Native Grassland Restoration

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Purple needlegrass (*Nasella pulchra*) is a native perennial bunchgrass of lower elevation grassland, chaparral, and oak savannah habitats in California. Heady (1988) states that purple needlegrass, "dominated the valley grassland" and reported that the total extent of this species probably exceeded 9 million ha. Purple needlegrass was designated as the California State Grass in 2004 (http://www.statesymbolsusa.org/California/grass_purpleneedle.html). Today, purple needlegrass is still present in much of its original range, but these landscapes are now dominated by exotic annuals, especially bromes, filarees, and wild oats. The cause of the displacement of purple needlegrass with exotic annuals is thought to be from a combination of intensive livestock grazing, changes in fire regimes, rodent activity, cultivation, and the highly competitive nature of the exotic annual species.

Purple needlegrass is well adapted to California's Mediterranean Climate, which is characterized by mild wet winters and warm dry summers. The annual precipitation within the range of purple needlegrass varies greatly, from 200 cm in the northwestern portion of California to less than 12 cm in the southern San Joaquin Valley (Heady 1988). But even in the wettest areas, the summer drought lasts from four to eight months, causing purple needlegrass to go into a dormancy that is not broken until the fall rains. In the coastal prairies of southern California, purple needlegrass has a relatively short active growing period typically lasting from January until June.

Restoration of grassland habitats in California is often synonymous with restoration of the purple needlegrass population. Research on methods to shift the dominance in grassland from the invasive annuals to purple needlegrass have included fire and livestock grazing , clearing and planting and mowing (Dyer and Rice 1997). All of these methods have had some successes, but none seem to be in common usage. All of these restoration methods are initiated in the late spring or summer. Grazing, for example, requires forage, which means that the invasive grasses or forbs have to be allowed to persist long enough to produce sufficient growth for the livestock. Prescribed fire requires fuel, so again the invasive plants have to be allowed to grow and in this case to be the process of senescence in order to be dry enough to burn. In both of these situations, this does not occur until the end of the rainy season in California. The invasive plants, therefore, have had the benefit of most of the annual precipitation and the purple needlegrass has been deprived.

A basic concept of weed ecology is that competition between plants begins when plant growth starts and that the longer the weedy plants are allowed to compete, the greater their negative impact on the desirable vegetation (Lanini et al 2002). Several authors have described the near impossibility of establishing purple needlegrass in the face of competition from invasive annuals (Nelson and Allen, 1993). Dyer and Rice (1997) showed a strong negative correlation between weed competition and purple needlegrass growth and survival. This response was not affected by grazing with sheep (*Ovis aries*) in April or summer burning.

We designed our research based upon the premise that invasive plant control early in the winter rainy season would benefit an existing but sparse purple needlegrass population by making precipitation available to the native grass instead of the exotic flora. Our research tested the hypothesis that there are specific dosages of POST herbicides that would be sufficient enough to kill the invasive plants but that would not kill or significantly damage purple needlegrass. Testing this hypothesis had two principle components; evaluating the efficacy of POST herbicides on the invasive plants and determining the injury caused to mature purple needlegrass by these herbicides.

Two experiments, both replicated once in time, were established to test our hypothesis. One utilized an established purple needlegrass nursery located in the Cheeseboro Canyon area of the National Park Service Santa Monica Mountains National Recreational Area. At this location, the nursery was kept free of invasive plants; which allowed an assessment of the impact of the POST herbicide treatments without the confounding effects of weed competition. The other experiment was conducted at the California Department of Fish and Game Rancho Jamul Ecological Reserve located near the town of Jamul in San Diego County. This location had a sparse natural population of purple needlegrass in an area dominated by invasive Mediterranean annuals, especially ripgut brome and wild oats. Both of these sites were former livestock ranches for about 150 years.

Field research at the Santa Monica location was conducted in 2007 and again in 2009. For these experiments, individual nursery plots seeded in 2005 with relatively uniform populations of purple needlegrass were used as replicate blocks. Both experiments utilized a Randomized Complete Block Design with four replications in 2007 and three replications in 2009. Purple needlegrass plants on the day of treatment in 2007 and 2009 had an average height of 9 inches. Herbicide treatments were fluazifop-P-butyl at (6 and 12 oz/A in 2007 and 12 and 18 oz/A in 2009); clethodim at 8.5 and 17 oz/A; glyphosate at 16 and 32 oz/A; and triclopyr at 32 oz/A; along with an untreated control. Herbicide applications were made on January 22, 2007 and on February 26, 2009. Herbicide application was made with a hand-held CO_2 pressured small plot sprayer with a single 8006vs flat fan nozzle. Operating pressure measured at the nozzle was 20 psi and spray volume was 34 gpa both years. Herbicide impact on purple needlegrass was measured quantitatively about 4 months after treatment by biomass (green weight) and diameter of the basal area of treated plants.

At the Rancho Jamul location, two field experiments were established that consisted of the same 13 herbicide treatments plus an untreated control. Herbicide treatments were applied twice to each plot; in the year of initiation and the following winter season. Each site had a sparse, non-uniform population of purple needlegrass; each experiment was located so that all plots had some living plants on the day of treatment. Both sites had burned in fall wildfires in 2003 and 2007. Experimental design was a randomized complete block with four replications. Herbicide treatments were fluazifop-P-butyl at 12 and 18 oz/ac, clethodim at 17 and 34 oz/ac, glyphosate at 16 and 32 oz/ac, fluazifop-P-butyl plus triclopyr at 12 plus 32 oz/ac and 18 plus 32 oz/ac, aminopyralid at 7 oz/ac, fluazifop-P-butyl plus aminopyralid at 12 plus 7 oz/ac and 18 plus 7 oz/ac, and clethodim plus aminopyralid at 17 plus 7 oz/ac and 34 plus 7 oz/ac. All herbicides were applied with a hand-held CO_2 pressured small plot sprayer through a boom with five 8002vs flat fan nozzles at an average spray volume of 45 gpa.

There were no differences between treatments for biomass, basal diameter, or the ratio of biomass to basal diameter for the Santa Monica sites. We did not see any visual differences between treatments on the day that we collected the quantitative data. The experiments conducted at the Santa Monica site demonstrate that all of the herbicides tested at these dosages can be used without significant injury to purple needlegrass under these conditions.

At Rancho Jamul, in general, fluazifop-P-butyl and glyphosate appeared to be relatively safe to purple needlegrass. Aminopyralid was also safe to purple needlegrass, both alone and in combination with fluazifop-P-butyl. Clethodim caused significant injury to purple needlegrass across both sites and years. At the end of two years of herbicide treatment, purple needlegrass cover is about four times greater than the untreated control for some of the successful treatments. Of the 13 herbicide treatments investigated in these two experiments, four treatments show promise for use on a broader scale. These treatments include both rates of glyphosate and the two combination treatments of fluazifop-p-butyl plus triclopyr.

References:

Dyer, A.R. and K.J. Rice. 1997. Intraspecific and diffuse competition: the response of *Nasella pulchra* in a California grassland. Ecological Applications 7:484-492.

Heady, H.F. 1988. Valley grassland. Pages 491-514 in M.G. Barbour and J. Major, ed. Terrestrial vegetation of California. Wiley Interscience, John Wiley and Sons, New York, New York.

Lanini, W.T., J.M. DiTomaso, and R.F. Norris. 2002. Weed Biology and Ecology, pages 29-52. *in* Principle of Weed Control 3rd ed. Thompson Publications, Fresno, CA.

Nelson, L.L. and E. B. Allen. 1993. Restoration of *Stipa pulchra* grasslands: effects of mycorrhizae and competition from *Avena barbata*. Restoration Ecology 1: 40-50.