

Effect of Selective Grazing by Sheep on the Control of Leafy Spurge (*Euphorbia esula* L.)¹

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Perennial noxious weeds are a problem in many areas, one of the most serious being leafy spurge (*Euphorbia esula* L.). Recommendations for the control of leafy spurge involve at least two years of intensive cultivation, the use of selective herbicides, or the use of soil ster-

ilants. Such measures are expensive and may be difficult to apply effectively (Hanson and Rudd, 1933, and Muencher, 1930). There are many infested areas where these control measures cannot be efficiently utilized because of cost or other factors. These are light soil areas where

the danger of wind erosion is great, stony lands where farm machinery cannot be successfully used, and native pastures where only a cheap, effective measure can be considered.

The competition provided by a perennial grass sown on leafy spurge-infested areas has been suggested as one means of control (Pavlychenko and Kirk, 1946). This method reduced the density of shoots but did not result in death of the roots. Grazing by sheep has been advocated

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as an effective type of control (Wood, 1944, and 1945), although no data of a quantitative nature were given in support of this view.

The objectives of this study were to determine the effects of selective grazing by sheep on a mixed crested wheatgrass-leafy spurge pasture.

Methods

An area near Pearce, Alberta, that had become severely infested with leafy spurge was selected for the study. In 1940 the area had been seeded with crested wheatgrass (*Agropyron cristatum* L.) in a four-replicate rate and space of seeding experiment involving 17 treatments in a randomized complete block design. While good stands of crested wheatgrass were obtained from all seedings, the competition provided by the grass did not control leafy spurge. By 1952 the experimental area supported a uniform stand of crested wheatgrass mixed with a variable cover of leafy spurge. The experimental design mentioned above was used in the analysis of vegetation, each of the original plots being considered a sampling unit, four replicates of each being available for study and analysis. The terms 'sampling unit' and 'replicate' have been retained for convenience in spite of the fact that the entire area was grazed by sheep from 1952 to 1956 inclusive.

The vertical point method (Levy and Madden, 1933) was used in making vegetation analyses in September of each year. Five hundred points per sampling unit were examined and only those points striking the base of a plant of leafy spurge or crested wheatgrass at ground level were recorded as 'hits.' Notes were made on the relative acceptability of species present, on the reaction of sheep to grazing the cover, and on the behavior of leafy spurge plants

Table 1. Average basal area of leafy spurge per sampling unit by replicates for the period 1952-1956 (data transformed).

Year	Area per sampling unit				Average
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	
1952	1.50	2.84	3.60	4.61	3.14
1953	1.28	3.00	3.32	5.40	3.25
1954	2.66	2.51	3.62	4.86	3.41
1955	0.15	0.15	0.90	0.15	0.34
1956	0.15	0.45	0.15	0.15	0.22
L.S.D. (P=0.05)					0.60
L.S.D. (P=0.01)					0.80

present in an adjoining ungrazed field of crested wheatgrass.

The 30-acre field was stocked with mature ewes each year at a rate of one and one-half head per acre for a grazing period that lasted approximately from May 1 to September 30. In 1952 it was not possible to start grazing until June 11.

Percentage basal area data were subjected to angular transformation before the data shown in the accompanying tables were analysed (Snedecor, 1946).

Results and Discussion

A summary of the data on basal area of leafy spurge for the period 1952-1956 is shown in Table 1. It will be noted that the basal area of leafy spurge was significantly ($P<0.01$) reduced after four years of grazing indicating that, for the experimental site, this was the minimum length of time required before effective control of the weed was attained. Only scattered plants of leafy spurge remained on the study area after 1954 and those that persisted were much reduced in vigor.

The data also reflected the patchy nature of leafy spurge throughout the study area. An analysis of variance of the data summarized in Table 1 showed a significant difference ($P<0.01$) in basal area of leafy spurge between replicates. This difference can be attributed to the patchy occurrence of leafy spurge over the study area and to its relative abundance on two of four replicates. This fact had a bearing on

management of the sheep, which will be discussed later.

The analysis also showed a significant difference ($P<0.01$) in basal area of leafy spurge between years. This reduction in weed cover was due to selective grazing by sheep. By using the percentage data obtained during the course of the experiment and calculations not shown herein, a decrease of 98 percent in the basal area of leafy spurge was shown to have occurred over the five-year period.

That grazing by sheep, and not some climatic or edaphic factor, was responsible for the reduction in basal area of leafy spurge is



FIGURE 1. Several representative grazed plants of leafy spurge (left) and a single ungrazed plant from an adjoining field (right), all of which grew in admixture with crested wheatgrass.

Table 2. Average basal area of crested wheatgrass per sampling unit by replicates for the period 1952-1956 (data transformed).

Year	Area per sampling unit				Average
	Rep. 1	Rep. 2	Rep. 3	Rep. 4	
1952	18.11	16.66	18.31	17.52	17.65
1953	17.94	19.29	20.22	21.25	19.68
1954	19.68	20.45	20.01	19.31	19.86
1955	19.16	19.32	18.31	17.90	18.67
1956	22.12	22.63	22.03	21.22	22.00
L.S.D. (P=0.05)					0.70
L.S.D. (P=0.01)					1.01

indicated in Figure 1. The intensity of grazing used was sufficient to keep leafy spurge plants in the condition shown throughout the grazing period. It should be noted that leafy spurge plants from the adjoining ungrazed field remained in a vigorous condition during the experimental period in spite of annual cutting for hay production and competition with crested wheatgrass.

A summary of the data on basal area of crested wheatgrass for the period 1952-1956 is presented in Table 2. The data showed that the basal area of crested wheatgrass was significantly greater ($P<0.01$) at the end of the test than at the beginning. This indicated that the grass cover was not damaged as a result of the grazing treatment.

Observations made during the course of the experiment suggested that there are a number of points that should be noted by individuals interested in controlling leafy spurge through selective grazing by sheep. It is important that grazing be started early in the season before the weed makes much growth. It was observed that sheep readily grazed small plants of leafy spurge but were reluctant to consume the more mature plants. A mature stand of leafy spurge, therefore, should be mowed before grazing is permitted. Sheep in numbers sufficient to keep the weed closely cropped should be used. Control of leafy spurge through grazing is accomplished by exhausting the carbohydrate

reserves in the roots, and this can be done only by preventing or severely reducing the development of leafage.

It is not advisable to attempt to control distribution of the sheep for at least the first three years of grazing. During this study it was noted that the sheep tended to congregate on those areas where leafy spurge was most abundant, and hence, they were more effective in consuming the developing plants than if an attempt had been made toward uniform utilization of the whole area. However, uncontrolled distribution will eventually lead to localized over-grazing. Thus an attempt toward more uniform utilization of the pasture should be made when, on the basis of number and vigor of leafy spurge plants, it appears that control has been attained.

Occasional losses by poisoning may be encountered. Sheep losses were a factor in 1952, when relatively large plants of leafy spurge were being grazed, but not thereafter, when grazing was started at an earlier date and only small plants were present. Post-mortem examinations conducted by the Animal Diseases Research Institute (Western), Lethbridge, showed that leafy spurge was responsible for the poisoning losses.

Crested wheatgrass appears to be a useful grass in a leafy spurge control program. This grass becomes harsh and unpalatable to sheep during the summer months, and during this period it was noted that the ani-

mals tended to graze leafy spurge and to avoid crested wheatgrass almost entirely. Kentucky bluegrass, a species that remains green and palatable during the summer months, was present in small volunteer areas throughout the field. The Kentucky bluegrass plants on these areas were severely weakened through over-grazing nearly as rapidly as the leafy spurge.

A further point noted in this study is that, even after five years of grazing by sheep, some plants of leafy spurge remained alive although much reduced in vigor. Thus, if such land were to be used for crop production, leafy spurge should be carefully watched, as these remaining plants could, under poor management, re-infest the entire area.

The results reported demonstrate a tenet of range management, namely, that it is possible to manipulate the vegetation of an area by taking advantage of the differing grazing habits of livestock. In this study, through selective grazing by sheep over a five-year period, an area that was badly infested with leafy spurge was converted to good crested wheatgrass pasture containing a very limited amount of leafy spurge.

Summary

A study was undertaken to determine the effectiveness of selective grazing by sheep on the control of leafy spurge. A study site was selected that was badly infested with leafy spurge and that had previously been seeded with crested wheatgrass. Grazing started in 1952 and was continued until 1956. During this interval, vegetation changes were followed with the vertical point method.

The results show that selective grazing by sheep is an effective method for use in controlling leafy spurge and that at least four years of grazing are re-

quired before such control can be attained. During the study period the basal area of crested wheatgrass increased significantly ($P < 0.01$) whereas that of leafy spurge showed a significant decrease ($P < 0.01$). Observations made during the course of the experiment are discussed. These are of practical interest to pasture managers.

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