Performance and Physiology of Steers Following Grazing of Toxic Tall Fescue as Influenced by Feeding Soybean Hulls on Pasture and Postgraze Steroid Implantation

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ABSTRACT

Carryover effects of feeding soybean hulls (SBH) on toxic tall fescue (Schedonorus arundinaceus [Schreb.]) pasture and effects of postgraze steroid implantation on performance and physiology of steers were evaluated in a 2-yr experiment. Following grazing, 36 steers were assigned to 9 pens, and pens were randomly assigned 3 to the following pasture-pen combinations: 1) feeding SBH on pasture and postgraze steroid implantation (WF/WI), 2) without feeding SBH on pasture and postgraze steroid implantation (WOF/WI), and 3) without feeding SBH on pasture and without postgraze steroid implantation (WOF/WOI). Responses to the pasture-pen combinations were regressed over days on the nontoxic diet and regression slopes were compared. Steers fed SBH on pasture tended (P < 0.10) to have greater BW at the start of the experiment than those not fed on pasture, but BW was similar to WOF/WI by the conclusion of the experiment. Average daily gain was similar (P > 0.10) between WF/WI and WOF/WI, and WOF/WI had greater (P < 0.05) ADG and BW than WOF/WOI at the conclusion of the experiment. Dry matter intake was similar (P > 0.10) among treatments and increased nonlinearly over days on the nontoxic diet and stabilized in 25 to 30 d. Rectal temperatures declined nonlinearly (P < 0.001) from above 40.2°C to less than 39.5°C in 4 d, and serum prolactin increased (P < 0.001) and stabilized in 28 to 30 d. Results indicate that feeding SBH to steers on toxic fescue and postgraze steroid implantation can improve postgraze performance, but without improving rates of recovery from toxicosis.

Key words: beef cattle, tall fescue, fescue toxicosis, rectal temperature, serum prolactin

INTRODUCTION

Fescue toxicosis is a malady that is attributed to consumption of ergot alkaloids produced by the endophyte Neotyphodium coenophialum. Fescue toxicosis was estimated to annually cost the cattle industry 460 million dollars (Hoveland, 1993), but presently the cost is probably closer to one billion dollars. Symptoms of the malady include retention of rough hair coat, elevated body temperature, labored respiration, decreased serum prolactin, and poor weight gain (Schmidt and Osborn,
Alkaloid toxicants bind biogenic amine receptors in peripheral vasculature and reduce the animal’s ability to dissipate body heat (Oliver, 2005).

Although poor weight gain and market value of cattle exhibiting symptoms of toxicosis have limited the widespread use of tall fescue for commercial stocker production (Hoveland, 1993), a significant number of feeder calves produced in the fescue belt have grazed toxic tall fescue before transport to feedyards. Dilution of ergot alkaloids by interseeding clovers or feeding concentrates has been recommended as a management option to alleviate fescue toxicosis (Ball, 1984; Ball et al., 2002). Another consideration is the common use of steroid implants in commercial feedyards to enhance weight gain and feed efficiency (Utley et al., 1980; Mader et al., 1994), which could have an effect on physiology of feeder calves that have been backgrounded on toxic fescue. Experiments have reported that elevated rectal temperature and low serum prolactin concentrations in steers grazed on toxic fescue can rapidly change after they are switched to nontoxic diets (Aiken et al., 2001; Aiken et al., 2006). Although it could not be concluded from these experiments that there was full recovery from toxicosis, it was suggested that health and well-being was improved and stabilized. Combining the feeding of concentrates or nontoxic hay on toxic fescue pasture and implantation with steroids after calves are removed from toxic fescue pastures could improve postgraze performance and physiology. A 2-yr experiment was conducted to evaluate the combined effects of pelleted soybean hulls (SBH) fed to steers on toxic fescue pasture and postgraze steroid implantation on BW changes, DM intake, rectal temperatures, and serum prolactin following removal from toxic tall fescue and placement on nontoxic diets.

**MATERIALS AND METHODS**

A pen experiment was conducted in 2004 and 2005 at the University of Kentucky Animal Research Center in Woodford County. Steers used in the experiment were used in a grazing experiment that evaluated the effects feeding pelleted SBH on steer weight gain and physiology with a protocol described by Aiken et al. (2008). The experimental protocol was reviewed and accepted by Institution’s Animal Care and Use Committee at the University of Kentucky.

The experiment was initiated after the termination of grazing on September 23 in 2004 and September 12 in 2005. Twelve steers were randomly selected from a group of 16 that were previously fed SBH on toxic fescue pasture (Aiken et al., 2008) for use in the pen experiment. These steers plus 12 steers from pastures without SBH feeding were ear implanted with Synovex-S (200 mg progesterone, 20 mg estradiol; Fort Dodge Animal Health; Fort Dodge, KS). Three combinations of pasture-pen treatments were assigned to small pens (4 steers/pen) in a completely randomized design with 3 replications: 1) feeding SBH on pasture and postgraze steroid implantation (WF/WI), 2) without feeding SBH on pasture and with postgraze steroid implantation (WOF/WI), and 3) without feeding SBH on pasture and without postgraze steroid implantation (WOF/WOI). Pens had concrete floors and were partially covered under a 3-sided barn.

**Figure 1.** Relationships between days on nontoxic diet (DNTD) and BW changes for steers grazed on toxic tall fescue pasture and subsequently placed on corn silage-concentrate rations in pens. Effects of feeding pelleted soybean hulls (SBH) on pasture and postgraze implantation with steroid hormones were evaluated with the following treatment combinations: 1) feeding SBH on pasture and postgraze steroid implantation (WF/WI), 2) without feeding SBH on pasture and with postgraze steroid implantation (WOF/WI), and 3) without feeding SBH on pasture and without postgraze steroid implantation (WOF/WOI).
Steers were fed corn silage (48.5%, DM basis), cracked corn (36.8%), and a supplement (14.7%) that contained corn gluten meal (11.0% in total diet DM), limestone (1.2%), ground corn (0.5%), salt (0.5%), urea (0.3%), dicalcium phosphate (0.7%), vitamin A, D, and E premix (0.02%; Burkman Feeds; Danville, KY), and Rumensin 80 (0.01%; Elanco Animal Health; Greenfield, IN). The silage-concentrate mixture was fed free-choice to target approximately 5% orts. The cattle were fed daily between 0900 and 1000 h; feed samples were collected weekly and dried in a forced-air oven for 72 h to determine DM. Feed bunks were cleaned weekly to measure total orts, and the orts were subsampled to determine DM. Total dry weight of orts was subtracted from total dry weight of feed and divided by 7 to estimate daily feed consumption. For days the cattle were weighed, total daily pen consumptions were divided by total BW to calculate DM consumption as a percentage of BW. The cattle were weighed unshrunken on d 0 (before initial placement in pens), 7, 14, 28, 43, 56, and 70 in 2004, and on d 0, 7, 16, 31, 44, 58, 71 in 2005. Weights recorded on d 14 in 2004 and on d 16 in 2005 were used as initial BW for calculating ADG during the pen experiment to allow sufficient ruminal turnover from forage to the silage-concentrate diets and to allow enough time for ration adjustment to minimize differences in gut fill.

Rectal temperatures were recorded using a Cooper digital thermometer (Cooper-Atkins Corp., Middlefield, CT) on d 0, 1, 2, 5, and 7 in 2004 and on d 0, 1, 2, 3, 6, 7, 10, and 16 in 2005. Approximately 10 mL of blood was collected from the jugular vein of each steer on days rectal temperatures were recorded and on d 14, 28, 43, 56, and 70 in 2004 and on d 31, 44, 58, and 71 in 2005. Blood was centrifuged for 15 min at 10,000 × g to obtain serum, which was stored frozen (0°C) and subsequently assayed for prolactin following procedures of Bernard et al. (1993).

Heat indices for mean daily ambient temperature and relative humidity were calculated for days that rectal temperatures were recorded with an equation described by Tarazon-Herrera et al. (1999). Weather data was collected from a weather station that was within 1 km of the experimental site.

Statistical Analyses

Responses were analyzed using PROC MIXED of SAS (Littell et al., 1996). Pen was used in all analyses as the experimental units. Year was analyzed as a random effect and as the main plot component in statistical models. Effects of pasture-pen treatment combinations on response variables were analyzed as the subplot component and days on nontoxic diet (DNTD) was evaluated as sub-subplot feature. The DNTD were analyzed as a covariate and pasture-pen treatment as a dummy variable (Freund and Littell, 1981). Least squares means for treatments were compared at 0, 35, and 70 DNTD using the PDIF option of SAS if there was a treatment effect and no interactions between treatment and the regression coefficients. Carryover effects of feeding on pasture were determined by comparing WF/WI with WOF/WI, and effects of implantation were evaluated by comparing WOF/WI with WOF/WOI.

RESULTS AND DISCUSSION

Weight Gain

Body weight increased nonlinearly over DNTD (Figure 1), with the fourth-order regression slope being

![Figure 2](image-url). Relationships between days on nontoxic diet (DNTD) and changes in DM intake for steers following grazing of toxic tall fescue pasture and placement on corn silage-concentrate rations in pens. Neither feeding soybean hulls on pasture or postgraze implantation with steroids affected (P > 0.10) DM consumption. The relationship was therefore determined using observations that were pooled over the pasture and pen treatment combinations.
significant \( P < 0.01 \). Body weight declined over the first 7 to 10 DNTD, which was likely due to a reduction in gut fill with low DM intake during the early part of the experiment. The linear regression slopes differed \( P < 0.01 \) among treatments. On the first day of the experiment, there was a tendency for greater \( P < 0.10 \) BW for steers that were fed SBH on pasture. By 35 DNTD, BW for WF/WI tended to be greater \( P < 0.10 \) than WOF/WI, and was greater \( P < 0.05 \) for WOF/WI than for WOF/WOI. By the end of the experiment (70 DNTD), BW for WF/WI and WOF/WI, and BW for WOF/WI remained greater \( P < 0.10 \) than for WOF/WOI.

Average daily gain did not differ \( P > 0.10 \) between WF/WI (1.79 ± 0.15 kg/d) and WOF/WI (1.82 ± 0.14 kg/d). There could have been some compensatory weight gain in the early part of the pen experiment that allowed WOF/WI steers to overcome the advantage of greater weight gain on pasture from feeding SBH (Aiken et al., 2008). Implantation with steroid hormones resulted in WOF/WI steers having greater final BW and ADG than WOF/WOI steers. Improved weight gain efficiency by implanting with steroid implants has been well documented with exclusive forage (Dinius et al., 1978; Mader et al., 1994) and concentrate-based (Utley et al., 1980; Rumsey, 1982; Rumsey and Hammond, 1990) diets.

DM Intake

There was a cubic increase \( P < 0.001 \) in DM intake over DNTD, but no differences \( P > 0.10 \) among treatments in the y-intercepts and regression coefficients (Figure 2). There was a steep increase in DM intake over the first 14 DNTD, followed by gradual increases and a stabilization of intake in 25 to 30 DNTD. These results compare with Hicks et al. (1990) who reported DM intake of a high-concentrate ration by steers to increase linearly and plateau in 21 to 28 d. Therefore, a carryover effect of fescue toxicosis on DM intake of the nontoxic diet was not indicated. Initial BW can influence DM intake (Thornton et al., 1985; Hicks et al., 1990), but heavier initial BW of steers fed SBH on pasture did not contribute to higher DM consumption on a relative BW basis.

Rectal Temperature

There was a cubic decrease \( P < 0.001 \) in rectal temperature over DNTD (Figure 3). Rectal temperature rapidly declined and stabilized to between 39.2 and 39.5°C in 4 DNTD. Mean ambient temperatures were generally mild (<25°C) during the monitoring period (Figure 4), which likely contributed to the rapid decline in rectal temperatures. With ambient temperatures above 25°C, Aiken et al. (2006) reported that rectal temperatures of steers grazing toxic tall fescue and subsequently placed on corn silage-concentrate rations in pens. Effects of feeding pelleted soybean hulls (SBH) on pasture and postgraze implantation with steroid hormones were evaluated with the following treatment combinations: 1) feeding SBH on pasture and postgraze steroid implantation (WF/WI), 2) without feeding SBH on pasture and with postgraze steroid implantation (WO/WI), and 3) without feeding SBH on pasture and without postgraze steroid implantation (WO/WOI).
that rectal temperatures did not differ in these cattle at the conclusion of grazing toxic fescue, but it is possible that steers fed SBH on pasture may have had a quicker adaptation to the pen ration that caused additional heat increment from higher gut fill, greater nutrient metabolism, or both. However, as previously discussed, steers fed SBH on pasture did not have greater DM intake. Rectal temperatures for WF/WI steers stabilized slightly above 39.2°C, whereas they stabilized at approximately 39.2°C for the WOF/WI and WOF/WOI steers. Although rectal temperature of cattle is affected by ambient temperature, a rectal temperature of 39.2°C for cattle is considered conducive to a healthy and stable animal in a thermal neutral environment (Smith, 1986).

**Serum Prolactin Concentrations**

Although prolactin has not been implicated as a causal factor in fescue toxicosis (Strickland et al., 1993), the hormone is used as a marker of toxicosis because it is consistently in low concentrations in cattle exhibiting toxicosis (Sleper and West, 1996). There was a cubic increase \( P < 0.001 \) in prolactin concentrations over DNTD and the y-intercepts and regression terms were similar \( P > 0.10 \) among treatments (Figure 5). Serum prolactin initially was very low (< 5.0 ng/mL), but rapidly increased over a 14-d period and was followed by gradual increases until serum prolactin stabilized at concentrations >80 ng/mL in 28 to 30 DNTD.

Prolactin concentrations in steers following grazing of toxic tall fescue and placement on nontoxic diets have shown to rapidly increase and stabilize in 8 to 10 d (Aiken et al., 2001). In a similar experiment, Aiken et al. (2006) reported that prolactin concentration had increased but had not stabilized by 10 d following removal from toxic tall fescue. Factors associated with the animal (e.g., genetics, BW, and body condition) and environment (e.g., ambient temperature and photoperiod) likely combine to affect the time for prolactin to increase and stabilize.

**IMPLICATIONS**

Results indicated that feeding SBH on toxic fescue pasture can generate greater BW, but postgraze implantation with progesterone and estradiol steroids of cattle not fed on pasture can provide compensatory weight gain to cancel the higher, postgraze BW from feeding SBH on pasture. Dry matter intake increased and stabilized in 25 to 30 d and was not influenced by the pasture-pen treatment combinations. Rectal temperature rapidly declined and stabilized in 4 d, and serum prolactin increased and stabilized in 28 to 30 d. Results showed that feeding SBH on toxic fescue pasture can generate greater postgraze BW, but BW of nonfed
cattle can be compensated by implanting with steroids. Physiology and well-being of cattle exhibiting fescue toxicosis can rapidly improve once they are placed on nontoxic diets; however, it cannot be determined from the data if there was complete clearance of ergot alkaloids from the tissues of these cattle.

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