Dairy Australia
Your Levy at Work

Cool Cows: Cooling in the dairy shed

This fact sheet is part of the Profitable Dairying series - *Good business management reduces greenhouse gas emissions.*

Dairy farmers are impacted by a changing climate. Dairy farmers are already adapting farming practices to seasonal changes and increasing climate variability.

The Australian dairy industry also has a role in mitigating the impacts of climate change.

In hot weather, standing in the dairy holding yard before milking can be the most stressful part of the day for a productive dairy cow. This is especially the case if the cow is already heat stressed when she arrives at the holding yard.

As the diagram below illustrates, a dairy cow actively manages the body heat content or heat she carries within herself all the time. If the cow is able to dissipate all the metabolic heat she produces internally and the heat she gains from her external environment, then her heat load remains normal, as evidenced by her core body temperature and breathing rate.

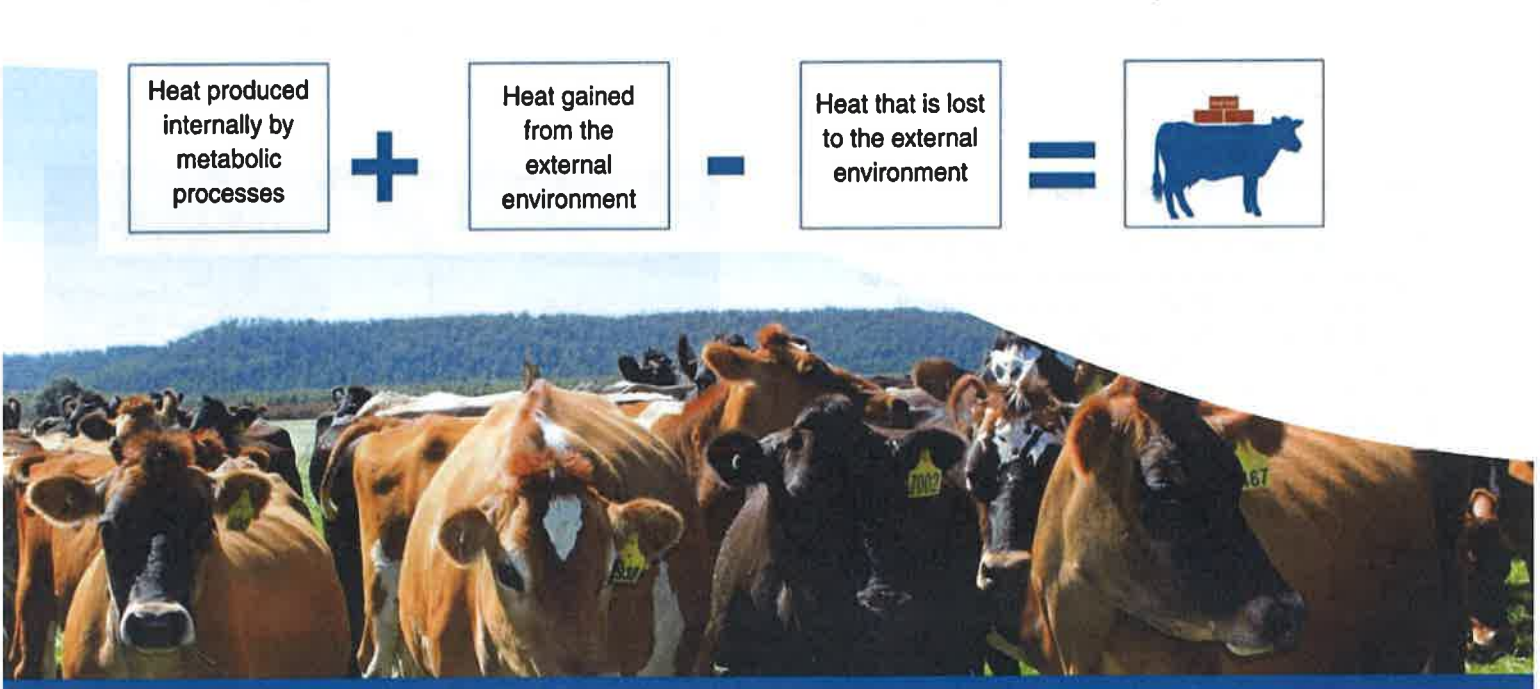
However, if the sum of metabolic heat produced internally by the cow and the heat gained from her external environment begins to exceed the amount that is lost from her body to the external environment, the cow's heat load starts to build.

Once heat load reaches a critical point, a chain reaction of physiological changes occurs that has far-reaching effects, not only for the cow's milk production, but also for her milk quality, fertility, health and welfare.

In the holding yard

Closely packed cows in a holding yard that has inadequate cooling systems on a hot day will rapidly accumulate body heat. Research shows that:

- without cooling, the core body temperature of cows can increase within just 20 minutes of entering the dairy holding yard,
- cows that are cooled in the holding yard produce more milk than cows that are not cooled, and
- milk production can drop by 10-25% of more in high heat stress events and by 40% in extreme circumstances.



Milking management to help reduce heat gain

1. Adjust milking times
Walking cows to the dairy during the hottest part of the day (about 3pm) adds to their heat load. Research shows that delaying afternoon milking until 5pm may increase milk yield by up to 1.5 litres per cow per day.

On hot days, milk and feed cows before 10am. On heat wave days, have it done by 9am. Try to offer feed to cows as soon as they exit the dairy and have the paddock or feed-out area ready and ensure that every cow gets a fair go.

2. Wet the holding yard before cows arrive
Wetting the holding yard for the hour before cows arrive in the holding yard will dissipate the heat stored in the mass of the concrete. This can be done by hosing, flood washing or sprinkling.

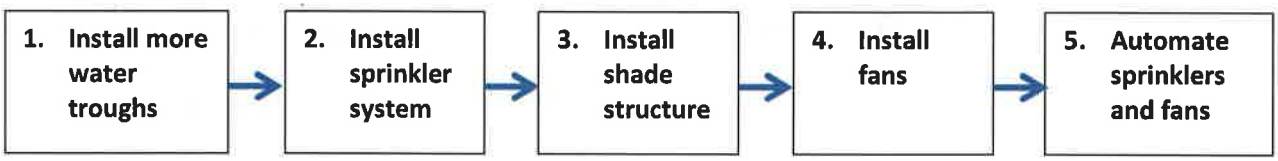
3. Limit cows' time in the holding yard
Limiting cows' time in the holding yard will limit the amount of heat they accumulate. Ideally, cows should be in the holding yard for less than one hour per milking.

Cows should not be packed too tight to ensure that air can flow freely around their bodies. Holstein-Friesian cows should be provided with 1.5 m^2 space per cow, Jerseys with 1.2 m^2 per cow.

Consider running two milking groups if your cows are waiting in the yard much longer than one hour.

Step-by-step development of a dairy holding yard's cooling capacity

Developing the cooling capacity of a dairy holding yard can be considered as a series of steps in which items of cow cooling infrastructure or equipment are progressively installed depending on budgets. The aim is to start simple, and then add cooling capacity over time as necessary, depending on how susceptible the herd is to heat stress. *(Factors that determine a herd's susceptibility to heat stress are: location, breed, genetics, age and liveweight, and level of milk production).*



Step 1. Install more water troughs

Water availability is the first priority in reducing the impact of heat stress. Cows should have access to cool drinking water at all times in hot weather. If troughs are not in place consider installing a large water trough on the approach to the dairy holding yard and another on the exit side of the dairy. Locate each trough in a wide passage, preferably on the outside of cow traffic curve.

Another option is coffin-style troughs along the sides of the dairy holding yard, designed so cows have to place their heads through the fence to drink.

Step 2. Install a sprinkler system

A sprinkler system (with a spray curtain over the entry to the dairy parlour) is an easy, low cost step. For less than $1,000 it is possible to install a system with a controller / timer to run sprinklers on an on / off cycle which will pay for itself after only a few days use.

For keys to success with sprinklers, go to: Cool Cows Sprinklers and Fans

For sprinkler design considerations for maximum effectiveness, go to: Cool Cows Design Considerations Sprinklers

Step 3. Install a shade structure

Research shows that shade is always preferable to evaporative cooling in terms of the cow productivity benefits it provides.

A shade structure can cost tens of thousands of dollars to install. For a shade-cloth structure, expect to pay approx. $40-45 per square metre installed. To provide 300 large cows with 1.5 m^2 of shade per cow as recommended would therefore require a shade-cloth structure covering 450 m^2, costing about $20,000. For a solid-roofed structure, the cost may be about double this, but it will be more effective than a shade-cloth structure and have a much longer life.

Many shade structures pay their way in only a few years. To assess the cost: benefit of a shade structure on your farm, go to: Cool Cows Cost Benefit Calculator

For information on shade-cloth and solid-roofed structures, go to: Cool Cows Infrastructure

For information on shade-cloth structure design considerations for maximum effectiveness, go to: Cool Cows Design Considerations

For information on solid-roofed structure design considerations for maximum effectiveness, go to: Cool Cows Solid Roofed Structures

Step 4. Install a set of fans

Fans are very effective at cooling cows when used in conjunction with sprinkling as increasing airflow from 0 m/second to 1 m/second increases heat loss from a wet cow three-fold. Fans can be an especially useful complement to sprinklers on warm to hot days when there is little or no wind.

Fans range in cost from about $550 to $2,000 each, depending on their design and capacity, plus installation.

For fans to cool cows effectively, the ambient temperature must be lower than the cow's body temperature, and the cow's skin must be wet (through sprinkling or sweating).

For keys to success with fans, go to: Cool Cows Sprinklers and Fans

For fan design considerations for maximum effectiveness, including the number of fans required, go to Cool Cows Design Considerations Fans

Step 5. Automate sprinklers and fans

Automatic controls for sprinkler systems and fans, so they turn on and off at the appropriate times saves energy costs and water.

Using a holding yard as a cow cooling centre

A dairy holding yard with full cooling capacity will not only keep cows cool prior to milking but can be used for longer periods in the middle of the day on very hot days as a cow cooling centre to help cows off-load heat.

Research shows that cows permitted to stay in a cooled holding yard for 3-4 hours per day during extremely hot weather usually produce at least 2 litres extra milk per cow per day.

Are all cows in your holding yard being cooled?

It is common to see holding yards in which the back section of the yard is not serviced by cooling systems provided at the front section of the yard. It is also common to see yards where sprinklers and fans are poorly maintained and some are not working. This creates problems for cows.

Many cows do not like sprinklers. If sprinklers don't cover the whole yard, this will therefore lead to jostling between dominant and more subordinate cows and many cows will not receive adequate evaporative cooling.

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Cool Cows

Shade, sprinklers and fans on dairy farms

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Foreword

DEALING WITH heat stress is an important part of caring for our animals. The good news is that it can be managed effectively.

Heat stress affects milk production and income, and its impact on cow fertility, health and welfare lasts well beyond the seasonal hot weather.

Dairy Australia's Cool Cows program, launched in 2008, is involved in a number of important research and farm demonstration activities. It has delivered more than 60 on-farm workshops and other extension activities to date, all in close collaboration with farmers, advisers, researchers and industry partners. Cool Cows also provides dairy farmers and their advisers with practical information and innovative web-based tools via its website, www.coolcows.com.au.

Shade and evaporative cooling play important roles in managing heat stress in Australian dairy herds. However, many farmers have doubts about the capital cost, payback period or lack the detailed design and management information required to proceed with confidence.

In response to this, the Cool Cows program has developed this *Shade, sprinklers and fans on dairy farms* booklet and a new *Cost Benefit Calculator* web tool. These initiatives enhance the Cool Cows information and tools already available, and put the industry in a good position to deal with heat stress effectively into the future.

These new Cool Cows resources are supported by funding from Dairy Australia and the Australian Government Department of Agriculture, Fisheries and Forestry under FarmReady, part of the Australia's Farming Future initiative.

I encourage you to use these terrific resources.

Ian Halliday
Managing Director
Dairy Australia

Introduction

THERE are three locations on a dairy farm where you can focus your cooling efforts:

- Paddocks and laneways
- Dairy yard
- Feedpad

Which of these locations works best for you will depend on a number of factors, including:

- Your herd's susceptibility to heat stress – low / moderate / high – based on location, breed, milk production level and age profile of herd.
- Whether you need to deal with prolonged periods of hot weather or only need to manage infrequent heat wave events.
- How much tree shade you already have in your paddocks and laneways.
- Whether you are willing to wait long enough for shade trees to grow.
- What irrigation infrastructure and water you have available.
- Whether it is feasible to provide adequate tree shade in paddocks to all your cows each day, given the size of your herd.
- What feeding infrastructure and equipment you have? Do you have a feedpad and mixer wagon? Is the feedpad surface concrete?
- Which feeding system you use (see page 4 for systems 1 to 5 as classified by Dairy Australia's Grains2Milk program). If you use a hybrid system (system 4) or a TMR system (system 5) and do not graze cows over summer, then how much tree shade you have in paddocks and laneways is irrelevant.
- Whether you have a shady loafing paddock available near the dairy.
- Walking distances for cows between paddocks and the dairy, and between the dairy and the feedpad (if you have one).
- How many hours your cows spend in the dairy yard before each milking.
- How many times a day you milk.
- Whether you own the farm or not, and how long you plan to be on the farm.

Wherever you choose to focus your cooling efforts, and whatever infrastructure option(s) you choose to set up, there are many things you need to consider before you invest.

Sections 1 to 3 of this booklet describe the main options for shade, sprinklers and fans you should consider for your farm. For each option, its strengths and limitations are listed and the keys to success are described. The most interesting information is likely to be found in the case studies from farms across Australia.

Section 4 discusses an issue that is often not given enough attention – stock water supply.

Be sure to read Section 5, which describes design considerations that could mean the difference between a shade structure or evaporative cooling system that works extremely well for you for a long time and one that disappoints.

www.coolcows.com.au

For more information about keeping your cows cool, visit Dairy Australia's Cool Cows website at www.coolcows.com.au. You can also access it via www.dairyaustralia.com.au.

The website gives you free access to these user-friendly tools:

- **ACTIONS GENERATOR** tool helps you identify actions you can make on your farm to improve your heat stress management.
- **COST BENEFIT CALCULATOR** tool estimates the likely return on investment and payback period for a new cooling infrastructure item on your farm.
- **WEATHER FORECASTER** tool enables you to monitor the daily heat stress risk level in your local area and adjust your cooling strategies to suit.

THE FIVE main feeding systems used by Australian dairy farmers are:

1. LOW BAIL

Grazed pasture + other forages + up to 1 tonne grain or concentrate in the bail.

2. MODERATE-HIGH BAIL

Grazed pasture + other forages + >1 tonne grain or concentrate in the bail.

3. PMR

Grazed pasture for most or all of year + Partial Mixed Ration on feedpad and/or grain or concentrate in the bail.

4. HYBRID

Grazed pasture for less than 9 months/year + Partial Mixed Ration on feedpad and/or grain or concentrate in the bail.

5. TMR

Zero grazing. Cows housed and fed Total Mixed Ration.

Paddocks & laneways

Trees for shade

If you want to keep your cows cool, always start with shade. Shade is the most effective way of reducing heat load because it blocks solar radiation, so providing shade to the herd should be your first priority.

Priorities for cooling cows

1. Use shade first

Minimise heat gain – block solar radiation

2. Use sprinklers and fans

Maximise heat loss – encourage evaporative cooling

Natural paddock shade

Trees can be planted in paddocks or laneways and can reduce the radiant heat load by 50% or more.

The shade and shelter that trees in paddocks and along laneways provide can be used strategically to manage both heat gain in summer and heat loss in winter.

Strengths:

- Trees are the cheapest method of providing shade.
- Trees absorb CO_2 and don't require electricity to establish or maintain.
- Trees enhance local biodiversity.

Limitations:

- It takes many years to establish plantings.
- It can be difficult to provide adequate shade every day during paddock rotation.
- Trees along laneways can be a risk in severe wind conditions.
- You may need supplemental irrigation to establish or speed up tree growth.

Case study

Trees for shade

Background

The existing farm (108 ha) has been planted out with about 28,000 trees over the past 20 years. The owners have acquired another 35 ha and eventually this will also be planted out.

Costs were subsidised initially by a local agroforestry project.

The primary aim was to provide shade and shelter for the dairy herd. The agroforestry potential was seen as a secondary benefit to the property, as their focus was milking cows – not growing timber.

In the early 1990s the property reconfigured the farm layout and planned the renewal of internal fencing. The project provided a great opportunity to renew fencing at a subsidised rate.

The property developed a whole farm plan that matched soil types and trees species, aligned paddocks and proposed tree plantings to maximise shade and shelter for the summer and winter months.

Farmer's name: Mark

Facts about the farm layout:

- **Designed by: Mark, with assistance through local agroforestry project**
- **Constructed by: Mark, with some contract labour**
- **Lifespan: Indefinite**

Other cooling infrastructure on this farm:

- **Sprinklers in dairy yard**

As part of the whole farm plan, areas of the property were also re-lasered which allowed separate bays to be constructed specifically for tree plantings. This allowed the trees to be strategically watered – separate from the irrigation bays which the herd accessed for grazing.

The tree bays were ripped and trees planted in late December, and also in autumn using root stock and

Note the north-south orientation of plantings. Cattle can access shade all day simply by shifting from eastern to western side of the paddock in the afternoon.

Case study

The majority of fences are still in place, segregating the tree planting bays and the irrigation (grazing) bays.

bare-rooted trees. The property found it easier to manage weeds with the late December plantings.

Bays were planted out with 4-6 rows of trees, which incorporated different species to provide upper and lower storey cover (i.e. both shade and shelter in a single paddock).

Furrows adjacent the plantings were used to direct irrigation water to the trees, which also minimised the spread of water in the bays and subsequent weed growth.

Species planted included – red gums, flooded gums, spotted gums, iron bark, grey box, yellow box, black box, melaleuca, acacia wattle, West Australian swampy yate.

Swampy yate was planted along fence lines that bounded channels. The leaves from this tree fall on the ground and release a weed-repelling toxin. This is beneficial as the farm is certified biodynamic and is unable to use synthetic fertilisers or chemicals for weed control and reducing grass growth in and around the banks of the channels.

Mark's management tip

Manage recently sown pasture bays (up two years old) carefully to prevent 'pugging' along the fence lines where the cows stand to access shade/ shelter. High traffic areas down the lower end of the bays also need to be managed during pasture establishment. Some re-sowing may be required.

Case study

Trees for shade and shelter

The main laneways leading to and from the dairy have established plantings. Cows are therefore happy to travel to and from the dairy during hot weather.

The daily milking routine remains unchanged regardless of the weather conditions. The cows are provided with shade and shelter every day, therefore it has never been an issue walking the herd to the dairy.

Over the past 10 years the property has never seen a cow enter the dairy showing signs of heat stress (e.g. excessive panting).

The cows utilise the tree shade and shelter as required. The herd usually seeks shade when the temperature exceeds 25°C (in summer this is usually around 10 am).

The herd has access to tree bays to control grass and weeds, however they prefer to stand on the green grassed irrigation bays than directly under the trees. It appears the grassed bays provide a cooler environment than the tree bays where there is no green grass in the summer months. The dry areas under the trees re-radiate heat from the ground – grassed areas don't re-radiate as much heat.

If strong cool winds are present in the winter the herd can be put in the 'bush block' with some hay. The thick tree density provides shelter from the winds. The dry areas under the trees re-radiate heat from the ground – grassed areas don't re-radiate as much heat.

If strong cool winds are present in the winter the herd can be put in the 'bush block' with some hay. The thick tree density provides shelter from the winds.

Combination of upper and lower storey plantings – providing both shade and shelter.

Trees on the southern side of the laneway – cows prefer to walk under the canopy which is shaded in the afternoon.

Mark's comment

We are very satisfied with all the work we've put in and believe the trees play an invaluable role in our dairying operation. Additional trees will be planted along the main laneway to complete the shade/shelter corridor.

Case study

What would you change?

Knowing what you know now...

Mark says that they'd reduce the number of rows planted per bay – 4-6 is too many. With low water allocations trees can out-compete perennial pastures in adjacent irrigation bays, especially if there is a dry spring and no water available for irrigation. However, if water is available then both trees and pasture can co-exist without affecting each other.

Tree belts running east – west should have no more than 2-3 rows to avoid pugging paddocks in winter and excess shade.

If a single row of trees is planted ensure multiple varieties are used to produce an upper and lower storey, otherwise the shelter component will be insufficient. Mark believes he planted too many tall eucalypts and not enough smaller 'habitat' trees.

Trees indigenous to their area are more likely to survive than trees adapted to other environments.

If planting out paddocks exclusively for young stock and dry cattle there is less need for shade, as compared to lactating cows. Young heifers are content to sit in the sun, while a lactating cow will seek shade in comparable temperatures.

Comments from the experts

This property adheres to all the key design principles. Aspects of the design worth noting include:

- **The plantings were established in fenced off bays to protect the trees from cattle hooves, excessive deposition of manure and removal of bark or branches.**
- **North-south orientation of the paddocks means the herd can access shade all day simply by shifting from the eastern to the western side of the paddock in the afternoon.**
- **Shade and shelter is provided in the majority of paddocks, as well as the main laneways leading to/from the dairy.**
- **The property has a whole farm plan and trees were matched to soil characteristics.**

Tree plantings in paddocks and laneways have been well thought out and planned to provide good levels of shade and shelter to the herd in every season.

An original six-row planting – understorey strategically grazed by the herd.

Well-cambered laneways draining away from the trees – dairy in the background.

Keys to success

- **WHEN REDESIGNING** farm layouts, consider orientating the long axis of paddocks north-south to help maximise shade/shelter.
- **AIM FOR** 4 m² of shade/cow at midday.
- **SEEK RECOMMENDATIONS** on suitable tree and shrub species from an adviser, e.g. Greening Australia, Regional NRM bodies like local CMA, DPI or Landcare.
- **STRATEGICALLY PLANT** species based on natural traits, e.g. West Australian swampy yate, can minimise grass growth beneath its canopy through the secretion of a toxin.
- **DECIDUOUS TREES** will allow solar radiation to penetrate through canopies and allow laneways to dry out quicker in the winter.
- **FENCE OUTSIDE** the perimeter of the tree root systems to protect trees from excessive compaction and manure that may kill some species.
- **LOCATE FEED** and drinking water 20-30 metres away from trees so that cows don't defecate excessively in the shaded areas.

It's said that the best time to plant trees was 20 years ago. The next best time is now! These photos show what can be achieved in a short time.

A web-based commercial tool called WebShade ShadeAudit can help you quantify the existing shade on your farm and plan to increase shade cover. For more information, visit www.webshade.com.au

Paddocks & laneways

Portable shade structures

Priorities for cooling cows

1. Use shade first

Minimise heat gain – block solar radiation

2. Use sprinklers and fans

Maximise heat loss – encourage evaporative cooling

The most effective way of reducing heat load is to block solar radiation by providing shade. When not enough natural paddock shade is available, artificial shade can be used to minimise cows' exposure to solar radiation.

Portable paddock shade structures may incorporate shade cloth or corrugated iron roofing.

Wheels or skids enable the structures to be towed behind a tractor or four-wheel motorbike to where they are needed.

Portable paddock shade

These structures are very effective when no other cooling is available in paddocks, such as overhead sprinklers (e.g. lateral move and centre pivot irrigators).

These shade structures can be located in paddocks/laneways, in dry corners of centre pivot irrigated paddocks or near portable feeding troughs and hay rings.

Strengths:

- Enables you to bring the shade to the cows, as opposed to cows to the shade.
- Best suited to smaller herds.
- Can be readily moved with the animals, or moved to cleaner, drier locations close to feed and water when necessary.

Limitations:

- May need several structures to provide sufficient shade for all animals.
- May lead to localised pugging, nutrient build-up or compaction if not shifted regularly.
- A time cost needs to be allocated to shifting shade structures.
- Shorter useful life than a permanent shade structure.
- Vulnerable to high winds.

Case study

Portable shade structures

Background

With little tree cover on many parts of the farm and none in the centre pivot area, a number of paddock shade structures were built in 2001 at the cost of about $5,000/structure.

Shade structures are used between December and March and on average are used by the cows for about 3 hours/day – generally between 11 am and 3 pm.

Once built, the structures have practically no running costs and are moved around the farm by four-wheel motorbike as required.

Farmer's name: Frank

Facts about the structures:

- Designed by: WA Department of Agriculture staff
- Built by: Vasse Research Centre staff and some made commercially
- Lifespan: Now 9 years old; expected to last another 10 years with some maintenance

Other cooling infrastructure on this farm:

- Sprinklers in dairy yard
- Fans over bails in dairy

Shade structures are located in the laneway adjacent to the centre pivot so cows can seek shade after their morning grazing.

The dimensions of the shades used on this farm are:

- Base frame: 150 mm x 50 mm
- Main supports: 50 mm x 50 mm
- Shade frames: 25 mm x 25 mm
- Pitch of shade cloth: about 30%
- Tension applied to shade cloth
- Length of shade: 8.0 m
- Width of shade: 4.0 m
- Vertical height: 3.2 m in the apex
- Total length including draw bar: 9.0 m

Shelters are high enough so that heat is not reflected from under the roof back down onto the cows, and cows do not interfere with the roof structure if riding on the back of another.

Frank's comment

When we bring them out for the first time at the start of summer, the cows run over to the structures before they have even been set up!

They obviously enjoy the comfort they get from the shades.

Case study

Hooks and eyelets attach the shade cloth securely to the frame. Struts ensure that flapping is kept to a minimum.

Chains used to prevent roof spans from being blown off the support trusses.

What would you change?

Knowing what you know now...

Frank suggests that it is important to remember that lots of building materials deteriorate in the sun.

The rope and plastic latches used to fix shade cloth were affected by UV radiation and had to be repaired or replaced every one or two seasons. Frank recommends using pre-tensioned cables to fix shade cloth to steel frames.

Also, use second-hand wheels and tyres where possible. Standard fit Holden rims are good – they are cheap and readily available.

Frank's management tip

Use latches or chains to prevent shade structures from being blown off their support beams / trusses. These structures may not be suitable for farms that regularly experience high winds.

Shade structures are lifted using a cantilever system.

Comments from the experts

The portable shade structures suit the needs of this farm very well.

Shade cloth is porous, which enables heat that is evaporated from cows underneath to vent through the cloth. This reduces humidity underneath the shade cloth and creates air movement by circulating air from the sides of the shade structure up through the material. Cows can off-load heat by means of evaporation and convection.

The small amount of radiation that penetrates through the shade cloth assists in drying out the earthen surface beneath. This improves cow comfort and reduces the risk of mastitis outbreaks.

Other options

A simple, low-cost design, but one that might not be suitable in windy conditions. Note some shade cloth tears along the edges.

An iron-roofed structure will re-radiate heat on the cows underneath, so where possible create a larger gap between the cows and roof.

Keys to success

- **IF LOCATED** near property boundaries, shade structures should be positioned to take advantage of any natural tree shade from neighbouring vegetation on road reserves.
- **RE-LOCATE STRUCTURES** if manure builds up or the ground underneath is muddy. This reduces the risk of mastitis around calving time – the risk is particularly high if the condition of cows' teat ends is poor.
- **BEFORE YOU** build your own structure, seek professional advice from a registered engineer or builder.
- **IF USING** shade cloth, install it properly under tension, so it is not damaged by winds. Make sure that it blocks at least 80% of sunlight.
- **SEEK PROFESSIONAL** advice from a registered builder or structural engineer, as the height of the portable shades will affect wind loads on the structure.
- **WIND LOAD** will increase with roof height, and therefore the base needs to be heavier and wider to prevent the wind from tipping the structure over.
- **ENSURE THERE** is a gap between the portable sections of the roof (when raised), so that heat can be vented through the top of the structure. This is especially important for iron roofed structures.
- **ENSURE THE** footings and the base of the structure is wide enough to support the roof spans – this needs to be worked out for the specific individual structure.

Paddocks & laneways

Sprinklers

Priorities for cooling cows

1. Use shade first

Minimise heat gain – block solar radiation

2. Use sprinklers and fans

Maximise heat loss – encourage evaporative cooling

Providing shade minimises heat gain in cows in the first place, but if they have accumulated heat load, then you need to do all you can to maximise heat loss via evaporation.

Paddock sprays and sprinklers wet the cow's hair and skin. As the water evaporates, heat is off-loaded from the cow to the surrounding environment. This increases with air movement.

Sprays and sprinklers work best in low humidity conditions.

Paddock sprays & sprinklers

Cows cool themselves by standing in the evaporative zone of paddock sprays rather than directly under the water.

Strengths:

- Cheap capital outlay.
- Effective method of cooling a large number of cows.

Limitations:

- Requires access to reliable water supply.
- Needs to be shifted daily.
- Effective in low humidity areas only.

'Cow Cooler' water jet sprinkler.

Case study

Paddock sprinkler

Background

Terry farms in an irrigation district. He bought a towable 'Cow Cooler' water jet sprinkler with a geared head after hearing about its success from a number of other farmers.

The unit is mounted on a frame that is equipped with a fire fighter pump and long suction hose that can draw water from on-farm channels, dams or tanks. The system was designed by an ex-dairy farmer from Kyabram in Victoria.

The system is suited to most dairying regions that have dry temperate climates with low humidity, as long as water is available for pumping. It requires a close, reliable water source.

On days where the temp is 30°C or more, the 'cow cooler' starts operating at 10-11 am. The cows can move in and out of the water jet while they are grazing or feeding from the hay rings if they are confined from fresh pasture.

Terry said the cows will come and cool down then move back to grazing away from the water jet. When they are cooling themselves they never stand directly under the jet of water but rather stand close to the mist that comes off the jet in the 'evaporative zone'.

On very hot and humid days over 35°C the cows are shifted from the pasture paddocks to a loafing paddock with tree shade, water and hay rings located within 100 m of the dairy. During these days the cows move back and forth from the shade to the water jet, and some also feed from the hay rings.

The unit runs on petrol and the petrol tank holds about 10 litres of fuel, which can operate the pump for about 18 hours at 75-85% of maximum engine revs.

Farmer's name: Terry

Facts about the sprinkler system:

- Designed by: Local ex-farmer
- Installed by: Terry
- Lifespan: Been operating for seven years without failure, minimal rusting

Other cooling infrastructure on this farm:

- Loafing paddock 100 m from dairy with tree shade, water and hay rings

The herd facing downwind cooling their backs.

Terry's comment

The pump can be used for other applications by simply removing the water jet (the green unit shown in the photographs).

I use it for general washing and flushing jobs around the farm.

Case study

On average, petrol is added every second day at a cost of about $12.50 (e.g. 10 L of fuel at $1.25/L).

The unit was bought in 2002/03 for $3,300 ($4000 at today's prices) and includes the following features:

- 5 HP motor with 5 cm Davey fire fighter pump
- 30 m; 5 cm suction hose
- 3.5 cm jet (orifice diameter)
- Geared head to control movement of the jet – it can be stationary or complete a full rotation
- Small splash plate creates a mist of water that cover the cows
- Application radius is 30 m
- Height of sprinkler orifice – about 2 m from the ground
- The head is angled at about 20° and shoots water to a height of about 5 m
- Water use efficiency is between 3,000 and 3,500 L/hr.

Set up into the wind – cows standing downwind in the 'evaporative zone', not directly under the water jet.

Comments from the experts

The cow cooler adheres to the key principles of a sprinkling system by providing large droplets of water that wet the cow's hair coat to the skin. The water then evaporates.

Portable and quick to set up, it is a good way to help cool large numbers of cows in the paddock when shade is limited. It is a cheap investment that can also be used for other jobs around the farm.

It is an option suitable for those farmers who graze cows throughout the hot season. It should be considered as a supplement to paddock shade, not a substitute.

Geared head which can stay stationary, complete short arcs or 360° rotations.

Terry's management tip

Shift the cow cooler daily, otherwise cows will pug the wetted area then start sitting in the wet, muddy patches.

If this occurs then the cell count may increase dramatically so get onto it early.

Centre pivots and travelling irrigators

Centre pivots and travelling irrigators can also provide cows with evaporative cooling on warm to hot days.

This photo was taken in south-east South Australia on a 40°C day with strong northerly winds.

The pivot was orientated east-west.

Note that the majority of the 700-cow herd is standing in the 'evaporative zone' south of the sprinklers rather than directly under the sprinklers.

Keys to success

- **SHIFT PADDOCK** sprinkler daily to avoid pugging and cows sitting in wet/muddy patches and so reduce the risk of mastitis.
- **A CLOSE,** reliable water source.

Dairy yard

Shade structures

Priorities for cooling cows

1. Use shade first

Minimise heat gain – block solar radiation

2. Use sprinklers and fans

Maximise heat loss – encourage evaporative cooling

Minimising heat gain through shade should be the first priority for farmers hoping to keep their cows cool.

There are two main options for providing shade in the dairy yard.

The cheapest is shade cloth and if well-constructed and maintained it can have a lifespan of at least 10 years. Solid-roofed shade structures last much longer, but are more expensive to build.

If complemented with sprinklers and air movement at milking time, shade provided at the dairy yard is particularly effective in cooling cows. If the cows' skin is wet, air movement enhances cooling. It also allows for faster milk let down and more incentive for the herd to walk to the dairy.

Shade cloth structures

Shade cloth minimises solar radiation – the cows can voluntarily seek shade to off-load heat via evaporation.

Strengths:

- Shade cloth is porous, so heat evaporated from cows can vent through it.
- The small amount of radiation that penetrates through the shade cloth ensures the concrete surface regularly dries out, which prevents mould/bacteria from establishing on the concrete and reduces risk of the cows slipping.
- Can be manufactured off-site then installed in a day.
- Can be removed in cooler months.
- In most council areas no planning permit is required, as shade cloth is not considered a solid roof structure.

Limitations:

- Can be affected by hail damage and machinery exhausts.
- Shorter lifespan compared to a solid-roofed structure.
- If not well-designed and constructed, shade cloth can rip in high wind.

Solid-roofed structures

Strengths:

- Offers significant protection from both solar radiation and wet conditions.
- Improves the operating environment for milking staff.
- Much longer useful lifespan than a shade cloth structure.

Limitations:

- A building permit is required.
- There is a significant cost to build and it may take several weeks to build.

Case study

Dairy yard shade cloth structure

Background

Over the past 30 years extensive tree planting has been undertaken on this property, but a number of these plantings have died as a result of water stress due to on-going drought. With insufficient tree shade for the grazing rotation and the reduced availability of irrigation water, the property has had to rationalise its total irrigable area. In addition, the original Jersey herd was changed to Holstein-Friesians, which are more affected by heat stress.

These factors required a re-think about how to reduce the impact of heat stress on the herd, so alternate means of providing shade were considered.

The owners organised for their nutritionist to complete a cost-benefit analysis of the capital cost and payback of the shade structure and sprinkler system based on potential milk loss due to heat stress.

A 110 x 100 m feedpad was built in 1996 and the shade structure over the dairy yard was installed in 1997.

Farmers' names: James, Rose and Glenn

Facts about the shade structure:

- Designed by: Local contractor
- Built by: Contractor built steel frame on-site, farm staff assisted with the placement and securing of shade cloth over the frame; took 2-3 weeks
- Lifespan: Now 13 years old and not showing any signs of deterioration; expected to last at least another 10 years

Other cooling infrastructure on this farm:

- Low-pressure sprinklers along feed alleys of feedpad
- Sprinklers at top of yard to pre-cool concrete, plus both sides of dairy yard
- Extensive tree plantings in majority of milker paddocks

Do your figures before you start ...

A 20 m x 20 m yard area can be covered with shade cloth for about $17,000-$20,000 (incl. support posts, footings and concrete, shade cloth manufacture and installation with a 10-year warranty).

Comparatively, a gable-style steel roof designed and installed to meet local council building standards could cost up to about $50,000, but the useful lifespan will be around 20-30 years.

Case study

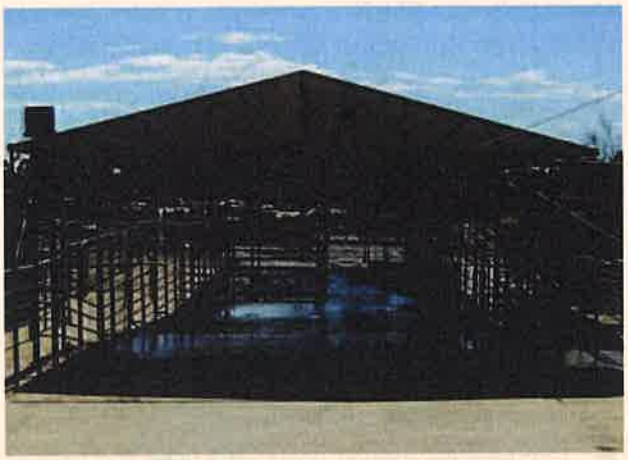
The dairy is centrally located. The top of the yard where the cows move on to the milking platform is not covered by shade cloth, however there are sprinklers located on both sides of the yard fence. These are used to pre-cool the yard before the afternoon milking.

When temperatures reach 28-30°C, cows usually walk back to the feedpad and shaded yard at around 10.30-11 am. In summer and early autumn the herd spends about seven hours a day on the feedpad and shaded area, not including the pre-milking feeding time.

The shade cloth area is equipped with oscillating garden sprinklers that are used to pre-cool the yard before the afternoon milking and this allows cows to off-load heat via conduction through their contact with the cooler concrete surface. The feedpad has low-pressure water jet sprinklers along each feed alley.

Support posts were installed in the top section of the dairy yard so that the shade structure could be extended over the whole yard, but this has not been done. At most, a cow will spend an hour in the uncovered section before milking. The farmers feel there is no justification for extending it as the cows never show signs of heat stress when entering the platform. The overhead sprinklers can be used in the uncovered section of the yard if required.

Four oscillating garden sprinklers are mounted upside down on the southern side of the yard (right hand side of the photo).



Southern end of the dairy yard covered with shade cloth, feedpad in the background.

James' comment

The cows are not stressed or spending time and energy trying to get cool. They are eating and producing milk instead!

The herd is calmer during milking, which makes the job for the milkers less frustrating and less stressful overall.

Also, we think that the cooling infrastructure has helped remove the fluctuations in our in-calf rate.

Case study

The steel trusses and support posts; 90% solar rating shade cloth cost $8,000 for materials, construction and installation in 1997 (about $20,000 in today's dollars).

The shade cloth structure has the following dimensions:

- Area under shade in the holding yard – 37 m long x 12 m wide.
- Uncovered section of the holding yard – 13 m long x 12 m wide.
- 11 trusses were used with 3.4 m spacings.
- Height of apex was 4.2 m.
- Pitch of shade cloth was calculated once truss and apex height was confirmed.
- Circular steel support posts were used and spaced about every 3.4 m.

Water for the property is sourced from the irrigation channel as part of the property's allocated water.

Two pumps supply pressurised water to the property (one acts a back-up or, alternatively, they can be run in series if demand is high).

Tech screws and metal plate that attach the shade cloth to the steel frame (shade cloth is stretched over the frame – not attached to the apex of the frame).

Roof trusses

Comments from the experts

This property exemplifies all the key principles associated with providing shade and shelter for the herd.

In addition to the shade cloth structure over the southern end of the dairy yard, the property also has sprinklers along the feed alleys of the feedpad, under the shade cloth and on the fence of the uncovered portion of the dairy yard. Tree plantings mean that the farmers can also provide paddock shade and shelter for the herd in both hot and cold conditions.

The combination of the feedpad and cooling infrastructure ensures the herd is willing and able to eat on hot days. They would average more 'fully fed' days than comparable herds that have no access to shade and shelter.

For more information about shade cloth structures, go to page 49.

Case study

Dairy yard solid-roofed shade structure

Background

This farm in the southern Riverina in NSW has opted for a solid roofed structure over its dairy yard. The 400-cow Holstein-Friesian herd averages more than 10,000 litres/cow/lactation and with batch calving there are plenty of cows in early lactation in the hot months, so minimising heat stress is a priority.

The farm operates a 'hybrid' feeding system. During summer there is no pasture available to graze and the herd is fed a total mixed ration (TMR) on a feedpad, so managing heat stress by using paddock shade is not an option.

The farmer chose to focus cow cooling efforts at the dairy rather than the feedpad because the dairy yard has a cement floor. Increased lameness risk by having cows standing on concrete for long periods was outweighed by the increased risk of mastitis if cows spent all day under a shade shelter in a bare paddock or on a earthen feedpad.

The fact that the herd is milked three times a day further swayed the farmer in favour of investing at the dairy yard.

Initially, sprinklers and a shade cloth were installed, but in 2009 the decision was made to replace the shade cloth with a permanent pitched roof made of steel and corrugated iron that follows the profile of the dairy shed roof.

The shade structure has the following dimensions:

- The dairy yard roof is 30 m by 15 m.
- The roof is 3.7 m high at the eaves – pitched at 20°.
- Open ridge vent is 300 mm wide.

Craig's management tip

To gain from evaporative cooling, ever cow needs to feel the air moving. Fans in the dairy yard give cows more benefit from the sprinklers, especially on hot, still days.

Farmers' names: Craig and Penny

Facts about the shade structure:

- **Designed by: Local contractor**
- **Built by: Local contractor**
- **Lifespan: At least 25 years**

Other cooling infrastructure on this farm:

- **Sprinklers and fans in dairy yard**

Case study

Although it cost more than $30,000, the farmer expects the permanent roof will pay for itself within two summers through sustained feed intakes and milk production, with the added bonus of improved fertility.

Understanding how important air flow is to maximise evaporative cooling with sprinklers, and having observed that many hot days in the district also tended to be very still, the farmer has also installed 3 large fans at the entry to the shed direct air over the holding yard.

On hot days, cows spend most of their time between feeds in the dairy yard (cows can also access the dairy shed, which provides the same area of shade).

What would you change?

Knowing what you know now...

Six more fans will soon be installed further down the length of the dairy yard to help keep air moving over all cows in the yard.

The sprinkler system will also be refined with a timer, providing an adjustable on/off cycle that will conserve water.

The next major cooling investment on this farm is likely to be a shade structure over the feedpad, done in conjunction with other developments at the feedpad that will reduce mastitis risk.

Craig's comment

In the past, the heat resulted in a dip in milk production which tended to last until the end of lactation. Now with the roof, the cows' feed intake remains normal on hot days and allows us to maintain milk production.

Keys to success

Shade cloth structures

- **SEEK PROFESSIONAL** advice from a registered engineer and/or builder.
- **USE SHADE** cloth with a minimum solar rating of 80%, minimum 300 GSM (gram per square metre), and at least a 10-year warranty against UV degradation. Green or black material is preferred.
- **APPLY SUFFICIENT** tension to shade cloth to prevent damage during windy conditions. Monitor tension regularly, especially after strong winds.
- **MINIMUM HEIGHT** should be 3.6 m (ideally 4 m) to allow for adequate airflow under the structure, effective use of sprinklers and fans, and good machinery access.
- **A PITCHED** roof is better than a flat roof as it enhances convective air movement.
- **SUPPORT POSTS** used should be structural grade steel. They should be located outside the dairy yard to prevent contact with manure and water, and so they don't interfere with yard washing.
- **DEEP FOOTINGS** should be left to cure for an extended period (at least 2-3 weeks) before bearing any load.

For more information about shade cloth structures, go to page 49.

Damage to shade cloth caused by tractor exhaust. This shade cloth structure is only 3.5 m high.

Solid-roofed structures

- **USE ALUMINIUM** or white galvanised iron sheets to increase the rate of solar reflection.
- **MINIMUM HEIGHT** should be at least 3.7 m at lowest roof height and at least 4.5 m along the centre to allow for adequate airflow underneath the structure, effective use of sprinklers and fans, and good machinery access.
- **ROOF PITCH** should be at least 20° (ideally 30°) to enhance air movement.
- **A CONTINUOUS** ridge opening will promote convective heat dissipation via the 'stack effect'.
- **GUTTERING AND** downpipes should comply with the state plumbing code.

For more information about solid-roofed structures, go to page 53.

Damage to shade cloth caused by poor maintenance. Ensure that springs that become detached are re-attached as soon as possible.