Multi-Species Grazing on Leafy Spurge Infested Rangeland comparing Twice-Over Rotation Grazing versus Seasonlong Grazing

(A Three-Year Summary)

[1]Jack D. Dahl, [2]Kevin K. Sedivec, [1]Timothy C. Faller, [2]Jerrold Dodd, [3]James Karn,

[1]Don Stecher, and [2]Lyndon Johnson

[1]Hettinger Research Extension Center. Hettinger, ND 58639. [2]Animal and Range Science Dept., North Dakota State University, Fargo, ND 58105. [3]Northern Great Plains Agricultural Research Center, Mandan, ND 58554.

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Introduction

Herbicides continue to be the primary method of attempted control and/or eradicate of leafy spurge (*Euphorbia esula* L.) (Lym et al. 1995). However, controlling large infestations with herbicides is not economically feasible (Bangsund et al. 1996). There is also a lack of labeled herbicides that provide effective control of leafy spurge in environmentally sensitive areas. This noxious weed, which is extremely persistent and competitive, has contributed significantly to economic losses to the livestock industry (Leitch et al. 1994).

Use of grazing as a biological control for leafy spurge has become more acceptable in the past ten years. Goats are an excellent tool to control and reduce leafy spurge infestations (Sedivec and Maine 1993, Hanson 1994, Prosser 1995, Sedivec et al. 1995). The use of sheep as a biological control method was proven in the late 1930's and early 1940's by Helgeson and Thompson (1939), and Helgeson and Longwell (1942). However, there have been many disagreements in the literature concerning the effective use of sheep on leafy spurge (Landgraf et al. 1984) due to the aversive chemicals found in the latex of leafy spurge. Research by Lym and Kirby (1987) has also shown that cattle totally or partially avoid leafy spurge infested sites and intensify use on non-infested sites.

Multi-species grazing, the concurrent use of rangeland by more than one kind of animal, has been advocated to maximize animal production on native rangeland (Merrill and Miller 1961). It is an important concept in rangeland management because rangelands usually consist of one or more classes of vegetation (Merrill et al. 1966). However, no published reports have documented the potential use of sheep and cattle in a multi-species grazing approach to improve graminoid species use, increase plant richness, and to control leafy spurge on leafy spurge infested rangeland.

The objectives of this study were to: 1) determine effects of multi-species grazing using twice-over rotation grazing system (TOR), seasonlong grazing treatments (SL), and nonuse treatment (NU) on leafy spurge control and 2) evaluate the degree of disappearance of herbage and livestock performance on TOR and SL using a multi-species grazing program.

Study Area

The research was conducted on two separate tracts of land in Morton County. The first tract was Sections 31 and 32, T139N, R81W, in south central North Dakota, approximately two miles southwest of Mandan. This tract consisted of 603 acres of native rangeland owned by the North Dakota State Correctional Center. The second tract was on the north half of Section 9, T138N, R81W on 237 acres of native rangeland operated by the Northern Great Plains Research Laboratory, approximately three miles south of Mandan. Both tracts are found in the Missouri Slope Prairie Region and associated with the Heart River Watershed drainage. 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). Leafy spurge infestations were mapped before the study and estimated to cover 30 percent of each tract of rangeland.

The TOR consisted of four pastures grazed from 15 May to 1 October by one heard of cow/calf pairs and mature dry ewes. A total of 96 animal units of cattle (85 - 1200 lb. cows with calves) and 33 animal units of sheep (200 - 135 lb. mature white-face ewes without lambs) or a total 532 AUMs grazed the TOR treatment in 1996 and 1997. Cattle animal units were reduced to 85 animal units of cattle (76 - 1200 lb. cows with calves) in 1998; however, sheep animal units remained the same and a total 491 AUMs grazed the TOR in 1998. The overall stocking rate was 0.88 AUMs/acre in 1996 and 1997 and 0.82 AUMs/acre in 1998 on the TOR treatment. Stocking rates were decreased due to below average winter snow cover and rain fall in the spring 1998.

The SL treatment was grazed moderately light in 1996 due to lack of range evaluation data and unknown carrying capacities. Twenty-seven animal units of cattle (35 - 700 lb. Yearling steers) and 8 animal units of sheep (48 - 135 lb. mature white-face ewes without lambs) or a total 144 AUMs grazed the SL treatment in 1996. The overall stocking rate was 0.68 AUMs/acre in 1996 on the SL treatment. The SL treatment was grazed by yearling steers and mature ewes and stocked with 37 animal units of cattle (49 - 705 lb. yearling steers) and 13 animal units of sheep (78 - 135 lb. mature white-face ewes without lambs) or a total 207 AUMs grazed in 1997 and 1998. The overall stocking rate was 0.88 AUMs/acre in 1996, 1997, and 1998 on the SL treatment.

Sheep were placed on pasture approximately 15 May each year when leafy spurge was ready for grazing and cattle placed on pasture 1 June when native cool season grass species reach grazing readiness (3-4 leaf stage). Livestock species were removed from the treatments when 50 to 60 percent degree of graminoid disappearance was reached or 1 October. During all three years livestock grazed until 1 October.

Methods

Objective 1

Leafy spurge density was counted in six 32 ft by 16 ft exclosures. Three exclosures were systematically placed in each of the TOR and SL treatments. Each 32 ft by 16 ft exclosure was subdivided in two 16 ft by 16 ft plots with one plot randomly assigned a grazed treatment (TOR or SL) and second plot an ungrazed treatment (NU). A 2.5 ft buffer was placed along the inside border of each grazed and ungrazed plot to prevent an edge effect. Each plot was further stratified into 11 in^2 (0.1 m^2) quadrats and each quadrat assigned a number. Ten 11 in^2 quadrats were randomly selected in each treatment for leafy spurge density counts. Leafy spurge densities were collected in the first week of June throughout the duration of the study.

Objective 2

Forage production and degree of disappearance for leafy spurge, graminoid, shrubs, and other forbs were determined using a pair-plot clipping technique (Milner and Hughes 1968). Eight cages were dispersed in each of the four pastures of the TOR. Four of the cages were systematically placed in leafy spurge infested sites and four in non-infested sites. Twelve cages were systematically placed in the SL, six cages placed on leafy spurge infested sites and six cages on non-infested sites. Two plots were clipped from each cage using a 24 $inch^2$ (0.25 m2) frames.

Livestock performance and production were determined for both cattle and sheep and expressed as average daily gain. Weights were taken when animals were allocated to and removed from each treatment.

Data Analysis

Differences in leafy spurge stem density were tested between treatments and years using the multi-response permutation procedure (Biondini et al. 1988). Forage degree of disappearance 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

Leafy spurge stem density did not change ($P>0.05$) on either the TOR, SL or NU treatments after two years of multi-species grazing. However, percent leafy spurge stem densities changes appear to show potential trends for each treatment. Leafy spurge stem densities were reduced by 13.2 % after one year and 20.1 % after two years of multi-species grazing on the SL treatment. Leafy spurge stem densities increase 20.5% after one year and decreased 3.0 % after two years of multi-species grazing on the TOR treatment. Both NU treatments showed increases in stem densities in 1997 and 1998, averaging an increase of 13.4 % after one year and 11.7 percent after two years. The results after two multi-species grazing showed a decrease in leafy spurge stem densities on both the TOR and SL treatments compared to increases on the NU treatments (Table 1).

An infra red photo comparing multi-species grazing (bottom) and cattle only grazing (top) after one year of grazing. The light pink to red color is leafy spurge and the darker red is shrubs and trees.
(Photo by Paul Nyren, CGREC)

These results followed similar trends found by Lym et al. (1997) comparing multi-species grazing with cattle and angora goats. They reported seasonlong grazing reduced leafy spurge stem density faster than rotational grazing, even in year two. Results of this study would support Lym et al. (1997) in that seasonlong grazing using a multi-species approach would reduce leafy spurge stem density faster than rotational grazing. In both treatments and years, there was evidence that sheep were removing the flowering parts of the plant and preventing most seed production by leafy spurge, which supports Barker's (1996) statement that sheep will remove the flowering parts of the plant and most seed production by mature leafy spurge plants.

Degree of leafy spurge disappearance on both treatments was similar throughout the three grazing seasons 1996, 1997, and 1998. The degree of leafy spurge disappearance varied from 41% to 61% over three grazing seasons in both treatments. Grass and grass-like species degree of use within leafy spurge infested communities increased on both treatments after the first grazing season (Table 2). Grass and grass-like plant species disappearance in leafy spurge infested sites was 1% on the SL and 2% on the TOR treatment. However, by the second grazing season, grass and grass-like degree of disappearance increased to 33% on the SL and 20% on the TOR on leafy spurge infested communities. In the third year, degree of grass and grass-like species disappearance showed a slight increase again on leafy spurge communities compared to 1997 (Table 2).

Cow average daily gain (ADG) was higher ($P<0.05$) on the TOR treatment in 1997 than 1996. However, cow ADG was lower ($P<0.05$) in 1998 than 1996 and 1997. Calf ADG was similar ($P>0.05$) throughout the three grazing seasons. Steer ADG was not different ($P>0.05$) between years 1996 and 1997, however, decreased ($P<0.05$) in 1998 compared to 1996 and 1997 on the SL treatment (Table 3).

Ewe ADG on the TOR treatment was lower ($P<0.05$) in 1997 and 1998 compared to 1996, dropping from 0.32 lb/day in 1996 to 0.25 lb/day and 0.26 lb/day in 1997 and 1998, respectively. Seasonlong ewe ADG increased ($P<0.05$) from 1996 to 1997; however, there was a significant decrease ($P<0.05$) in ewe ADG from 1997 to 1998 with 1996 and 1998 not different ($P>0.05$). When analysis ewe performance between treatments, ewe ADG was higher ($P<0.05$) on the TOR in 1996 and 1998 with no treatment differences ($P>0.05$) occurring in 1997.

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Table 1. Leafy spurge stem densities on the seasonlong (SL) and twice-over rotation (TOR) grazing treatment and ungrazed treatments (standard errors in parentheses) in 1996, 1997, and 1998.

Treatment	1996	1997	**% change 1996 to 1997**	1998	**% change 1996 to 1998**
-------------------- # / 11 inch^2----------------------					
SL[1]					
Grazed	14.4 (1.9)[a]	12.5 (1.0)[a]	***-13.2***	11.5 (1.5)[a]	**-20.1**
Ungrazed	14.7 (1.9)[a]	14.9 (1.0)[a]	+ 1.3	17.1 (1.3)[a]	+16.3
TOR[1]					
Grazed	13.2 (1.5)[a]	15.9 (1.4)[a]	***+20***.5	12.8 (1.1)[a]	**- 3.0**
Ungrazed	8.6 (1.3)[a]	10.8 (1.2)[a]	+25.6	9.2 (1.3)[a]	+7.0

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

Table 2. Herbage production (+/- the standard error) and degree of disappearance (%) on ungrazed (UG) and grazed (G) plots of the twice-over rotation (TOR) and seasonlong (SL) grazing treatments in 1996, 1997, and 1998.

1996

Site Treatment	Grass & **Grass-like**	Forb	Shrub	**Leafy Spurge**	**Total**
------------lb/acre ----------					
Native					

TOR-UG	*2468 ± 269*	*144 ± 56*	*6.5 ± 6.5*	*0 ± 0*	***2619***
TOR-G	1625 ± 160	148 ± 62	0 ± 0	0 ± 0	**1773**
% USE	**34**	**+2**	**100**	**0**	**32**
SL-UG	*2784 ± 306*	*344 ± 75*	*8 ± 8*	*0 ± 0*	***3136***
SL-G	2197 ± 300	406 ± 104	3 ± 3	0 ± 0	**2643**
% USE	**21**	**+34**	**55**	**0**	**15**
Leafy Spurge					
TOR-UG	*1419 ± 206*	*1.5 ± 1.5*	*0 ± 0*	*1144 ± 262*	***2412***
TOR-G	1390 ± 188	1.5 ± 1.5	0 ± 0	677 ± 168	**1919**
% USE	**2**	**0**	**0**	**41**	**20**
SL-UG	*1713 ± 154*	*6 ± 6*	*0 ± 0*	*856 ± 165*	***2576***
SL-G	1700 ± 143	19 ± 19	0 ± 0	454 ± 94	**2173**
% USE	**1**	**+221**	**0**	**47**	**16**

1997

Treatment	Grass & **Grass-like**	Forb	Shrub	**Leafy Spurge**	**Total**
------------lb/acre ----------					
Native					
TOR-UG	*1883 ± 156*	*120 ± 57*	*0*	*1.0 ± 1.0*	***2005***
TOR-G	1194 ± 130	42 ± 20	0	0.6 ± 0.6	**1237**

% USE	**37**	**51**	**0**	**40**	**38**
SL-UG	*2042 ± 322*	*162 ± 75*	*33 ± 18*	*0 ± 0*	***2238***
SL-G	1384 ± 179	47 ± 21	0 ± 0	0 ± 0	**1403**
% USE	**32**	**71**	**100**	**0**	**36**

Leafy Spurge					
TOR-UG	*1298 ± 249*	*35 ± 30*	*0*	*955 ± 187*	***2270***
TOR-G	1034 ± 132	4 ± 4	0	367 ± 120	**1404**
% USE	**20**	**89**	**0**	**61**	**38**
SL-UG	*1239 ± 169*	*2.7 ± 2.7*	*7 ± 7*	*822 ± 89*	***2073***
SL-G	830 ± 119	6.0 ± 6.0	0 ± 0	355 ± 88	**1221**
% USE	**33**	**+113**	**100**	**47**	**35**

1998

Treatment	Grass & **Grass-like**	Forb	Shrub	**Leafy Spurge**	**Total**
------------lb/acre ----------					
Native					
TOR-UG	*1380 ± 89*	*104 ± 19*	*0*	*0 ± 0*	***1484***
TOR-G	1054 ± 101	66 ± 15	0	0 ± 0	**1120**

% USE	**24**	**36**	**0**	**0**	**25**
SL-UG	*1803 ± 144*	*119 ± 41*	*5 ± 5*	*0 ± 0*	***1925***
SL-G	1134 ± 107	80 ± 24	4 ± 4	0 ± 0	**1218**
% USE	**37**	**32**	**20**	**0**	**37**

Leafy Spurge					
TOR-UG	*1291 ± 154*	*36 ± 12*	*0*	*776 ± 100*	***2103***
TOR-G	947 ± 98	6 ± 3	0	299 ± 44	**1252**
% USE	**27**	**83**	**0**	**61**	**40**
SL-UG	*870 ± 124*	*0 ± 0*	*0 ± 0*	*480 ± 110*	***1350***
SL-G	521 ± 71	4 ± 4	0 ± 0	255 ± 77	**780**
% USE	**40**	**+400**	**0**	**46**	**42**

Table 3. Livestock average daily gains (standard errors in parentheses) for individual classes of livestock on treatments: twice-over rotation (TOR) and seasonlong (SL) for 1996, 1997, and 1998.

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

Cow	0.78 (0.05)[a]	1.00 (0.05)[b]	0.01 (0.04)[c]
Calf	2.33 (0.03)[a]	2.32 (0.03)[a]	2.42 (0.03)[a]
Ewe	0.32 (0.01)[a]	0.25 (0.01)[b]	0.26 (0.01)[b]
SL			
Steer	1.99 (0.04)[x]	1.84 (0.03)[x]	1.54 (0.04)[y]
Ewe	0.23 (0.03)[x]	0.28 (0.03)[yb]	0.22 (0.01)[x]

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

[2] **Sheep (ewe) treatments with the same letter within each year are not significantly different (P>0.05).**