Effects of Clipping on Dry Matter Yields of Basin Wildrye

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Highlight: *Total seasonal dry matter yields of individual spaced basin wildrye plants clipped to three heights and reclipped at three time frequencies declined drastically each successive year from 1970 through 1973. Dry matter yields of plants clipped to 15 cm or at 3-week time frequencies declined the greatest with each successive year of clipping. Time of clipping during the growing season had less influence on total seasonal dry matter yields than did clipping height and frequency. This suggests that grazing basin wildrye during the growing season may be possible on a limited basis only.*

Basin wildrye (*Elymus cinereus* Scribn. and Merr.) attracts range managers because of its early growth and production. Basin wildrye is found on river banks, in ravines, on moist or dry slopes, and on the plains from Minnesota to British Columbia and south to Colorado and California.

Basin wildrye is a coarse, robust, bunch type, perennial, cool season grass with stems up to 3 meters (10 feet) high. It tillers profusely and produces abundant forage. Young shoots may be grazed, but they soon become coarse and unpalatable as plants mature.

Lack of resistance to spring grazing is one of the major problems associated with basin wildrye (Forest Service, 1937; Krall et al., 1971). Basin wildrye formerly was very important as winter forage in parts of Nevada, Utah, and Idaho, but overgrazing new growth during the spring months has greatly reduced or eliminated stands.

Ergot may be a problem because it causes poor seed set under some conditions. Potential danger from ergot should be considered in grazing mature plants.

Basin wildrye is slightly higher in ash, crude fiber, and crude protein than are 67 common western range grasses but is slightly lower in ether extract and nitrogen-free extract (Knight et al., 1911). Chapman (1969) reported that basin wildrye is a highly cross pollinated species with extensive genetic variation.

Krall et al. (1971) reported that single clipping treatments of basin wildrye during the period from growth initiation to full bloom followed by removal of all growth to a 5-cm stubble at the end of the growing season reduced yields in the year of clipping and the year following. Growth reduction was greatest when plants were clipped at the boot stage. Perry and Chapman (1974) found that total nonstructural carbohydrates (TNC) declined rapidly during the boot stage of development. They also reported a severe depletion of TNC following clippings to 10 and 30 cm with significantly less recovery of those plants clipped to 10 cm. They hypothesized that severe depletion of carbohydrate reserves following clipping was associated with lack of resistance to spring grazing.

Because of the attractiveness of this forage plant to the range manager and lack of information on this grass, we studied: (1) the effect of clipping to three heights beginning at six starting dates with subsequent harvests at three time intervals on total seasonal dry matter yields continued over a period of years, and (2) the pattern of growing point elongation and other phenological phenomena.

Procedure

Individual basin wildrye seedlings from a Soil Conservation Service collection, Wyoming 107, were grown in peat-moss pots in the greenhouse to the 2 to 3-leaf stage. Seedlings were then transplanted to the field in early August, 1968, in a 3-foot grid and hand watered each day for 1 month to assure establishment. Replacements of the same age were transplanted for those seedlings which died. In May, 1969, timothy (*Phelum pratense* L.) was interseeded in 30-inch bands in both directions for a uniform stand for weed control, and the basin wildrye plants were allowed to become established. They received a single irrigation in mid July, 1969, to aid in establishment; thereafter, they received no supplemental irrigation. Weeds were removed by hand and growth of timothy was controlled with a lawn mower.

To determine the effect of clipping on dry matter production, individual basin wildrye plants were clipped to 45, 30, and 15 cm starting on June 6, 15, 22, 1970. Subsequent dry matter accumulation was measured at 3-, 6-, and 9-week intervals until the current year's production ceased. Forage was oven dried at 65°C to a uniform moisture content of about 12%. These treatments were also imposed during 1971 with three additional, earlier starting dates (May 17 and 25, and June 2). All clipping treatments were continued at approximately the same starting dates for 1972 and 1973.

The average number of tillers per mature plant (late boot stage to fully headed) was estimated on 52 plants in June, 1970, by measuring the circumference of the plants in cm and counting the tillers in a 15-cm circumference of a representative portion of each plant. Plant height and growing point location were recorded in centimeters from soil surface

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Table 1. The total precipitation (inches) for each month, 1970 through 1973, and the long term precipitation and temperature (°F) average from 1958 to 1970 at the Montana Agricultural Experiment Station, Bozeman, Montana.

Month	Total precipitation					Avg temp.
	1970	1971	1972	1973	1958-70	1958-70
January	.57	.40	.28	.61	.52	21.1
February	.31	.51	.52	.05	.36	26.6
March	1.57	.41	1.17	.79	.96	29.9
April	1.43	3.09	1.69	1.99	1.32	40.6
May	3.62	3.07	1.32	1.08	2.35	51.1
June	1.57	2.85	2.90	3.65	2.80	57.9
July	3.38	.25	1.33	.47	1.42	65.0
August	.49	.97	1.48	1.22	1.25	63.7
September	2.21	2.10	1.53	2.48	1.20	53.7
October	1.92	.71	2.43	1.45	1.31	45.1
November	1.26	.67	.42	1.02	1.07	32.1
December	.50	.21	.38	1.14	.46	23.8
Total	18.83	15.24	15.45	15.95	15.02	

to the top of the plant and to the growing point, respectively, during 1971.

The experiment was conducted in a randomized complete block design with two replications. The basic experimental unit consisted of six plants. The net result is that each treatment mean is of a maximum of 12 plants treated alike. Years, starting dates, clipping heights, and intervals were jointly analyzed with their interactions as a factorial arrangement for the treatments initiated in 1970 and separately for the treatments initiated in 1971. Two analyses of variance were conducted for dry matter production.

The study was located at the Plant and Soil Science Field Laboratory 6 miles west of Bozeman, Montana. The yearly rainfall data for the station during the study as well as a long term temperature and rainfall average are given in Table 1. The average freeze free season between 1958 and 1970 was 102 days, with May 31 and September 10 as the average date for the last and first freeze, respectively.

Results and Discussion

Plants increased in height in a normal growth pattern (Fig. 1). Growing points were 30 cm in height at the first sampling

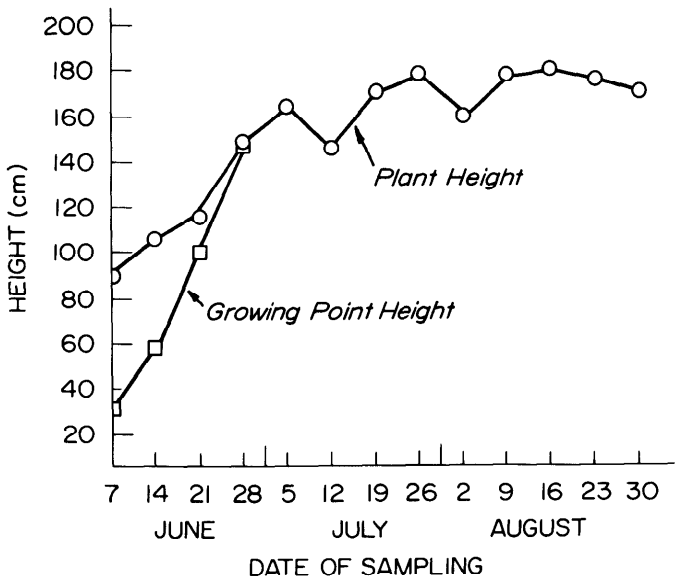

Fig. 1. *Plant height and height of growing point of basin wildrye plants during the 1970 growing season at Bozeman, Montana.*

Table 2. Total seasonal dry matter yield (g/plant) of basin wildrye clipped at three heights and at three frequencies averaged over three starting dates, 1970 through 1973.

Year	Clipping ht (cm)	Frequency of harvest			Means
		3 weeks	6 weeks	9 weeks	
1970	15	253*	261	287	240
	30	225	241	231	
	45	205	239	218	
1971	15	84	124	150	173
	30	168	181	185	
	45	201	251	208	
1972	15	50	65	97	89
	30	89	75	105	
	45	100	123	92	
1973	15	23	28	41	39
	30	38	34	44	
	45	43	47	46	
Means		124	140	142	

*L.S.D. $P_{.05} = 38$

(June 7) with complete elongation by June 28. Krall et al. (1971) found that basin wildrye growing points protruded above the soil surface in mid-May at Bridger, Montana. The period of rapid elevation of growing points in basin wildrye is associated with a rapid decline in total nonstructural carbohydrates (TNC) as reported by Krall et al. (1971) and Perry and Chapman (1974). Thus, clipping or grazing of basin wildrye at the boot stage (some time in June) corresponds to a period of low TNC. With low clipping heights during this sensitive period, plants could become severely weakened (Perry and Chapman, 1974).

Plants had an estimated average of 105 tillers, 90% or more of which were fertile. Little to no regrowth of new tillers was observed following removal of the growing point. Thus, heavy utilization of basin wildrye with exposed growing points would interfere with regeneration of photosynthetic tissue.

The effect of clipping to three heights at three frequencies averaged over three starting dates on total seasonal dry matter yields over a 4-year period is shown in Table 2. Significant differences were not detected among the means of the three starting dates. The lack of difference in yield among starting dates is attributed to removal of the growing point at all initial harvests except for the 45-cm clipping height at the first starting date (approximately June 6 all 4 years). Little regrowth occurs in basin wildrye following growing point removal because the grass produces few vegetative tillers. Although not significant, the last starting date (approximately June 22 all 4 years) yielded the greatest total seasonal forage, which was expected because of dry matter accumulation with maturity.

The treatment effects of the previous years on total seasonal dry matter production is reflected by the significant decline in yield each successive year (Table 2). Dry matter yields during the fourth year of clipping were less than 20% of the first-year clipping yields.

The clipping height means averaged over all treatments for all years were 122, 135, and 148 g/plant for the 15-, 30-, and 45-cm clipping heights, respectively. Plants clipped to 15 cm during 1970 yielded more total seasonal forage than plants clipped to 30 and 45 cm, but the rate of decline in forage yields associated with the 15-cm clipping was much greater than the 30- or 45-cm clippings with subsequent years (Fig. 2). Basin wildrye rarely displays leaves below 15 cm at maturity.

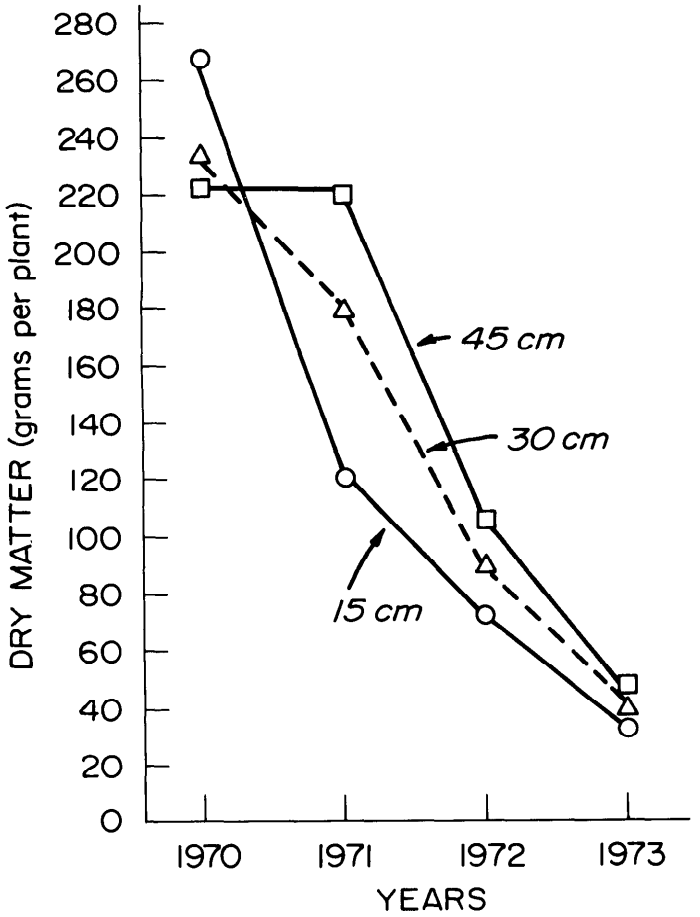

Fig. 2. *Total seasonal dry matter yield (g/plant) of basin wildrye clipped at three heights and averaged over three starting dates and three frequencies, 1970 through 1973.*

Thus, plants clipped to low heights after elevation of growing points have minimum photosynthetic tissue during the remaining growing season.

The clipping frequency means averaged over all treatments for all years were 124, 140, and 142 g/plant for the 3-, 6-, and 9-week frequencies, respectively. Even with little regrowth occurring with these treatments, the 3-week clipping frequency was most detrimental for total seasonal dry matter yields each year.

During the first 2 years of the study, significant differences existed among clipping heights for each frequency of harvest (Table 2). However, these differences were less during 1972 and no differences existed among the treatments in 1973. Plants clipped to 15 cm, particularly at the 3-week frequency, declined in total seasonal dry matter production most during the first 3 years of the study (Fig. 2). However, by the fourth year, all treatments resulted in low total dry matter production. It is not likely that the tremendous difference in yields is due entirely to environmental differences among the 4 years, although rainfall was somewhat below normal during the 1973 growing season (Table 1).

In 1971, untreated mature basin wildrye plants were clipped to 15, 30, and 45 cm. The same plants were reclipped at the same time in 1972 and 1973 to detect any decline in dry matter yields when clipped at maturity. The yield differences (Table 3) of 225 g between the 15- and 30-cm clippings during 1971 show a significant amount of plant material present at the stem bases. The decline in yield over

Table 3. Dry matter yields (g/plant) of mature basin wildrye clipped at three heights, 1971 through 1973.

Year	Clipping height (cm)		
	15	30	45
1971	823	598	540
1972	344	350	335
1973	226	152	172

the 3-year period represents the sensitivity of basin wildrye to clipping even at maturity. Plants clipped to 15 and 30 cm had little to no photosynthetic tissue remaining.

In 1971 three additional starting dates with the same clipping heights were initiated (Table 4). As in the previous study, the greatest amount of significant variation occurred among the yearly means. The rate of decline for all treatments between 1971 and 1973 was pronounced. Thus, harvesting of basin wildrye herbage during the period from the onset of spring growth through maturity will decrease total seasonal yields. Furthermore, harvest during this period results in drastic yield reductions each of the following years.

The majority of plant dry matter was obtained from the second harvest following the initial harvests for these starting dates as the growing points were not removed at the initial harvests.

There was significant variation among starting date means, with more production from the second starting date for the first year only. Thereafter no significant difference existed for starting dates.

During 1971 and 1972, plants clipped at 9- and 6-week frequencies yielded more total seasonal dry matter than plants clipped at 3-week frequencies (Fig. 3). Plants clipped at 9-week frequencies had a longer period of time to recover and grow.

When clipping occurred to a height immediately above the growing point, culm elongation following clipping consisted of stem material with an inflorescence and little leafy tissue above the clipping height. Regrowth looked like a barren culm, particularly at the 9-week interval. TNC must have been utilized for this stem material because of reduction in photosynthetic material. Clipping of leafy tissue at several stages resulted in no leaf blade extension. Regrowth following some harvests had very short leaf blades on the upper plant portions. Apparently the leaf blade meristematic area was no longer active after such clippings. Generally, height of

Table 4. Total seasonal dry matter yield (g/plant) of basin wildrye clipped at three frequencies and at three starting dates averaged over three clipped heights, 1971 through 1973.

Year	Starting date[1]	Frequency of harvest			Means
		3 weeks	6 weeks	9 weeks	
1971	1	224[2]	346	489	374
	2	221	451	581	
	3	252	402	399	
1972	1	73	101	190	115
	2	90	119	188	
	3	69	105	102	
1973	1	31	34	95	49
	2	31	46	75	
	3	28	50	50	
Means		113	183	241	

[1] Starting dates were May 17, 25, and June 2 during 1971 and at approximately the same dates during 1972 and 1973.
[2] L.S.D. $P_{.05} = 48$

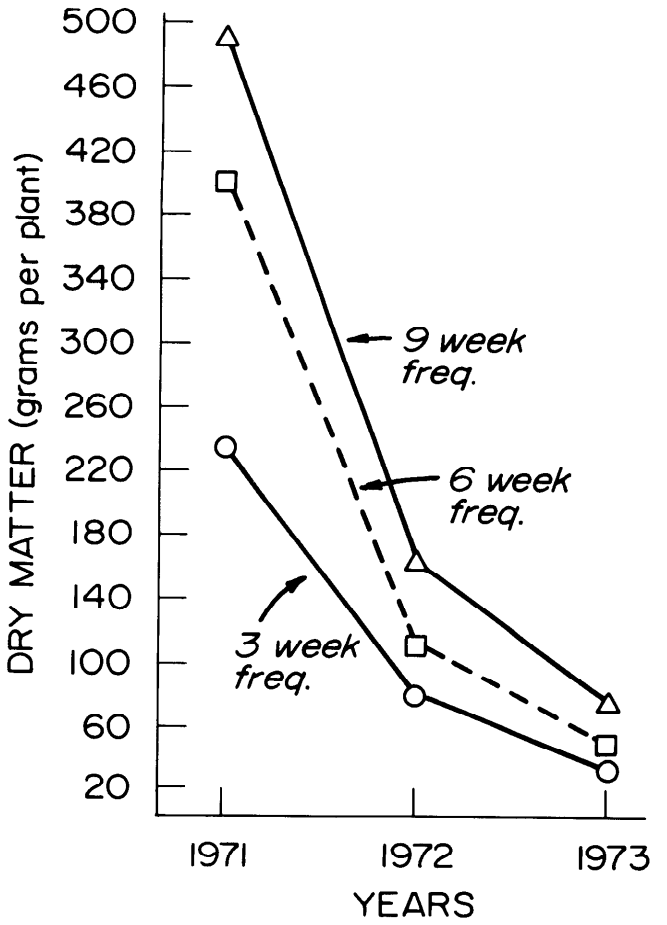

Fig. 3. *Total seasonal dry matter yield (g/plant) of basin wildrye clipped at three frequencies averaged over three starting dates and three clipping heights, 1971 through 1973.*

regrowth (culm elongation) was less on plants clipped to 15 cm than on plants clipped to 45 cm for each harvest frequency. It was observed that the previous year's clipping to 15 cm markedly reduced plant circumference, height, and vigor each successive year.

Several factors may be involved in basin wildrye's sensitivity to grazing and clipping. Certainly, carbohydrate reserves are a vital consideration. Perry and Chapman (1974) and Krall et al. (1971) reported low levels of TNC for basin wildrye. Perry and Chapman (1974) found that TNC declines very appreciably following clipping particularly to low heights during the boot stage with little recovery going into winter. Fall growth which normally occurs with cool season grasses does not occur with basin wildrye. Thus, any TNC utilization of low clipped plants during summer is not replenished before winter. In addition, basin wildrye has a very high fertile to vegetative stem ratio, which requires more energy for tissue manufacture. The grass also possesses few leaves near the soil surface for photosynthesis. These observed and reported associations with basin wildrye may account for the sensitivity of basin wildrye to grazing or clipping.

Conclusions

Because of the severity in decline of forage yields each successive year following clipping of basin wildrye, we suggest that grazing of this grass in early spring may only be possible on a limited basis. From our data and those of Krall et al. (1971), basin wildrye is sensitive to clipping any time during the growing season particularly during the boot stage of development. Management may require that only 50% of the herbage be removed and that plants be grazed prior to the boot stage of development. It is difficult, however, to control grazing to remove only half of the herbage. Thus, utilization of this grass may be limited to the winter months. Although it is unpalatable and of low forage value during winter, it may be valuable for calving in winter or early spring provided severe grazing is not allowed on new growth.

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THESIS: THE UNIVERSITY OF WYOMING

Elk Distribution in Relation to a Deferred Rotation Grazing System, by Charles A. Oakley, MS, Range Management. 1971.

The study was conducted from June to September, 1970, on the elk herd within the Pole Mountain Range District of Medicine Bow National Forest. Domestic livestock were grazed on the District throughout the summer period under a deferred rotation grazing system. The principal objective of the study was to determine if the rotational system of grazing had any effect on elk distribution.

The total elk population was estimated at approximately 130 animals. The 1970 calf crop was high, indicating a potentially growing herd. Five elk were observed on the study area with blue neck bands. These elk were transplanted from Yellowstone National Park to the Laramie Peak area in February, 1968.

Forbs were the predominant food item consumed during the summer. Peak forb consumption occurred in July. In August, there was a notable increase in browse utilization, especially aspen.

Allotment cross fences were observed to have had a minimal effect on elk distribution.

The rotational system of grazing seemed to have little effect upon elk distribution, except in June when the cow elk were calving and in September when the initiation of the rut begins. On these two occasions, elk movement was detected away from the cattle to adjacent pastures with no cattle.