Fall Defoliation Of Bluebunch Wheatgrass: Tiller Growth and Development

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Winter grazing is a common practice in some parts of the sagebrush steppe which have less harsh winter weather. Traditionally, resource managers have felt that livestock grazing in the fall and winter had little or no impact on grasses such as bluebunch wheatgrass, because the plants were in a quiescent state with little or no growth taking place. Recent research has shown that plants such as bluebunch wheatgrass can develop tillers in the fall if rainfall is adequate. These fall-produced tillers then overwinter and provide a significant portion of the next growing season's forage production. There is speculation that standing dead stems from the previous growing season provides some benefit to newly produced fall tillers, perhaps by minimizing environmental stress. This study was undertaken to determine the effect of fall clipping upon later growth and development in the subsequent growing season. Responses of interest were tiller survival, tiller density, aboveground yield, and leaf photosynthetic rate.

METHODS

Two sites were selected for the study, with one on a south facing slope and the other on an east-facing slope. Soils are frigid Lithic or Aridic Argixerolls on the east slope and frigid, shallow Xerollic Durargids on the south slope. Bluebunch wheatgrass was the dominant grass on both sites.

The study was set up with four replications and four treatments at each site using 6 x 6 yard plots separated by 1 yard alleys. One of four treatments was applied to each plot. Treatments were no clipping (NC), 4-inch clipping height (4C), 2-inch clipping height, (2C) and clipping to ground level (GC). These treatments provided for no alteration of the bunch (NC), minimal alteration by clipping just above the height of live tillers (4C), moderate alteration by removing some live tissue (2C) and maximum alteration by removing all live leaf tissue (GC). Clipping was accomplished the first week of November, after fall tillers had developed. Because no precipitation was received in September, plots were sprinkler-irrigated in late September to provide one inch of water to all plots.

Plants were measured before clipping treatments. Tiller density in two plants in each plot was determined by inserting a 2 x 4 inch open ended frame into the bunch and counting all live tillers within the frame. Additionally, five live tillers were marked at the base with wire loops to provide data on tiller growth and winter mortality. In June, seven months post-treatment, final tiller measurements were made. All topgrowth in each of the two plants per plot was clipped to ground level, oven dried, and weighed to determine aboveground biomass.

Photosynthetic rate of individual bluebunch wheatgrass leaves was determined on two plants in each plot beginning in April. Individual leaves were placed into a leaf cuvette and CO_2 uptake was determined using a LICOR 6200 Portable Photosynthesis System.

RESULTS

Irrigation stimulated tiller development in early October, and by November 1 all plants had developed about 2.7 inches of new growth and averaged 2 leaves per tiller. Prior to clipping there were no differences between treatments, with plant growth and tillering activity being similar in all plots.

Winter survival was essentially complete for all treatments, at about 98 percent (Table 1). No significant increase in tiller mortality was associated with clipping in November, even at ground level. Additionally, there were no differences noted between east and south sites for overwinter survival of tillers. While tiller survival was similar, there was a tendency toward increased flowering effort for clipped treatments over unclipped treatments.

Table 1. Overwinter survival (%) and floral tiller formation (%) of bluebunch wheatgrass plants either left untreated or clipped at one of four intensities in November 1992, Northern Great Basin Experimental Range.

Treatment	Tiller Survival	Flowering Tillers
Unclipped	98	49
Clipped to 4 in. height	96	54
Clipped to 2 in. height	98	55
Clipped to ground level	98	54

Tiller density, as measured by frames inserted into the bunches tended to be higher for plants in treatment 4C, with an average 775 tillers/yd^2 more tillers in 4C than NC, although the difference was determined to be statistically nonsignificant (Table 2). Biomass within bunches tended to be higher in clipped treatments than in unclipped treatments (Table 2).

Table 2. Live tiller density (tillers/ft^2) and live biomass per unit basal area (lb/ft^2) of bluebunch wheatgrass plants either left untreated or clipped at one of four intensities in November 1992, Northern Great Basin Experimental Range.

Treatment	Tiller density	Live biomass
Unclipped	529.8	0.35
Clipped to 4 inch height	616.0	0.54
Clipped to 2 inch height	513.9	0.60
Clipped to ground level	466.7	0.53

After clipping in November, maximum height of live leaves in unclipped plots averaged about 2,7 in. By definition, plant height of treated plots was 4-, 2-, and 0-inches for the three respective clipping treatments. Four months later, in March, unclipped plants and plants clipped at 4-inch height had grown about 0.4 inches. By contrast, plants which had been clipped to 2 inches or ground level had grown .7 and 2 inches, respectively. Even with this significant growth increment by intensively clipped plants, they remained significantly shorter than unclipped plants in March. Later, in June, these differences were not significant, although plants clipped to ground level the previous fall were still about 2 inches shorter than unclipped plants.

Photosynthetic rate of bluebunch wheatgrass was not affected by clipping treatment (Table 3). Photosynthesis in late April was about 18 μmole/m^2/sec. and decreased in a uniform fashion across all treatments as soil water was depleted. Plants were in severe water stress by midday in the last week in May, and we were unable to obtain reliable measurements of photosynthesis at that time. Drought stress appeared to lower net photosynthesis early in spring, and may have served to cover any potential differences attributable to treatments. As would be expected, photosynthetic rates for plants on the south facing site decreased earlier than for plants on the east site because water stress developed more rapidly on that site.

Table 3. Net photosynthetic rate (μmole/m^2/sec) of bluebunch wheatgrass leaves in spring following clipping treatment the previous November 1992, Northern Great Basin Experimental Range.

Treatment	April 23	May 7	May 21
Unclipped	19.0	13.5	9.0
Clipped to 10 cm	16.1	14.5	8.8
Clipped to 5 cm	16.8	12.1	8.5
Clipped to ground	16.0	13.1	9.1

DISCUSSION

Bluebunch wheatgrass showed minimal response to clipping in fall. Foliar height was reduced during the growing season following clipping in November, however this did not appear to have measurable impact on tiller development or yield. Flowering and seed production was similar for both clipped and unclipped plants.

Plants clipped to ground level were able to replace lost leaf tissue, and showed a significantly increased growth increment between November and March, when measurements were first taken in spring. Apparently the plants were able to mobilize sufficient carbohydrate reserves to initiate new growth as soon as soil temperature was high enough. We did not measure carbohydrate reserves, however research at other locations has clearly demonstrated that carbohydrate storage is decreased, at least temporarily, following intensive clipping or grazing. After March, the growth increment was similar for all treatment groups and it is likely that photosynthesis was providing carbohydrates needed for growth.

While clipping during the growing season can stimulate development of new tillers, no evidence of that effect was found after clipping in fall. In spring following clipping, density of live tillers was the same for all clipping treatments. This, coupled with the almost 100 percent survival of marked tillers points to the fact that essentially all of the early spring growth of bluebunch wheatgrass was obtained from tillers initiated the previous fall. Removal of tillers in fall therefore has important implications relating to competitive interactions between bluebunch wheatgrass and neighboring plants the following spring. Complete removal of live leaves in fall will delay the start of active growth, because the plant is forced to develop new leaves before active photosynthesis can begin.

Photosynthetic rate was highest in April when conditions for growth were best. No changes in rate were attributable to clipping treatment. The predominant factor influencing photosynthesis was water stress caused by the rapid decrease in soil water that year.

In this experiment we found no evidence that clipping at moderate levels caused any negative impact on bluebunch wheatgrass. While clipping to ground level did show some effects the following growing season, responses in terms of tiller survival and development were somewhat less than expected. This lack of response may have resulted from the fact that tillers were small at the time of clipping in November, which may have minimized negative impacts on the plant.