INTERACTIVE EFFECTS OF FORAGE AND BREED ON STEER PERFORMANCE INVOLVING ENDOPHYTE-INFECTED TALL FESCUE AND SENEPOL CATTLE

R. Browning Jr
Cooperative Agricultural Research Program
Tennessee State University, Nashville, TN, USA 37209-1561

INTRODUCTION
Tall fescue (*Festuca arundinacea* Schreb.) is a cool-season grass grazed by cattle in many parts of the United States. Most tall fescue pastures are infected with the fungal endophyte *Neotyphodium coenophialum*. The grass and endophyte share a mutually beneficial symbiotic relationship. The endophyte produces ergot alkaloids that are beneficial to host grass performance but detrimental to cattle performance (Porter, 1995). Poor growth rates usually occur when cattle consume endophyte-infected tall fescue (Paterson *et al.*, 1995). Hyperthermia often develops in cattle consuming endophyte-infected tall fescue. Heat stress is detrimental to growth rates in cattle as it influences metabolic rate and appetite (Morrison, 1983; Hahn, 1999). Heat-tolerant cattle breeds are often considered for use in production systems where heat stress is a concern (Turner, 1980; Browning *et al.*, 1995; Hammond *et al.*, 1996). The objective of this study was to assess the growth of heat-sensitive and heat-tolerant *Bos taurus* breeds when fed endophyte-infected tall fescue or orchardgrass (*Dactylis glomerata* L.), an alternative cool-season grass.

MATERIAL AND METHODS

Animals. Heat-sensitive Hereford (*n = 30; H*) and heat-tolerant Senepol (*n = 28; S*) steers were fed endophyte-infected tall fescue (TF) or orchardgrass (OG) over two summers to assess breed differences in sensitivity to the tall fescue endophyte in a 2×2 factorial experiment. Each breed was represented by several sires and two herds of origin that use endophyte-infected tall fescue as their base forage. Steers were born in the spring of 1999.

Protocol. In each study year, all 58 steers were managed as one group and fed OG hay from December to May. In May, steers were paired within breed and farm of origin by weight and randomly assigned to TF or OG experimental diets. Observations of respiration rates, daytime shade use (0900 to 1700) and body weight were made periodically from June to October, 2000 (Year 1) and June to September, 2001 (Year 2). Experimental diets were started in July. Experimental diets included hay and seed for 12 weeks in Year 1. Ergot alkaloids are highly concentrated in TF seed. The experimental diet consisted of hay for 6 weeks during the summer of Year 2.

Statistics. Data were tested with analysis of variance techniques using general linear model procedures of the SAS statistical software package (SAS Institute, Cary, NC, USA). The split-plot model for analyzing data included the terms breed and treatment in the whole plot, and time in the subplot. Data from each year were analyzed separately. Probability levels less than 0.05 for the F-statistic indicated significant differences within a main effect exist or that two- or three-way
interactions were present between breed, diet, and time. For interactions, Fisher's protected LSD procedure separated least squares means (alpha = 0.01).

**RESULTS AND DISCUSSION**

Maximum daily ambient temperature during June, July, August, and September of 2000 averaged 30, 33, 33, and 28 °C, respectively. The TF hay was 78 % infected with endophyte in Year 1. Breed×diet×time affected (P < 0.05) respiration rates. Respiration rates were similar for all breed-forage groups before treatment. Each breed-forage combination differed for respiration rates during treatment (table 1). Fescue increased (P < 0.05) respiration rates for each breed. Shade use was not measured pretreatment in 2000. During treatment, breed×diet affected (P < 0.01) shade use. As with respiration rates, each breed-forage combination differed for proportion of times that animals were observed under the shade (table 1). Increased respiration rates and shade use in HTF and STF indicated that tall fescue induced heat stress in both breeds. Pretreatment growth rates were similar among groups as no breed×diet interaction was detected. After 12 wk on experimental diet, a breed×diet interaction was detected (P < 0.01). Tall fescue reduced growth rate in Hereford, but not in Senepol steers in Year 1 under conditions of amplified hyperthermia.

**Table 1. Growth and thermoregulatory traits of Hereford and Senepol steers on orchardgrass or tall fescue**

<table>
<thead>
<tr>
<th></th>
<th>HOG</th>
<th>HTF</th>
<th>SOG</th>
<th>STF</th>
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<tr>
<td><strong>Year 1</strong></td>
<td></td>
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<tr>
<td>Respiration Rate (breaths/min)</td>
<td>77&lt;sup&gt;C&lt;/sup&gt;</td>
<td>96&lt;sup&gt;A&lt;/sup&gt;</td>
<td>50&lt;sup&gt;D&lt;/sup&gt;</td>
<td>87&lt;sup&gt;B&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>Daytime Shade Use (%)</td>
<td>53&lt;sup&gt;C&lt;/sup&gt;</td>
<td>91&lt;sup&gt;A&lt;/sup&gt;</td>
<td>5&lt;sup&gt;D&lt;/sup&gt;</td>
<td>77&lt;sup&gt;B&lt;/sup&gt;</td>
<td>5</td>
</tr>
<tr>
<td>Growth Rate (g/d)</td>
<td>581&lt;sup&gt;A&lt;/sup&gt;</td>
<td>291&lt;sup&gt;B&lt;/sup&gt;</td>
<td>551&lt;sup&gt;A&lt;/sup&gt;</td>
<td>528&lt;sup&gt;A&lt;/sup&gt;</td>
<td>39</td>
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<tr>
<td><strong>Year 2</strong></td>
<td></td>
<td></td>
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<tr>
<td>Respiration Rate (breaths/min)</td>
<td>83&lt;sup&gt;A&lt;/sup&gt;</td>
<td>88&lt;sup&gt;A&lt;/sup&gt;</td>
<td>46&lt;sup&gt;B&lt;/sup&gt;</td>
<td>52&lt;sup&gt;B&lt;/sup&gt;</td>
<td>3</td>
</tr>
<tr>
<td>Daytime Shade Use (%)</td>
<td>41&lt;sup&gt;A&lt;/sup&gt;</td>
<td>44&lt;sup&gt;A&lt;/sup&gt;</td>
<td>7&lt;sup&gt;B&lt;/sup&gt;</td>
<td>7&lt;sup&gt;B&lt;/sup&gt;</td>
<td>2</td>
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<tr>
<td>Growth Rate (g/d)</td>
<td>510&lt;sup&gt;A&lt;/sup&gt;</td>
<td>90&lt;sup&gt;B&lt;/sup&gt;</td>
<td>566&lt;sup&gt;A&lt;/sup&gt;</td>
<td>555&lt;sup&gt;A&lt;/sup&gt;</td>
<td>71</td>
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A,B,C,D Least squares means with different letter within a row are different (P < 0.01).

Random diet assignments in Year 2 resulted in 40 of 58 steers changing dietary treatment from their Year 1 assignment. Maximum daily ambient temperature during June, July, and August of 2001 averaged 29, 31, and 31 °C, respectively. The TF hay was 75 % infected with endophyte. Respiration rates and shade use were not affected by a breed×diet×time, diet×time, or diet in Year 2. As a main effect, breed affected (P < 0.01) thermoregulatory traits. Senepol steers had lower respiration rates and shade use compared to Hereford steers (table 1). Pretreatment growth rates were similar among groups as no breed×diet interaction was detected. During the 6-wk experimental diet period a breed×diet interaction was detected (P < 0.01). Tall fescue reduced growth rate in Hereford, but not in Senepol steers in Year 2 under conditions of mild heat stress. Respiratory distress, reduced daytime grazing, and reduced feed intake have been reported in cattle.
CONCLUSION
Endophyte-infected tall fescue fed during the summer significantly disrupted thermoregulatory function in steers in one of two years, exacerbating hyperthermia in the Hereford and causing hyperthermia in the Senepol. Endophytic fescue reduced weight gain of Hereford steers in both years, including the year of minimal heat stress. Conversely, weight gain of Senepol steers was not adversely affected by endophytic fescue in either year, including the year of induced heat stress. Thermoregulatory mechanisms of Senepol and Hereford cattle appear similar in sensitivity to the adverse effects of the fescue endophyte. This agrees with previous work at this location in which thermoregulatory traits of Hereford and Brahman (Bos indicus) steers were similarly responsive to acute ergot alkaloid treatment (Browning, 2000). However, the breeds differ prominently in their ability to gain weight when on an endophytic fescue diet. Senepol growth performance on endophyte-infected tall fescue suggest that heat-tolerant breeds hold potential to enhance cattle performance in production systems using endophyte-infected tall fescue as the base forage.

REFERENCES