RESPONSE OF CRESTED WHEATGRASS (Agropyron desertorum) GROWTH AND CARBON ALLOCATION TO FALL DEFOLIATION

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INTRODUCTION

Tiller recruitment predominately occurs in the fall for some cool-season perennial grasses. Several researchers in the sagebrush-steppe have reported the majority of tillers for crested wheatgrass and bluebunch wheatgrass present in the spring were produced the previous fall following late summer or fall precipitation. In eastern Oregon, precipitation is generally adequate to initiate tiller growth in September or October. Over a five-year period in this area, 80 to 90 percent of all crested wheatgrass tillers present in the spring were produced the previous fall. Under dry fall conditions tiller recruitment occurred in November. Fall tillers can become physiologically active, producing sugars in the winter if conditions are suitable. Crested wheatgrass leaves are capable of photosynthesis and carbohydrate production at temperatures near freezing. Early photosynthetic activity in fall-produced shoots may reduce demands for stored carbohydrates during initial spring growth. The presence of green leaves early in the growing season may also provide a competitive advantage for acquisition of soil water and nutrients.

Development of new shoot tissue in the fall provides a source of high quality forage for many wild and domestic herbivores prior to winter. Very little work, however, has focused on the defoliation of active leaf tissue in the fall. Our goal was to ascertain the effects of defoliating photosynthetically active replacement tillers in the fall. We wanted to know if fall defoliation of new replacement tillers would: (1) increase winter tiller mortality, (2) decrease root growth and carbon allocation to the roots, and (3) decreases peak standing crop during the following growing season.

DISCUSSION

The decline in tiller recruitment was the only consistent response to fall defoliation over the two-year period (Table 1). If we account for both the increase in tillers in the control plots and the decline in the fall defoliated plots, fall defoliated plants produced 25 and 21 percent fewer tillers than control plants in 1988-1989 and 1989-1990, respectively. However, the decline in tillers was not a result of an increase in winter mortality. The primary cause was the cessation of tiller development immediately following fall defoliation. Fall defoliation did not affect individual shoot weight, reproductive shoot density, or peak standing crop during the following growing season.

Table 1. Performance of crested wheatgrass under two fall defoliation treatments during the fall and spring of 1988-1989 and 1989-1990, at the Squaw Butte Experimental Range.

	Control	Defoliated
Tiller Density (#/ft^2)		
1988-1989		
Fall	254	229
Spring	284	190
% Change	11.3^a	-14.8^b
1989-1990		
Fall	275	240
Spring	281	207
% Change	2.7^a	-18.0^b
Mortality (%)		
1988-1989	8.7^a	9.4^a
1989-1990	9.0^a	10.0^a
Reproductive Shoots (#/ft^2)		
1989	129^a	127^a
1990	0	0
Grams/Tiller 1990	0.054^a	0.060^a
Biomass (lbs/ac)		
1989	200^a	192^a
1990	180^a	175^a

Means followed by similar lower case letters are not significantly different between treatments ($p \leq 0.05$).

During fall tiller development, carbohydrates were produced in the leaves and translocated to the roots in both years. Carbon uptake by leaves and allocation to roots in the fall was significantly greater in 1988 than in 1989 (Figure 1). Soil moisture and temperature conditions were more optimal for growth in the fall of 1988 as compared to 1989. Defoliation significantly reduced carbohydrate allocation to the roots under the wetter and warmer growing conditions in the fall of 1988. Carbohydrate allocation was not altered by defoliation in 1989.

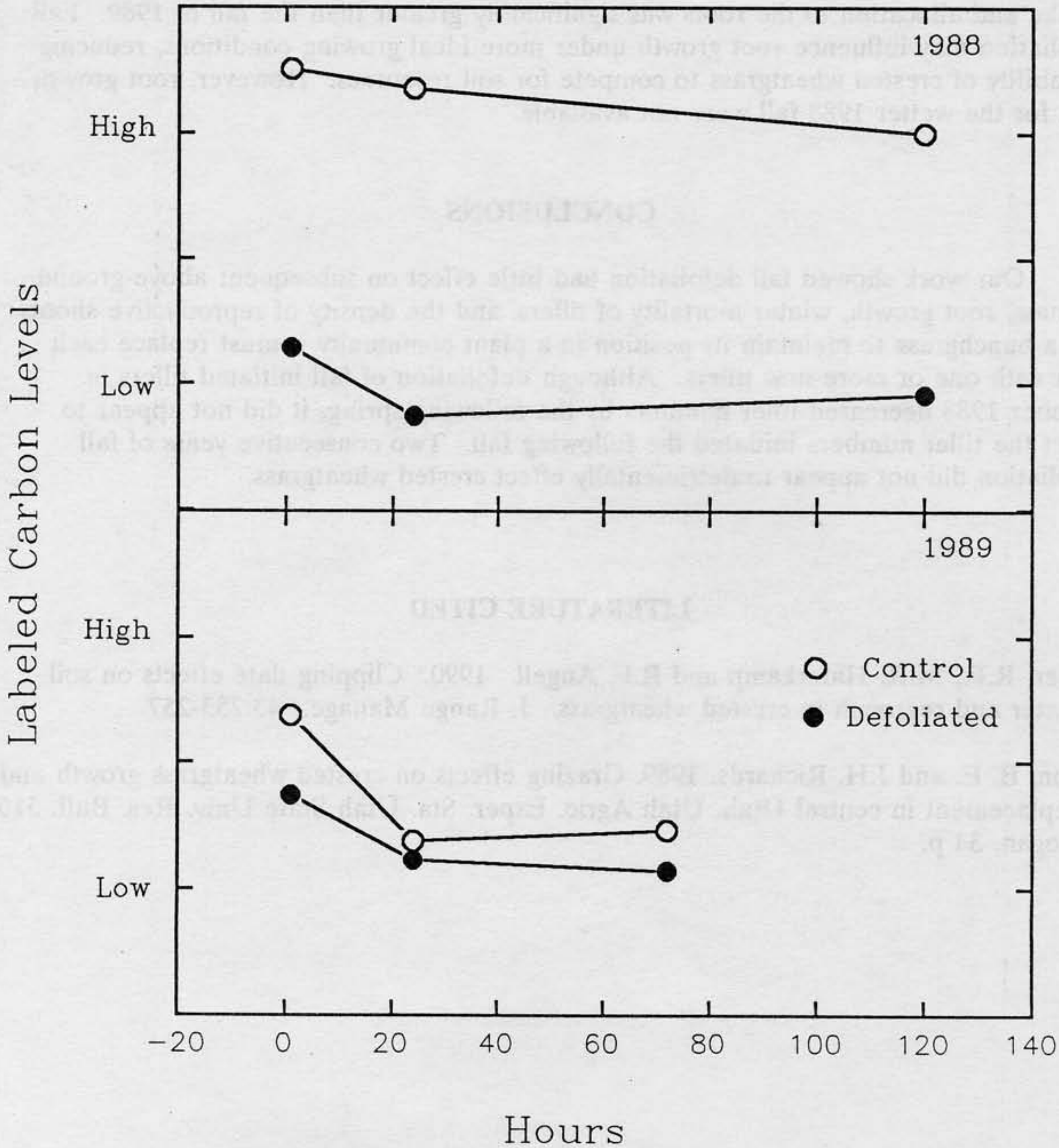

Figure 1. The relative amount of assimilated carbon translocated to the root following defoliation. Plants were labeled with C_{13}, 24 hours following defoliation. Samples were collected 1, 24, 72 and 144 hours following labeling in 1988 and 1989.

Root growth during the fall of 1989 and into the following spring was not affected by defoliation of newly recruited tillers. Continued allocation of carbon to the roots and a reduced above-ground carbon sink, due to the discontinuation of tiller development, may lessen the affect of fall defoliation on root development. However, fall defoliation did reduce carbon flow to the roots in the fall of 1988, when carbon uptake and allocation to the roots was significantly greater than the fall of 1989. Fall defoliation may influence root growth under more ideal growing conditions, reducing the ability of crested wheatgrass to compete for soil resources. However, root growth data for the wetter 1988 fall were not available.

CONCLUSIONS

Our work showed fall defoliation had little effect on subsequent above-ground biomass, root growth, winter mortality of tillers, and the density of reproductive shoots. For a bunchgrass to maintain its position in a plant community it must replace each tiller with one or more new tillers. Although defoliation of fall-initiated tillers in October 1988 decreased tiller numbers by the following spring, it did not appear to effect the tiller numbers initiated the following fall. Two consecutive years of fall defoliation did not appear to detrimentally effect crested wheatgrass.

LITERATURE CITED

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