

Effect of Time and Extent of Harvesting Basin Wildrye¹

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Highlight

Single clipping treatments of basin wildrye during the period of 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. Removal of $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ or all of the herbage at any one of three dates in the spring of one year reduced yield the following year. Growth decreased as the level of herbage removal increased and with years of treatment or delay in harvest time when $\frac{3}{4}$ or all of the herbage was cut. Growth reduction was greatest when herbage was cut at the boot stage which coincided with the period of rapid elevation of growing points above the soil surface and with a decrease in total available carbohydrates (TAC). Grazing of basin wildrye in early spring, based on data presented, would probably be quite detrimental just as cutting was.

Basin wildrye (*Elymus cineris* Scribn. and Merr.) has often attracted the range manager because of its early growth and good production. The species is often confused with giant wildrye (*Elymus condensatus* Presl.). The two spe-

cies differ mainly in pubescence of lemmas, compoundness of spike, width of leaf blades and area of adaptation (Hitchcock, 1950). Giant wildrye is found on sandy areas mostly near the coast from Alameda county to San Diego county California; whereas 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.

Most descriptions of basin wildrye have been given under the heading of giant rather than basin. In all future reference in this paper basin wildrye will be used whether

the literature cited refers to giant or basin.

Perhaps the best description of basin wildrye is given in the *Range Plant Handbook* (Anonymous, 1937). Excerpts from this description are as follows: "It is a coarse, robust plant with stems up to 12 feet high and growing in large bunches, often several feet in diameter, from short, thick, knotted, perennial rootstocks. This bunchgrass usually grows in moist or wet saline situations in bottomlands, along stream and ditch banks, and in gullies and canyons. It is also found in moderately dry, rich soils, not uncommonly associated with wheatgrass and sagebrush. Basin wildrye is grazed to some extent while young, but soon becomes coarse and tough and is not utilized as summer forage if more palatable feed is available. However, the plants produce an enormous amount of forage and, where allowed to stand, provide a considerable amount of winter feed for cattle and horses. Formerly this species was very important as a winter forage plant in parts of Nevada, but overgrazing, especially during the spring months when growth was starting, has greatly reduced or eliminated it."

"In Oregon and Washington, where basin wildrye occurs in considerable abundance, this species is extensively cut for hay and, if mowed early, provides fair roughage. It is moderately palatable to cattle and horses in California and the Northwest, except during the fall when it becomes very hard and dry. After winter rains begin it softens and is again grazed. Basin wildrye rates as an inferior forage

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species, insofar as palatability and nutritive quality. The following chemical analysis compares the composition of basin wildrye with the average of 67 common western range grasses (Knight et al., 1911):"

	Basin wildrye (%)	Average composition, 67 grasses (%)
Ash	9.81	7.48
Ether extract	1.13	2.05
Crude fiber	40.82	35.92
Crude protein	9.01	8.02
Nitrogen-free extract	39.15	46.53

The seasonal growth pattern of basin wildrye differs from those of other dryland cool-season grasses. The phenological events of this species occur over an extended period of time. Winter dormancy is broken in early March at Bridger, Montana, with the first leaves emerging between March 10 and March 20. Growth is retarded at this time by continued cool temperatures. Basin wildrye starts spring growth five days earlier than bluebunch wheatgrass (*Agropyron spicatum* (Pursh.) Scribn. and Smith) but reaches the heading stage 13 days later. It blooms 13 days later and matures seed 16 days later.² The very long vegetative stage delays other phenological stages and causes this early spring growing species to be classed as a late maturing plant. The extended vegetative stage and prolific vegetative production would seem to make basin wildrye an ideal spring grazing plant.

The major problem in maintaining basin wildrye as pasture seems to be its lack of resistance to spring grazing. Because of the paucity of information concerning this species we studied: (1) the effect of clipping once during the growing season upon total season yield (first cut plus regrowth) and upon subsequent yield; (2) the effect of time and amount of herbage removal on growth; and (3) the pattern of growing point elongation and seasonal carbohydrate trends.

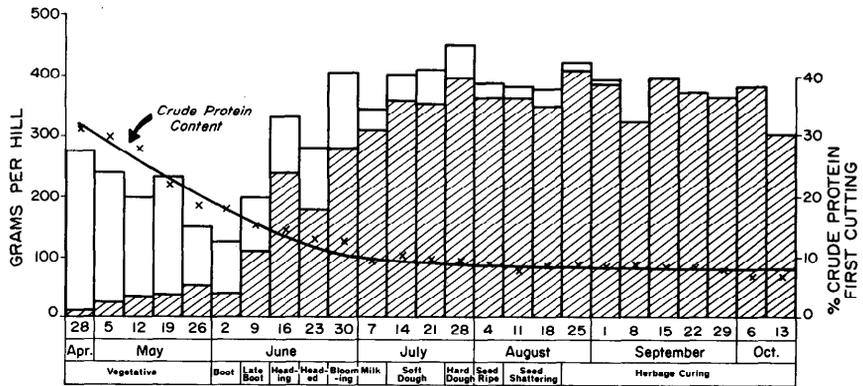


FIG. 1. Yield at time of clipping (hatched bars), regrowth yield (plain bars) and crude protein content of basin wildrye in 1966 at Bridger, Montana.

Seasonal Growth Patterns, Regrowth and Protein Content

Procedure

Basin wildrye was planted in 150 hills spaced on 3-foot centers at Bridger, Montana, in April, 1965. Ten seeds were planted in each hill. In 1966 one hundred vigorous hills were selected for study and divided into four replications of 25 hills each. Each hill within a replication was assigned one of 25 clipping dates at which time it was clipped to a 5-cm stubble height. The data from these treatments provided a seasonal growth curve over a 25-week period. The herbage harvested on these dates was analyzed for crude protein content.

All plants were again clipped to a 5-cm stubble height to measure regrowth on November 2, 1966.

On June 19, 1967, plants were harvested at the boot stage. Yields obtained were used to evaluate the effect of clipping treatments in the previous year. During the study the experimental area was not fertilized, but was adequately supplied with water and was kept weed free.

Results and Discussion

The growth curve of basin wildrye, as shown by weekly interval harvests, was typical of that expected for a grass (Fig. 1). Cutting prior to bloom reduced the total seasonal yield (first cutting plus regrowth). Yield reduction was most

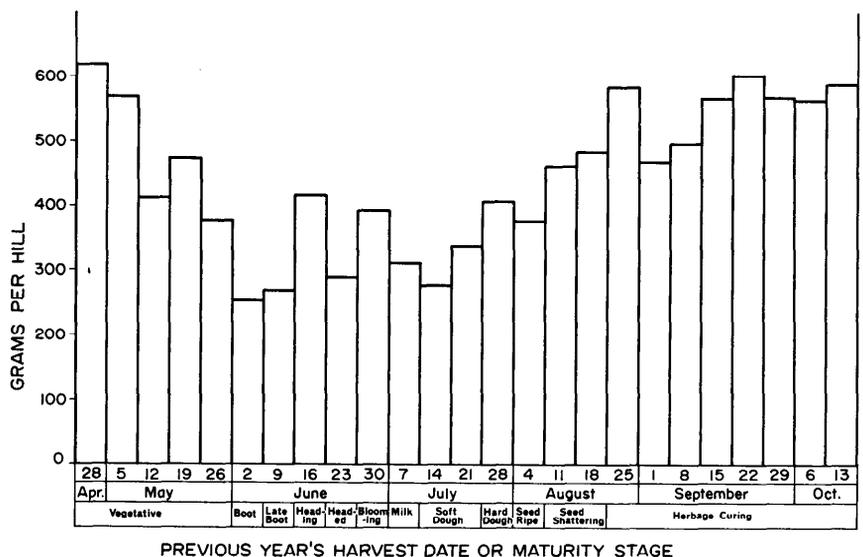


FIG. 2. The effect of a single clipping at different dates in 1966 (weekly intervals) on the yield of basin wildrye in 1967 at Bridger, Montana.

² Unpublished data, Bridger Plant Materials Center, Bridger, Montana.

Table 1. Yields¹ (kg/hill) of basin wildrye in 1970 as influenced by years of herbage removal treatments in previous years at Huntley, Montana.

Years of treatment	Amount of herbage previously removed ²				
	none	¼	½	¾	all
One (1969)	1.26 ³	1.14	.98	1.08	.72
Two (1968 and 1969)	1.26	.93	.94	.75	.54
Three (1967, 1968 and 1969)	1.26	1.02	.81	.69	.47

¹ LSD (.05) for comparing herbage removal treatments within a treatment duration period equal .13 kg; for comparing treatment duration periods within a level of herbage removal equal .25 kg.

² Values presented represent averages of 3 stages of harvests which were 18, 38 and 76 cm of height.

³ Year block effects were accounted for by adjusting all yield data to a common check.

severe when the first cutting occurred a week prior to the boot stage or at boot stage. Crude protein content declined from 31% in late April to near 10% when seed was in the milk stage and to near 8% at the end of the season. The latter value is higher than normally found for range grasses at this time.

In general, cutting anytime from the second week in May through seed maturation reduced the yield the following year (Fig. 2). Reduction in yield was greatest from cutting at the boot or late boot stage. These data agree with those for tall wheatgrass where yields were lower the following year after cutting at the boot stage than after cutting at flowering (Stroh and Law, 1967).

Effect of Time and Amount of Herbage Removal on Growth

Procedure

Basin wildrye was cut at three different dates in the spring, with five levels of defoliation within each date for a period of either 1, 2, or 3 years. The experiment was conducted as a split-split plot randomized block design with three replications. The basic experimental unit consisted of one hill seeded with approximately 10 seeds of the strain Wy 107. One hundred and thirty-five hills spaced on 3-foot centers were seeded at Huntley, Montana, in 1966 and allowed to establish one year. These were subdivided into three replications of 45 hills each. Each replication was then

divided into three groups of 15 hills each. Durations of cuttings (1, 2, or 3 years) were then randomly assigned to each group. The one-year duration cutting treatment was cut only in 1969, the two-year in 1968 and 1969, and the three-year in 1967, 1968 and 1969. Each group of 15 was then further subdivided into three groups of five hills each. Three harvest dates, coinciding with plant heights of approximately 18, 38, and 76 cm were randomly assigned to each group of five hills. Each of the five hills was then assigned a degree of herbage removal of (1) no herbage removed, (2) one-fourth of herbage removed, (3) one-half of herbage removed, (4) three-fourths of herbage removed and (5) all herbage removed. For treatments 2, 3, and 4 above, the crown was visually divided into four parts and the appropriate amount of herbage clipped to 5 cm.

At the end of each growing sea-

son all plants were cut back to a 5-cm stubble height. In June, 1970, one year after the completion of the above harvest treatments, all plants were harvested at early bloom to measure the effect of the previous treatment.

Results and Discussion

In general, yields in 1970 decreased as a result of increased amounts of herbage removal in previous years (Table 1). Yields decreased most with increased duration of treatment when ¾ or all of the herbage was removed. With ¼ or ½ of the herbage removed yields were decreased, but the duration of treatment at these herbage removal levels had little effect on yield.

When only ¼ or ½ of the herbage was harvested, time of harvest (as determined by plant height) had little effect on subsequent yield (Table 2). However, removal of ¾ or all of the herbage was most detrimental when plants were 76 cm high and least detrimental when cut early, at an 18 cm height. The 76 cm height corresponds to the boot stage of development shown to be critical in Figures 1 and 2 and to the period of rapid growing point elongation (Fig. 3).

Seasonal Height of Growing Point and Total Available Carbohydrate

Procedure

In 1969, position of growing point and total available carbohydrate (TAC) were measured at Bozeman, Montana, at weekly intervals on individual spaced plants

Table 2. Yields¹ (kg/hill) of basin wildrye in 1970 as influenced by degree of herbage removal at different heights in the three preceding years at Huntley, Montana.

Height when ³ cut (cm)	Amount of herbage previously removed ²				
	none	¼	½	¾	all
18	1.26 ⁴	1.04	.95	1.00	.78
38	1.26	1.10	.88	.86	.62
76	1.26	.97	.90	.66	.33

¹ LSD (.05) for comparing differences among herbage removal treatments within a cutting height equal .13 kg; for comparing differences due to previous cutting height within a herbage removal treatment equal .41 kg.

² Values presented are averages of treatments for one, two and three years duration.

³ Approximate values estimated to be within ± 7 cm.

⁴ Year block effects were accounted for by adjusting all yield data to a common check.

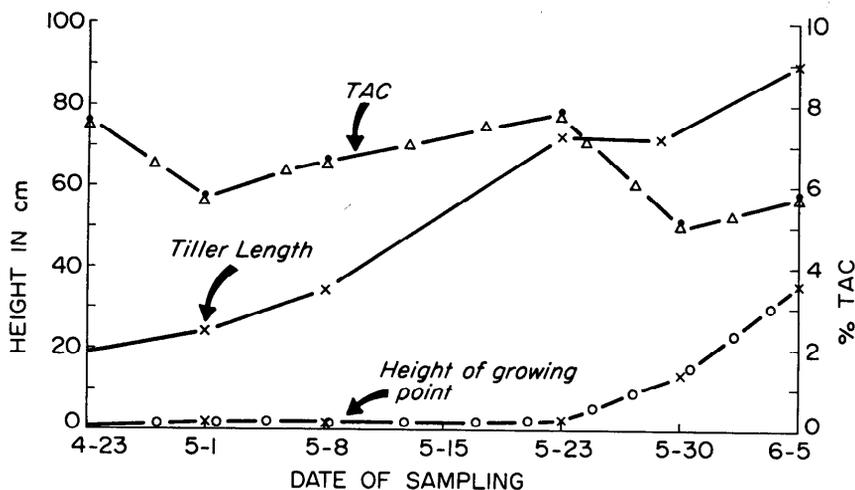


FIG. 3. Tiller length, height of growing point and total available carbohydrates (TAC) in crowns of basin wildrye during the early spring growing season at Bozeman, Montana.

of the strain Wy 107 from the onset of growth until heading. Four or more plants were sampled weekly from April 23 to June 5. Five random tillers were selected from each plant for measurements at each sampling date. The height of the growing point and length of the tiller were measured from the point of tiller attachment to the root. At each sampling date basal stem tissue was separated from each plant for analysis of TAC by the enzyme hydrolysis technique (Smith, 1969).

Results and Discussion

Tillers increased in length in the manner expected in a normal growth pattern (Fig. 3). Growing points did not protrude above the soil surface until early boot stage on May 23. From this date until June 5 heads in the boot elongated from 1.2 to 13.2 cm. TAC was less than 8% at growth initiation. It declined to less than 5% with the initiation of new growth, rose to nearly 8% at early boot and declined again during head development. The seasonal pattern of TAC was similar to that observed for bromegrass during similar stages of development (Okajima and Smith, 1964). The values reported are slightly lower than those reported for bromegrass (Okajima and Smith, 1964), and are much lower than those reported for crested wheat-

grass (Hyder and Sneva, 1959) during similar stages of development. Baker and Garwood (1961), however, report levels of 4 to 6% TAC in orchardgrass throughout April and May. The level of TAC in one species as compared to that of another may have little significance in determining susceptibility to grazing intensity. Species seem to vary a great deal in levels of TAC stored and the seasonal pattern within a particular species may be markedly affected by climatic conditions and thus vary from location to location (Blaser et al., 1966).

Our data (Fig. 3) may explain detrimental effects of cutting basin wildrye at the early boot stage (Figs. 1 and 2). At the time of head elongation, carbohydrates decreased, and the growing point was elevated to where it could be removed by grazing. Branson (1953) reported that the height to which growing points are elevated, and the ratio of fertile to vegetative stems are factors critical to the persistence of a species under grazing pressure. We estimated that 90% or more of the stems of these basin wildrye plants were fertile, which is a high proportion. Thus, if we utilize basin wildrye at the boot stage, we are not only grazing at a time of low TAC but are also removing the growing point which interferes with regeneration of photosynthetic tissue.

Discussion

One harvest of all of the herbage of basin wildrye during the period from the onset of spring growth through full bloom will decrease total season yields. Furthermore, harvest during this period results in yield reduction the following year. The most critical period of harvest was during the boot stage. At this time, growing points are elongating rapidly above the soil surface. This period of growing point elongation is associated with head formation and appears to be accompanied by a drop in total available carbohydrate in crowns.

From our time of clipping and herbage removal studies it appears that management to permit grazing this species in early spring is possible on a limited basis. Such management, however, would require that no more than 50% of the herbage be utilized and that it be grazed prior to the boot stage. It is difficult, however, to control grazing to remove only 1/2 of the herbage. Grazing systems which permit periodic rest from grazing during early growth and booting stages might be effective in maintaining the species and should be evaluated. Because of its earliness and yield potential, effective spring utilization of basin wildrye could lengthen the grazing season by several weeks. The difficulty of managing this sensitive species, however, might outweigh the advantages which could accrue.

Literature Cited

- ANONYMOUS. 1937. Range Plant Handbook. Forest Service, U. S. Dep. Agr., Washington, D. C.
- BAKER, J. K., AND E. A. GARWOOD. 1961. Studies of root development in plants V: Seasonal changes in fructosans and soluble-sugar contents of cocksfoot herbage, stubble and roots under two cutting treatments. J. of British Grassland Soc. 16:263-267.
- BLASER, R. E., R. H. BROWN, AND H. T. BRYANT. 1966. The relationship between carbohydrate accumulation and growth of grasses under different microclimates. Int. Grassland Congr. Proc. 10:147-150.
- BRANSON, FARREL A. 1953. Two new

- factors affecting resistance of grasses to grazing. *J. Range Manage.* 6:165-171.
- HITCHCOCK, A. S. 1950. *Manual of the Grasses of the United States*. 2nd Edition. U. S. Dep. of Agr. Misc. Publ. No. 200. 1051 p.
- HYDER, D. N., AND F. A. SNEVA. 1959. Growth and carbohydrate trends in Crested Wheatgrass. *J. Range Manage.* 12:271-276.
- KNIGHT, H. G., F. E. HEPNER, AND A. NELSON. 1911. *Wyoming Forage Plants and their chemical composition*, Studies No. 4. Wyo. Agr. Exp. Sta. Bull. 87. 152 p.
- OKAJIMA, HIDEO, AND DALE SMITH. 1964. Available carbohydrate fractions in the stem bases and seed of timothy, smooth bromegrass, and several northern grasses. *Agron. J.* 4: 317-320.
- SMITH, DALE. 1969. Removing and analyzing total nonstructural carbohydrates from plant tissue. Research Report 41. College of Agr. and Life Sci. Univ. of Wisconsin.
- STROH, JAMES R., AND ALVIN G. LAW. 1967. Effects of defoliation on the longevity of stand, dry matter yields and forage quality of Tall Wheatgrass (*Agropyron elongatum* Host Beauv.). *Agron. J.* 59: 432-435.