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Effects of corn steep liquor supplementation on performance and herbivory patterns of beef

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Effects of Corn Steep Liquor Supplementation on Performance and Herbivory Patterns of Beef Cows Grazing Native Range Infested with Sericea Lespedeza (*Lespedeza cuneata*)

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Introduction

Sericea lespedeza (*Lespedeza cuneata*) is classified as an invasive plant throughout the Great Plains, and approximately 600,000 acres of grassland in Kansas have been infested with this species. The aggressive nature of the plant decreases native grass production by up to 92% through a combination of prolific seed production, canopy dominance, and production of chemicals that are harmful to other plant species. Herbicides retard the spread of sericea, but their application is expensive. Moreover, herbicides can be lethal to ecologically important, non-target plant species. Goat grazing has been shown to reduce sericea lespedeza seed production significantly, but widespread use of goat grazing faces significant cultural and economic challenges in the Kansas Flint Hills.

Increased grazing pressure on sericea lespedeza by beef cattle, the most economically relevant herbivore in the region, may slow its spread and facilitate some measure of biological control. Unfortunately, mature plants contain high levels of condensed tannins that decrease protein digestion by beef cattle, and these compounds are potent deterrents to grazing. Supplementing corn steep liquor has been shown to alleviate the negative effects associated with ingestion of condensed tannins when beef cattle are fed prairie hay contaminated with sericea lespedeza. In addition, beef cows supplemented with corn steep liquor did not discriminate between sericea lespedeza-contaminated and sericea lespedeza-free prairie hay in a preference trial. Therefore, the objective of our study was to evaluate the effects of supplemental corn steep liquor on herbivory patterns and performance of beef cows grazing native tallgrass rangeland infested with sericea lespedeza.

Experimental Procedures

Our study was conducted from May 1 through October 1, 2011, in Chautauqua County, KS, on nine native tallgrass pastures located approximately 10 miles southeast of Sedan. Pastures were burned April 10. Plant species composition of pastures was estimated immediately before initiation of the trial using a modified step-point technique (Table 1).

Lactating crossbred beef cows with calves ($n = 145$; initial cow body weight = $1,276 \pm 201$ lb; initial calf body weight = 306 ± 71 lb) were blocked by age and calving date and assigned randomly to one of two treatments. Treatments consisted of no supplementation or supplementation with corn steep liquor. Cow and calf body weights were measured at monthly intervals from June 1 through October 1; cow body condition scores (scale = 1 to 9; 1 = emaciated, 9 = obese) also were assessed at those times. Cow-calf pairs were allowed to graze freely from May 1 through October 1. Cows were

exposed to natural-service breeding from May 1 through July 15. Calves were weaned September 1 at an approximate age of 200 days. Cow pregnancy rates were determined by rectal palpation 75 days after bulls were removed from pastures.

Native tallgrass pastures (9 pastures; 124 ± 42 acres each) heavily infested with sericea lespedeza were assigned randomly to the unsupplemented and supplemented treatments. Animals were assigned randomly to pastures within designated treatment groups. All pastures were stocked at 1.2 acre/animal unit months (AUM), a rate typical of the Kansas Flint Hills. Beginning June 1, cow-calf pairs were fed supplemental corn steep liquor that was delivered 3 times per week in portable feed bunks (2 linear feet of feeder space per cow). Delivery of corn steep liquor was prorated for an average daily intake of 1.0 gallon/cow daily (i.e., 4 lb dry matter per cow daily). Prior research reported that 4 lb corn steep liquor per cow daily (dry basis) provided complete relief from the symptoms of condensed tannin consumption among beef cows fed prairie hay contaminated with sericea lespedeza. Corn steep liquor, a viscous, liquid byproduct of wet-corn milling, was purchased from Archer Daniels Midland in Columbus, NE, and each truckload was sampled randomly to determine chemical composition (Table 2).

Two permanent 330-foot transects were established in each pasture at the onset of the trial (June 1) to estimate aboveground forage biomass, botanical composition, and sericea lespedeza herbivory. Total forage biomass and sericea biomass were estimated by clipping all live plant material from within randomly placed sampling frames (10 in.²; 10 frames per pasture) at a height of 0.4 in. on June 1, July 1, August, September 1, and October 1. Sericea lespedeza and all other forage plants were placed in separate paper bags. Samples were sun-dried at the collection site for subsequent laboratory analysis. Herbivory of individual sericea lespedeza plants was estimated visually at the end of the study (October 1) at 16-foot intervals along each transect. The closest sericea lespedeza plant to each point was examined for evidence of defoliation (Table 3).

Results and Discussion

No performance differences were observed throughout the duration of the study. Forage quality followed an anticipated pattern from June through October (Table 2) but was generally greater than previously reported for annually burned, native tallgrass prairie during the summer months. Improved forage quality is typical of moderate drought conditions due to abnormally slow rates of forage maturation. Forage crude protein contents were relatively high during May and October and were lowest during August, following the hottest, driest month of the year. Concentrations of neutral detergent fiber (NDF) and acid detergent fiber (ADF) were generally the inverse of crude protein. Interestingly, concentrations of crude protein and NDF in sericea lespedeza were generally more favorable than the average of available pasture forage on a month-by-month basis.

Initial, average, and final total forage biomass and sericea lespedeza biomass did not differ ($P \geq 0.52$) between treatments (Table 3). As expected, corn steep liquor supplementation did not have an immediate, pasture-scale influence on sericea lespedeza biomass availability. The proportion of sericea lespedeza plants with visual evidence of herbivory tended to be greater ($P = 0.09$) on pastures grazed by supplemented cows (94.2%) compared with pastures grazed by unsupplemented cows (80.2%; Table 3).

Supplemental corn steep liquor fed at 4 lb of dry matter per cow daily was associated with increased herbivory of sericea lespedeza during a summer grazing season. Moreover, beef cow and calf performance were not adversely affected by condensed-tannin consumption under these circumstances. As expected, corn steep liquor supplementation did not have an immediate, pasture-scale influence on sericea lespedeza biomass availability; however, we speculated that repeated applications of corn steep liquor supplementation on sericea lespedeza–infested tallgrass pastures may impair seed-producing capabilities of the plants, potentially leading to a long-term decline in plant numbers for sericea lespedeza.

Implications

The cost of the corn steep liquor at the initiation of our trial was \$61/ton; cost per cow was estimated at \$26.40 for the 120-day period of our study (i.e., $8.8 \text{ lb} \times 120 \text{ days} \times \$0.031/\text{lb}$; as-fed basis).

A liquid feed-handling system and portable feed bunks ($10 \times 1 \text{ ft}$) were purchased to store and feed the corn steep liquor at an installed cost of \$6,000. Assuming a 5-year period of depreciation, the annualized cash cost of this equipment was \$1,200. For a 100-head cow herd, cost for the storage system and bunks would have been \$12/cow annually. Delivery of corn steep liquor three times weekly (i.e., 40 deliveries/season @ \$20/delivery) was estimated at \$8/cow annually. Under these conditions, cost for supplementation with corn steep liquor was estimated at \$46.40/cow annually. A commonly used stocking rate across the Flint Hills of Kansas is 8 acres/cow during a 6-month summer grazing season, so cost for corn steep liquor supplementation was estimated at \$14.28/acre annually (i.e., $\$46.40 \div 8 \text{ acres}$). Treating sericea with herbicides was estimated to cost \$12–16/acre annually at the time of this writing. It remains to be seen whether or not supplementation of cows with corn steep liquor will provide a degree of control comparable to that achieved with annual herbicide treatment.

Table 1. Botanical composition of native tallgrass pastures grazed from May 1 through October 1

Item		Percentage
Grasses		83.22
Big bluestem	<i>Andropogon gerardii</i>	19.50
Little bluestem	<i>Schizachyrium scoparium</i>	16.94
Sedges	<i>Carex</i> spp.	14.11
Indiangrass	<i>Sorghastrum nutans</i>	7.88
Scribner's panicum	<i>Dichanthelium oligosanthos</i>	5.00
Tall dropseed	<i>Sporobolus asper</i>	4.94
Switchgrass	<i>Panicum virgatum</i>	2.44
Sand paspalum	<i>Paspalum setaceum</i>	2.17
Green bristlegrass	<i>Setaria geniculata</i>	1.89
Hairy grama	<i>Bouteloua hirsuta</i>	1.67
Purple top	<i>Tridens flavus</i>	1.33
Sideoats grama	<i>Bouteloua curtipendula</i>	0.50
Blue grama	<i>Bouteloua gracilis</i>	0.17
Other grasses	<i>n</i> = 21	4.68
Forbs		14.29
Lance-leaf ragweed	<i>Ambrosia bidentata</i>	2.38
Western ragweed	<i>Ambrosia psilostachya</i>	1.42
Grassleaf goldenrod	<i>Euthamia graminifolia</i>	1.28
Sericea lespedeza	<i>Lespedeza cuneata</i>	0.96
Heath aster	<i>Symphotrichum ericoides</i>	0.59
Purple prairie clover	<i>Dalea purpurea</i>	0.03
Dotted gayfeather	<i>Liatris punctata</i>	Trace
Other forbs	<i>n</i> = 67	7.63
Woody plants		2.49

Table 2. Nutrient composition of range forage, sericea lespedeza, and corn steep liquor available to beef cows and calves grazing native tallgrass pastures (dry matter basis)

Item	Constituent ¹						
	% DM	% OM	% CP	% NDF	% ADF	% Ca	% P
Range forage							
June 1	92.0	92.6	9.1	53.1	37.2	0.91	0.11
July 1	91.7	93.0	9.2	47.3	36.5	1.08	0.08
August 1	91.8	93.0	7.3	53.5	39.0	0.95	0.08
September 1	91.9	93.3	9.9	46.3	36.3	1.02	0.10
October 1	92.1	93.7	11.1	45.4	38.5	1.09	0.12
SEM	0.05	0.10	0.03	0.55	0.56	0.024	0.005
Sericea lespedeza							
June 1	91.5	93.4	13.1	39.2	33.9	1.19	0.12
July 1	91.5	94.0	11.0	41.7	39.5	1.19	0.08
August 1	91.8	94.3	11.3	43.1	38.4	1.07	0.12
September 1	91.8	94.5	10.6	40.5	41.2	1.23	0.10
October 1	91.8	93.9	13.0	37.1	36.6	1.23	0.13
SEM	0.05	0.02	0.04	0.38	0.58	0.029	0.003
Corn steep liquor	45.1	88.1	34.4	3.1	2.0	0.11	1.90

¹DM = dry matter; OM = organic matter; CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; Ca = calcium; P = phosphorus.

Table 3. Effects of corn steep liquor supplementation on range forage biomass, sericea lespedeza biomass, and sericea lespedeza herbivory by beef cows and calves grazing native tallgrass pastures

Item	Unsupplemented	Supplemented	SEM	P-value
Initial total forage biomass, lb dry matter/acre	1,852	2,019	809	0.87
Average total forage biomass, lb dry matter/acre	2,312	2,445	867	0.88
Final total forage biomass, lb dry matter/acre	3,309	4,014	809	0.52
Initial sericea lespedeza biomass, lb dry matter/acre	231	310	568	0.92
Average sericea lespedeza biomass, lb dry matter/acre	703	1,048	563	0.55
Final sericea lespedeza biomass, lb dry matter/acre	1,939	2,214	568	0.72
Sericea lespedeza stems grazed, % of total	80.2	94.2	6.7	0.09