

Reprinted with permission from: Proceedings: Leafy Spurge Strategic Planning Workshop¹, Dickinson, North Dakota. March 29-30, 1994. pp. 80-88.

Sponsored by: U.S. Department of the Interior; U.S. Department of Agriculture, Forest Service; Rocky Mountain Elk Foundation; and DowElanco.

Biocontrol of leafy spurge using angora goats

KEVIN K. SEDIVEC, WILLIAM T. BARKER, and TERRY A. MESSMER

Extension Rangeland Management Specialist; Professor, Animal and Range Sciences, North Dakota State Univ., Fargo; and Extension Wildlife Specialist, Utah State University, Logan, Utah

Abstract:

Utilization and control of leafy spurge by angora goats were determined in 1991, 1992 and 1993. Angora goats were stocked at 0.34 acres per Animal Unit Month (AUM) in 1991 and 0.83 acres per AUM in 1992 and 1993. Leafy spurge and brush stem densities were collected in mid-May of each year to determine overall change in plant numbers using 1 ft² plots on replicated line transects. Overall degree of use of leafy spurge, grass and brush were determined using the paired-plot clipping technique. Leafy spurge stem densities were reduced 12.5 percent, however not significant ($P>0.05$) after one year of grazing and reduced 39.9 percent ($P<0.05$) after two years of grazing. No significant ($P>0.05$) changes in relative frequency of leafy spurge and grass herbage production occurred after two years of grazing. The leafy spurge and shrub components were extensively grazed during all three years of the study. Degree of use by goats on leafy spurge was 64, 92 and 97 percent in 1991, 1992 and 1993, respectively. Shrub degree of use was 94, 92 and 89 percent in 1991, 1992 and 1993, respectively. Angora goat grazing on leafy spurge infested rangeland significantly ($P<0.05$) reduced leafy spurge stem densities after two years of grazing.

¹ Workshop Coordinator: Roger J. Andrascik, Resource Management Specialist, Theodore Roosevelt National Park, Medora, ND. Compiler: Nancy S. Ohlsen, Natural Resource Specialist, Theodore Roosevelt National Park, Medora, ND. Editor: Claude H. Schmidt, Agric. Exp. Stn., NSDU Extension Svc., NDSU, Fargo, ND.

Introduction

Leafy spurge (*Euphorbia esula* L.) continues to be a serious problem in North Dakota, infesting over 1 million acres of land, predominately rangeland. Chemicals remain the primary method for control in attempt for eradication. Biological control methods have received much interest in recent years. Insects have shown great potential, but appear to be many years away before sufficient populations can be propagated and warrant serious control potential (Lacey *et al.* 1985). Grazing with sheep has been a control method since the 1930's, but utilized sparingly (Helgeson and Thompson 1939, Helgeson and Longwell 1942, Bartz *et al.* 1985). Angora goats have received much attention in recent years as a potential leafy spurge control tool. Studies conducted on the use of goats as a leafy spurge control method have been limited, but have shown consistent results (Maze 1989, Hanson and Kirby, 1993, Sedivec and Maine, 1993, Sedivec *et al.* 1993).

Research evaluating diet preference of angora goats varied slightly among studies, but consistently show primary use of browse and grass species, with lower utilization of broadleaf species or forbs. Bryant *et al.* (1979) and Malechek (1970) showed angora goat diets to consist of about 40 percent browse, 48 percent grass and 12 percent forbs (Note: leafy spurge was not present in these areas where diets were collected). Angora goats have been introduced to Camp Grafton South in southeastern Eddy County as a biological control method for leafy spurge. Grazing rights on Camp Grafton South were leased to private individuals and grazed with cattle. Grazing distribution has been and will continue to become less efficient due to frequent heavy infestation of leafy spurge. Project objectives were to determine 1) if angora goats will significantly reduce the stem and herbage density of leafy spurge, 2) determine a recommended stocking rate of angora goats on leafy spurge infected pastures.

Procedures

The study was conducted on a 15 acre parcel located on Camp Grafton South in southeast Eddy County adjacent to the east shore line of North Twin Lake in Sec. 4, T 148 N, R 63 W. The study site was situated on a west-facing slope with the upland plant communities classified. These plant communities were classified as high, mid, and low prairie, and open woodland (Dix and Smeins 1967).

Leafy spurge stem counts were conducted prior to the introduction of angora goats on May 15, 1991 to achieve initial stand counts. Stems were counted using 1 ft² frames on four line transects in the spring of the year prior to grazing in 1991, 1992 and 1993.

Paired-plot clipping technique comparing grazed and nongrazed sites were designed using 5 ft² cages to determine forage production and degree of use for leafy spurge, shrubs, grass, and other forbs. Data was collected on September 16, August 25, and August 19, 1991, 1992 and 1993, respectively.

Stocking rates were set high in the first year of the trial to achieve high use of an unutilized, non-controlled leafy spurge plant community. The second and third year of the study were stocked the same and at a lower, more moderate stocking rate to obtain lower

utilization of the grass species. The 1991 stocking rate was 44 animal unit months (AUMs) from May 25 to September 14 (3.67 months). The 1992 stocking rate was 18 animal unit months from May 19 to August 24 (3.18 months). The 1993 stocking rate was 18 animal unit months from May 20 to August 18 (2.95 months).

Leafy spurge stem counts were tested for significant ($P < 0.05$) main effects using multi-response permutation procedure (MRPP) (Biondini *et al.* 1988). Each year was tested to determine number of years required to significantly ($P < 0.05$) reduced leafy spurge stem counts.

Results and discussion

Leafy spurge stem densities were reduced from 3.91 stems per ft² to 3.42 stems per ft², or a 12.5 percent reduction after one year of grazing, however no significant ($P > 0.05$) differences were noted (Table 1). Leafy spurge stem counts were collected on May 20, 1993 to achieve a two year angora goat grazing response. Leafy spurge stem counts were significantly reduced to 2.35 stems per ft², or a 39.9 percent ($P < 0.05$) reduction from 1991. Although shrubs were reduced 44.51 percent (Table 1), no significant difference was noted.

Table 1. Stem density reduction of leafy spurge and shrub species at Camp Grafton South near McHenry, ND from 1991 to 1993.

Date collected	Number of stems per ft ²			
	Leafy spurge ¹	P-value ²	Shrubs	P-value
May 25, 1991	3.91 ^a		----	
May 19, 1992	3.42 ^{ab}	0.517	1.64 ^c	
May 20, 1993	2.35 ^b	0.039	0.91 ^c	0.437
Stem Density				
Reduction	39.90		44.51	

¹Percentages with the same letter do not differ significantly ($P > 0.05$).

²P-value represent comparison of 1991 and 1992, and 1991 and 1993 for leafy spurge, 1992 and 1993 for shrubs.

Forage production on the nongrazed plots of the paired cages had a density ratio of 77.5 percent grass, 22.5 percent leafy spurge in 1991 (Table 2). Cages were re-paired each spring and paired plots clipped for herbage production. No significant ($P > 0.05$) differences occurred between yearly reduction or increases (Table 2). After two years of grazing, the ratio was 77.9 percent grass, 22.1 percent leafy spurge, an overall increase in grass density of 0.5 percent and a reduction of leafy spurge density by 2.0 percent with no significant ($P > 0.05$) differences noted.

Table 2. Percent change in herbage production by weight from 1991 to 1993 at Camp Grafton South near McHenry, ND.

Year	Leafy spurge	P-value	Grass species ¹	P-value ²
1991	22.5 ^a		77.5 ^b	
1992	15.7 ^a	0.512	84.3 ^b	0.676
1993	22.1 ^a	0.988.	77.9 ^b	0.967
Percent change	- 2.0		+ 0.5	

¹ Percentages with the same letter do not differ significantly (P>0.05).

² P-value represent comparison of 1991 and 1992, and 1991 and 1993 for both leafy spurge and grass.

Leafy spurge utilization or degree of use was 64, 92, and 97 percent in 1991, 1992 and 1993, respectively (Table 3). Grass degree of use was 43, 34, and 23 percent in 1991, 1992 and 1993, respectively. However, the high prairie site, dominated by blue grama grass, was utilized to a much higher extent in 1991 and 1992, and slightly heavier in 1992, with degree of use 60, 68 and 27 percent in 1991, 1992 and 1993, respectively. The mid and low prairie sites, dominated by Kentucky bluegrass, were utilized to a lesser extent, with degree of use 28, 23 and 18 percent in 1991, 1992 and 1993, respectively.

Table 3. Herbage production (lbs/acre) and degree of use (percent) on leafy spurge, and grass species by angora goats in 1991, 1992 and 1993.

Treatment	Leafy spurge			Grass species		
	1991	1992	1993	1991	1992	1993
Ungrazed	703	456	845	2416	2451	2929
Grazed	253	36	27	1370	1605	2249
Degree of use	64	92	97	43	34	23

The shrub component consisted primarily of western snowberry, with wild prairie rose comprising a small fraction of the total shrub community. Degree of use by goats was very intense for all years of the trial (Table 4). Over 90 percent of the shrub component was utilized in 1991 and 1992, and 89 percent utilized in 1993.

Goats controlled the spread of leafy spurge after two years of grazing by a 39.9 percent (P<0.05) reduction in stems. The grass species were utilized, but less than 50 percent for years 1991 and 1992, and less than 25 percent in 1993. Stocking rates were at too high of a degree to minimize grass consumption, but leafy spurge use was exceptional.

Table 4. Herbage production (lbs/acre) and degree of use (percent) on shrub species by angora goats in 1991, 1992 and 1993.

Treatment	1991	1992	1993
Ungrazed	15	189	70
Grazed	1	16	8
Degree of use	94	92	89

The shrub component was excessively utilized in all years of the study. At the current stocking intensity, the shrub component should be significantly reduced over time. Recommended angora goat stocking rates as it correlates to leafy spurge control was difficult to measure based on our data. If recommendations are based on minimizing grass use, our stocking rates were too high. This would indicate the recommended stocking rate should be less than 2.3 goats per acre for 3.05 months (9 goats per acre per month) for total rangeland acres. Based on initial forage production figures from Table 3, only 22.5 percent of the land base was leafy spurge, or 3.4 acres of leafy spurge. The stocking rate per acre of leafy spurge was 35 goats per 3.4 acres of leafy spurge, or 10.3 goats per acre of leafy spurge for 3.05 months (31 goats per acre of leafy spurge per month). Thus, the recommended stocking rate per acre of leafy spurge is much less than 10.3 goats per acre leafy spurge.

Further years of research will be needed to determine if the present stocking rates will continue to significantly reduce leafy spurge stem densities. The current stocking rates were very successful in reducing leafy spurge flowering and eliminating seed production. No plants were allowed to flower at these stocking rates and no leafy spurge stems remained at the end of the grazing season.

References

- Bartz, S., B. Landgraf, P. Fay, and K. Havstad. 1985. Leafy spurge (*Euphorbia esula*) as a forage component for ewes and lambs. SID Res. Digest. pp. 39-42.
- Biondini, M.E., P.W. Mielke Jr., and K.J. Berry. 1988. Data-dependent permutation techniques for the analysis of ecological data. *Vegetation* 75:161-168.
- Bryant, F.C., M.M. Kothmann, and L.B. Merrill. 1979. Diets of sheep, angora goats, Spanish goats, and white_tailed deer under excellent range conditions. *J. Range Manage.* 32(6):412-417.
- Dix, R.L. and F.E. Smeins. 1967. The prairie, meadow, and marsh vegetation of Nelson County, North Dakota. *Canadian J. of Botany.* 45:21-58.
- Hanson, T.P and D. Kirby. 1993. Angora goat grazing for leafy spurge (*Euphorbia esula*) management. Abstr. No. 187, Soc. for Range Manage. Annual Meeting, Albuquerque, NM. Feb. 14-19, 1993.
- Helgeson, E.A. and E.J. Thompson. 1939. Control of leafy spurge by sheep. *North Dakota Agric. Exp. Sta. Bimonthly Bull*, Vol. II, Number 1, Sept., 1939. pp 5-9.
- Helgeson, E.A. and E.J. Longwell. 1942. Control of leafy spurge by sheep. *North Dakota Agric. Exp. Sta. Bimonthly Bull*, Vol. IV, Number 5, May, 1942. pp 10-12.

- Lacey, C.A., P.K. Fay, R.G. Lym, C.G. Messersmith, B. Maxwell, and H.P. Alley. 1985. Leafy spurge: distribution, biology and control. Circ. 309, Montana State Univ. Coop. Ext. Serv., Bozeman, MT.
- Malechek, J.C. 1970. The botanical and nutritive composition of goat diets and lightly and heavily grazed ranges in the Edwards Plateau of Texas, Ph.D. Diss., Texas A&M Univ., College Sta. 61 p.
- Maze, G. 1989. Experimental leafy spurge control program. U.S. Fish and Wildl. Serv. Status Rep. Upper Souris Nat. Wildl. Refuge, Foxholm, ND.
- Sedivec, K.K., T.A. Messmer, and W.T. Barker. 1993. Biological control of leafy spurge using angora goats. Camp Grafton South annual report, Devils Lake, ND.
- Sedivec, K.K. and R.P. Maine. 1993. Angora goat grazing as a biological control for leafy spurge: A three-year summary. *In* proceeding: 1993 Leafy Spurge Symposium, July 26-28, Granby, CO.
- Sedivec, K.K., W.T. Barker, and T.A. Messmer. 1994. Biocontrol of leafy spurge using angora goats. *In* Proceedings: Leafy Spurge Strategic Planning Workshop, March 30-31, 1994, Dickinson, North Dakota. Theodore Roosevelt National Park, Medora, North Dakota.