

Clipping Effects on Dry Matter Yields and Survival of Basin Wildrye

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Highlight: *Effects of frequency and height of clipping basin wildrye over a 4-year period on yield and plant survival in the fifth year were studied. Yield and survival were reduced with close and frequent clippings (6 vs 9 week frequencies and 15 vs 30 cm heights), but growth stage at the first clipping did not significantly reduce either yield or survival. We conclude that reduced yield and survival in response to the clipping treatments are due to a previously reported decline in plant vigor, which is related to levels of carbohydrate reserves.*

Management of range vegetation must be based on minimizing reduction in stands and plant vigor due to forage removal. If heavy use severely limits growth or regrowth potential and plant vigor, plants may survive, but yield little, or death may occur. The quality and quantity of carbohydrate reserves are critical factors in both plant regrowth and in survival (McKendrick, 1971). Low carbohydrate reserves are associated with reduced vigor and plant mortality. Weinmann (1952) reported that depletion of carbohydrate reserves lowered plant tolerance to frost, heat, and drought conditions. According to Cook (1966), care must be taken in grazing management to maintain carbohydrate reserve levels of grasses above critical minimum values to avoid death of individual tillers. Intermediate wheatgrass plants cannot recover from clipping as a result of reduced vigor when the total water soluble carbohydrate fractions in stem bases are depleted to 1%, according to Ogden and Loomis (1972). Owensby et al. (1974) observed a reduction in tiller density, herbage yield, and total nonstructural carbohydrate content with increasing clipping frequency.

Basin wildrye (*Elymus cineris* Scribn. and Merr.) is sensitive to clipping or grazing throughout the growing season. 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 (1975) found that total seasonal dry matter yields of basin wildrye declined drastically each successive year of a 4-year study involving many clipping combinations. Dry matter yields of plants clipped to 15 cm or clipped at 3-week intervals 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. Perry and Chapman (1974) reported that total nonstructural carbohydrates (TNC) declined rapidly during the boot stage of development. They also reported a severe depletion of TNC following clipping 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.

We studied the effects of 4 years of clipping of established basin wildrye plants on survival and dry matter production in the fifth year.

Materials and Methods

For each of 4 years (1970 through 1973), the same basin wildrye plants were clipped to 45, 30, or 15 cm. Annually, clippings were initiated at six times based on phenological development, and regrowth was harvested throughout each season at one of three frequencies: 3, 6, or 9-week intervals. The field design and treatments have been described in detail by Perry and Chapman (1975). During the last week of June, 1974, all plants were clipped to a uniform height of 30 cm, and any material from previous years' growth was removed to minimize bias from different clipping heights during the preceding 4 years. Forage was oven dried at 65°C to a uniform moisture content of about 12%. Percent survival for the various clipping treatments was estimated as the ratio of living plants in June, 1974, to the number of plants in the start of the study in 1970.

Dry matter yield data for the 1974 harvest were analyzed following standard analysis of variance methods for a factorial arrangement of treatments in a randomized complete block design. A fixed model was assumed; thus, variation due to starting dates and clipping heights and frequencies, and interactions among these factors were all tested with error mean square. Analysis of percent survival was carried out on arcsin transformed data.

The study was located at the Plant and Soil Science Field Laboratory 6 miles west of Bozeman, Montana. Climate data have been reported by Perry and Chapman (1975).

Results and Discussion

Frequency of harvest and clipping height means varied significantly for both yield and plant survival (Table 1). Clipping height affected yield and survival more than frequency of harvest. Date of first harvest did not affect either yield or survival.

Clipping at 6- or 3-week intervals for 4 years reduced yields in 1974 more than clipping at a 9-week frequency, and the effect of clipping at 3-week intervals was more pronounced than that for 6-week intervals (Table 2). Similarly, yields were

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Table 1. Summary of analyses of variance for dry matter production and percent survival during 1974 of basin wildrye previously clipped under different starting dates (SD), clipping frequencies (I), and clipping heights (H) during 1970 through 1973.

Source	D.F.	Mean squares	
		Dry matter production	Survival (%)
Replications	1	5.6	22.2
Starting dates (SD)	5	212.1	201.4
Frequency (I)	2	1373.5**	902.6*
Height (H)	2	13053.2**	2675.5**
SD × I	10	276.3**	347.8
SD × H	10	124.8	119.8
I × H	4	69.3	534.8*
SD × I × H	20	151.0	270.8
Residual	53	90.1	208.5
Total	107	392.6	294.1

*Significant at $P = .05$.

**Significant at $P = .01$.

reduced with lower clipping heights. Mean yields for the 15, 30, and 45 cm heights were 29, 49, and 67 g per plant, respectively. Clipping at 15 and 30 cm for 4 years, compared with 45 cm, markedly reduced dry matter yields in 1974. Basin wildrye rarely displays leaves below 15 cm at maturity. Little regrowth occurs in basin wildrye following the removal of the growing point because few vegetative tillers are produced. Thus, plants clipped to low heights, 15 and 30 cm, after elevation of growing points have minimum photosynthetic tissue remaining during the growing season.

The starting date × frequency of harvest interaction also was significant for dry matter yield. Dry matter yields in 1974 of plants previously clipped at the 3-week interval were significantly lower than those of plants clipped at the 9-week interval for the first four starting dates, but not for the last two starting dates. Since growing points were removed at the initial harvest for the last two starting dates, regardless of clipping height, marked yield differences due to frequency of harvest were not expected at the later stages of development.

Survival was not affected by frequency of clipping for plants clipped to heights of either 30 or 45 cm (Fig. 1). Survival was proportional to clipping frequency for plants clipped to 15 cm. Survival data do not reflect in which year plants died.

We believe that plants which did not survive clipping treatments probably died because the treatments led to excessively low nonstructural carbohydrate reserves. These reserves provide energy for regrowth following defoliation (Jameson, 1963). Perry and Chapman (1974) reported that

Table 2. Dry matter yields (g/plant) of basin wildrye plants clipped to 30 cm in late June, 1974, following 4 years of clipping at three frequencies, three heights, and six starting dates.¹

Starting dates ²	Frequency of harvest			Means
	3 week	6 week	9 week	
1	43 cdef ³	43 def	62 ab	50
2	39 ef	56 bc	68 a	54
3	40 ef	50 bcd	53 bcd	48
4	37 f	42 def	54 bcd	45
5	48 cdef	47 cdef	44 cdef	46
6	51 bcde	49 cdef	51 bcde	50
Means	43 t	48 s	55 r	

¹ Reported data were averaged over the three clipping heights.

² Starting dates (May 17, 25, June 2, 6, 15, and 22) were approximately the same for the previous years clippings.

³ Means within rows or columns followed by different letters are significantly different $P .05$ using Duncan's multiple range test.

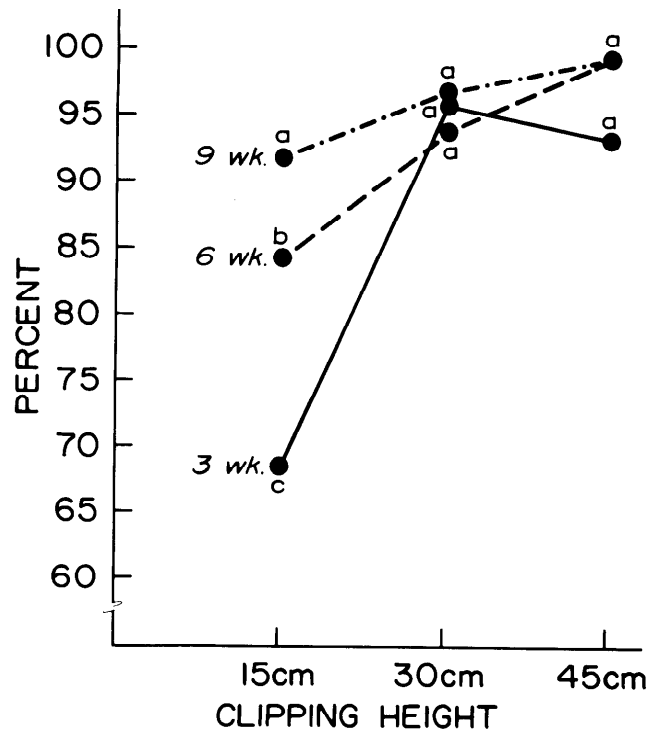


Fig. 1. Percent plant survival of basin wildrye in 1974 following 4 years of clipping at three frequencies, three heights, and averaged over six starting dates.

nonstructural carbohydrate reserves declined to less than 3% in response to severe clipping treatments, while plants of the less severe clipping treatments recovered more quickly and had higher TNC levels. These data support our previous work, which shows that basin wildrye cannot survive frequency of herbage removal, which approximates that which would normally occur under actual grazing.

The lack of significant variation among starting date means for yield and survival was not expected (Table 1). We previously reported (Perry and Chapman, 1975) drastic yield reductions in response to successive years of clipping at different stages of development, including the boot stage, which Krall et al. (1971) reported to be the stage most sensitive to clipping.

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