Barrier Effect of the Shrub *Elaeagnus commutata* on Grazing Cattle and Forage Production in Central Alberta¹

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Highlight

Excellent condition range occurred under silverberry shrubs while fair to good condition range occurred between shrubs. The herbaceous layer dominants, rough fescue and western porcupine grass, produced nearly twice as much under shrubs. Forb increasers had a lower frequency and produced less herbage under shrubs. Silverberry is an increaser but the barrier effect it has on grazing cattle permitted a small patch of grassland directly beneath each shrub to return to near-climax condition.

Silverberry (*Elaeagnus commutata*²) is an important shrub in the central Alberta parkland. Many stems are interconnected to form a clone. The roots of the shrub bear nodules which are capable of fixing nitrogen (Moore, 1964). Studies of the fescue grasslands in Alberta (Moss and Campbell, 1947) and Saskatchewan (Coupland and Brayshaw, 1953) revealed that the shrub occurred only occasionally about 20 years ago. Silverberry is now widely distributed in these grasslands. The cause of increased shrub cover has not been investigated. It is probably related to overgrazing and cycles of high annual precipitation.

Shrubs and trees often reduce the potential yield of understory forage species (Blaisdell, 1949; Ivan, 1960; Johnston and Smoliak, 1968; Little, 1961; Robertson, 1947; Scott, 1967; and Thomas et al., 1968). The detrimental effects of woody plants on economically important herbaceous species are widely known but the beneficial effects of a few shrubs on palatable forage species is often overlooked. In a crested wheatgrass stand having both rubber rabbitbrush and big sagebrush, Frischknecht (1963) found that when grazed, more forage was produced directly under rubber rabbitbrush than in adjacent openings. Big sagebrush, in contrast, lowered forage yields. The barrier effect of a plant

on a grazing animal is not limited to shrubs and domestic livestock. Daubenmire (1968) showed in a photograph (p. 59) that grazing jackrabbits had destroyed all phlox growing between clumps of bluebunch wheatgrass. The only surviving plants were in the protection of clumps of wheatgrass.

Corns and Schraa (1965) observed that silverberry interfered with utilization of forage by cattle. In an experiment that excluded grazing, they found no significant increase in herbage yield when silverberry was killed with herbicides. In contrast, McIver (1963) obtained increased forage yield when silverberry, aspen poplar and snowberry (*Symphoricarpos* sp.) were controlled. Since the yield data were lumped, however, no conclusions can be made about the separate effect of each species on forage yield.

This paper pursues further some of the observations of Corns and Schraa (1965). The objective was to investigate the effect of silverberry on forage production and utilization by grazing cattle.

Study Area and Methods

The study was conducted on the University of Alberta Ranch, 95 miles southeast of Edmonton, Alberta. The major types of vegetation are the fescue grasslands and aspen poplar (*Populus tremuloides*) groves. The fescue grasslands occurred on uplands underlain by soils of the Dark Brown or Thin-black soil zones while the aspen groves usually occupied depressions having deeper soils of the Black or Dark Grey Wooded soil zones.

In the study area, the shrub layer was dominated by 12 to 17 year old stands of silverberry. The shrub had about 40% canopy cover and 1000 stems per acre (Fig. 1). The herbaceous layer was dominated by rough fescue. The orthic chernozem soils have developed on glacial outwash material. Soils were very stony loams. The average annual precipitation was 15 inches with 10 inches occurring in the growing season (Can. Dept. Transport. Meteorol. Div., 1966, 1967).

The study area was used as a calving range. Grazing was from about April 1 to June 15 each year.

Five 10 by 20 ft cattle exclosures were randomly located and erected in the spring of 1967 prior to grass growth. Line transects 3 by 16 ft were randomly located within the exclosures; the transects extended an equal distance outside. Ten shrubs within the transects, 5 inside and 5 outside the exclosure, were randomly selected for sampling. A 10 inch diameter circular plot was located directly under the shrub. Another plot of the same size was randomly located in an adjacent opening between shrubs. Twenty-five paired plots were sampled for herbage yield inside the exclosure and another 25 outside. Eight pairs were lost in transport resulting in the comparisons being made on 17 pairs. The 17 pairs of 10 inch plots inside the exclosures permitted an estimate of herbage production under shrubs and between them. The difference in yield inside versus outside the exclosures permitted an estimate of utilization. Once the cattle were removed in mid-June, all herbage was clipped, bagged and frozen. At a later date, dead herbage was separated into dead grass and dead forbs; the green

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²Common and scientific names follow Moss (1959).

FIG. 1. Silverberry—rough fescue range at end of grazing period, ungrazed—left, grazed—right.

herbage was hand-sorted to species, oven dried and weighed. Rough fescue and western porcupine grass were lumped together because their vegetative parts were indistinguishable after freezing. Western porcupine grass constituted from 5–25% of the combined weight.

Results and Discussion

The openings between shrubs had a richer flora than under shrubs (Table 1). Many of the forb increasers or invaders had a considerably higher frequency between shrubs and four species with frequency values ranging from 9–27% only occurred between the shrubs. These observations agree with Moss and Campbell (1947) who noted that under pristine conditions, rough fescue grew almost to the exclusion of other higher plants but under grazing or mowing, secondary grasses, sedges and forbs increased in importance.

Production figures in Table 2 substantiate the frequency data. There was significantly more herbage under shrubs than between them. Of the 1092 lb/acre more under shrubs, only one-fifth, 232 lb/acre, was green growth; the rest was dead

Table 2. Production (lb/acre) under shrubs versus in openings between shrubs.

	Under shrubs	Between shrubs	Difference and confidence interval ¹
Herbage			
All herbage	2276	1184	1092 ± 657
Green herbage	1107	875	232 ± 222
Dead herbage	1169	314	855 ± 328
Grass and Forbs			
Green grass	860	458	402 ± 119
Green forbs	246	416	-170 ± 155
Dead grass	1020	255	765 ± 293
Dead forbs	149	59	90 NS ²
Species			
Rough fescue (<i>Festuca scabrella</i>) and Western porcupine (<i>Stipa spartea</i> var. <i>curtiseta</i>)	760	356	404 ± 127
Three-flowered avens (<i>Geum triflorum</i>)	71	8	63 NS
Bearded wheatgrass (<i>Agropyron subsecundum</i>)	73	52	21 NS
Bluebell (<i>Campanula rotundifolia</i>)	19	7	12 NS
Dandelion (<i>Taraxacum officinale</i>)	24	97	- 73 ³ NS
Wild strawberry (<i>Fragaria virginiana</i>)	9	43	- 34 NS
Yarrow (<i>Achillea millefolium</i>)	22	55	- 33 NS
Blunt sedge (<i>Carex obtusata</i>)	24	49	- 25 NS
Northern bedstraw (<i>Galium boreale</i>)	40	56	- 16 NS
Prairie sage (<i>Artemisia ludoviciana</i>)	55	69	- 14 NS

¹ at 95% level, except for green forbs which is at 90% level of significance.

² NS = no significant difference.

³ negative sign (-) indicates species with greater production between shrubs.

Table 1. Frequency (% of 34 observations) of occurrence of selected species.

Species	Under shrubs	Between shrubs
Golden aster (<i>Chrysopsis villosa</i>)		9
Prickly rose (<i>Rosa acicularis</i>)		9
Pussy-toes (<i>Antennaria</i> sp.)		12
Milk vetch (<i>Astragalus striatus</i>)		27
Western willow aster (<i>Aster hesperius</i>)	18	29
Mouse-ear chickweed (<i>Cerastium arvense</i>)	15	38
Wild strawberry (<i>Fragaria virginiana</i>)	32	47
Dandelion (<i>Taraxacum officinale</i>)	59	85
Prairie sage (<i>Artemisia ludoviciana</i>)	85	94
Blunt sedge (<i>Carex obtusata</i>)	94	100
Rough fescue (<i>Festuca scabrella</i>) and Western porcupine grass (<i>Stipa spartea</i> var. <i>curtiseta</i>)	100	100

herbage. Green grass, most of which was rough fescue and western porcupine grass, continued to be double under shrubs what it was between shrubs (860 vs. 458 lb/acre). There were fewer green forbs under shrubs (246 vs. 416 lb/acre). There was four times as much dead grass under than between shrubs.

Cattle grazed less intensively upon the green herbage under shrubs than on that between shrubs (34 vs. 46%) (Table 3, Fig. 2) but actual weight grazed was about equal (379 vs. 399 lb/acre). The amount of dead material eaten was very different under shrubs versus between them (311 vs. 89 lb/acre) but the percentage used was the same. On the average, more forage was eaten under the shrubs (699 vs. 488 lb/acre) but more intensive

Table 3. Weight (lb/acre) of forage eaten and level of use (%) sustained under shrubs versus in opening between shrubs.

	Amount grazed		Percentage use	
	Under shrubs	Between shrubs	Under shrubs	Between shrubs
Herbage				
All herbage	690	488	30	41
Green herbage	379	399	34	46
Dead herbage	311	89	27	28
Grass and forbs				
Green grass	310	176	34	42
Green forbs	69	223	28	54
Dead grass	377	107	37	38
Species				
Rough fescue and Western porcupine grass	301	170	40	48
Bluebell	18	7	94	97
Three-flowered avens	70	5	98	66
Prairie sage	17	17	31	25
Bearded wheatgrass	19	12	25	23
Northern bedstraw	- 8 ¹	46	- 20 ¹	82
Yarrow	- 1	37	- 5	71
Wild strawberry	- 2	16	- 22	37
Dandelion	- 17	32	- 71	33
Blunt sedge	- 30	14	-125	29

¹ negative sign (-) indicates a greater weight in grazed plots than in ungrazed ones.

use was sustained in openings between shrubs (41 vs. 30%). Similarly, greater use occurred on green grass between the shrubs (42 vs. 34%) but the amount eaten was less than under the shrubs (176 vs. 310 lb/acre). More green forbs were eaten between the shrubs (223 vs. 69 lb/acre) and the percentage use was higher (54 vs. 28%).

Northern bedstraw, yarrow, wild strawberry, blunt sedge, and dandelion produced more under shrubs in grazed areas than in ungrazed areas. These species were apparently able to grow more rapidly after grazing than the dominate grasses. In the exclosures, the ungrazed grass probably prevented comparable growth. More intensive grazing has probably occurred for years between shrubs. It has reduced grass yield and allowed all five species mentioned above to increase (Table 2).

The breeding herd of cattle requires a relatively constant amount of forage each spring but the forage supply varies from year to year. The intensity of forage use is inversely related to forage supply. In 1967, percentage use of green herbage was 34% under shrubs and 46% between shrubs (Table 3). These differences were not large and did not seem to account for the major differences in species composition and production under shrubs versus between them. The small differences in percentage use in 1967 were probably due to

Fig. 2. A patch of lightly grazed grassland protected by silverberry stems.

high forage production, a result of heavy precipitation in August, 1966 and the spring of 1967. Greater differences in the percentage of forage used under shrubs versus between them could probably be expected in average or dry years.

Amounts of herbage remaining at the end of two grazing seasons (carry over) are compared in Table 4 to evaluate the effect of precipitation and associated factors on yield. Herbage left after the 1966 grazing season was estimated from the weathered material harvested in ungrazed plots. 1966 had below normal precipitation (1.5 inches) while 1967 had above normal precipitation (4 inches) in May and June (Can. Dept. Transport, Meteorol. Div. 1966, 1967). In 1967, there was a 25% increase in animal unit months of grazing. All categories had greater amounts left after the 1967 grazing season. There was 36% more forage under shrubs and 124% more between shrubs. Most of the increase can be attributed to the greater yield of forbs. Weathering during the winter of 1966-67 would reduce the weight of grass and forbs left

Table 4. Comparison of herbage (lb/acre¹) left after 1967 grazing season with that left after 1966 grazing season.

	Weight		Percent change	
	Under shrubs	Between shrubs	Under shrubs	Between shrubs
Herbage left—1967	1590	702		
Herbage left—1966	1169	314	36	124
Grass left—1967	1190	439		
Grass left—1966	1020	255	17	72
Forbs left—1967	400	263		
Forbs left—1966	149	59	168	346

¹ all weight differences under shrubs versus between shrubs are significant at the 95% level with one exception, forbs left—1966.

after the 1966 grazing season and harvested in June, 1967. The 17% difference in weight of grass under shrubs (1020 lb/acre for 1966 vs. 1190 lb/acre for 1967) probably closely reflects weathering loss. Although both grasses and forbs increased with increased precipitation, the forbs had the greater response. The variation in forage yield in response to precipitation and associated factors was greater on the poorer condition range between shrubs than on the excellent condition range under shrubs.

It has been demonstrated that fewer forbs occurred under the shrubs and many other forbs had a lower frequency and yield (Table 1 and 2). Rough fescue and western porcupine grass yielded twice as much under the shrubs and their leaves were twice as long. These grass species were the dominants of the herbaceous layer and produced 60–70% of the total annual yield. Grassland patches under the shrubs appeared to be equivalent to the relict rough fescue grasslands studied by Moss and Campbell (1947). The differences in species composition and dominance under shrubs versus between them are probably caused by a difference in grazing intensity. The mechanical barrier effect of the shrub is considered the major factor influencing grazing intensity. The nitrogen-fixing property of silverberry does not seem to be an influencing factor since Frischknecht (1963) found that rubber rabbitbrush, a shrub that does not fix nitrogen, had a similar effect on cattle grazing crested wheatgrass.

Moss and Campbell (1947) indicated that silverberry rapidly expanded on overgrazed range in the parkland region by means of long rhizomes. Therefore, silverberry is considered an increaser. It seems unusual that one of the effects of this increaser is to help restore a part of the range to near-climax condition. The only part of the range in excellent condition was that directly beneath the shrubs.

The patches of excellent condition range under shrubs made up about 10% of the area. The remainder was in fair to good range condition. Actual influence of the shrubs on herbaceous vegetation was probably more widespread, since in this area rough fescue is rhizomatous. Grass plants protected by the shrubs probably extended into openings between shrubs. Plants growing partly under a shrub and partly in the open were probably more vigorous than those plants not so protected.

Silverberry at 1000 stems/acre had a beneficial effect on forage production under spring grazing in the rough fescue grassland studied. The results probably apply as well to extensive areas of the thin-black soils in central Alberta. It is not known, however, how dense the silverberry must be before the shrub creates a distribution problem for grazing cattle. Grazing is probably effectively prevented in very dense stands of silverberry that occur on fertile soils of the black soil zone.

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