MLA R&D update

Animal welfare benefits of shade

Meat & Livestock Australia funded project B.FLT.4014 to review the animal welfare benefits of shade.

Optimising welfare of feedlot cattle

Livestock care is fundamental to the success and sustainability of every feedlot. Australia's red meat customers and consumers, both domestically and overseas, seek reassurance that livestock are cared for humanely and ethically. A characterisation of what constitutes animal welfare is required before discussing the effect of shade on animal welfare.

Animal welfare is often described through the Five Freedoms. It defines that for appropriate animal welfare during an animal's life it is as free as possible from hunger, thirst and malnutrition; thermal and physical discomfort; pain, injury and disease; expresses normal behaviour; and is free from fear and distress. The five freedoms are an outcome-based system. The provisions outline the husbandry necessary to promote the outcomes. As such, the concept is easy to convey to cattle producers. In addition to the five freedoms, any outcome-based working protocol for the evaluation of animal welfare must include chronic indices of failure to cope with physical and emotional challenge (Webster, 2016).

Table 1: Five Freedoms of animal welfare

Freedom	Provisions
Freedom from thirst, hunger and malnutrition	By ready access to a diet to maintain full health and vigour
Freedom from thermal and physical discomfort	By providing a suitable environment including shelter and a comfortable resting area
Freedom from pain, injury and disease	By prevention or rapid diagnosis and treatment
Freedom from fear and distress	By ensuring conditions which avoid mental suffering
Freedom to express normal behaviour	By providing sufficient space, proper facilities and the company of the animal's own kind

Based on the Five Freedoms, and consideration of the peer reviewed literature in this review it can be advocated that providing shade to feedlot cattle during periods of excessive heat load:

- Improves freedom of choice for normal shade seeking behaviour of feedlot cattle
- Alleviates possible thirst and dehydration
- Mitigates possible thermal discomfort
- Reduces possible pain and disease
- Decreases possible fear and distress

Promotion of best-practice design shade adoption will lead to the above improvements, relative to the five freedoms, independent of breed and geographical location.

Understanding thermal regulation and shade seeking behaviour

On hotter days cattle in a field will seek shade as a natural behaviour. This does not mean that they will necessarily get 'heat stressed' if there is no shade as they can use other strategies to reduce their body's 'heat load', such as panting or reducing their feed intake. However, these alternative strategies come at a cost as they divert energy away from growth and maintaining good health.

Animals are often subject to variation in environmental temperature and respond through thermoregulatory mechanisms. Thermal regulation balances heat gain/production with heat losses to the surrounding environment in an attempt to maintain thermal neutrality. Thermal regulation can occur through either changes in their physiology (eg. panting, reducing feed intake) or behavioural mechanisms (eg. seeking shade). In contrast to physiological thermoregulation, behavioural thermoregulation offers an effective means of controlling body temperature while minimising water loss through panting and maximising time allocated to activities such as feeding.

The easiest method for determining if cattle are experiencing heat stress is by observing their panting. Cattle that breathe with their mouths open are heat stressed. A simple panting scoring system can be used. When cattle are at rest in their pens, the first sign of heat stress is open mouth breathing followed by tongue extension. The further the tongue is extended, the greater the heat load of the animal.

Excessive heat load in feedlot cattle during the summer months can result in significant production losses and animal welfare considerations. High body heat loads can develop in feedlot cattle when a combination of local environmental conditions and animal factors exceed the animal's ability to dissipate body heat. Initially it will lead to a reduction in feed intake and therefore production losses. However, with severe or prolonged elevations in body temperature, tissue organ damage can result, and in some instances large numbers of cattle in individual feedlots have been lost during these extreme weather conditions.

Some cattle breeds are genetically more heat tolerant than others. However, heat tolerance is also behavioural. Cattle may deal with lack of shade by grazing and walking in the cool of the day or at night, and by utilising good airflow to help evaporation.

Cattle will seek shade when it is available regardless of whether they are breeds adapted to hotter climates (*Bos indicus*) or southern breeds (*Bos taurus*), and even in mild climatic conditions (Rovira and Velazco, 2010; Daly 1984; Bennett *et al*. 1985; Blackshaw *et al*. 1987). Shade helps reduce heat loading from the sun, especially for dark-coloured animals that readily absorb heat. In the absence of adequate shade, animals will try to find any form of shade they can — it could be from a fencepost or another animal's shadow.

Responses to shade

The provision of shade in feedlot pens can provide cattle with an option to escape extreme heat events, or even just to regulate their physiology to minimise their body's thermal regulation effort.

Studies have shown that, in beef and dairy cattle in natural grazing environments, shade utilisation increases with increasing air temperature, solar radiation or temperature humidity index (Rovira and Velazco, 2010; Kendall et al. 2006; Tucker et al. 2008). Dairy cattle provided with increased shade allocation under pasture situations during summer spent twice as much time under shade (25% vs 50%) and showed less aggressive interactions (Schulz et al. 2010).

For feedlot steers provided with 100% solar block polyvinyl shade cloth (21.6 m^2 per head; 50% of pen area) spent from 80% to 96% of their time under shade for normal and emergency thresholds of the temperature-humidity index, respectively (Brown-Brandl et al. 2005). Whilst another study found that under non-heat wave conditions on average 50% of feedlot steers were at any time point under 70% solar block shade cloth (2.0 to 4.7 m^2/head) in a summer feedlot experiment in South East Queensland. Under heat wave conditions, on average 90% of cattle accessed shade at any time point (Sullivan et al. 2011).

The above literature demonstrates the strong biological drive of *Bos taurus* cattle to seek shade, and escape thermal discomfort.

Bos indicus cattle also benefit from shade for productivity and animal welfare. Studies with Brahman cross cattle with access to 3.3 to 4.0 m2/hd of roofed shade had reduced stress hormones, reduced respiration rate, improved hydration and had greater feed intake, gain and efficiency (Barajas et al. 2013, Barajas et al. 2018a; Barajas et al. 2018b, Ramos-Saurez et al. 2018).

Numerous scientific papers have reported the benefit of shade for decreasing respiration rate, panting score or productivity in *Bos taurus* cattle (Brown-Brandl et al. 2005; Gaughan et al. 2009; Gaughan et al. 2010; Mitlohner et al. 2001; Mitlohner et al. 2002; Sullivan et al. 2011; Hagenmaier et al. 2016).

Mortality has been prevented in severe heat waves through provision of shade. A survey in the USA of 36 farmer-feeders (9,830 head) in Iowa reported that 35 pens with shade had a mortality of 0.2% whereas 46 pens without shade had a mortality of 4.8% (Busby and Loy, 1996). Similar observations have been made in the Australian feedlot industry.

Observational evidence from Australian lot feeders indicates that cattle that experience bouts of excessive heat load, are more susceptible to bovine respiratory disease post a heat stress event as well as feed intake variation. Feed intakes of severely affected lots of cattle may never recover.

We now have good evidence that:

- Shade lowers respiration rate, panting score and stress hormones in feedlot cattle
- Shade alleviates de-hydration of cattle
- Both *Bos taurus* and *Bos indicus* cattle can respond to shade
- Shade alleviates mortality, fear and distress during heat wave conditions
- Shade improves feedlot performance

Management strategies to optimise welfare with shade

Moisture accumulation under shade can occur as shade seeking is normal behaviour for feedlot cattle as reported above.

To limit this accumulation and optimise welfare a variety of shade and/or engineering designs are recommended in the MLA Beef cattle feedlots: design and construction manual. These include:

- Retractable shade designs
- Separate panel designs
- Corrugated iron strip design with spaces to encourage drying
- Centre square designs with gaps to encourage drying
- Longitudinal shade rows in the North to South direction
- Correct inclination of shade to encourage drying in morning sun
- Covered housing systems.
- Increased shade allocation to allow the cattle the space to spread out.
- Correct shade height
- Correct positioning of water troughs away from shade

Providing shade at an appropriate density for the class of cattle allows animals to spread out, and for wind movement to encourage convection cooling and pen floor drying. Lot feeders should maintain appropriate pen cleaning intervals and surface maintenance in shaded pens.

Ongoing Research

MLA is supporting ongoing research on the animal welfare benefits of shade in southern regions of Australia. This includes determining the year-round animal welfare and production effects of conventional shade systems. Novel designs are also being explored including dual purpose shade-shelter structures that may offer some beneficial protection during rain events. Results of these projects will be made available in 2021.

References

Barajas, R., P. Garces, and R. A. Zinn. 2013. Interactions of shade and feeding management on feedlot performance of crossbred steers during seasonal periods of high ambient temperature. Prof. Anim. Sci. 29:645–651.

Barajas, R., B. Cervantes, J. Guerra-Liera, and A. Ramos-Suarez. 2018a. Influence of pen-shade area on feedlot performance of finishing bulls in a warm environment. J. Anim. Sci Vol. 96, Suppl. S3:15.

Barajas, R., B. J. Cervantes, B. O. Lopez, D. Jimenez-Leyva, and L. Avendaño-Reyes. 2018b. Pen-shade and morning versus afternoon feeding on feedlot-performance and respiratory rate of growing calves under hot weather. J. Anim. Sci Vol. 96, Suppl. S3

Bennett, I.L., Finch, V.A., and C.R. Holmes. 1985. Time spend in shade and its relationship with physiological factors of thermoregulation in three breeds of cattle. Applied Animal Behaviour Science 13:227-236.

Blackshaw, J.K., Blackshaw, A.W., and T. Kusano. 1987. Cattle behaviour in a saleyard and its potential to cause bruising. Australian Journal of Experimental Agriculture 27:753-757.

Brown-Brandl, T. M., R. A. Eigenberg, J. A. Nienaber, and G. L. Hahn. 2005. Dynamic response indicators of heat stress in shaded and non-shaded feedlot cattle, Part 1: Analyses of indicators. Biosyst. Eng. 90:451-462.

Busby, D., and D. Loy. 1996. Heat stress in feedlot cattle: Producer survey results. A. S. Leaflet R1348. Iowa Agric. Exp. Stn., Iowa State Univ., Ames.

Daly, J.J. (1984). Cattle need shade trees. Queensland Agricultural Journal 109:21-24.

Kendall, P. E., P. P. Nielsen, J. R. Webster, G. A. Verkerk, R. P. Littlejohn, and L. R. Matthews. 2006. The effects of providing shade to lactating dairy cows in a temperate climate. Livest. Sci. 103:148-157.

Gaughan, J. B., S. M. Holt, and R. H. Pritchard. 2009. Assessment of housing systems for feedlot cattle during summer. Prof. Anim. Sci. 25:633–639.

Gaughan, J. B., S. Bonner, I. Loxton, T. L. Mader, A. Lisle, and R. Lawrence. 2010. Effect of shade on body temperature and performance of feedlot steers. J. Anim. Sci. 88:4056–4067.

Hagenmaier, J.A., C. D. Reinhardt, S. J. Bartle, and D. U. Thomson. 2016. Effect of shade on animal welfare, growth performance, and carcass characteristics in large pens of beef cattle fed a beta agonist in a commercial feedlot. J. Anim. Sci. 2016.94:5064–5076.

Mitlöhner, F. M., J. L. Morrow, J. W. Dailey, S. C. Wilson, M. L. Galyean, M. F. Miller, and J.J. McGlone. 2001. Shade and water misting effects on behavior, physiology, performance, and carcass traits of heat-stressed feedlot cattle. J. Anim. Sci. 79:2327-2335.

Mitlöhner, F. M., M. L. Gaylean, and J. J. McGlone. 2002. Shade effects on performance, carcass traits, physiology, and behaviour of heat-stressed feedlot heifers. J. Anim. Sci. 80:2043–2050.

Rovira, P and J. Velazco. 2010. The effect of artificial or natural shade on respiration rate, behaviour and performance of grazing steers, New Zealand Journal of Agricultural Research, 53:4, 347-353.

Schütz, K.E., A.R. Rogers, Y.A. Poulouin, N.R. Cox, and C. B. Tucker. 2010. The amount of shade influences the behavior and physiology of dairy cattle. J. Dairy Sci. 93 :125–133.

Ramos-Suarez, A., J. Guerra-Liera, B. Cervantes and R. Barajas. 2018. Influence of Pen-shade area on hematocrit and white blood cells of feedlot cattle during hot season. J. Anim. Sci Vol. 96, Suppl. S3:10.

Sullivan, M.L, A. J. Cawdell-Smith, T. L. Mader, and J. B. Gaughan. 2011. Effect of shade area on performance and welfare of short-fed feedlot cattle. J. Anim. Sci. 2011. 89:2911–2925.

Tucker, C. B., A. R. Rogers, and K. E. Schütz. 2008. Effect of solar radiation on dairy cattle behaviour, use of shade and body temperature in a pasture-based system. Appl. Anim. Behav. Sci. 109:141-154.

Webster, J. 2016. Animal welfare: Freedoms, dominions and 'a life worth living'. Animals 6:35

Disclaimer