Effect of Removal of Standing Dead Material on Growth of *Agropyron spicatum*

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Highlight: Standing dead was clipped from clumps of bluebunch wheatgrass, with no other disturbance. Clumps without dead material, compared to those with, had less green material and shorter leaves but did not differ in height or number of flowering culms or head lengths. Standing dead appears to be beneficial to bluebunch wheatgrass.

Agropyron spicatum (bluebunch wheatgrass), in the ungrazed condition, grows in clumps with a dense accumulation of dead culms and leaves, collectively known as standing dead. Standing dead modifies the environment of young leaves, and to a lesser degree older leaves, by intercepting sunlight and reducing air movement. Reduced light intensity may decrease photosynthetic activity. On the other hand, reduced air movement may favor a reduced vapor pressure deficit at the leaf surface and reduced water stress in plant tissues, compensating perhaps for the reduced light intensity. This report describes the effect on bluebunch wheatgrass of the removal of standing dead without the removal of live material. The results of this research are relevant to ecosystems studies focusing on the effect of standing dead on the growth of bluebunch wheatgrass.

Grazing studies have dealt with the effect of removal of both live and dead material from rangeland grasses during the growing season (Rickard et al. 1975; Mueggler 1972, 1975; Wilson et al. 1966; Heady 1950). In contrast, this study addresses the effect of removing dead material early in the season before growth initiation of new leaves.

Study Area and Methods

The study site is the Arid Lands Ecology Reserve located on the United States Energy Research and Development Administration's Hanford Reservation in southcentral Washington. The site occupies a gently sloping, east-facing slope on the Rattlesnake Hills at an elevation of approximately 390 m (1,300 ft). The vegetation is classified as the *Artemisia tridentata*/*Agropyron spicatum* association (Daubenmire 1970). The soil is a silt loam with very few rocks in the upper 2 m of profile. Precipitation is approximately 200 mm (8 inches), most of which comes in fall, winter, and early spring. Growth is arrested in summer by drought and in winter by cold. Most species grow in the period between January and June when soil water content and temperatures are simultaneously conducive to growth.

Seventy-three clumps of bluebunch wheatgrass were randomly selected and individually identified in an area approximately 100 m by 20 m. On January 14, 1976, no live leaves were present and 35 clumps were clipped to the crowns with scissors. The material from each clipped clump, all dead, was bagged, dried in a 60°oven, and weighed. By June 15, 1976, growth had stopped and all 73 clumps were clipped. The live and dead material was hand separated and oven dried as before. The weights of the dead material were added for the January and June harvests.

Leaf length, number and height of flowering culms per clump, head length, and basal area were measured in the field before clipping. Leaf length was estimated by measuring the total length of 18 leaves randomly chosen from the periphery and center of each clump. Height of flowering culms and head length were estimated by measuring up to 18 flowering culms and the length of the attached seed head. The total number of flowering culms was recorded for each clump. Leaves and flowering culms were measured from the soil surface to the end of the unbent structure. Basal area (length × width) was estimated by measuring the longest and shortest dimension of each clump.

These data were analyzed in three steps. First, averages for leaf length, height of flowering culms, and head length were calculated for each clump. Second, the distribution of the data for all parameters (leaf length, height of flowering culms, head length, basal area, number of flowering culms, and live and dead weight) was tested for normality using all clumps because the *t*-test (Snedecor and Cochran 1967) requires the data to have a normal distribution. Basal area, number of flowering culms, leaf length, and live and dead weights were transformed to a normal distribution using natural logs. Third, basal area was noticeably different between the treatments for reasons unknown and unrelated to the treatments (clipping height left the growing points undamaged). Accordingly, the effect of basal area on the other parameters was statistically removed from the other parameters as follows: A regression equation using all clumps was calculated for each parameter using that parameter as the dependent variable and basal area as the independent variable. The regression equation was used to calculate estimated values of each parameter, which were subtracted from the observed values to obtain residuals. The residual values were used in the *t*-test to compare treatments within parameters.

Results and Discussion

The untransformed means and standard errors for all parameters are summarized in Table 1. The standard errors are descriptive only and are not to be used to determine significant differences because the untransformed data does not have a normal distribution. Removing standing dead material decreased the weight of the new generation of leaves and culms by 28%, decreased the loss of standing dead by 21%, decreased leaf length by 25%, but did not significantly change the number of flowering culms per clump, the height of the flowering culms, or the head length.

There are several possible explanations for the measured changes following removal of standing dead. The decrease in live weight suggests that any increase in photosynthetic rate with increased light intensity is offset by a decreased carbon

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Work was performed under contract EY-76-C-06-1830 with the United States Energy Research and Development Administration.

Manuscript received June 13, 1977.

Table 1. Means and standard errors for the seven parameters measured in the two treatments. Data here are not transformed to a normal distribution and thus standard errors are not to be used to determine significant differences.

	Treatment	
Parameter	Without standing dead N=35	With standing dead N=38
Live (gm/clump)	11.2 ± 1.4	15.6 ± 1.9*
Dead (gm/clump)	35.4 ± 5.3	27.9 ± 3.8*
Leaf length (cm)	19.8 ± .4	26.5 ± .6**
Number flowering culms	7.6 ± 1.7	15.0 ± 3.5
Height flowering culms (cm)	23.8 ± 2.8	27.1 ± 3.3
Head length (cm)	4.0 ± .4	3.7 ± .4
Basal area (cm²)	366.4 ± 43.0	448.1 ± 67.9

*Treatments different at = .05.
**Treatments different at = .001.

dioxide absorption rate because of greater air movement and subsequent increased plant water stress. In other words, in intact clumps, the effect of reduced light intensity is more than compensated for by the possible sheltering effect of standing dead in this arid environment.

The greater growth of bluebunch wheatgrass clumps shaded with dead material contrasts with results of studies on wheat (Fischer 1975) and potatoes (Sale 1976) in which shade reduced yield. These results are also in contrast to the increase in bluebunch wheatgrass shoot production, leaf length, length and number of flowering culms, and head length following a wildfire in this same pasture (Uresk et al. 1976). Since fire removes standing dead, it appears that fire may have more of a growth stimulating effect than previously thought because simple removal of standing dead decreases growth. The wildfire mentioned above reduced competition for the bluebunch wheatgrass by removing all *Artemisia tridentata* (big sagebrush) shrubs and some weaker individuals of other perennial species. Reduced competition has been found to increase growth in bluebunch wheatgrass (Mueggler 1972). Ash deposition and associated higher early season soil temperature from the darkened surface may also account for some of the increased growth of bluebunch wheatgrass in the burned area (Kozlowski and Ahlgren 1974).

Decomposition of dead material proceeds most rapidly during the January-to-June growing season (Wildung et al. 1975) and the unclipped clumps were also probably losing dead material during this time. The 21% differences in standing dead between the two treatments is probably close to the percentage of dead material lost through fragmentation and decomposition.

The decrease in leaf length on the clipped clumps may be an effect of higher light intensity acting to constrain cell elongation, or simply a reflection of less leaf weight.

The small differences between treatments for height and number of flowering culms and length of seed heads indicate that reproductive performance was not affected by the removal of standing dead.

These data suggest that standing dead is beneficial to bluebunch wheatgrass and is not a deterrent to growth.

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