2001 Sheep Day Report

EFFECTS OF MULTI-SPECIES GRAZING ON LEAFY SPURGE (*Euphorbia esula* L.) INFESTED RANGELAND USING ROTATIONAL GRAZING

(A Three-Year Summary)

[1]Luke Samuel, [1]Kevin K. Sedivec, [2]Timothy C. Faller, [2]Jack D. Dahl, and [3]Lyndon L. Johnson

[1]Animal and Range Sciences Dept., North Dakota State University, Fargo, ND 58105.

[2]Hettinger Research Extension Center, Hettinger, ND 58639.

[3]USDA, Forest Service, Eagle, CO 81631.

Introduction

Leafy spurge is a plant widely dispersed across the northern hemisphere, including the United States and Canada, with a distribution center in the Caucasus Region of Asia (Croizat 1945 in Noble and MacIntyre 1979). This plant is found on every continent except Australia (Lacey et al. 1985). Leafy spurge is believed to have been introduced into mainland North America before 1872 (Callihan et al. 1991). Leafy spurge now infests thirty-nine states in the United States including every northern state and every Canadian province except Newfoundland (Lacey et al. 1985). One million hectares (two and a half million acres) in North America are infested by leafy spurge (Noble et al. 1979 in Noble and MacIntyre 1979), with an estimated 400,000 hectares (one million acres) in North Dakota (N.D. Dept. of Agriculture 1996).

Traditional approaches for controlling leafy spurge, e.g. herbicides, are becoming cost prohibitive as this noxious weed continues to spread. Many forms of biological and cultural controls have come into practice over the past twenty years. Grazing sheep on leafy spurge infested rangeland is one such cultural control. Cattle do not graze leafy spurge and often avoid leafy spurge-infested communities, creating opportunities for multi-species grazing with sheep. Multi-species grazing is the concurrent use of rangeland by more than one kind of animal, and this approach utilizes more than one class of vegetation (Merrill et al. 1966). Cattle and sheep grazing has the potential to reduce leafy spurge density, increase plant species richness, and improve the economic viability of a cattle operation on leafy spurge infested rangelands.

Research Objectives

The objectives of the study were to determine if simultaneous grazing of leafy spurge infested rangeland with cattle and sheep employing a twice-over-rotational grazing system in concert with biological control will (1) reduce leafy spurge density compared to season-long grazing and (2) enhance livestock grazing efficiency compared to season-long grazing.

Study Area and Design

This project was conducted on leafy spurge infested rangeland in western North Dakota from 1998 through 2000. The study area is located approximately ten kilometers (six miles) north of Sentinel Butte or 240 kilometers (150 miles) west of Bismarck, North Dakota. Two tracts of rangeland of 257 and 160 hectares (635 and 395 acres) comprise the replicated multi-species grazing trial in the Badlands vegetative region of North Dakota. Vegetation in this region is typical of northern mixed grass prairie and is classified as a wheatgrass-grama-needlegrass (Agropyron, Bouteloua, Stipa) plant community (Barker and Whitman 1989). Leafy spurge infested approximately forty to fifty percent of the land on these two study sites.

The research tested the effect of twice-over rotation (TOR) and season-long (SL) grazing on leafy spurge infested rangeland using multi-species grazing with cattle and sheep in conjunction with a biological control program. Each of two tracts of land were blocked into four cells with one cell randomly selected as SL treatment. The remaining three cells in each replicate were grazed using TOR grazing treatment. Two 0.40 hectare (one acre) exclosures were developed on each replicate by stratifying each treatment and randomly selecting points for development. The four exclosures, containing forty to fifty percent leafy spurge, were excluded from grazing and classified as biological control treatments.

Fifty permanent 100-meter line transects were systematically located in leafy spurge clumps (26 transects) and native range (devoid of leafy spurge) vegetation sites (24 transects) throughout the replicates to monitor changes in leafy spurge stem density and plant species richness. Barbour et al. (1999) defined density as the number of plants rooted within each quadrat. Species richness is simply the number of species per unit area; diversity is a combination of richness and evenness, i.e., species richness weighted by species evenness (Barbour et al. 1999). Peet (1974 in Ludwig and Reynolds 1988) termed this "the dual concept of diversity," i.e., diversity combines species richness and relative species abundance.

Four transects were located in each cell of the TOR grazing treatments, eight transects in each SL treatment, and two in each of the biological control cells (0.40 hectare exclosures). In addition, two permanent line transects designed to monitor effects of leafy spurge on rangeland without grazing, biological, or other management were located in areas dominated by leafy spurge adjacent to each replicate.

Leafy spurge density and graminoid species frequency is collected every five meters using a 0.10 square meter frame and forb and shrub density and frequency is collected every five meters using a 0.25 square meter frame on the 100-meter line transects.

Livestock performance and production data is collected for cattle and sheep for determination of average daily weight gain and gain per area. Livestock are weighed at the beginning and end of each grazing season.

Treatment and year effects for leafy spurge stem density, and livestock performance were analyzed using a general linear model (GLM) (SPSS 1999). A mean separation was performed when significant ($P<0.05$) differences were found using Tukey's Honesty Significant Difference.

Grazing Treatments and Grazing Plan

Cattle grazed each treatment from 1 June through 15 September while stocked in accordance with the recommended carrying capacity of the land as outlined in USDA Natural Resources Conservation Service technical guidelines (1984). Sheep grazed from 15 May through 15 September while stocked at forty percent of carrying capacity without adjustments to cattle numbers.

Carrying capacity of the TOR grazing treatment is 142.4 animal unit months (AUMs) and 73.6 AUMs on replicates #1 and #2, respectively. Stocking rates of the TOR grazing treatments were 0.28 AUMs/acre for both replicates #1 and #2. Type of cattle grazed is Angus-Hereford cross cow/calf pairs with cows weighing approximately 545 kilograms (1200 pounds). Thirty-six cow/calf pairs grazed replicate #1 and 18 cow/calf pairs grazed replicate #2. Since sheep will be stocked at forty percent of carrying capacity, sheep will graze 57.5 AUMs (replicate #1) and 33 AUMs (replicate #2) on the TOR grazing treatments. Type of sheep was mature white-faced ewes of which 86 head grazed on replicate #1 and 45 head grazed on replicate #2.

Carrying capacity of the SL grazing treatment was 39.6 and 33.9 AUMs on replicates #1 and #2, respectively. Stocking rates of the SL grazing treatments were 0.31 and 0.32 AUMs/acre on replicates #1 and #2, respectively. Type of cattle grazed is Angus-Hereford cross cow/calf pairs with cows weighing approximately 545 kilograms (1200 pounds). Ten cow/calf pairs grazed replicate #1 while 8 cow/calf pairs grazed replicate #2. Since sheep will be stocked at forty percent of carrying capacity, sheep will graze 16 AUMs (replicate #1) and 15 AUMs (replicate #2) on the SL grazing treatments. Type of sheep grazed is mature white-faced ewes, with 23 head on replicate #1 and 20 head on replicate #2.

Livestock graze the SL treatment continuously throughout the grazing season. Livestock graze the TOR grazing treatment as one herd and rotate simultaneously. The entire herd of cattle and sheep graze one cell at a time, grazing forty percent of the available carrying capacity of the cell in the first rotation and sixty percent of available carrying capacity in the second rotation.

Results and Discussion

After three grazing seasons, leafy spurge stem densities were significantly reduced ($P<0.05$) on the TOR Upland and Lowland sites from 1998 to 2000. Significant ($P<0.05$) difference was also found when comparing stem densities at TOR vs. SL Upland and Lowland sites (Table 1).

Cow average daily gain (ADG) was not significantly ($P>0.05$) different between TOR and SL treatments. However, cow ADG was lower ($P<0.05$) in 1999 compared to 1998 and 2000 on the TOR treatment. Calf

ADG was not ($P>0.05$) difference between TOR and SL treatments for all three years. However, Calf ADG was lower ($P<0.05$) in 1998 then 2000 on the TOR (Table 2).

There was no ($P>0.05$) difference in ewe ADG between TOR and SL treatments over the three years of the study. Ewe ADG was higher ($P<0.05$) on SL and TOR treatments in 1999 compared to 1998 and 2000 (Table 3).

Table 1. Leafy spurge stem densities on the season long (SL) and twice-over-rotation (TOR) grazing treatments in 1998, 1999, and 2000.

Treatment[1]		**1998**[2]	**2000**[2]	**% Change from 1998 to 2000**
			# Stems/ 0.10 m^2	
Seasonlong				
	Control	13.9 ± 1.3^{ax}	12.8 ± 1.4^{ax}	-7%
	Upland	9.7 ± 0.8^{ax}	10.8 ± 1.3^{ax}	11%
	Lowland	18.4 ± 1.1^{ax}	15.6 ± 1.3^{ax}	-15%
Twice-over				
	Control	8.8 ± 0.8^{ax}	8.9 ± 1.3^{ax}	1%
	Upland	9.1 ± 0.6^{ax}	6.3 ± 0.5^{bz}	-31%
	Lowland	18.2 ± 0.8^{ax}	9.2 ± 1.0^{by}	-49%

[1] **Treatments with the same letter are not significantly different ($P\leq0.05$) (a, b, and c).**

[2] **Years with the same letter within each treatment are not significantly different ($P\leq0.05$) (x, y, and z).**

Table 2. Cow and calf average daily gains (ADG) for the season long (SL) and twice-over-rotation (TOR) treatments from 1998, 1999, and 2000.

Treatment	1998	1999	2000
		lb/day	
Cows			

Seasonlong	$1.13 \pm .12^{ax}$	$0.01 \pm .14^{ay}$	$1.21 \pm .13^{ax}$
Twice-over Rotation	$0.80 \pm .08^{ax}$	$0.07 \pm .07^{ay}$	$0.78 \pm .10^{ax}$
Calves			
Seasonlong	$2.23 \pm .08^{ax}$	$2.28 \pm .08^{ax}$	$2.43 \pm .06^{ax}$
Twice-over Rotation	$1.99 \pm .05^{ax}$	$2.19 \pm .07^{axy}$	$2.22 \pm .04^{ay}$

[1] **Treatments with the same letter, for the same class of livestock, are not significantly different ($P \geq 0.05$) (a, b, and c).**

[2] **Years with the same letter, for the same class of livestock, within each treatment are not significantly different ($P \geq 0.05$) (x, y, and z).**

Table 3. Ewe average daily gains (ADG) for season long (SL) and twice-over-rotation (TOR) treatments during the 1998, 1999, and 2000 grazing seasons.

Treatment[1]	**1998**[2]	**1999**[2]	**2000**[2]
		lb/day	
Seasonlong	$0.21 \pm .01^{ax}$	$0.35 \pm .02^{ay}$	$0.26 \pm .02^{ax}$
Twice-over	$0.20 \pm .003^{ax}$	$0.36 \pm .009^{ay}$	$0.25 \pm .005^{ax}$

[1] **Treatments with the same letter are not significantly different ($P \leq 0.05$) (a, b, and c).**

[2] **Years with the same letter within each treatment are not significantly different ($P \leq 0.05$) (x, y, and z).**

Summary

The preliminary results from this multi-species grazing trial are encouraging. The addition of sheep to a cattle only grazing operation was shown to effectively reduce leafy spurge stem densities. To date, the TOR treatment had better control over the three years of the study, with both SL and TOR grazing treatments reducing leafy spurge stem densities. Stocking rates for the two replicates remained the same for the duration of the study with no treatment effects occurring on livestock performance. Overall, cattle and sheep grazing simultaneously did not adversely affect the ADG of cows, calves, or ewes. Multi-species grazing is a good alternative for leafy spurge control while allowing for an increased carrying capacity of the land with no adverse affects on livestock performance.

Literature Cited

Barbour, M.G., J.H. Burk, W.D. Pitts, F.S. Gillam, and M.W. Schwartz. 1999. Terrestrial plant ecology. Addison Wesley Longman, Inc., Menlo Park, Calif.

Barker, W.T. and W.C. Whitman. 1989. Vegetation of the northern Great Plains.NDSU Research Rpt. No. 111. Fargo.

Callihan, R.H., J.P. McCaffrey, and V.J. Parker-Clark. 1991. Leafy spurge: biology and management. Univ. of Idaho College of Ag., Cooperative Ext.System Ag. Exp. Sta. Current Information Series 877.

Lacey, C.A., P.K. Fay, R.G. Lym, C.G. Messersmith, B. Maxwell, and H.R. Alley. 1985. The distribution, biology and control of leafy spurge. Montana State Univ. Cooperative Ext. Service Circular 309, in cooperation with NDSU and the Univ. of Wyoming.

Ludwig, J.A. and J.F. Reynolds. 1988. Statistical ecology: a primer on methods and computing. John Wiley and Sons, New York, New York.

Merrill, L.B., P.O. Reardon, and C.L.Leinweber. 1966. Cattle, sheep, goats... mix'em up for higher gains. Texas Agr. Prog. 12:13-14

Noble, D.L. and D.C. MacIntyre. 1979. Management program for leafy spurge. Rangelands 1:247.

North Dakota Dept. of Agriculture. 1996. Weed control survey by county. N. D. Dept. of Ag., State Capitol Building, Bismarck.

SPSS. 1999. Statistical producers fro Social Science. Marketing dept. SPSS. Inc. Chicago, Ill.