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RESTORING PERENNIAL GRASS STRUCTURE AND COMPOSITION TO CHEATGRASS INFESTED RANGELAND AND PASTURES IN WESTERN MONTANA

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Abstract

A field trial tested herbicide applications in conjunction with perennial grass seeding to manage invasive annual grasses and restore perennial grasses to two invaded rangeland and pasture sites in Sanders County, Montana. After nine years of evaluation, the results suggest using 12 ounces of imazapic (Plateau®), or a mixture of 6 ounces of imazapic plus 6 ounces of glyphosate, prior to a fall dormant seeding for best results. Sow pubescent wheatgrass if a non-native grass species is desired or bluebunch wheatgrass if a native grass species is desired. After the grasses had established for five years, pubescent wheatgrass tolerated annual grazing by cattle whereas bluebunch wheatgrass declined without one or more years of recovery from cattle grazing.

Figure 1. Ten-year-old bluebunch wheatgrass seeded into spotted knapweed near Plains, Montana. Photograph by NRCS.

Land Use: Rangeland and Pasture

Much of western Montana is rangeland and pasture supporting a vital livestock industry and a diversity of wildlife.

Resource Concern: Plant Condition

Large areas of rangeland and pasture in western Montana have degraded plant condition with inadequate structure and composition to achieve an acceptable level of ecological function. As a result of various factors such as drought, fires, and grazing, the structure and composition of these plant communities have changed over time from predominantly diverse native perennial plant species to communities dominated by non-native grasses and forbs, many of which are listed as noxious. Inventories of degraded sites list cheatgrass (*Bromus tectorum*), bulbous bluegrass (*Poa bulbosa*), spotted knapweed (*Centaurea stoebe*), sulfur cinquefoil (*Potentilla recta*), common St. Johnswort (*Hypericum perforatum*), and Dalmatian toadflax (*Linaria dalmatica*) in areas with degraded plant condition. Where these plants dominate, forage and biomass production is below potential, season of use is limited, and areas are avoided by livestock and wildlife because of toxic weeds. Secondarily, these communities have exposed soil subject to erosion, or have biomass accumulation that can increase wildfire frequencies and intensities. In addition, the quantity and quality of cover and shelter is inadequate to meet the requirements of wildlife species.

Figure 2. Cheatgrass biomass buildup in pastures is a wildfire hazard (Camus Prairie, Montana). Photograph by NRCS.

Restoring plant structure and composition on severely degraded sites may require seed inputs. In the Bitterroot Valley in southwestern Montana, rangeland dominated by spotted knapweed and cheatgrass remained dominated by those species except where bluebunch wheatgrass (*Pseudoroegneria spicata*) or intermediate wheatgrass (*Thinopyrum intermedium*) were seeded, even in the absence of livestock grazing (Sheley et al., 2001; Rinella et al., 2012). Seeding

bluebunch wheatgrass or intermediate wheatgrass restored perennial grass production, and in the case of intermediate wheatgrass, suppressed the production of spotted knapweed (Rinella et al., 2012).

Objective: Restoring the Grass Structural Component to Degraded Plant Communities

Where plant condition is severely degraded, restoring adequate plant community structure and composition is facilitated by reducing competition from undesirable plants combined with seed inputs of desirable plants. The objective of this trial was to test herbicide treatments, combined with seeding perennial grasses, in order to restore the perennial grass structural component of these communities.

Sites: Two Rangeland Sites in Sanders County, Montana

Restoring perennial grass structure and composition was tested on two sites in Sanders County, Montana, one on Camus Prairie (see Figure 1), and the other near Plains (see Figure 2). The Plains site had a southerly aspect with a 20% slope, whereas the Camus Prairie site had an easterly aspect with a 5% slope. Elevation was 2,500 feet and the soils were Big Arm silty. The average annual precipitation was 15 to 19 inches at Plains and 10 to 14 inches at Camus Prairie, falling mostly in winter and spring. A reference plant community was composed of bluebunch wheatgrass, rough fescue (*Festuca campestris, F. scabrella*), Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa secunda*), prairie junegrass (*Koleria macrantha*), Columbia needlegrass (*Achnatherum nelsonii*), western wheatgrass (*Pascopyrum smithii*), arrowleaf balsamroot (*Balsamorhiza sagittata*), lupine (*Lupinus* spp.), skunk-bush sumac (*Rhus trilobata*), western snowberry (*Symphoricarpos occidentalis*), and Rocky Mountain juniper (*Juniperus scopulorum*). The Plains site was composed of cheatgrass, bulbous bluegrass, spotted knapweed, sulfur cinquefoil, Dalmatian toadflax, and common St. Johnswort. The Camus Prairie site was composed of cheatgrass, bulbous bluegrass, crested wheatgrass (*Agropyron cristatum*), and biscuitroot (*Lomatium* spp.).

Herbicide Treatments: Three Herbicide Treatments and a No Herbicide Control

There were three herbicide treatments; glyphosate applied as a 48.7% Roundup® formulation at 12 ounces product per acre, imazapic applied as Plateau® at 8 ounces product per acre, and glyphosate mixed with imazapic at 6 ounces plus 6 ounces product per acre. At the Plains site, picloram was included in the herbicide solution as Tordon® at 16 ounces product per acre to target the broadleaf weeds. The Plains site had fall herbicide applications only and the Camus Prairie site had fall and spring herbicide applications. Herbicides were applied with a plot sprayer delivering 15 gallons of spray solution per acre to 10-foot by 50-foot plots. At Plains, the three herbicide treatments and the no spray control were randomized within each of the seven 20-foot by 100-foot grass seeding blocks and applied 11 October 2006. At Camus Prairie, the herbicide treatments within each grass seeding plot (10-foot by 50-foot) were completely randomized. The fall application was sprayed 11 October 2006, and the spring application was sprayed 19 April 2007.

Seeded Grasses: Six Grass Treatments and a No Seed Control

Five pasture grass species and a native mix were no-till drill seeded at the Critical Area Planting (Code 342) pure live seed (PLS) seeding rate based on Montana Plant Materials Technical Note, Seeding Rates for Conservation Species for Montana, MT-46 (Rev. 4) (Majerus et al., 2013) and compared to a no seed control. The pasture grasses (PLS pounds per acre seeding rates) were ‘Manska’ pubescent wheatgrass (*Thinopyrum intermedium*, 20 lb/A), ‘Hycrest’ crested wheatgrass (*Agropyron cristatum x Agropyron desertorum*, 10 lb/A), ‘Manchar’ smooth brome (*Bromus inermis*, 10 lb/A), and ‘Bozoisky-Select’ Russian wild rye (*Psathyrostachys*

juncea, 10 lb/A). The native mix (PLS seeding rates) consisted of 'Goldar' bluebunch wheatgrass (6 lb/A), 'High Plains' Sandberg bluegrass (0.4 lb/A), 'Trailhead' basin wildrye (*Leymus cinereus*, 1.2 lb/A), "Critana' thickspike wheatgrass (*Elymus lanceolatus*, 1.2 lb/A), and 'Secar' Snake River wheatgrass (*Elymus wawawaiensis*, 1.2 lb/A). The Plains site and the fall Camus Prairie site were seeded 9 November 2006, and the spring Camus Prairie site was seeded 19 April 2007. There was no livestock grazing at the Plains site which received only light wildlife utilization. The Camus Prairie site was fenced during the first five years of the trial, after which it was open to cattle grazing annually on a continuous basis.

Evaluations

The herbicide treatments were evaluated 31 May 2007 by visually estimating the percentage reduction of cheatgrass and bulbous bluegrass (and broadleaf weeds at Plains) in the treated plots compared to the no herbicide control. At that time, the drill rows of the seeded grasses were difficult to locate but some grass emergence was noted.

Evaluation in the spring of 2008 found no seeded grasses on the plots at Camus Prairie. Cheatgrass, bulbous bluegrass and biscuitroot (*Lomatium triternatum*) were abundant on the site. At the Plains site, there was enough grass emergence to conduct a sampling. The site was sampled by a Montana Conservation Corps crew on 16 July 2008. Densities of seeded grasses were counted within one row-foot at three random locations within the middle two drill rows of each treatment plot (six sample plots per treatment). The presence of cheatgrass, other weeds (spotted knapweed, sulfur cinquefoil, St. Johnswort, Dalmatian toadflax), and other grasses were also noted.

Seeded grass stands and vigor were also evaluated during the summer of 2009 (year three of the planting), 2011 (year five of the planting) and in the spring of 2015 (year nine of the planting).

Results: Herbicide Control of Exotic Grasses

We observed cheatgrass and bulbous bluegrass in every plot during the evaluation period. These grasses were reduced temporarily where herbicides were applied, but were excluded long-term where seeded grasses established. An analysis of variance test was used to analyze the herbicide control data from each site to determine herbicide treatment effects on cheatgrass and bulbous bluegrass control relative to no herbicide application the year after application. For the model, seeded grass blocks were used as replications. The analysis showed herbicides controlled cheatgrass and bulbous bluegrass differently ($p<0.05$, Table 1). At the Plains site, glyphosate provided a 25% reduction in cheatgrass and bulbous bluegrass, less than imazapic (69% reduction) and imazapic plus glyphosate (64% reduction), which were not statistically different from each other. The fall application at Camus Prairie resulted in 31% reduction of cheatgrass and bulbous bluegrass where glyphosate was applied which was statistically the same as the 51% control where imazapic was applied. Imazapic plus glyphosate resulted in the greatest control at 81%. Imazapic provided the least control (53%) of the herbicide treatments applied in the spring at Camus Prairie, but control was similar to glyphosate (64%). The 80% control observed in the imazapic plus glyphosate plots was greater than the control achieved with imazapic, but not glyphosate.

At Plains, picloram provided 100% control of the broadleaf weeds. In these plots, we observed natural regeneration of Sandberg bluegrass regardless of the grass seeded.

Table 1. The effect of herbicide treatment on cheatgrass and bulbous bluegrass control relative to no herbicide application.

Herbicide	Percent cheatgrass and bulbous bluegrass control		
	Plains	Fall Camus Prairie	Spring Camus Prairie
	%	%	%
Glyphosate	25 B*	31 B	64 AB
Imazapic	69 A	53 B	53 B
Imazapic + Glyphosate	64 A	81 A	80 A

*** Means within a column followed by different letters are significantly different at α=0.05.**

Results: Grass Establishment

The results from density count at Plains in 2008, the second summer after seeding, are shown in Figure 3. No smooth brome plants were found, and no seeded grasses were found in any of the no herbicide plots. The species with the most consistent establishment was pubescent wheatgrass. Russian wildrye was only found in two sample plots where it was found at high densities (19 and 43 plants per square foot).

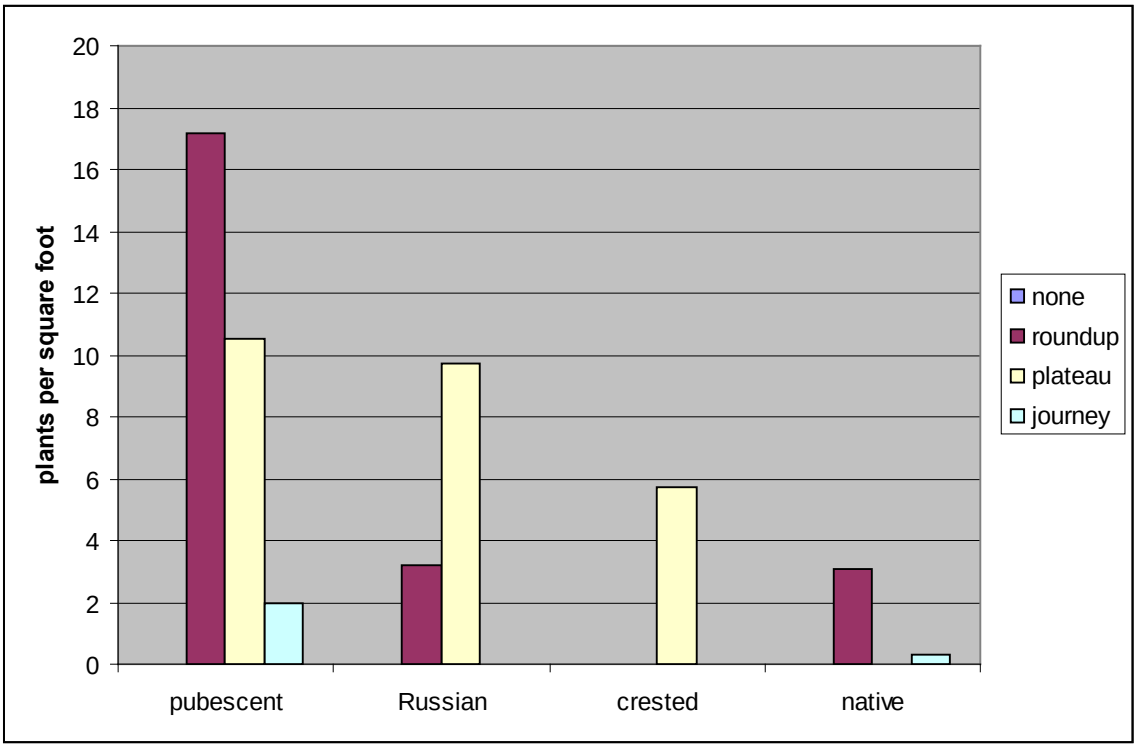

Figure 3. The mean densities of seeded grasses in each herbicide treatment at Plains in July 2008, the second summer after seeding.

At Plains during the year five evaluation, we observed “excellent” full stands of pubescent wheatgrass in all herbicide treatments (see Figure 4). In the no-herbicide plot the lower-half of the stand was fully established, but there were no plants in the upper-half. This suggests the drill may not have been fully charged with seed when the seeding started and no seed was planted in the upper-half. Where the native grasses were seeded, we observed “excellent”, full stands of bluebunch wheatgrass in the glyphosate and the glyphosate plus imazapic treatments

but stand failure in the no-herbicide and imazapic treatment plots. The crested wheatgrass stand was rated “very poor” where glyphosate and imazapic were sprayed, “poor” where imazapic was sprayed, and “failures” in the glyphosate and no-herbicide plots. The Russian wildrye stand was “very poor” where glyphosate was sprayed and “failures” where imazapic, imazapic plus glyphosate were sprayed, and in the no-herbicide plot. Orchardgrass and smooth brome failed to establish in any of the plots at the Plains site.

Figure 4. Pubescent wheatgrass plots at Plains after five growing seasons. Photograph by NRCS.

During the year nine evaluation at Plains, stand evaluation results were the same as the year five evaluations. We observed “excellent” full stands of robust pubescent wheatgrass plants where they had initially established. In addition, pubescent wheatgrass was spreading outside the plots west of where it was seeded. We also observed “excellent”, full stands of bluebunch wheatgrass persisting where it had established (see Figure 5). The few plants of crested wheatgrass and Russian wildrye that initially established were still growing vigorously.

Figure 5. Bluebunch wheatgrass plots at Plains nine years after seeding. Photograph by NRCS.

At Camus Prairie, during the year three evaluation, we observed for the first time, “fair” stand establishment of bluebunch wheatgrass in the glyphosate plus imazapic fall-seeded plot. It was also the first time we observed “fair” stands of pubescent wheatgrass in the fall seeded and herbicide treated plots, but not in the fall seeded no-herbicide plot. All other grass plots in both the fall seeding and spring seeding failed to establish.

By the year five evaluation, the established pubescent wheatgrass plots filled in to form “excellent” stands (see Figure 6). Where bluebunch wheatgrass established, plant bunches filled in to form a “good” stand. We observed no establishment in the plots that had previously failed. After the year five evaluation, the plots were opened to cattle grazing.

Figure 6. Pubescent wheatgrass plots at Camus Prairie at the year five evaluation before the site was opened to grazing. Photograph by NRCS.

Nine years after seeding, and after four years of cattle grazing at the Camus Prairie site, we observed “excellent” stands of evenly grazed pubescent wheatgrass where it was seeded in the fall and where herbicides were sprayed. The “good” stand of bluebunch wheatgrass seeded in the fall where glyphosate plus imazapic was sprayed had diminished to a “poor” stand. All other grass by herbicide combinations were failures.

Recommendations

For restoring perennial grass structure and composition to cheatgrass and bulbous bluegrass infested rangeland and pastures in western Montana, the results of this trial support a recommendation of seeding pubescent or bluebunch wheatgrass. Fall dormant seeding is recommended. These recommendations are supported by the results of seeding studies in the Bitterroot Valley, Montana (Rinella et al., 2012; Jacobs et al., 2006; Sheley et al., 2001; Velagala et al., 1997) that found strong establishment of intermediate, pubescent, and bluebunch wheatgrass in rangeland communities dominated by spotted knapweed and cheatgrass. Bluebunch wheatgrass also established well in a study near Lolo, Montana, on a pasture site dominated by leafy spurge (*Euphorbia esula*), cheatgrass, and other weedy species (Jacobs and Knudsen, 2006). Pubescent wheatgrass is recommended on sites grazed annually by cattle. Bluebunch wheatgrass is recommended where native grass is desired and a grazing prescription that includes one or more years of rest between grazing can be adopted. The results also support a fall application prior to seeding of imazapic at 12 ounces product per acre (Plateau®), or 6 ounces per acre imazapic plus 6 ounces per acre glyphosate, to reduce the risk of stand failure by competition from cheatgrass and bulbous bluegrass, and picloram at 16 ounces product per acre to reduce the risk of failure by competition from broadleaf weed such as spotted knapweed.

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