Multi-Species versus Single Species Grazing on Rangelands Infested with Leafy Spurge

(A Three-Year Summary)

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Acknowledgments: *We would like to give a special and well-deserved thanks to the Hettinger Research Extension Center staff (Dennis Bentsen, Dave Pearson, Rich Olson, and Terri Lindquist). Also we would like to thank Dennis Whitted, Dr. Chad Prosser, Dean Cline, and Kim Vader for their help in collecting vegetative data.*

Introduction

Grazing animals can help control leafy spurge by increasing the competitiveness of desirable plants through time of grazing and selective removal of the foliage (Lajeunesse et al. 1995). Lajeunesse et al. (1995) also stated that when grasses are grazed, they are temporarily weakened and plant competition is altered in favor of leafy spurge. They also reported that similar results are present when leafy spurge is grazed and the advantage shifts to the grasses. However, leafy spurge must be grazed intensive enough and at a sufficient stocking rate to deplete root reserves to reduce the competition of the leafy spurge (Sedivec et al. 1995).

Research has shown that Angora goats reduce leafy spurge infestations and is an excellent tool to control leafy spurge (Sedivec and Maine 1993, Hanson 1994, Prosser 1995, Sedivec et al. 1995). Sheep are also an excellent tool in controlling leafy spurge (Christenson et al. 1938, Helgeson and Thompson 1939, Helgeson and Longwell 1942, Landgraf et al. 1984, Kronberg and Walker 1993). However, many disagreements still exist over sheep consuming leafy spurge (Landgraf et al. 1984) because of the aversive chemical components found in the latex of leafy spurge. This latex has been reported to be an irritant, emetic, and purgative when consumed (Lym and Kirby 1987). Selleck et al. (1962) also report that this aversive chemical found within leafy spurge can cause scours and weakness in cattle, which

can result in the death of the animal.

Prosser (1995) and Prosser et al. (1995) showed grazing cattle in combination with goats increased grass and grass-like use by cattle, reduced leafy spurge stem densities, and reduced overall leafy spurge production after two years of grazing compared with single species grazing of cattle. Since Prosser (1995) found a significant benefit with multi-species grazing using cattle and goats, and since both goats and sheep graze leafy spurge, great potential exists with cattle and sheep as a viable tool to better manage leafy spurge infested rangelands. However, no reports have documented the potential use of sheep and cattle together to improve graminoid species use, increase plant species richness, and control leafy spurge.

The objectives of this study were to: 1) determine if multi-species grazing with cattle and sheep on leafy spurge infested rangeland will reduce leafy spurge density compared to single class grazing and 2) determine if grazing leafy spurge infested rangeland with both cattle and sheep together will improve grazing efficiency and livestock performance compared with single class grazing program. This study is designed to be conducted for 10 years. This three-year summary will compete phase 1 of the project with plans to complete the project in 2005.

Study Area

This study was conducted on Section 32, T139N, R81W of Morton County owned by the North Dakota State Correctional Center in south central North Dakota, approximately two miles southwest of Mandan, and on the north half of Section 9, T138N, R81W of Morton county on native rangeland operated by the Northern Great Plains Research Laboratory, approximately three miles south of Mandan. The study area was located in 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).

Grazing treatments were multi-species and single species grazing on three replicated 20 acre blocks. Replicate one and two were within the North Dakota State Correctional Center land and replicate three on the Northern Great Plains Research Center. Each of the replicates were subdivided into four 5 acre plots and treated with either a cattle only treatment (CO), sheep only treatment (SO), cattle and sheep treatment (CS), and a non use control (NU). Treatments were randomly selected within each block. The experimental design was a randomized complete block design (RCBD).

Sheep were placed on treatments approximately 15 May when leafy spurge was ready for grazing and cattle 1 June when native cool season grass species reach grazing readiness (3-4 leaf stage). Livestock species were removed from treatments when 50 to 60 percent degree of graminoid use or before 15 September.

Each 20-acre research block had one plot grazed by two yearling steers (CO), one grazed by ten mature ewes (SO), and one grazed by one yearling steer and five mature ewes (CS). Stocking rates were about

1.5 AUMs/acre for the CO, SO, and CS treatments, respectively. Stocking rates for this trial were designed for 3.5 months of grazing for the steers and 4.0 months of grazing for the ewes.

Methods

Objectives 1

Leafy spurge density counts were obtained by using permanent 109-yard (100 m) line transects and counts collected every five meters using an 11 in^2 (0.1 m^2) quadrat. Two transects were systematically placed in each of the four replicated treatments (CO, SO, CS, and NU). One transect was selected based on leafy spurge location within the treatments to assure full length of transect comprised leafy spurge and the second transect located on non-leafy spurge infested sites for a control. Leafy spurge densities were monitored over the three years to determine effectiveness of sheep grazing. Leafy spurge densities were collected annually at the end of May. All leafy spurge stems greater than 1 inch in height were counted to minimize counting seedlings (little to no seedlings survive in an established community).

Leafy spurge, grass and grass-like, shrub, and forb herbage production was determined by clipping in late July on the NU treatment when vegetative species reached peak production (Whitman et al. 1952). The NU was stratified into 7.5 yd by 7.5 yd (7 m x 7 m) plots. A 7.5 yd (7 m) buffer strip was implemented to prevent an edge effect. Twenty-five plots were randomly selected and clipped within each NU using a 24 in^2 (0.25 m^2) frame.

Objective 2

Degree of disappearance of leafy spurge, grass and grass-like, forbs, and shrubs were determined for each treatment at the end of the grazing season by stratifying each treatment into 7.5 yd by 7.5 yd (7 m x 7 m) plots. Twenty-five quadrats were randomly selected and clipped using 24 in^2 (0.25 m^2) frame on each grazed and non use treatment to determine disappearance.

Livestock performance and production were collected for both cattle and sheep by determining average daily gain. Both classes of livestock were weighed before pasture turn out and monthly to follow performance throughout the grazing season. Final livestock weights were collected at the end of grazing season.

Data Analysis

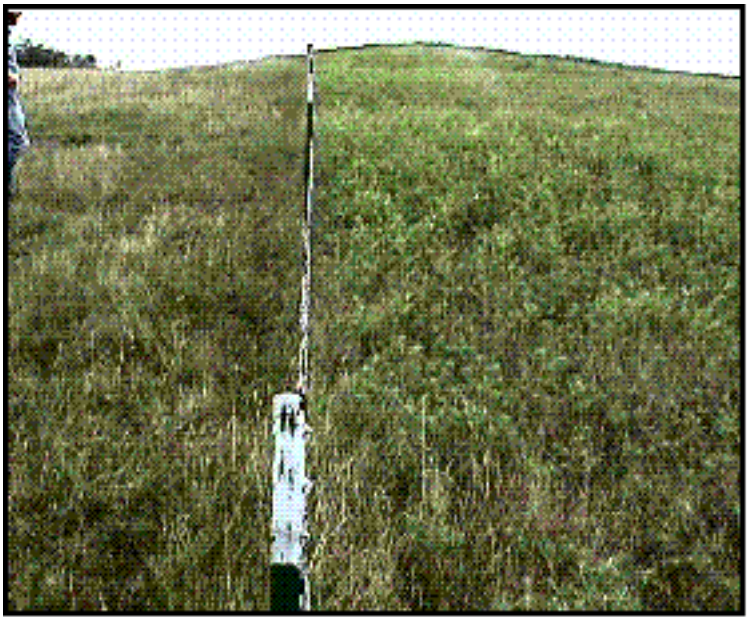
Treatment differences for leafy spurge stem density were tested between treatments and years using the multi-response permutation procedure (Biondini et al. 1988). Forage degree of use and livestock

performance between treatments and years were analyzed using analysis of variance. Significant differences were tested at a p-value < 0.05.

Results and Discussion

A significant (P<0.05) reduction in leafy spurge stems occurred after two grazing seasons on the SO treatment. Leafy spurge was reduced from 10.4 stems/11 in^2 in 1996 to 6.7 stems in 1997 and 2.5 stems in 1998, a reduction of 36% after one year (P>0.05) and 75% after two years (P<0.05) . There was no significant (P>0.05) change in leafy spurge stem density on the CS, CO, and NU treatments after two years (Table 1).

The leafy spurge stem density changes found in this study are very similar to results found in studies the use of Angora goats with and without cattle (Prosser 1995, Prosser et al. 1995, and Prosser et al. 1997). Prosser et al. (1997) showed that after one grazing season leafy spurge stem density was reduced by 30.8% on the goat only treatment; however, they found a reduction of 23.1% on the cattle and goat treatment. They also found that there was no change (P>0.05) in leafy spurge stem densities after one grazing season but a significant reduction after two years on the goat only trial.



To your right is our control treatment and to the left is our multi-species treatment.

Cattle only (right) and Sheep only (left) after two years of grazing.

Herbage production was similar (P>0.05) for all growing seasons in 1996, 1997, and 1998 (Table 2). Results would indicate that after three growing season leafy spurge has not effected the production of grass and grass-like plants, forbs, and shrub species production. Leafy spurge production also has not changed (P>0.05) during the three growing seasons.

Leafy spurge degree of disappearance increased on all treatments from 1996 to 1998 (Table 3). The SO treatment went from 76% to 98% leafy spurge disappearance from 1996 to 1998, and the CS treatment went from 62% to 88% from 1996 to 1998. There was an increase ($P<0.05$) in leafy spurge disappearance in the CO treatment with 23% disappearance in 1996 compared to 50% in 1997 and 1998. These results in leafy spurge disappearance on the CO treatment would indicate that steers were consuming leafy spurge; however, due to the design and location of watering facilities, the leafy spurge disappearance was more likely due to a trampling affect. As graminoid disappearance increased on CO treatment, so did leafy spurge disappearance, indicating with more use of the graminoids, more grazing and trampling occurs (Table 3). Grass and Grass-like degree of disappearance ($P>0.05$) was similar throughout the grazing seasons within and between grazing treatments.

Steer average daily gain (ADG) was not different ($P>0.05$) between treatments (CO and CS) for either years of the study (Table 4). There was no change ($P>0.05$) in steer ADG between years on the CS treatment. However, there was a decrease ($P<0.05$) in ADG between years 1996 and 1998 on the CO treatment. Ewe ADG was not different ($P>0.05$) between treatments (SO and CS) for either years of the study, similar to the steer performance results. There was a decrease ($P<0.05$) in ewe ADG between years 1996 and 1998 on both SO and CS treatments (Table 4). These results would indicate multi-species grazing improved the performance of the steers; however, had no negative or positive impact on sheep performance compared to single species grazing. In these three years, this improvement in steer performance was seen by having a less negative impact on performance versus the reduction in performance as seen on the CO treatment between years.

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Table 1. Leafy spurge stem densities per 11 inch^2 quadrat (standard errors in parentheses) on the cattle only (CO), sheep only (SO), cattle and sheep (CS), and control (NU) treatments for 1996, 1997, and 1998.

Treat-ment[1]	1996	1997	**% change 1996 to 1997**	**1998**	**% change 1996 to 1998**
	----------# of Stems/11 inch^2 quadrat----------				
CO	9.8 (1.2)^a	12.0 (1.2)^a	+22	10.8 (1.0)^a	+10
SO	**10.4 (0.9)^a**	**6.7 (0.7)^a**	**-36**	**2.5 (0.6)^b**	**-75**
CS	**11.6 (1.0)^a**	**12.3 (1.0)^a**	**+6**	**11.6 (1.0)^a**	**0**
NU	9.8 (1.1)^a	11.4 (1.3)^a	+16	11.1 (1.2)^a	+13

1 Years with the same letter within each treatment are not significantly different (P>0.05).

Table 2. Herbage production (lb/acre) (standard error in parentheses) on the non use treatment in 1996, 1997, and 1998.

Herbage[1]	1996	1997	1998
----------lb/acre ----------			
Leafy spurge	**339 (66)[a]**	**396 (64)[a]**	**350 (47)[a]**
Grass & Grass-like	**1543 (128)[a]**	**1325 (157)[a]**	**1041 (77)[a]**
Forb	119 (42)[a]	84 (25)[a]	46 (13)[a]
Shrub	79 (61)[a]	13 (10)[a]	15 (8)[a]

[1] Years with the same letter within each herbage class are not significantly different (P>0.05).

Table 3. Degree of herbage disappearance on the cattle only (CO), sheep only (SO), and cattle and sheep (CS) treatments for the grazing season of 1996, 1997, and 1998.

1996

Treatment	Grass & Grass-like	Forb	Shrub	Leafy Spurge	Total
----------% Use ----------					
CO	***17%***	34%	85%	**23%**	**20%**
SO	***14%***	53%	56%	**76%**	**27%**
CS	***22%***	36%	90%	**62%**	**30%**

1997

Treatment	Grass & Grass-like	Forb	Shrub	Leafy Spurge	Total
----------% Use ----------					
CO	***30%***	26%	72%	**50%**	**33%**
SO	***38%***	74%	1%	**86%**	**49%**
CS	***29%***	54%	75%	**66%**	**38%**

1998

Treatment	Grass & Grass-like	Forb	Shrub	Leafy Spurge	Total
----------% Use ----------					
CO	***33%***	9%	60%	**50%**	**37%**
SO	***41%***	62%	45%	**98%**	**55%**
CS	***31%***	65%	90%	**88%**	**47%**

Table 4. Livestock average daily gains (standard errors in parentheses) for individual livestock classes on the (CO) cattle only, (SO) sheep only, and (CS) cattle and sheep treatments for 1996, 1997, and 1998.

Treatment & Livestock Class[1]	1996[2]	1997[2]	**1998[2]**
----------lb/day ----------			

CO Steer	1.76 (0.07)[a]	1.61 (0.13)[ab]	1.23 (0.06)[bx]
CS Steer	1.53 (0.32)[a]	1.12 (0.16)[a]	0.96 (0.13)[ax]
SO Ewe	0.16 (0.02)[y]	0.07 (0.02)[yz]	0.04 (0.02)[z]
CS Ewe	0.16 (0.02)[y]	0.09 (0.03)[yz]	0.07 (0.02)[z]

[1] Years with the same letter within each treatment are not significantly different (P>0.05).

[2] Treatments with the same letter within each livestock class are not significantly different (P>0.05).