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# Interactions of shade and feeding management on feedlot performance of crossbred steers during seasonal periods of high ambient temperature

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## ABSTRACT

*Three experiments were conducted to evaluate the influence of shade and feeding management on performance of crossbred steers during periods of high ambient temperature. Exp. 1 evaluated the influence of shade (0 vs. 3.3 $m^2$/steer) on growth performance and dietary NE. Air temperature and humidity averaged 29.7°C and 44%, respectively. Shade improved DMI (6%, $P < 0.10$) and ADG (9%, $P < 0.05$). Exp. 2 and 3 evaluated the interaction of shade (0 vs. 2.4 $m^2$/steer) and feeding schedule (providing 70% of DMI at 0630 vs. 1430 h). Air temperature and humidity for both studies averaged 31°C and 41%. In Exp. 2, providing shade increased ($P < 0.05$) DM and water intake (5 and 30%, respectively). There were interactions ($P < 0.05$) between shade and feeding schedule on ADG, gain efficiency, and dietary NE. In the absence of shade, providing 70% of DMI in the afternoon increased ADG (22%), gain efficiency (14%), and dietary NE (6%). However, in the presence of shade, feeding schedule did not affect cattle performance or dietary NE. In Exp. 3, providing shade increased ADG (14%, $P < 0.10$), gain efficiency (10%, $P < 0.05$), and dietary NE (6%; $P < 0.05$). Providing 70% of DMI in the afternoon did not affect ($P > 0.20$) ADG but increased (4%, $P < 0.10$) dietary NE. It is concluded that both provision of shade and management of feeding schedule are effective tools for improving growth-performance and efficiency of energy use in feedlot cattle.*

**Key words:** heat load, shade, feeding schedule, cattle

## INTRODUCTION

High ambient temperatures coupled with high relative humidity and solar radiation depresses growth performance of feedlot cattle (Hahn, 1997; Mader et al., 1999). Reductions in ADG are attributable to heat-load effects on energy intakes (Hahn, 1997; Mitlöhner et al., 2002). Managing heat load by altering timing of feed delivery, amount of feed delivered, or both at each feeding has improved growth performance (Brosh et al., 1998). For example, feeding cattle later in the day offsets the occurrence of peak heat increment with minimal environmental heat load (Reinhardt and Brandt, 1994; Brosh et al., 1998). Another means of reducing heat load is to reduce exposure to direct solar radiation by providing shade (Bond and Laster, 1975; Blackshaw and Blackshaw, 1994; Mader et al., 1997). A simple shade structure can reduce the radiant heat load in cattle by 30% or more through interception of direct solar radiation (Bond and Laster, 1975). The objective of this study was to evaluate the benefits of providing shade and feeding management to encourage proportionately greater feed intake during the evening and early morning hours on feedlot performance of otherwise more heat-tolerant crossbred cattle.

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## MATERIALS AND METHODS

### Location

Trials were conducted at the University of California, Desert Research and Extension Center, in El Centro, California. The center elevation is 15.2 m below mean sea level. Summer minimum and maximum daily temperatures average 22.7 and 40.2°C, respectively, with 41.0% average relative humidity.

### Animals

All procedures involving animal care and management were in accordance with and approved by the University of California, Davis, Animal Use and Care Committee. Three feedlot growth-performance trials involving 278 medium-frame crossbred steers (approximately 25% Brahman content with the remainder represented by Hereford, Angus, Shorthorn, and Charolais breeds in various proportions) were conducted.

### Experimental Procedures

***Exp. 1.*** Seventy crossbreed steers (295 ± 8 kg) were blocked by weight and assigned within weight blocks (5 steers/pen) to 14 soil-surfaced pens (5.5 m × 14.4 m with 4.22-m fenceline feed bunk and automatic waterers) in an 84-d growth-performance trial started in July 1992. Treatments consisted of 0 versus 3.3 $m^2$/steer of horizontal shade located in the central area of the pen. The orientation of the shade was east to west. The roof of the shade was galvanized steel sheets that were coated in aluminum and zinc. The roof was mounted in 7.6-cm-diameter steel pipes. The height of the shade was 3.6 m above the floor. Fences were metal pipe connected with steel cables. Waterers were float-activated water supply, fitted with a water-flux meter. Water consumption was measured weekly.

***Exp. 2.*** The experimental phase was started in August of 1993 and was 56 d long. A total of 112 crossbred steers (329 ± 3 kg) were blocked by weight and assigned within weight blocks (7 steers/pen) to 16 pens (as described in Exp. 1) with 2 shade levels (0 vs. 2.4 $m^2$ of shade/steer) and 2 feeding strategies (70% of daily feed delivery provided at 0630 h and 30% at 1430 h vs. 30% of daily feed delivery provided at 0630 h and 70% at 1430 h).

***Exp. 3.*** Ninety-six crossbred steers (244 ± 3 kg) were used in a 56-d growth performance trial that was started in July of 1998. Steers were blocked by weight and assigned within weight blocks (6 steers/pen) to 16 pens (as described in Exp. 1) with 2 shade levels (0 vs. 2.8 $m^2$ of shade/steer) and 2 feeding strategies (70% of daily feed delivery provided at 0630 h and 30% at 1430 h vs. 30% of daily feed delivery provided at 0630 h and 70% at 1430 h). Upon initiation of the trial, steers were implanted with Synovex-S (Fort Dodge Animal Health, Fort Dodge, IA).

Composition of the finishing diets for each trial is shown in Table 1. In all trials, diets were prepared at approximately weekly intervals and stored in plywood boxes located in front of each pen. Diet DM was determined (oven drying at 105°C; AOAC International, 1995) on weekly composite samples. Steers were individually weighed. Initial and final weights were reduced 4% to account for digestive-tract fill (NRC, 1984).

***Estimation of Dietary NE.*** Assuming that the primary determinant of energy gain is weight gain, energy gain (EG) was calculated by the following equation: EG =

**Table 1. Composition of finishing diets used in experiments**

| Item | Exp. 1 | Exp. 2 | Exp. 3 |
|---|---|---|---|
| Ingredient composition, % (DM basis) | | | |
| Alfalfa hay | 20.00 | 4.00 | 8.00 |
| Sudangrass hay | — | 8.00 | 4.00 |
| Steam-flaked corn | 42.65 | 75.82 | 75.60 |
| Steam-flaked wheat | 21.44 | — | — |
| Yellow grease | 4.00 | 4.00 | 4.00 |
| Cane molasses | 8.00 | 5.00 | 5.00 |
| Blood meal | 0.30 | — | — |
| Feather meal | 0.30 | — | — |
| Poultry meal | 0.40 | — | — |
| Limestone | 1.26 | 1.29 | 1.70 |
| Urea | 0.40 | 1.20 | 1.20 |
| Magnesium oxide | — | 0.19 | — |
| Sodium bicarbonate | 0.75 | — | — |
| Trace-mineral salt[1] | 0.50 | 0.50 | 0.50 |
| Nutrient composition (DM basis)[2] | | | |
| NE, Mcal/kg | | | |
| Maintenance | 2.12 | 2.28 | 2.29 |
| Gain | 1.45 | 1.60 | 1.60 |
| CP, % | 14.10 | 12.38 | 12.97 |
| Ether extract, % | 6.30 | 7.15 | 7.48 |
| ADF, % | 10.30 | 6.32 | 5.60 |
| NDF, % | 12.94 | 13.38 | 12.06 |
| Calcium, % | 0.80 | 0.63 | 0.80 |
| Phosphorous, % | 0.32 | 0.28 | 0.28 |

[1]Trace-mineral salt contained $CoSO_4$, 0.068%; $CuSO_4$, 1.04%; $FeSO_4$, 3.57%; ZnO, 0.75%; $MnSO_4$, 1.07%, KI, 0.052%; and NaCl, 93.40%.

[2]Based on tabular values for individual feed ingredients (NRC, 1984) with exception of supplemental fat, which was assigned $NE_m$ and $NE_g$ values of 6.03 and 4.79 Mcal/kg, respectively.