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Cattle foraging behavior in leafy spurge-infested rangeland[1]

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Abstract:

Leafy spurge causes economic loss by reducing both herbage production and use. Herbage use by grazing cattle in various densities of leafy spurge (*Euphorbia esula* L. #[2] EPHES) was evaluated over a 3-year period in North Dakota. Forage production and disappearance were estimated in four density classes of leafy spurge. Use of cool- and warm-season graminoids, forbs, and leafy spurge was estimated during the middle and the end of each grazing season. Cattle used 20 and 2% of the herbage in the zero and low density infestations, respectively, by mid-season. Moderate and high density infestations were avoided until the milky latex in leafy spurge disappeared in early fall, and herbage availability in zero and low density infestations declined. Herbage use in moderate and high density infestations increased to an average of 46% by the end of the grazing season compared to 61% in zero and low density infestations. An annual herbage loss of at least 35% occurred in pasture infested with 50% density or more of leafy spurge.

Additional index words:

Cattle, herbage use, economic loss, EPHES.

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[2] Letters following this # symbol are a WSSA-approved computer code from Composite List of Weeds, Weed Sci. 32, Suppl. 2. Available from WSSA, 309 West Clark Street, Champaign, IL 61820.

Introduction

Leafy spurge is a long-lived perennial weed estimated to infest over 1 million ha in the Northern Great Plains and Rocky Mountain regions of the United States (4). Leafy spurge primarily infests pasture and rangeland where it decreases herbage production by as much as 75% (1, 11, 15). Annual losses in herbage and livestock production are estimated to cost the cattle industry $1.4 and $7 million in Montana and North Dakota, respectively (13, 15).

Leafy spurge contains a toxic substance that acts as an irritant, emetic, and purgative when taken internally. It causes scours and weakness in cattle and may result in death (16). The toxin has produced inflammation and loss of hair on the feet of horses that walked in freshly mowed stubble after haying (7) and has caused mortality of sheep in Alberta (6). Animals will eat the dried plant in hay (8), but cattle do not eat growing plants.

Leafy spurge infestations can reduce the livestock carrying capacity of pasture 50 to 75% (1, 11, 15). Much of this loss is due to decreased herbage production from leafy spurge competition; however, additional herbage losses occur as cattle avoid grazing areas infested with leafy spurge.

The purpose of this study was to determine herbage use by cattle grazing in various densities of leafy spurge.

Materials and methods

The study was conducted on a 121-ha pasture near Leonard, ND, during the 1984 through 1986 growing seasons. Average annual precipitation in southeastern North Dakota is 50 cm with 77% received during the growing season, April through September. Growing season and annual precipitation for 1984 through 1986 are summarized in Table 1.

Heavy early season cattle grazing resulted in two plant communities dominating the study pasture. Leafy spurge-dominated communities occurred throughout the pasture in varying weed densities, while Kentucky bluegrass (*Poa pratensis* L. # POAPR) dominated areas free of leafy spurge. Some native graminoid species generally were present in the leafy spurge-dominated communities: big bluestem (*Andropogon gerardii* Vitman # ANOGE), little bluestem (*A. scoparius* Michx. # ANOSC), switchgrass (*Panicum virgatum* L. # PANVI), blue grama [*Bouteloua gracilis* (Michx.) Torr. # BOBGR], Canada wildrye (*Elymus canadensis* L.), Scribner's panicum (*P. scribnerianum* Nash.) and various carices (*Carex* spp.). Nomenclature follows the Great Plains Flora Association (5).

The study pasture was managed under repeated seasonal grazing. Eighty cow-calf pairs in 1984 and 1985 and 73 pairs in 1986 were stocked on the pasture. Annual grazing dates were April 27 to Oct. 15, 1984 (169 days), May 3 to Oct. 3, 1985 (153 days), and May 1 to Oct. 1, 1986 (153 days). The recommended stocking rate for good condition native pasture (overflow range site) in this vegetative region is 2.6 AUM/ha [(animal-unit

month)/ha] (17). Stocking rates during the trial were 3.7, 3.4, and 3.2 AUM/ha for 1984, 1985, and 1986, respectively.

Herbage production and disappearance were estimated in four density classes of leafy spurge: zero, low, moderate, and high which corresponded to 0, 20 to 40, 40 to 60, and 60 to 80% leafy spurge canopy cover, respectively, and progressively decreasing herbage production (10). Leafy spurge density was determined annually by counting stems in 12 0.25 -m^2 quadrats/density class and by averaging across replicates. The experiment was a randomized complete block.

Four replicates were established within each density class using 1.2- by 2.4-m portable exclosures, except in 1984 when three replicates were established. A replicate consisted of an exclosure placed in each of the four leafy spurge density classes. Each density class was at least 1800 m^2 and was located within 50 m of the other density classes for each replicate. The exclosures were moved annually, but each replicate remained within the same general area of the pasture each year. Replications were established throughout the 121-ha pasture and were separated by at least 0. 5 km.

The zero density class of leafy spurge was established by applying picloram (4-amino-3, 5,6-trichloro-2-pyridinecarboxylic acid) at 1.1 kg ai/ha before cattle grazing each year. Artificial leafy spurge-free communities were established because existing leafy spurge-free communities lacked graminoid species diversity, especially warm-season species, due to previous heavy grazing.

Production and disappearance of cool- and warm-season graminoids, forbs, and leafy spurge were estimated July 12, 1985, and July 1, 1986, by clipping two paired, grazed and ungrazed 0.25-m^2 quadrats for each density class and replicate. Herbaceous production and disappearance during the latter portion of the growing season were estimated by clipping two additional paired, grazed and ungrazed 0.25-m^2 quadrats on Oct. 4, 1985, and Sept. 30, 1986, except in 1984 when four paired plots were harvested on Oct. 18 only. Herbage and leafy spurge samples were oven dried at 60ºC for 3 days and were reported on a dry weight basis. Ungrazed plots were used to estimate production while the difference between grazed and ungrazed plots was used to estimate disappearance. Data were analyzed using the general linear models procedure with LSD mean separation (18).

Results and discussion

Data for herbage production were similar and were averaged over years, except in the fall of 1986 (Table 2) when precipitation from July through September was 200% of the long-term average (Table 1). The 1986 above-average precipitation compared to 1984 and 1985 resulted in a 53% increase in total herbage production and in a different pattern of herbage use during the latter half of the grazing season. Therefore, herbage use in the latter half of 1986 was considered separately (Table 2).

Midsummer herbage production exceeded 1000 kg/ha in each leafy spurge density class and was dominated by cool-season species, mainly Kentucky bluegrass, which comprised nearly 80% of the total available herbage (Table 2). Midsummer cool-season herbage production was 30% greater on zero leafy spurge density sites compared to the

average herbage availability from all leafy spurge-infested sites. The increased availability is due to decreased leafy spurge competition (11). However, the decrease in leafy spurge competition did not increase warm-season species production.

Table 1. Precipitation and mean temperature near Leonard, ND.

	Precipitation									
	1984		1985		1986		Mean temperature			
Month	Observed	Normal	Observed	Normal	Observed	Normal	1984	1985	1986	Long-term
	(cm)	(%)	(cm)	(%)	(cm)	(%)			(C)	
April	5.7	132	1.3	31	19.9	460	7.5	8.7	6.4	5.6
May	2.9	52	16.2	291	4.1	74	12.9	16.3	14.1	13.1
June	11.6	138	9.1	109	4.7	55	18.6	16.0	19.2	18.4
July	2.3	32	4.3	59	20.5	278	21.6	20.9	21.5	21.4
August	0.6	9	9.1	128	10.8	152	23.1	18.2	17.8	20.4
September	3.9	97	4.8	118	6.8	167	12.8	12.2	13.5	14.3
Annual	46	96	60.5	126	74.6	155	5.8	3.8	5.7	4.7

Available midsummer herbage averaged approximately 70% of the annual yields estimated in the fall for each of the density classes (Table 2). Early season cattle grazing was limited to the zero leafy spurge density class despite the herbage abundance in all treatments. Cattle used 20% of the herbage in the zero density class by midsummer and only 2% in low density infestations. Cattle appeared to avoid moderate and high density classes of leafy spurge through midsummer, despite a stocking rate 21% higher than recommended and despite a limited supply and diversity of desirable herbage species.

The grazing pattern observed in the first half of the grazing season is the result of physiological characteristics of leafy spurge. It is one of the first species to appear in the spring, generally emerging in early to mid-April (9, 12). The plant grows rapidly, averaging 70 to 100 cm tall, and begins to flower and to set seed by mid-June. It has a characteristic milky latex which is prevalent in the plant during the early growing season. Injury through grazing or trampling causes the latex to flow immediately to seal the injury. This latex has been reported to cause skin inflammation, weakness, scours, and even death when ingested by grazing animals (6, 7, 8, 16). Grazing animals would be expected to avoid leafy spurge-infested sites when this latex is present.

Herbage production in the falls of 1984 and 1985 averaged between 1475 and 1770 kg/ha in the high and zero density leafy spurge infestations, respectively (Table 2). It also was dominated by cool-season graminoids. Expected herbage production for this site under normal growing conditions like 1984 and 1985 is 3900 kg/ha (17). Herbage production probably was less than expected in the zero density infestations because the native vegetation had not recovered from many years of leafy spurge competition.

Herbage disappearance by the end of the grazing season was similar in zero and low density leafy spurge infestations (Table 2). Disappearance averaged 62 and 60% of the available herbage in zero and low density leafy spurge stands, respectively, but only 50

and 41% in moderate and high leafy spurge densities, respectively. This represents a decrease in herbage yield and use of approximately 340 kg/ha in moderate and heavy leafy spurge density infestations compared to light and zero infestations.

Leafy spurge production each fall was similar in the zero and low density classes (Table 2). Leafy spurge regrew in the zero density areas in late August as top growth control from picloram declined. Most herbage had been grazed, and leafy spurge was less than 8 cm tall when fall samples were harvested. Thus, leafy spurge production was similar, despite much higher plant cover in the low compared to the zero density classes. The late-season regrowth by leafy spurge did not alter cattle grazing patterns.

Table 2. Herbage production and use by cattle in leafy spurge-infested areas estimated in midsummer and fall, averaged over two growing seasons.

		Ungrazed					Grazed					
Leafy spurge			Grass species			Total		Grass species			Total	
Class	Density	Leafy spurge	Cool	Warm	Forb	herbage	Leafy spurge	Cool	Warm	Forb	herbage	Disappearance
	(no./m^2)	(kg/ha)										(%)
Mid-summer (1985 and 1986)												
Zero	0	0	1130	260	10	1400	0	970	140	5	1115	20
Low	42	340	700	340	5	1045	260	640	380	10	1030	2
Moderate	112	590	880	210	20	1110	570	900	200	10	1110	0
High	170	1290	1000	170	5	1175	1050	940	230	5	1175	0
LSD (0.05)	7	280	110	60	13	80	280	110	60	13	80	12
Fall (1984 and 1985												
Zero	...	220	1510	250	10	1770	20	570	100	0	670	62
Low	...	230	1180	350	15	1545	70	470	140	5	615	60
Moderate	...	570	1320	350	85	1755	190	640	220	15	875	50
High	...	1270	1210	260	5	1475	410	720	140	5	865	41
LSD (0.05)		225	230	55	15	287	230	230	60	15	290	11
Fall 1986												
Zero	...	30	2470	440	5	2915	30	1810	440	5	2255	23
Low	...	320	1920	300	40	2260	185	980	370	10	1360	40
Moderate	...	510	2040	520	80	2640	280	1720	280	20	2020	23
High	...	630	1750	380	25	2155	420	1080	330	5	1415	34
LSD (0.05)		260	NS	NS	47	NS	260	954	NS	NS	NS	NS

Herbage use in moderate and high density leafy spurge infestations greatly increased between mid-season and end-of-season samplings. Two major factors contributed to this alteration in grazing behavior. First, concentration of grazing in zero and in low leafy spurge density infestations for much of the grazing season resulted in limited amounts of available herbage. Cattle had to seek alternative herbage in the higher density leafy spurge infestations. Also, leafy spurge begins to senesce in early to mid-September; and after fall frosts, the milky latex begins to disappear from the plant. Visual observations

indicated that cattle grazed high density leafy spurge-infested sites more readily after senescence.

Precipitation during the growing season in 1986 totaled 66.8 cm or over 180% of the long-term average of 36.8 cm (Table 1). Herbage production increased an average of 153% across all leafy spurge densities compared to 1984 and 1985 (Table 2). No differences in herbage production were determined between leafy spurge densities in 1986. Leafy spurge production generally decreased in 1986 compared to 1984 and 1985 despite similar densities of leafy spurge within classes each year and the increased moisture. Leafy spurge competes well with grass species because its deep root system can use water to a depth of at least 4.5 in (3). When moisture is not a limiting factor, grass species appear to compete more effectively with leafy spurge.

The increased herbage production probably caused the leafy spurge-infested sites to appear more attractive to cattle in 1986 and thus they were grazed more uniformly than in 1984 and 1985. Year-end use of herbage between leafy spurge density classes was not significantly different in 1986 (Table 2), despite early season grazing preference for zero and low density class infestations. Several factors contributed to this change of foraging behavior in 1986 compared to the previous 2 years. Leafy spurge plants were spindly and less branched; and the amount, robust size, and lushness of other herbaceous species diluted the density and dominated the appearance of leafy spurge-infested sites regardless of the degree of infestation.

The presence of leafy spurge in plant communities did influence foraging behavior of cattle. Cattle totally or partially avoided leafy spurge-infested sites with intense, frequent use of noninfested sites especially early in the grazing season. This unequal grazing distribution in noninfested sites decreased preferred herbage species, decreased herbage production diversity, and improved conditions for invasion of undesirable plant species such as leafy spurge. The presence of leafy spurge in plant communities led to inefficient use of available herbage and a presumed decrease in livestock production and animal performance (2, 14, 19). Cattle avoided internal and external contact with the milky latex, which reduced the available grazing area and herbage intake.

Herbage production, livestock performance, and monetary returns to a ranching enterprise would be correlated negatively with this behavioral response. Moderate and high leafy spurge densities reduced long-term herbage production approximately 16.5 to 33% in North Dakota on land that was 50 to 100% infested, respectively (11). A ranching enterprise would lose approximately 17.5% from cattle refusing to graze herbage in moderate and heavy leafy spurge infestations and an assumed but unmeasured animal product loss resulting from reduced intake. Land presently infested with leafy spurge represents an annual herbage loss of at least 35%. Besides production losses, treatment costs to manage infested sites and potential for increased hectares infested each year must be included to assess the economic impact of leafy spurge on a ranching enterprise.

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