RM CESU Completion Report
Rocky Mountains Cooperative Ecosystem Studies Unit (RM-CESU)

Project Title: Cheatgrass Restoration to Native Bunchgrass at Grant-Kohrs Ranch NHS

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Partner University: University of Montana

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Project Summary: Peter Rice will provide technical assistance on site preparation, herbicide prescriptions, reseeding methods, experimental design, and response sampling at Grant Kohrs Ranch NHS, Deer Lodge, Montana to assist with control of cheatgrass and restoration of native bunchgrass. The general approach to weed control combines litter reduction, herbicide, and planting treatments. The first step will be to use intensive grazing and/or mowing to reduce the litter layer on up to 10 acres impacted by cheatgrass.

Lessons Learned:

This project tested the state of knowledge methods for suppressing cheatgrass (*Bromus tectorum*) and establishing native bluebunch wheatgrass in a severely degraded management unit at the Grant-Kohrs Ranch. These methods had shown some successes, or at least promise, for restoring cheatgrass dominated sites but the history of field results in practice has been inconsistent. The reasons for failed establishment at particular sites and/or time periods for the treatments are often unrecognized. Accordingly site specific applications of these cheatgrass restoration methods are in large part still operational experiments. We tested combinations of attempted litter reduction, herbicide spraying, and drill seeding of Secar Bluebunch Wheatgrass (a.k.a. Secar Snake River Wheatgrass). We conducted replicated small plot tests of five herbicide prescriptions. From this five part trial we anticipated getting one or more successful prescriptions that could be applied in the future to most of the degraded management unit (~10 acres).

Methods and Treatments

There were two sets of test plots. One experiment was conducted on flat field terrain and a second on the steep west facing slope of a surface soil berm created by excavations for railroad bed construction. The experimental design is randomized complete blocks with three replications of the five herbicide treatments (Table 1). The flat field test plots are 10 x 60 feet. The berm slope test plots are 10 x 10 feet.

Table 1. Herbicide treatment schedule.

Herbicide Product	Product Rate (oz/ac)	Surfactant	Nominal Spray Timing	Actual Spray Timing
Matrix	3	0.125% NIS v/v	Post-Emergent first flush Late Sept/Early Oct	1-2 leaf stage Nov 5, 2009
Matrix	4	0.125% NIS v/v	Post-Emergent first flush Late Sept/Early Oct	1-2 leaf stage Nov 5, 2009
Outrider	1.33	0.25% NIS v/v	2 leaf stage Early-Fall (September)	2 leaf stage Sept 29, 2010
Plateau	8	None	Pre-emergent Early-Fall	no germination yet Sept 9, 2010
Journey	16	MSO 2 pt/ac	Post-emergent 2 to 3 leaf stage Mid-Fall	2-4 & tillering Oct 12, 2010

The herbicide application were made with a CO2 regulated backpack sprayer using six 8002 TeeJet nozzles with boom spacing to create a ten foot wide effective swath. The applications were made at a total volume 14 gallons per acre. Travel speed was determined by using a metronome.

Both test sites had dense litter cover from previous years cheatgrass. Attempts to reduce litter prior to herbicide spraying by spring grazing and summer/fall mowing were not successful. In November 2009 when the Matrix application were made the ground cover of litter measured by point intercept was 91% on the flat field plots and 95% on the berm slope plots. In September 2010 when the Plateau treatments were made the litter ground cover was 81%.

The native wheatgrass replant interval following Matrix treatments is 12 to 14 months. The replant interval for Plateau is 2 months, for Journey 1 months, and 0.75 to 1 month for Outrider. The flat field plots were drill seeded with Secar Bluebunch Wheatgrass at 12 lbs/ac pure live seed on October 28, 2010. The berm slopes were broadcast seeded with Secar Bluebunch Wheatgrass on the same date at 30.8 lbs/ac pure live seed. The late October timing of the planting constituted a fall dormant seeding.

Grass responses to herbicide treatments were sampled by the frequency grid method (Vogel & Masters. 2001. J range Management 54(6):653-655). A square metal frame containing

25 15x15 cm squares is located at 4 predetermined points along a transect bisecting the long axis of each treatment plot. The occurrence of cheatgrass, bluebunch wheatgrass, needle-and-thread grass (*Stipa comata*), or combined other perennial grasses is recorded. These herbicide treatment response measurements were made in first growing season (July 2011), second growing season (June 2012), and the flat field plots (not the berm plots) for the third growing season (June 2013) after the fall 2010 seeding. The above measurement allowed analysis of any benefit from the herbicides. In order to determine if there was any increase in bluebunch wheatgrass because of the seeding, irrespective of herbicide treatment, we sampled by frequency grid for 17 points outside the flat field seeded plots in 2013.

The frequency of occurrence grid data was analyzed by analysis of variance. Then pairwise comparisons were made between the no spray controls and each of the herbicide prescriptions by the two tailed Dunnett t-test. A one way analysis of variance was also calculated for the 2013 unseeded area versus all seeded plot.

Results: The fall 2009 Matrix treatments at both rates were very efficacious in reducing cheatgrass growth in the first growing season (2010) after spraying (Figure 1). Cheatgrass was reduced to trace occurrences in 2010. The in-situ perennial grasses were quite tolerant to the late fall Matrix treatments. However in the second growing season (2011) after spraying, the cheatgrass had reestablished in the Matrix plots at apparent densities equal to the no spray control plots. In addition the cheatgrass on these Matrix plots was taller and more fecund than the no spray control plants (Figure 2).

Figure 1. Cheatgrass suppression and perennial grass tolerance in the first growing season after previous fall applications of 3 (left center) and 4 (right center) oz/ac of Matrix. The far right and far left are plots with dense uncontrolled cheatgrass.

Figure 2. In the second year after spraying Matrix the cheatgrass was reestablished at high densities and fecundity; left side 4 oz/ac Matrix and right side a no spray control plot.

In 2011 the cheatgrass on the fall 2010 applied Outrider plots was slightly stunted relative to the no spray controls. The cheatgrass on the fall 2010 applied Plateau and Journey flat field plots did not exhibit any visual injury signs. However cheatgrass was greatly reduced on the Journey berm slope plots.

There was no significant ($p>0.05$) suppression of cheatgrass frequency of occurrence in the first year after drill seeding (Table 2a) except for the Journey berm slope plots (Table 3a). Bluebunch wheatgrass establishment was not significantly ($p\leq0.05$) enhanced by the herbicide treatments except for a slight increase in the flat field Journey plots (Table 2a) relative to the no spray controls in 2011. That differential increase in bluebunch wheatgrass in the flat field Journey plots was not significant in the second year after seeding. Needle-and-thread grass is the most native abundant species on the flat field plots. It was not affected by the herbicide treatments (Table 3b). Other perennial grasses were significantly more prevalent on the flat field Journey plots in 2012 (Table 2b), but no other significant responses were measured for these combined taxa. There were no significant herbicide treatment effects in 2013 although the frequency of occurrence of all grasses was lower on most of the flat field plots than it had been in the two previous years (Tables 2a & b) as 2013 had very low precipitation.

Although as of 2013 (3 years after drill seeding) the not seeded area had nominally fewer bluebunch wheatgrass plants than the drill seeded plots these counts did not differ significantly (one way ANOVA $p=.119$, Table 2a). The frequency of occurrence of the other grasses also did not differ significantly between the not seeded area and the seeded plots as of 2013 (Table 2a & b).

Table 2a. Percent frequency of occurrence of grasses in the 3 years after drill seeding the flat field plots and 2 years after broadcast seeding the berm plots. (***bolded ##.#** $p \leq 0.05$ using Dunnett two tailed t-test to compare the herbicide treatments with the No Spray controls)

Flats Treatment	cheatgrass 2011	cheatgrass 2012	cheatgrass 2013	bluebunch 2011	bluebunch 2012	bluebunch 2013
Matrix 3 o/a	96.3	98.0	98.0	20.3	33.3	12.0
Matrix 4 o/a	99.3	99.7	83.3	15.7	33.7	14.3
Outrider 1.33 o/a	88.3	92.7	53.0	12.0	12.7	9.0
Plateau 6 o/a	74.3	**76.0***	42.3	11.3	16.7	13.7
Journey 16 o/a	75.3	97.3	69.0	**28.3***	35.0	21.7
No Spray	89.7	94.7	66.3	8.3	11.7	18.2
Not Seeded Area			79.8			7.1

Table 2b.

Flats Treatment	needle & thread 2011	needle & thread 2012	needle & thread 2013	other perennial grasses 2011	other perennial grasses 2012	other perennial grasses 2013
Matrix 3 o/a	42.7	30.0	11.5	39.3	0.7	0.0
Matrix 4 o/a	23.0	7.7	0.3	39.0	1.0	1.0
Outrider 1.33 o/a	25.0	18.7	5.0	38.0	12.3	7.7
Plateau 6 o/a	50.3	45.3	35.7	44.0	16.0	19.7
Journey 16 o/a	63.7	41.3	29.7	56.3	**33.3***	16.7
No Spray	42.0	35.0	24.7	34.7	4.7	8.0
Not Seeded Area			33.9			7.9

Table 3a.

Berm Treatment	cheatgrass 2011	cheatgrass 2012	bluebunch 2011	bluebunch 2012
Not Seeded	94.3	100.0	5.3	5.3
Matrix 4 o/a	98.0	99.3	0.0	9.7
Outrider 1.33 o/a	82.3	97.7	0.0	6.0
Plateau 6 o/a	84.3	98.7	0.0	4.3
Journey 16 o/a	**13.3***	99.0	1.0	0.7
No Spray	99.7	100.0	3.7	10.3

Table 3b.

Berm Treatment	needle & thread 2011	needle & thread 2012	other perennial grasses 2011	other perennial grasses 2012
Matrix 3 o/a	0.3	0.0	28.7	17.0
Matrix 4 o/a	0.0	0.3	16.7	0.0
Outrider 1.33 o/a	4.3	0.0	12.0	0.0
Plateau 6 o/a	2.0	0.0	9.3	4.7
Journey 16 o/a	6.3	2.0	6.3	0.0
No Spray	4.0	0.7	32.7	3.7
Total	2.8	0.5	17.6	4.2

Discussion

Overall none of the treatment strategies were effective in promoting a successful stand establishment of the planted bluebunch wheatgrass. We were not able to reduce the litter by grazing or mowing, which if successful could have increased the efficacy of the Plateau treatment. A backing fire, if implemented when the soil-litter interface is dry could consume most of the litter and allow efficacious Plateau or Journey treatments. The west facing berm slopes present harsh conditions for establishing perennial grasses from broadcast seeding. Fall dormant drilling of the flat field sites could be expected to have had a more favorable outcome. However in all cases, the cheatgrass was poorly controlled at the times when the seeded grass could begin germination, thus any emerging bluebunch seedlings were subject to intense competition from the very dense and faster growing cheatgrass.

On the flat field site the no spray controls did have the lowest measured frequency of occurrence of bluebunch wheatgrass in the first two post-plant growing seasons. So there was a trend for bluebunch to have a higher frequency of occurrence for all the spray treatments; but this increase was statistically significant in only one case (Journey in 2011). Vogel and Masters (2001) suggest multiplying the grid frequency of occurrence value by a factor of 0.4 to provide a conservative estimate of the density per square meter for the planted grass. The maximum grid frequency of occurrence for bluebunch was 33 to 35 as of the second year post-plant, suggesting a bluebunch density of 13 to 14 seedlings per square meter. This density would be low for the prospects of establishing a successful stand. The seeding rate used on the flat field was 12 lbs/ac which is 415 seeds/meter square. It often takes three or more years post-plant for maximizing germination of seeded bluebunch wheatgrass and mature stand establishment. However even in the third year (2013) we did not have successful stand establishment.

Matrix provided a high level of cheatgrass suppression in the first spring after the fall spray treatments, but the grass tolerance replant interval did not allow seeding until the fall one year after spraying. The Matrix plots had returned to a high density of cheatgrass in the second growing season post-spray when the bluebunch wheatgrass could begin germination. The Matrix plots had very little litter in the first fall post-spray. We could have applied a low rate (2-4 oz/ac) of Plateau in the early in the second fall post-spray of Matrix, proceeded with the late fall dormant seeding, and possibly prevented reestablishment of cheatgrass in the following spring. A low rate Plateau follow-up treatment in the second fall after a first fall Matrix treatment would be a reasonable strategy to try to establish a bluebunch wheatgrass stand on this degraded management unit.