THE USE OF SHEEP ON LEAFY SPURGE INFESTED RANGELAND IN A MULTI-SPECIES APPROACH

by

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Introduction

Leafy spurge (***Euphorbia esula* L.**) is North Dakota's most destructive noxious weed, invading about one million acres of North Dakota, primarily rangeland (North Dakota Dept. Of Agriculture 1996). Chemicals continue to be the primary method of attempting control or eradicate leafy spurge (Lym et al. 1995), however, it is not economically feasible to control large infestations (Bangsund et al. 1996). Many areas infested with leafy spurge are environmentally sensitive, including wooded areas, stream and river banks, or on lands with a high water table. Most chemicals which provide effective control of leafy spurge cannot be applied to these sensitive areas due to the potential for damaging desirable plants and contamination of the ground water.

Use of grazing as a biological control measure has become more acceptable in the last ten years. Helgeson and Thompson (1939), and Helgeson and Longwell (1942) showed that sheep do graze leafy spurge and provide some control. However, no published reports have documented the potential use of sheep and cattle in a multi-species grazing approach to improve grass and grasslike species utilization, to increase plant richness, and to control leafy spurge on rangelands.

The objectives of this ten-year study are: 1) to determine if grazing leafy spurge infested rangeland with cattle and sheep together will improve grazing efficiency and livestock performance compared to a single class grazing program, and 2) to determine if multi-species grazing with cattle and sheep on leafy spurge infested rangeland will improve the diversity of plant species and reduce leafy spurge density

compared to single class grazing.

Data presented in this article are preliminary results covering two years of a ten-year research project.

Study Area and Procedures

The multi-species grazing project was conducted on sections 31 and 32, T139N, R81W of Morton County, on a 643-acre tract of native rangeland owned by the North Dakota State Correctional Center in south central North Dakota, approximately 2.5 miles southwest of Mandan, and on the north half of Section 9, T138N, R81W of Morton County on a 257-acre tract of native rangeland operated by the Northern Great Plains Research Laboratory. The second site is approximately 2 miles south of Mandan. Approximately 25 percent of each tract of land is infested with leafy spurge. The two tracts of land are located within the Missouri Slope Prairie region. Vegetation in this region is typical of northern mixed grass prairie (Barker and Whitman, 1988) and classified as a wheatgrass-grama-needle grass (***Agropyron, Bouteloua, Stipa***) plant community (Shiflet 1994).

The multi-species grazing project was separated into two trials. Trial #1 was used to study the effects of two different grazing management treatments, twice-over rotational grazing (TOR) and seasonlong grazing (SLG) using a multi-species approach to control leafy spurge. Trial #2 was used to study the effect of multi-species grazing (MSG) versus single class grazing (SCG) on leafy spurge density and plant diversity.

Twice-over rotational grazing treatment (TOR) consisted of **6**03 acres of native range, with a carrying capacity of 0.74 AUMs/acre (446 AUMs). The seasonlong grazing treatment (SL) consisted of 237 acres of native range, with a carrying capacity of 0.71 AUMs/acre (168 AUMs). The TOR was grazed by 96 animal units of cattle (85-1200lb cows with calves) and 33 animal units of sheep (200 mature dry ewes), or 645 grazing AUMs. The SL was grazed by 37 animal units of cattle (49-705lb yearling steers) and 13 animal units of sheep (78 mature dry ewes), or 250 grazing AUMs. Stocking rates for both treatments were 0.94 AUMs/acre. Sheep started grazing on May 15 when leafy spurge was ready for grazing (2 to 6 inches) and cattle started June 1 when cool season grass species reached grazing readiness (3 to 3.5 leafy stage). Species of livestock were removed from treatments on October 15 or when grass and grasslike plant species utilization reached 50 to 60 percent.

The MSG versus SCG trial consisted of three replicated 20 acre plots on native rangeland. Each 20-acre plot was subdivided into four five-acre quadrats, with one of the following treatments randomly assigned to each quadrat, cattle only (CO), sheep only (SO), cattle and sheep (CS), or nonuse (NU). The CO quadrat was grazed with two steers, the SO quadrat was grazed by ten sheep, and the CS quadrat was grazed by one steer and five sheep. Stocking rates were 1.4, 1.5, and 1.5 AUMs/acre for the CO, SO, and CS, respectively. Stocking rates for this trial were calculated to provide four and half months grazing for cattle and five months grazing for sheep. Livestock were removed from this trial once 50 to 60 percent utilizations of grass and grasslike species was achieved. Sheep grazing began on May 15 and cattle grazing on June 1 the same as in trial #1.

Leafy spurge density counts for Trial #1 were made within six replicated 32 by 16 foot exclosures subdivided into two 16 by 16 foot plots. Grazed and ungrazed treatments were randomly selected between the two plots. Each plot was then stratified into 12 inch^2 quadrats were randomly selected between the two plots. Each plot was then stratified into 12 inch^2 quadrats. Ten 12 inch^2 quadrats randomly selected to conduct leafy spurge density counts. Three exclosures were located within the TOR and three within SL. Leafy spurge density counts on Trial #2 were obtained using a permanent 109 yard transect with counts made every five and half feet using a 12 inch^2 quadrat. Transects were selected based on leafy spurge location within the treatments to assure that leafy spurge was present along the full length of transect.

Forage production and degree of use of leafy spurge, grass and grasslike, shrub, and other forbs were determined for Trail #1 using the pair-plot clipping technique (Milner and Hughes 1968). Trial #2 production of grass and grasslike, forbs, shrubs, and leafy spurge were determined by clipping the nonuse treatment when vegetative species reached peak production in late July (Whitman et al. 1952). Nonuse areas were stratified into seven and half by seven and half yard plots. Twenty-five quadrats were randomly selected and clipped within each NU area using a 24 inch^2 frame. Degree of use of leafy spurge, grass and grasslike, forbs, and shrubs were determined for each treatment at the end of the grazing season by stratifying each treatment into seven and half by seven and half yard quadrats using a 24 inch^2 frame.

Livestock average daily gains (ADG) were determined for both cattle and sheep. Both classes of livestock were weighed prior to pasture turnout and at the end of the grazing season.

Leafy spurge stem density and percent change among treatments from 1996 to 1997 were tested for significance using the multi-response permutation procedure (Biondini et al. 1988). Herbage production and degree of use were tested for significance between treatments and years using analysis of variance procedures. Analysis of variance was also used to determine significant changes in average daily gains between treatments and years.

Result and Discussion

Twice-over Rotational Grazing Versus Seasonlong Grazing

No significant changes ($P>0.05$) were found in leafy spurge stem density in either the TOR or SL grazing systems from 1996 to 1997 (Table 1). However, when comparing the two treatments, leafy spurge stem density was reduced ($P<0.05$) on the SL but increased on the TOR (Table 2). Degree of use of grass and grasslike species, and leafy spurge increased from 1996 to 1997 in both treatments (Table 3).

Average daily gains (ADG) were significantly different between 1996 and 1997 ($P<0.05$) for all classes of livestock, except calf ADG on the TOR system and sheep ADG on the SL system. A difference

(P<0.05) between the TOR and SL ADG sheep was found for both years (Table 4). Sheep ADG on the TOR treatment was higher (P<0.05) than on the SL in 1996, however, sheep ADG on the SL was higher (P<0.05) than for the TOR in 1997.

Multi-Species Grazing Versus Single Species Grazing

Leafy spurge stem density did not change (P>0.05) in the CO, SO, CS, or NU area from 1996 to 1997 (Table 5). However, there were leafy spurge density changes among treatments. Leafy spurge density decreased (P<0.05) on the SO treatment compared to an increase on the CO and NU treatments. There were no changes in leafy spurge density between SO and CS treatments (Table 6). The cattle only treatment had a greater percent increase in leafy spurge (P<0.05) compared to the CS treatment and there were no differences (P>0.05) between the CS and NU treatments (Table 6). There were no changes (P>0.05) in herbage production for grass and grass-like species, forbs, shrubs, and leafy spurge 1996 and 1997. Degree of use of both grass and grasslike species and leafy spurge increased (P<0.05) in all treatments from 1996 to 1997.

No differences (P>0.05) were found in steer ADG between years on the CO and CS treatments. However, in 1997 the ADG of sheep in the SO treatment was lower (P<0.05) than 1996, but there were no differences (P>0.05) in sheep ADG among treatments in either 1996 or 1997 (Table 7).

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Table 1. Average number of leafy spurge stem per 12 inch^2 frame on the twice-over rotational (TOR) and seasonlong grazing (SL) treatment for 1996 and 1997.

Treatment		1996 Average	1997 Average	P-value
SL				
	Grazed	14.4	12.5	0.84
	Ungrazed	14.7	14.9	0.75
TOR				
	Grazed	13.2	15.9	0.51
	Ungrazed	8.6	10.8	0.45

Table 2. Leafy spurge stem density change in (%) for twice-over rotational (TOR) and seasonlong grazing (SL) treatments for 1996 and 1997.

Treatment		Percent change
SL		
	Grazed	-13.2^{ax}
	Ungrazed	+ 1.2^{a}
TOR		
	Grazed	+20.5^{by}
	Ungrazed	+31.1^{b}

(a denotes SL only, b denotes TOR only, and x,y denotes treatment effect.)

Table 3. Degree of use (%) of grass and grasslike species, leafy spurge, and total herbage on the non leafy spurge (native) and leafy spurge infested sites (spurge) for the twice-over rotational (TOR) versus the seasonlong (SL) grazing treatments for 1996 and 1997.

Treatment & Site	Grass and Grass-like	Leafy spurge	Total
SL			
Native 96	21%	---	15%
Spurge 96	1%	47%	16%
Native 97	32%	---	36%
Spurge 97	33%	53%	41%
TOR			
Native 96	34%	---	32%
Spurge 96	2%	40%	20%
Native 97	37%	10%	38%
Native 97	39%	62%	48%

Table 4. Average daily gains (lbs/day) for individual classes of livestock on twice-over rotational (TOR) versus seasonlong grazing (SL) for 1996 and 1997.

Treatment	1996 ADG	Standard error	1997 ADG	Standard error	P-value
SL					
Steers	2.00	0.04	1.80	0.03	0.001
Sheep	0.23	0.03	0.28	0.01	0.071
TOR					
Cows	0.78	0.05	1.00	0.05	0.001
Calves	2.30	0.03	2.30	0.03	0.797
Sheep	0.32	0.01	0.25	0.01	0.001

Table 5. Average number of leafy spurge stems per 12 inch^2 frame on mutli-species versus single species grazing study for 1996 and 1997.

Treatment	1996 Average	1997 Average	P-value
Nonuse (NU)	9.8	11.4	0.626
Cattle only (CO)	9.8	12.0	0.731
Sheep only (SO)	10.4	6.7	0.725
Cattle & Sheep (CS)	11.6	12.3	0.815

Table 6. Leafy spurge stem density change between 1996 and 1997 for multi-species versus single

species grazing.

Treatment	Percent change
Nonuse (NU)	$+16.1^{bc*}$
Cattle only (CO)	$+22.7^{c}$
Sheep only (SO)	-36.2^{a}
Cattle & Sheep (CS)	$+ 5.5^{b*}$

* Denounces a significant difference at a P<0.10 between the cattle and sheep treatment and the nonuse.

Table 7. Average daily gains for individual classes of livestock on multi-species versus single species grazing study for 1996 and 1997.

Treatment	1996 ADG	Standard error	1997 ADG	Standard error	P-value
Cattle only (CO)	1.80	0.16	1.60	0.13	0.475
Sheep only (SO)	0.16	0.02	0.07	0.02	0.001
Cattle & Sheep (CS)					
Steer	1.50	0.32	1.10	0.16	0.307
Sheep	0.16	0.02	0.09	0.03	0.056