TECHNICAL NOTES

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"EFFECTS OF FREQUENT CLIPPINGS AT DIFFERENT STUBBLE HEIGHTS ON WESTERN WHEATGRASS (AGROPYRON SMITHII, RYDB.)"

We are continually observing in the field the effects of grazing on rhyzome activity of plants. We use the phenomena to point out why growing season grazing following mechanical or chemical treatment of our rangeland is detrimental.

The following article by A. C. Everson (summarized) supports our field observations. These data will be of significant value when working with ranchers who are anticipating brush control or mechanical treatment when rhizome producing plants are an important part of the plant association. Table I is particularly valuable data.

These data ware collected by Mr. Everson through greenhouse studies. The following article was abstracted from an article appearing in the January-February 1966 issue of the Agronomy Journal:

"Frequent close removal of photosynthetic tissue may materially decrease total top growth of plants. Root and rhizome growth may be retarded or completely stopped, and the ability of a plant to maintain itself may be greatly reduced. Clipping and grazing studies have shown the yields of forage and plant nutrients to be inversely related to the frequency and the intensity of defoliation. Results have usually indicated that the more frequent and severe the defoliation treatment, the greater the reduction of dry matter yield. Under normal plant growth the percentage of crude protein in plant tissues decreases from early growth to maturity. Among many who have shown that tissues that regrow after defoliation have a high percentage of crude protein are Newell and Keim, Runyon, and Watkins and Leveren. The percentage of carbohydrates in plant tissues under normal plant growth decreases rapidly with initiation of growth and, unlike crude protein, increases as the plants mature. Defoliation of growing plants, particularly excessive defoliation, reduces or prevents the accumulation of carbohydrate reserves and results in a reduction in the weight of storage organs.

Results and Discussion:

The total ovendry yields of the tops, roots and rhizomes are shown in Table I. Yields of the tops varied from 27.4 g for the 2.5-cm treatment to 67.6 g for the nonclipped. There was a progressively decreasing yield of tops that tended to be linear from the nonclipped to the plants clipped at 2.5 cms. Yields of roots and rhizomes were greatly reduced under all clipping treatments. Root weights of the least intense treatment plants (10.0 cm stubble) were only 13.7% and rhizome weights only 14.1% of the nonclipped.

The ratios of the yields of roots to tops and rhizomes to tops are also presented in Table I. The ratios for both the roots and the rhizomes became wider as the clipping treatment became more intense. There was a wider ratio between rhizomes and tops than between roots and tops.

TABLE I: Total ovendryyyields of tops, roots and rhizomes and top: root and top: rhizome ratios of western wheatgrass under frequent clipping at different stubble heights in greenhouse pots.

Clipping Height cm	Yields of Plant Parts Per 8 Pots						Roots to Tops Ratio	Rhizomes to Tops Ratio
	Tops*		Roots		Rhizomes			
	grams	% of NC+	grams	% of NC	grams	% of NC		
2.5	27.4	40.5	2.6	3.5	1.7	5.9	1:10.5	1:16.1
5.0	36.7	54.3	4.9	6.6	2.5	8.6	1: 7.5	1:14.7
7.5	43.1	63.8	6.2	8.3	2.8	9.6	1: 6.9	1:15.4
10.0	56.6	83.7	10.2	13.7	4.1	14.1	1: 5.6	1:13.8
Nonclipped	67.6	100.0	74.5	100.0	29.0	100.0	1: 0.9	1: 2.3

*Total Yields in 5 successive harvests. +NC = Nonclipped

TABLE 2: Concentration of crude protein, soluble sugars and starch in the tops, roots, and rhizomes of western wheatgrass following repeated clipping at different stubble heights:

Clipping Height cm	Mg per g	% of non-clipped	Mg per g	% of non-clipped	Mg per g	% of non-Clipped
	Crude Protein					
2.5	229.1	337	82.9	154	78.9	112
5.0	189.0	278	86.4	161	91.0	130
7.5	162.4	239	88.9	166	96.8	138
10.0	151.0	222	81.7	152	95.2	136
Nonclipped	67.9	100	53.7	100	70.2	100
	Soluble Sugars					
2.5	24.8	25	21.5	21	+	+
5.0	21.8	22	28.0	27	27.1	6
7.5	23.9	24	39.0	38	64.7	14
10.0	23.4	24	43.7	42	95.8	20
Nonclipped	98.4	100	104.0	100	471.1	100
	Starch					
2.5	29.2	10	49.4	16	151.0	28
5.0	34.6	11	64.2	21	256.5	47
7.5	44.5	14	149.0	49	316.4	58
10.0	51.3	17	163.8	54	294.0	54
Nonclipped	307.9	100	305.6	100	543.0	100

*Tissues of fifth harvest only. +Jars of filtrate were broken.

The concentration of crude protein, soluble sugars and starch in the tops, roots and rhizomes are presented in Table 2. The crude protein content per gram was

greater for the three plant parts of the clipped plants than for the nonclipped. This was especially true for the tops. As the height of the clipping became more intense the crude protein content of the tops gradually increased. This was not true for the roots and rhizomes. The crude protein content of the roots and the rhizomes of the clipped plants was much less than the tops under the respective treatments.

The soluble sugar content of the tops, roots and rhizomes of the clipped plants was less than that of the non-clipped. There was practically no difference in soluble sugar content among the tops of the plants clipped at different stubble heights. The soluble sugar content of the roots and the rhizomes decreased as the clipping treatment became more intense. The rhizomes of the less intensely clipped plants had more soluble sugars per gram than the roots.

The starch content of the tops, roots, and rhizomes of the clipped plants was much less than that of the nonclipped. As the clipping height became more intense the starch content of the three plant parts decreased.

The total yields of crude protein, soluble sugars and starch are shown in Table 3. The only nutrient produced in greater quantity be the clipped plants was crude protein by the tops. All other total yields of nutrients by the tops, roots and rhizomes were much less for the clipped plants than for the nonclipped.

he average number of culms per pot by clipping date is shown in Table 4. With he exception of those plants that were clipped to 2.5 cm the number of culms per pot was greater at the fifth clipping date than at the first clipping date.

TABLE 3: Total yields of crude protein, soluble sugars and starch for the tops, roots and rhizomes of western wheatgrass clipped at different stubble heights:

Clipping Height, cm	Crude protein, mg/8 pots			Sol. sugars, mg/8 pots			Starch, mg/8 pots		
	Tops*	Roots	Rhizomes	Tops	Roots	Rhizomes	Tops	Roots	Rhizomes
2.5	6277	216	134	680	56	+*	800	128	257
5.0	6936	423	228	800	137	68	1270	315	591
7.5	6999	551	271	1030	242	181	1918	924	886
10.0	8547	833	390	1324	446	393	2904	1671	1205
Nonclipped	4590	4001	2036	6652	7748	13662	20814	22693	15747

* Total for 5 harvests. + Jars of filtrate were broken.

TABLE 4: Average number of culms of western wheatgrass plants per pot on successful clipping dates:

Clipping Date	Average Number of Colms Per Pot				
	Clipping Height, cm				
	2.5	5.0	7.5	10.0	Nonclipped
June 5	10.0	9.5	9.7	9.9	9.9
June 26	15.0	16.7	15.4	15.9	14.0
July 17	10.1	16.5	18.7	21.6	19.5
August 7	8.4	16.2	21.6	24.3	25.4
August 28	7.9	14.5	20.6	28.5	32.0
% of beginning	79.0	152.6	212.4	287.9	323.2
% of nonclipped	24.7	45.3	64.4	89.1	100.0

Conclusions:

Clipping young western wheatgrass plants to 2.5, 5.0, 7.5 and 10.0 cm 4 times at 3-week intervals reduced the total yields of the tops, roots and rhizomes. Crude protein content per gram of tissue was greater for all parts of the clipping plants than for the nonclipped. As the height of clipping became more intense the concentration of crude protein in the tops increased. To maintain the crude protein content of the tops at a high level, occasional and controlled clipping or grazing would be recommended. The crude protein contents of the roots and rhizomes of the clipped plants were somewhat more than that of the nonclipped, but the content was similar among plants clipped to different stubble heights and did not increase as the clipping became more intense.

The total yield of crude protein was greater for the tops of the clipped plants, while the total yield of crude protein was greater for the roots and rhizomes of the nonclipped. These data are interpreted to indicate that crude protein synthesized by the tops of the clipped plants was utilized by the tops and was not available to the roots and rhizomes.

The concentration and total yield of soluble sugars and starch were less for the respective plant parts under all clipping treatments than for the nonclipped and decreased as the clipping became more intense. The clipped plants were apparently utilizing soluble sugars on a current basis. The important storage function of the rhizomes is indicated in that the rhizomes of the nonclipped plants had abou 471% more soluble sugars and 177% more starch per gram than the tops and roots of the nonclipped.

The mutal dependence and the interrelationships among the tops, roots and rhizomes of western wheatgrass and the crude protein, soluble sugars, and starch contents of the respective parts are indicated by this study. Crude protein was rapidly produced and accumulated in the top regrowth of clipped plants. Soluble sugars and starch were utilized more rapidly than they could be produced by the tops, as evidenced by the decreasing total amounts as the clipping treatments became more intense. There was less opportunity for sugars to be converted to starch as the clipping height was lowered. The intense clipping treatments did not permit sufficient photosynthate production to produce maximum yields of nutrients and plant parts. Intensive, frequent removal of photosynthetic tissues resulted in reduced root and rhizome growth which, in turn, prevented recovery and growth of the tops. Normal physiological interactions among the tops, roots and rhizomes became competitive rather than complementary.