersed with smaller natives (flax, cabbage trees, pittosporums).
Hard-to-farm, ungrazed dry/steep sidings and embankments	Ground-durable eucalypts or other high-value fast growing timber species.
Steep grazed areas ("too steep for the fert truck")	Wide-spaced poplars and willows (50-150 trees/ha).
In paddocks near homestead or paddock edges beside farm and public roads	Large specimen trees (chestnuts, oaks, elms, lime, cedar) and fruit or nut trees (preferably deciduous to encourage grass growth and cover year-round).



Poplars provide excellent summer shade and take minimal space around field boundaries.



Standard trees (large single stemmed trees) planted within a shelter/amenity planting will provide shade only a few years after planting.



Wide-spaced poplars provide shade, overhead shelter, soil stabilisation and biodiversity benefits.

How does shade benefit animals?

Animals standing in the sun gain heat from external sources - direct sunlight, reflected sunlight and surrounding air. In addition, heat is produced internally by fermentation of feed in the rumen and cell metabolism. Therefore, high-producing dairy cows with high levels of intake and metabolic rate generate internal heat. In a hot and/or humid environment, they cannot dissipate this heat load efficiently. Cows' sweating mechanisms are poor and they rely on respiration to cool themselves.

Heating from sunlight has the potential to stress livestock in New Zealand, particularly if ambient air temperatures exceed 20°C or humidity levels are above 75%. Livestock with black or thick coats are particularly at risk. In the Hawke's Bay, skin temperature on black cattle exposed to natural levels of summer sunlight, reached 50°C (Betteridge, et al. 2012).

Dairy cows that are too hot adapt their behaviour to try and stay cool – most notably by reducing the amount of time spent grazing, seeking shade, increasing water consumption and often collecting round water troughs. Heat stress can reduce feed intake and milk production. It can also negatively impact on reproductive performance and, in severe cases, can result in death (Roman-Ponce et al., 1977; De Rensis and Scaramuzzi, 2003, Armstrong, 1994).

A dairy cow's body temperature typically peaks during and following the afternoon milking. This is due to the long distances walked, exposure to sun on the races and a large number of animals being in close proximity to each other.

How shade trees can improve the situation

Shade trees intercept solar radiation reducing the amount striking stock by >50% and also reducing ambient temperatures by up to 10°C in summer.

Contrary to opinion, providing shade does not result in animals spending less time grazing. Research data indicates that cows provided with shade actually spend more time grazing per day than those without shade, resulting in increased dry matter intake. (Betteridge, et al. 2012).

Make a plan

All planting on-farm is better when it's planned.

All planting requires livestock exclusion and most requires access.

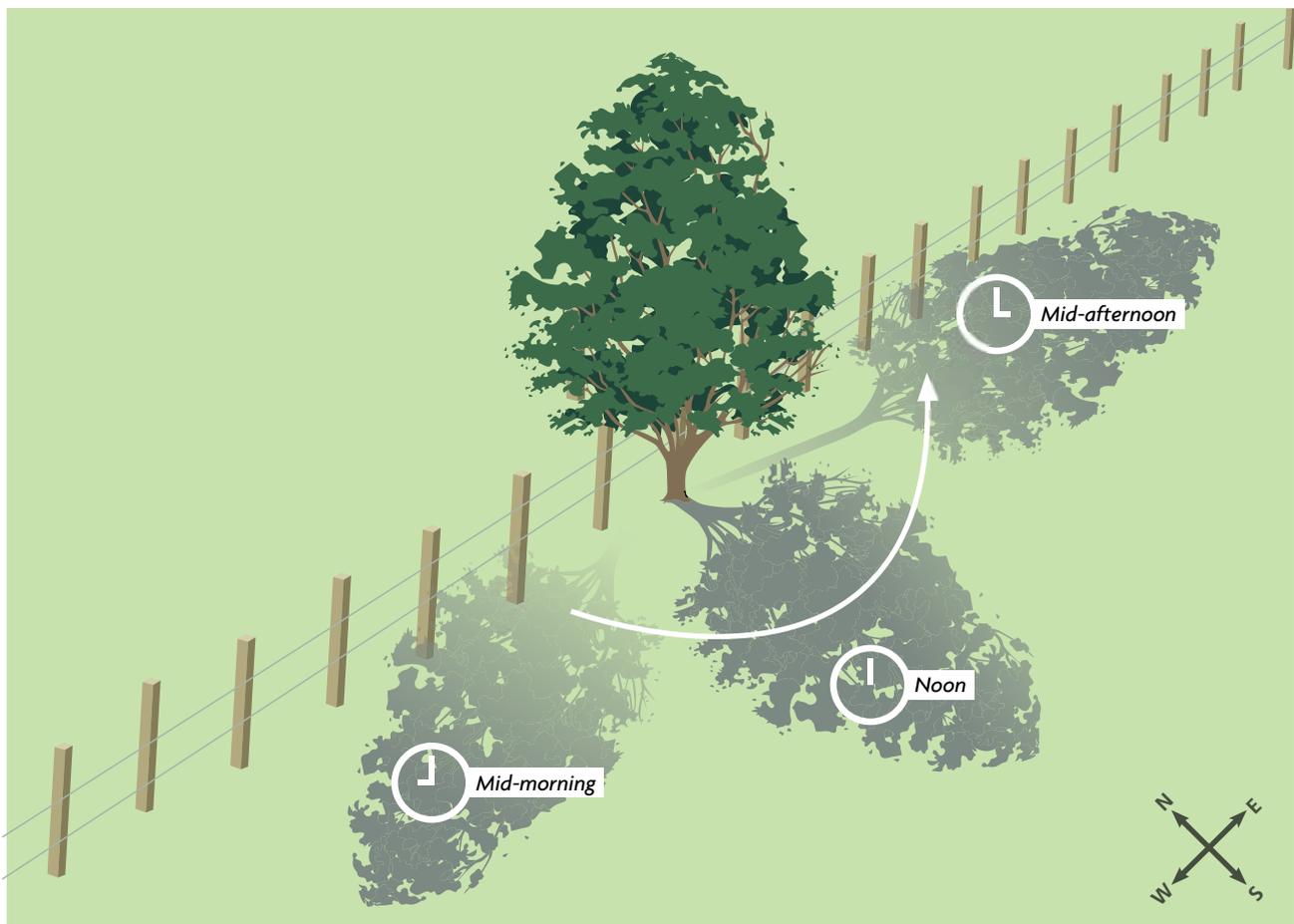
When planning shade plantings it is important to take a whole-farm approach. Think about how you would like the farm to look in future, and how shade plantings could provide other benefits on the farm.

Think about integrating your trees on farm with your riparian management plans. Shade is also excellent at promoting good water quality, reducing nuisance weed growth and supporting better communities of native fish and insects.

Design aspects

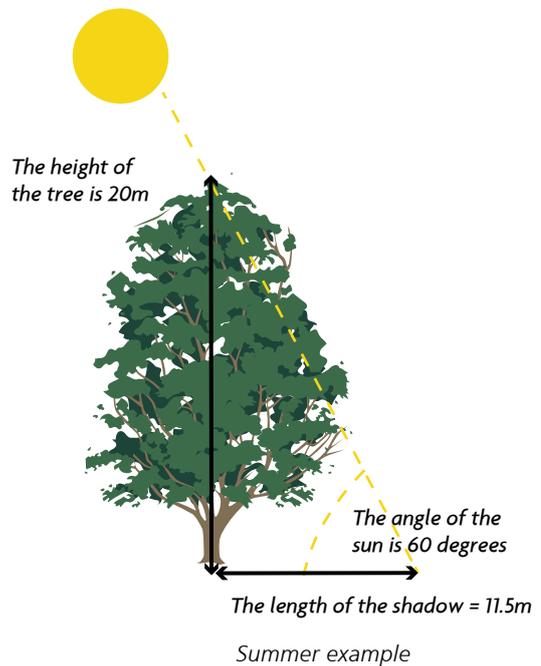
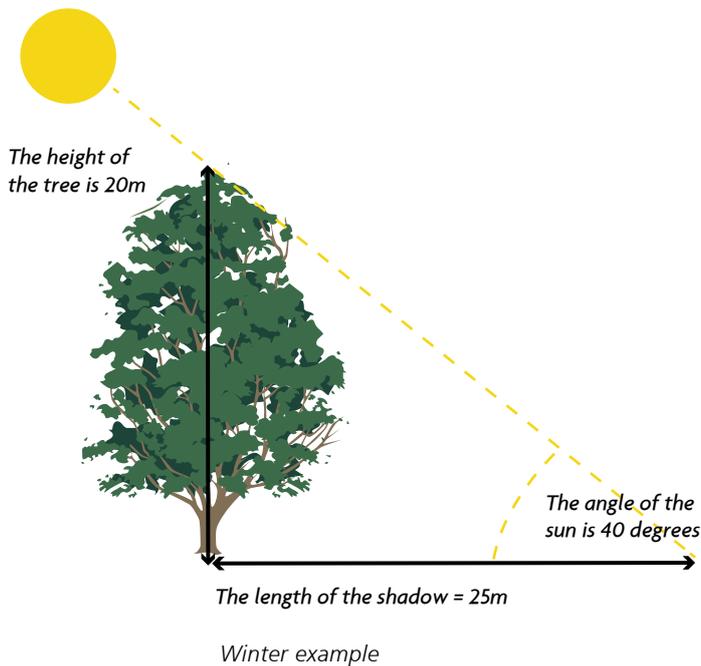
(i) How the sun moves around trees during the day

Animals will use shade at any time of day, but afternoon shade is particularly valuable. Trees on northern/western boundaries of paddocks provide the best shade throughout the day.



(ii) How the amount of shade changes depending on the time of year

The higher the sun is in the sky, the less the area of shade. During the middle of the day in summer, the sun is at its highest and there will be less shade available than at any other time.

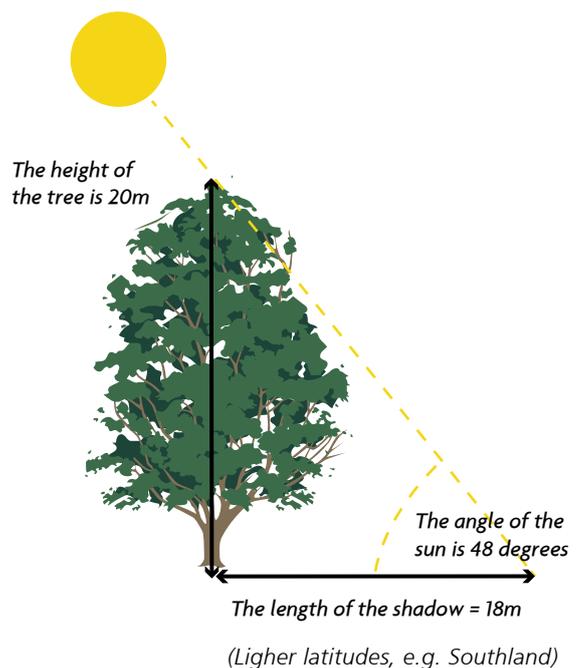
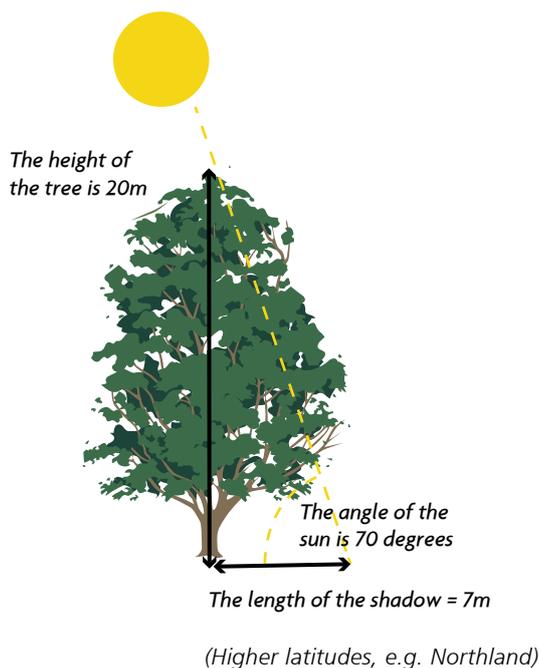


(ii) How, for any given latitude, the amount of shade changes depending on the time of year/day

The higher the sun is in the sky, the less the area of shade. In the middle of the day during summer, the sun is at its highest and there will be less shade available than at any other time.

(At higher latitudes, e.g. Northland, the angle of the sun will be greater than at lower latitudes, e.g. Southland – and the amount of shade created will be less, and vice versa).

At other times of year, and earlier and later in the day, shadows will also be longer.



(ii) How much shade?

Providing shade for as many animals as possible will help prevent large groups gathering under too few trees, which leads to high nutrient loading, soil compaction and pasture loss. A guideline, based on cattle housing standards, is 4-9m² of shade per cow (or 1m² per 100kg liveweight).

The table below shows the length of shadow created by a selection of mature trees when the sun is at 70° – an angle that represents a mid-New Zealand location in mid-summer, in the middle of the day, and so is an estimate of the minimum length of shade created.

For any given day and time, the actual area of shade available to livestock will vary according to the diameter of the tree as well as its height, and whether the tree is in the middle of a paddock or on a fence line, in which case stock may not have access to all the shade created.

Trees	Height after 5 years (m)	Growth rate	Mature height (m)	Mature width (crown diameter m)	Length of shadow (metres) of mature tree with sun at 70° (midday sun in summer)	Total area of shade if sun was at 90° i.e. directly overhead (m ²) and all shade available to livestock
Poplars	7	Fast	30	5	~ 11	19.6
Ground-durable eucalypts	6	Medium-fast	20	8	~ 7	50
English oak	4	Medium	25	15	~ 9	176
Cabbage tree	4	Medium	10	2	~ 4	3
Lemonwood (Pittosporum eugenoides)	3	Medium	12	3	~ 4	7
Totara	2	Slow	25	8	~ 9	50

Choosing the right species for shade plantings

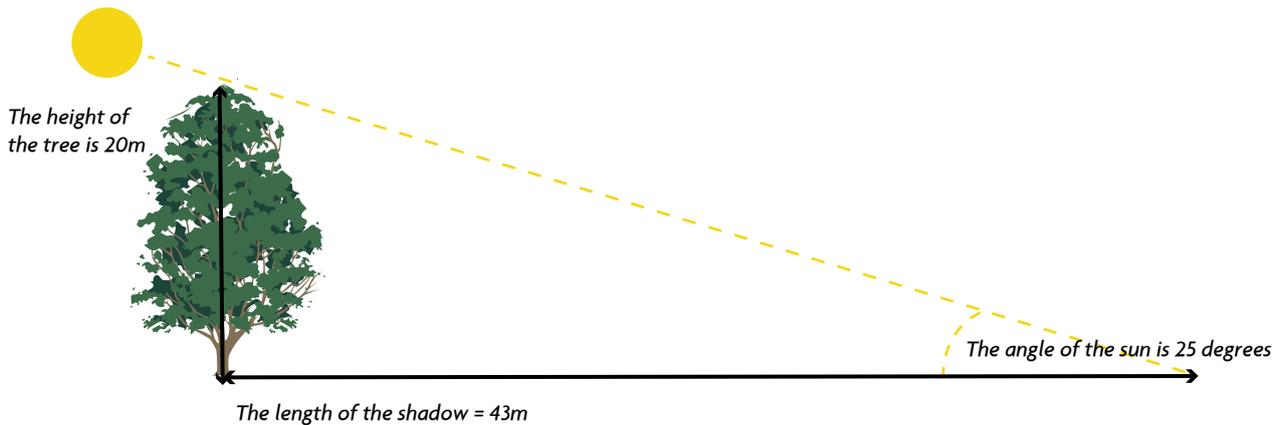
As a general guide, when considering providing shade for livestock, the taller the trees, and the broader their crowns, the better. For any given tree height, trees with broad crowns provide significantly more shade than narrow trees.

Species choice will depend on many factors, including the site, type of planting and any co-benefits you are hoping to gain. In general the best shade species are:

- fast-growing
- tall and broad
- wind firm
- without brittle branches.

Where available land is in short supply, trees are most likely to be located around the edge of paddocks or along raceways. Various poplars fit the bill well in many locations; they have the advantage of creating little shade in winter. In contrast, evergreen species, which include most conifers, eucalypts and native species, create good shade in summer but may cause problems with winter shading and frost retention in winter.

Plan plantings around buildings, laneways and yards carefully to avoid the risk of too much shade in winter. Think about the potential height of mature trees (5-40+ metres depending on species) and the long shadows created by the low angle of the winter sun – *a 20m-high tree will create a 40-50 metre shadow when in winter*. Deciduous trees with heavy leaf fall can also create work in autumn if planted too close to buildings, gutters and drains.



Winter sun provides long shadows. Plan to plant away from buildings.

Pruning shade trees

Pruning shade trees (removing all lower branches) means shade moves further out into the paddock. This discourages livestock from camping at the base of trees, reducing the risks of soil compaction, pugging and leachate loss from pasture.

Pruning dual-purpose shade/shelter belts requires careful thought. Reducing lower branches can cause the wind to speed up at stock-height. Here, inter-planting of shade belts with a row of low-stature trees can balance shelter with shade (flax, pittosporums, coprosmas).



Poplars provide shade and some shelter: a lower storey e.g. of flax would prevent the wind funnelling between the trees and increase the shelter value of this belt significantly. Trimmings from shelter belts can provide valuable fodder in summer.

Establishing shade plantings

Good site preparation is essential.

Livestock exclusion is crucial - even with fast-growing exotics. Trees need protection from browsing/rubbing by livestock and in addition some trees and their produce should not be eaten by livestock e.g. acorns from oak trees can cause sickness in cattle and macrocarpa needles can cause abortions in late pregnancy. Lines of trees can be fenced; individual trees will need protecting with hot wires or robust individual tree guards. Ripping may be needed on compacted sites.

Make sure trees are well-planted. Large 'standard' trees may need staking at planting to prevent collapse.

Release spraying is recommended for as long as necessary to allow the trees to get established; alternatively weed mats or mulch can be used for individual trees or small-scale plantings. Standard trees especially may benefit from irrigation: on dry sites, install pipes to their root zone at planting.



Standard trees along a farm track – trees are staked, mulched and protected by hot wires.



Long-term protection of individual shade trees provided by robust wooden shelters.

Indicative costs:

Cost item	How much	Other considerations
Fencing	Electric fencing \$5-\$8/m	Allow at least one metre between fences/tree guards and trees to prevent browsing damage by cattle.
	Post and batten fencing \$13-\$17/m	
Individual shelters/guards	Wide range of options available e.g. wire mesh guard, wooden frame.	Don't skimp, or your investment in trees will be wasted.
Plants	Poplar poles (2-3 metres) \$5-\$10 each	Species choice depends on site, planting design, and any desired co-benefits of the planting.
	Poplar rooted wands (1.5 m) \$4-\$6 each	
	Exotic species \$1-\$4/plant Native species \$2-\$7/plant	
	Larger 'standard' trees \$25-\$50 each (plus stakes and ties at \$4-\$6/tree).	Bigger plants provide quicker results but are more expensive to buy and plant.
Planting	Poplar poles \$4-5 per pole (contractor rates) Bare-rooted trees (small) \$75c-\$1/tree depending on scale of planting.	Planting costs increase with bigger plants. Standard trees often come in 10-litre bags. Contractors likely to charge by the hour for planting larger trees.
Weed control	25-30c/tree (contractor rates including herbicide) for 1.4 m ² spots.	May need several repeat applications. Mats or mulch are other options.
Shelters e.g. combiguards for small trees	\$1-\$3 each Some designs include a mat (to prevent weeds growing within the shelter).	Protect from rabbits, hares, and spray damage.

More information

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

Benefits of using poplars and willows on NZ dairy farms: Fact Sheet 06 (2015) Poplar and Willow Research Trust. Visit poplarandwillow.org.nz

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

An Introduction to Shadow Patterns. Visit hellistreeconsultants.co.uk