J. Dairy Sci. 97:3599–3605
http://dx.doi.org/10.3168/jds.2013-7649
© American Dairy Science Association®, 2014.

A field study of the behavioral and physiological effects of varying amounts of shade for lactating cows at pasture

K. E. Schütz,* N. R. Cox,† and C. B. Tucker‡[1]
*Innovative Farm Systems, Ruakura Research Centre, AgResearch Ltd., Private Bag 3123, Hamilton 3240, New Zealand
†Invermay Statistics Group, Invermay Research Centre, AgResearch Ltd., Puddle Alley, Private Bag 50034, Mosgiel, New Zealand
‡Department of Animal Science, University of California, 1 Shields Ave, Davis 95616

ABSTRACT

Shade reduces the negative effects of heat load, but little is known about how much is required for efficient cooling in commercial settings. The effect of the amount of shade on 8 Holstein-Friesian herds was studied for 2 consecutive summers (mean temperature: 23°C) on 6 commercial, pasture-based dairy farms. Farms varied in the amount of natural shade provided (range: 0 to 15.6 m^2 shade/cow). Time spent in shade, near water, eating, ruminating, lying, and standing were recorded between 1000 and 1530 h in 31 shaded and 11 unshaded paddocks using 20-min instantaneous scan observations of 15 focal cows/herd. Respiration rate and panting score (0 to 4.5) was recorded for focal animals once per hour. The total numbers of cows in shade, near water, and with panting scores ≥2 were recorded every 30 min. Cows without shade spent 4% more time lying than cows with shade (standard error of the difference, SED = 1.9%). A larger proportion of the herd had panting scores ≥2 when no shade was available (6 vs. 2% of the herd, SED = 1.2%), and respiration rates were higher by 8 breaths/min in cows without shade (SED = 4.7 breaths/min). Under the conditions tested, the maximum proportion of the herd that was observed using the shade increased by 3.1% for every 1-m^2 increase in shade size [standard error (SE) = 1.51%], and all cows were first seen simultaneously using shade when 2 m^2/cow was provided. For every 1-m^2 increase in shade, 0.3% fewer cows had panting score ≥2 (SE = 0.12%). We observed no significant relationships between the amount of shade available and any other variables. Although additional work is required to make specific recommendations, these results indicate that providing more shade allowed a higher proportion of animals to use this resource and reduced respiratory signs of heat load.

Key words: behavior, dairy cattle, physiology, shade amount

INTRODUCTION

Warm weather in summer may cause an increase in the heat load experienced by cattle and impair both animal welfare and production. Behavioral responses to high heat load include an increase in shade use (Tucker et al., 2008; Schütz et al., 2009, 2010) and time spent near water (Schütz et al., 2010; Legrand et al., 2011), decreased feed intake (Hahn, 1999; Ominski et al., 2002), and a reduction in lying time (Tucker et al., 2008; Schütz et al., 2010). Physiological responses to heat load include increases in respiration rate and body temperature (Ominski et al., 2002; Schütz et al., 2010). If behavioral and physiological mechanisms are insufficient to reduce heat load, this may lead to decreased milk production (Wheelock et al., 2010) and, in extreme cases, in mortality (Stull et al., 2008).

Shade is an important resource to cattle in summer. Cows will compete for shade (Schütz et al., 2010), and use of shade is positively related to solar radiation levels and warm weather (Kendall et al., 2006; Tucker et al., 2008; Schütz et al., 2009). Access to shade reduces respiration rate and body temperature (Kendall et al., 2007; Schütz et al., 2010, 2011) and we have previously shown that the cooling benefits of shade are greater if it blocks more solar radiation (Tucker et al., 2008) and if enough is provided for all cows to use it simultaneously (Schütz et al., 2010). For example, cows that had access to 9.6 m^2 shade/cow spent more than twice as much time in the shade compared with cows that had access to 2.4 m^2 shade/cow; in addition, respiration rates were lower and less aggressive behavior occurred when more shade was provided (Schütz et al., 2010). The findings indicate that shade may need to be large enough for all cows to use it at the same time, but the specific amount of shade needed per cow is unknown.

Recommendations in the literature range between 3.5 and 5.6 m^2 shade/cow for dairy cattle (Buffington et al., 1983; Collier et al., 2006), but these recommendations are largely based on changes in production measures

Received October 28, 2013.
Accepted March 4, 2014.
[1]Corresponding author: cbtucker@ucdavis.edu

(milk production, weight gain), which are likely to occur when behavioral and physiological responses have failed to prevent an increase in heat load. For example, beef cattle with access to >3.5 m^2 of shade/animal had higher feed intake and lower respiration rates than animals with 1.5 or 2.5 m^2 shade/animal, but did not have higher weight gain (Mader et al., 1997). In addition, all previous work has examined the effect of shade size in relatively small experimental groups. Large groups of cattle may utilize resources (e.g., shade, water, feed) in different ways than smaller groups because of differences in social dynamics. Ultimately, recommendations about the amount of shade per cow are needed at the commercial scale, thus the current work placed emphasis on on-farm conditions. In addition to limitations of experimental work, even less is known about shade provided by trees or shrubs in pasture-based systems, compared with shade structures. The aim of this study was to investigate how behavior and physiology change with amount of shade in a pasture-based, commercial dairy system in summer.

MATERIALS AND METHODS

Farms and Animals

All procedures involving animals were approved by the Ruakura Animal Ethics Committee as required under the New Zealand Animal Welfare Act 1999. Data collection was undertaken on 6 commercial dairy farms in New Zealand for 2 consecutive years from January until beginning of March (Southern Hemisphere summer). A total of 6 farms with 8 herds in the Waikato region (38°S, 175°E) were utilized. Average herd size, age, and milk production in February, for both years combined, was 213 cows (range: 148 to 280 cows), 4.5 yr (range: 2 to 17 yr), and 14.5 L/d (range: 10.4 to 19.8 L/d, based on herd bulk tank values for the month of February). Seventy-three percent of the herds were milked twice daily and 82% of herds were fed supplements (in paddock, separate paddock, or on feed pad before p.m. milking) in addition to grass.

On each farm, several paddocks were identified as suitable for observations, ranging from nonshaded paddocks (n = 11) to those that varied in the amount of available natural shade (n = 31). Observations were carried out on days when the herds were allocated to selected paddocks by the farmer following rotational grazing. Available shade in the shaded paddocks ranged between 0.89 and 15.6 m^2 shade/cow at 1200 h [median shade size was 3.8 m^2/cow ± 3.92 (SD)]. One or 2 water troughs (average height: 0.5 m, diameter: 1.3 m, circumference: 4.1 m, a float controlling the water level) were available in each paddock.

Estimation of Shade Size

To estimate the shade amount available in each paddock, we used a software program that calculates the shade cast by a solid object at different times of the day depending on season and location (WebShade, Balmain, NSW, Australia). In each paddock, the number and location of all trees, hedges, and shrubs that could cast shade, as well as the number and location of all water troughs, was recorded using a walking wheel (Fuller, Montréal, Québec, Canada). The height and width of each tree was recorded using laser binoculars with an accuracy of ±1 m and 0.1 m resolution (Leica Vector GIS, Leica AG, Heerbrugg, Switzerland). Paddock size was measured using the walking wheel, and all information was drawn to scale on millimeter-ruled paper and copied into WebShade. The program produces a shade projection per solid object based on location, date, time of day, and tree characteristics (height, width, shape). This enables calculation of the total amount of shade per paddock at different times of day and how far shade will be cast from a solid object. Shade for all observation paddocks was projected at 1000, 1200, and 1400 h, and the average was calculated. The projected shade at 1200 h around solid objects was marked using Pro-Earth plastic pin marker flags (Prospectors, Orange, NSW, Australia) to facilitate observations when shade was not visible because of cloud cover.

Behavioral and Physiological Measurements

Behavioral observations were carried out between 1000 and 1530 h (between morning and afternoon milking); this time period was chosen as the range that could be consistently measured on all farms and captures the peak of solar radiation (around noon) in this region (for description of diurnal variation in this measure in Waikato, see Tucker et al., 2008). Fifteen cows per herd were randomly chosen as focal animals and identified using tail paint (Tell-tail paint, FIL NZ Ltd., Mount Maunganui, New Zealand). For these animals, time budgets for lying, standing, and grazing were estimated using 20-min instantaneous scan sampling (Martin and Bateson, 1993); cattle had to be performing 1 of these 3 behaviors and the percentage of time engaged in each of these 3 accounted for all time observed. Cows were considered lying if their flank was in contact with the ground and standing if not. Cows were considered eating if feed (grass or supplements) was being ingested or could be seen in the mouth. Rumination was defined as chewing movements without feed in the mouth, regurgitation of feed, or both. Shade use and proximity to the water trough were also recorded with the same sampling interval. Shade use was measured in 2 ways

Download English Version:

https://daneshyari.com/en/article/10973909

Download Persian Version:

https://daneshyari.com/article/10973909

Daneshyari.com