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Performance of Purebred Senepol and Hereford Steers on Endophyte-Infected Tall Fescue in Tennessee

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Summary

Purebred Senepol and Hereford steers were fed orchardgrass or endophyte-infected tall fescue in two summers to assess breed differences in physiological responses to a fungus that infects tall fescue and causes hyperthermia and poor growth in cattle. In the summer of 2000, tall fescue increased ($P < 0.01$) respiration rates and daytime shade use in Hereford and Senepol steers compared to orchardgrass-fed contemporaries. In the summer of 2001, tall fescue did not affect respiration rates or shade use in either breed. Hereford had reduced ($P < 0.01$) weight gain on tall fescue compared to orchardgrass-fed contemporaries in both summers (291 vs 581 ± 39 g/d in 2000; 90 vs 510 ± 71 g/d in 2001). Senepol had similar growth rates on tall fescue or orchardgrass in 2000 (528 vs 551 ± 39 g/d) and 2001 (555 vs 566 ± 71 g/d). Senepol may be beneficial in tall fescue-based beef cattle production systems.

Introduction

Tall fescue (*Festuca arundinacea* Schreb.) is a cool-season grass commonly fed to cattle in the United States. The majority of tall fescue fields are infected with the fungal endophyte *Neotyphodium coenophialum*. The grass and endophyte have a mutually beneficial symbiotic relationship. The endophyte produces ergot alkaloids that enhance performance of the host grass but reduce the performance of grazing cattle. Poor weight gain occurs when cattle consume endophyte-infected tall fescue (Paterson et al., 1995). Hyperthermia often develops in cattle consuming endophyte-infected tall fescue (Osborn et al. 1992). 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). Senepol cattle have been raised in Tennessee on tall fescue diets since the mid-1980s (Linnabary et al., 1987a,b). However, their susceptibility to adverse effects of consuming the endophytic forage had not been examined. The objective of this study was to assess the comparative performance of Senepol cattle when fed endophyte-infected tall fescue.

Material and Methods

Hereford (n = 30; **H**) and Senepol (n = 28; **S**) were fed endophyte-infected tall fescue (**TF**) or orchardgrass (*Dactylis glomerata* L., **OG**) over two summers to assess breed differences in

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sensitivity to the tall fescue endophyte in a 2×2 factorial experiment. Tall fescue and orchardgrass are cool season grasses of similar nutritional quality used for pasture and hay in Tennessee. Each breed was represented by several sires and two herds that use endophyte-infected tall fescue as their base forage. Steers were born in the spring of 1999. 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 of 2000 and June to September, 2001. Experimental diets were started in July. Experimental diets included hay and seed for 12 weeks in 2000. Ergot alkaloids are highly concentrated in TF seed. The experimental diet consisted of hay for 6 weeks during the summer of 2001. Data were tested with analysis of variance techniques using general linear model procedures of SAS (SAS Institute, Cary, NC, USA). The split-plot model for analyzing data included the terms breed and treatment in the whole plot. Time and time interactions were included in the subplot. Data from each year were analyzed separately. For significant 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 averaged 30, 33, 33, and 28°C, respectively, in 2000. Tall fescue hay was 78% infected with endophyte in 2000. Breed×diet×time affected ($P < 0.05$) respiration rates. Respiration rates were similar for all breed-forage groups before treatment and were not altered ($P > 0.05$) during treatment for HOG and SOG. Each breed-forage combination differed for respiration rates during dietary treatment (Table 1). Shade utilization 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). The increased respiration rates and shade use by STF compared to HOG indicated that TF induced heat stress in both breeds. Pretreatment growth rates were similar among groups as no breed×diet interaction was detected. During the 12-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 2000 under conditions of amplified hyperthermia.

Maximum daily ambient temperature during June, July, and August averaged 29, 31, and 31°C, respectively, in 2001. The TF hay was 75% infected with endophyte in 2001. Respirations rate and shade use were not affected by a breed×diet×time or diet×time interactions. 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). Diet did not significantly alter thermoregulatory traits in 2001. 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 2001 under conditions of mild heat stress.

Table 1. Thermoregulatory and growth traits of Hereford and Senepol steers on orchardgrass or tall fescue

	HOG	HTF	SOG	STF	std. err.
Year 2000					
Respiration rate, breaths/min	77 [c]	96 [a]	50 [d]	87 [b]	3
Daytime shade use, %	53 [c]	91 [a]	5 [d]	77 [b]	5
Growth Rate, g/d	581 [a]	291 [b]	551 [a]	528 [a]	39
Year 2001					
Respiration rate, breaths/min	83 [a]	88 [a]	46 [b]	52 [b]	3
Daytime shade use, %	41 [a]	44 [a]	7 [b]	7 [b]	2
Growth rate, g/d	510 [a]	90 [b]	566 [a]	555 [a]	71

[a,b,c,d] Least squares means with different letter within a row differ ($P < 0.01$).

Respiratory distress, reduced time spent grazing, and lower feed intake levels occur in cattle consuming endophytic TF, particularly under high ambient temperature (Howard et al., 1992; Osborn et al., 1992; Peters et al., 1992). Increased respiration rates and daytime shade use in 2000 concur with those reports. Reduced growth rates in Hereford steers on TF were typical and occurred regardless of the severity of heat stress. Senepol heat tolerance is evidenced by their generally lower respiration rates and shade use in this study when compared to Hereford contemporaries. However, TF elicited clinical heat stress in the Senepol during 2000, showing the combined detrimental effects of high ambient temperature and ergot alkaloids of the TF diet on thermoregulatory mechanisms in cattle. Despite uncharacteristic heat stress, Senepol steers did not suffer poor growth after 12 weeks on the TF diet in 2000.

In conclusion, endophyte-infected tall fescue fed during the summer visibly altered thermoregulatory activity of steers in one of two years, exacerbating hyperthermia in the Hereford and causing hyperthermia in the Senepol. Endophyte-infected tall fescue reduced growth rates of Hereford steers in both years. Conversely, weight gain of Senepol steers was not adversely affected by endophytic fescue in either year. Thermoregulatory mechanisms of Senepol and Hereford cattle appear similar in sensitivity to the adverse effects of the tall 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 differed in their ability to gain weight when fed endophyte-infected tall fescue. Senepol hold potential to enhance cattle performance in endophyte-infected tall fescue-based beef cattle production systems.

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