EFFECTS OF PRESCRIBED BURNING ON BOTTLEBRUSH SQUIRRELTAIL

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Bottlebrush squirreltail (Sitanion hystrix) is a short-lived, perennial bunchgrass found in most of the sagebrush-grasslands of central and eastern Oregon. An outstanding feature of this grass is its ability to become established and spread in poor condition rangelands. Squirreltail is probably our only native bunchgrass capable of natural establishment in stands of cheatgrass (Bromus tectorum) and medusahead (Taeniatherum asperum).

Fire is considered a natural component of many range ecosystems. In recent years some of the potential benefits of controlled burning have come to be recognized, and its use as a range improvement tool has increased considerably. A prerequisite to the successful use of prescribed fire is an understanding of the effects of fire on range plants. The purpose of this study, therefore, was to evaluate the response of bottlebrush squirreltail to a midsummer, prescribed burn.

METHODS

In July of 1980, the Burns District of the BLM conducted a prescribed burn over an area covered with a dense stand of cheatgrass. The site was seeded to crested wheatgrass (Agropyron desertorum) that fall. This area is typical of many eastern Oregon annual ranges in that squirreltail occurs scattered throughout the stand. Prior to the burn, 144 squirreltail plants were located, permanently marked, and measured so that we could calculate the basal area of each bunchgrass. Half of these plants were located in control areas to be protected from burning.

The burn was conducted under warm, dry conditions, and with light to moderate winds: 75-80°F, 16-25 percent relative humidity, 5-10 mph winds. Foliage of all the grasses were dry and fully cured at this time, and squirreltail plants were in a state of summer dormancy. In June of the following summer we relocated the marked squirreltail plants. The basal area of each was remeasured. In addition, we sampled a number of morphological and biomass features of the plants. The root and crown portions of each plant were removed and later chemically analyzed for total nonstructural carbohydrates (TNC). This allowed us to evaluate the effects of fire on squirreltail relative to the unburned control plants. Results were statistically analyzed using standard analysis of variance and Student's t test methods.

RESULTS AND DISCUSSION

One concern of prescribed burning is the potential of injury to bunchgrasses from excessive heat or burnout of portions of the crown. A comparison of individual plant basal areas from 1980 to 1981 showed the fire caused no damage to the squirreltail plants (no change was observed in the control plants).

Table 1 summarizes some of the measurements we obtained in 1981 for both the burned and unburned squirreltail plants. Results of statistical analyses of each plant characteristic indicate significantly larger values for burned plants. Production of burned plants exceeded that of the unburned controls both aboveground (5.6 times greater) and belowground (1.5 times greater). Shoot growth, therefore, was favored proportionally over growth of roots. In addition, both the numbers of seedheads produced and the average weight of seedheads were greater among burned plants (7.6 times and 1.7 times, respectively). Finally, reserve carbohydrates in roots and crowns of burned plants were 1.3 times that of unburned plants. Therefore, in all cases, burning resulted in increased productivity in squirreltail.

Table 1. Comparison of average values for some characteristics of burned and unburned squirreltail plants[1].

Plant characteristic	Burn	Unburned
Total aboveground weight (g/cm^2)	0.52	0.09
Root weight (g/cm^2)	0.36	0.24
Number of seedheads ($no./cm^2$)	2.14	0.28
Seedhead weight (g/head)	0.12	0.07
Total nonstructural carbohydrates (g/cm^2)	6.66	5.29

[1] To account for the various sizes of plants, all values have been standarized to a per-unit basal area basis, ie. measurements on each plant were divided by its basal area.

Past work with wildfires and artificial combustion chambers have shown that squirreltail is one of our more fire-tolerant bunchgrasses. This is attributed primarily to its growth form: Its loosely clustered, coarse stems, with a minimum of leafy material, burn rapidly with little heat transferred downward into the growing points. However, all previous work indicates at least some degree of damage to squirreltail as a result of burning. Recovery periods of 1-3 years after fire have been observed. Our results indicate that under conditions of a controlled burn, squirreltail is not necessarily damaged by fire; and, in fact, production may increase immediately following this treatment.

A plant's response to fire is the result of two interacting factors. The first deals with the direct effects of fire on the plant itself. In our study, the effects of fire on basal area of squirreltail was used to test for direct fire damage. Negative impacts were not observed. Fire indirectly affects a plant by altering its environment: It reduces or increases competition with neighboring plants, and thus affects the availability of

water and nutrients, and it has the fertilizing effect of nutrient release. Our results show that, indirectly, this prescribed burn had a positive effect on production of squirreltail. This is likely explained, in part, by other changes we observed in the vegetation after the burn. Production of cheatgrass was similar for both the burned and unburned areas (999 pounds per acre versus 1008 pounds per acre). Cheatgrass density, however, was much less in the burn area (8 plants per square foot versus 166 plants per square foot). This resulted in fewer, but larger cheatgrass plants competing with the squirreltail bunchgrasses.

MANAGEMENT IMPLICATIONS

Bottlebrush squirreltail can be prescribe-burned with no damage to this bunchgrass. In this study, squirreltail production was increased many-fold one year after burning. Furthermore, the health and vigor of burned plants appeared to improve, as indicated by larger root systems and increased amounts of total nonstructural carbohydrates in roots and crowns. Greater numbers and weights of seedheads, and the reduced density of cheatgrass, indicate a potential to establish squirreltail seedlings after burning.