

Controlling Cheatgrass in Winter Range to Restore Habitat and Endemic Fire

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Abstract—Habitat managers can better prepare a program for prescribed burns, wildfire management, and maximum forage biomass by understanding the response of key shrubs to the tools utilized to reduce cheatgrass (*Bromus* spp.) competition. Application of Plateau® herbicide, prior to annual brome germination, at rates up to 8 oz/acre with or without surfactant gave acceptable annual brome reduction without adverse injury to true mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), and sagebrush (*Artemisia* spp.). By removing cheatgrass prior to or after a burn, shrub winter range species can more efficiently and vigorously re-occupy the site or survive the burn.

Introduction

Fine fire fuel management programs are being implemented by Game and Fish to reduce loss of big game winter range. Prescribed fire has been an important tool to regenerate brush, improving winter browse. However, severe drought during the late 1990s and early 2000s have favored annual brome species (*Bromus* spp.) and allowed this invasive weed to influence burn area recovery. Wyoming critical winter habitat areas have had an increase of annual brome, such as cheatgrass (*Bromus tectorum*), after wildfire, resulting in decreased desirable vegetation including grass, shrubs and forbs. These results have alerted Wyoming Game and Fish to evaluate areas prior to a prescribed burn to determine if an annual brome component is present and if likelihood of habitat degradation, rather than improvement, may occur. If the site has potential of degradation due to annual brome release, Plateau® herbicide, imazapic, is incorporated into the winter range improvement plan for pre-emergence control of cheatgrass.

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Increasing use of the herbicide Plateau, imazapic, for selective control of annual brome in Western wildlands has dictated the need for increased knowledge of tolerant brush species. Western bunchgrass and forb tolerance trials have shown Plateau to be an acceptable tool for release of desirable plant species and renovation of annual brome infested areas¹ (Foy 2003, Rayda 2003). In general, Plateau is not effective at control of brush; however, some brush species exhibit unacceptable injury. Brush tolerance to Plateau is key when considering use of this herbicide for selective control of annual brome prior to a prescribed burn for critical winter range brush regeneration.

In addition, Plateau is gaining recognition and use as a tool to produce aesthetically acceptable fuel breaks and green strips. Plateau can selectively remove the fine annual brome fuel from more fire resistant bunch grasses and shrubs. Removal of the annual brome helps eliminate an ignition fuel as well as eliminating the main fire carrier. Fire modeling of Plateau treated areas utilizing the BehavePlus fire model has shown significant reduction of flammable biomass as well as decreasing flame height and length (Kury 2003). Applications of Plateau are typically broadcast, applied over the top of brush remaining in the green strip for aesthetic, moisture catching, or soil stabilizing purposes. Brush tolerance is an important aspect when considering the use of Plateau for enhancing green strips and fuel breaks, as well as an additional tool for habitat improvement.

Tolerance Mechanism

Plateau herbicide, imazapic, is a member of the imidazolinone family. The active ingredient of an imidazolinone herbicide controls susceptible plants by binding to the acetohydroxyacid synthase (AHAS) enzyme and preventing production of three essential amino acids. Plant tolerance to imidazolinones can be due to inherent differences in the AHAS enzyme itself and/or differences in the stability of the enzyme. For some species, such as legumes, tolerance to imidazolinones is contributed to their ability to metabolize the herbicide active ingredient. Mature tissues in plants appear to be relatively unaffected by inhibition of the AHAS enzyme (Shaner 1991). This accounts for the higher susceptibility of annual versus perennial plants, since perennial plants

¹Data on file with BASF Corporation, J.L. Vollmer, Laramie, WY, as "GRASS AND FORB TOLERANCE TO PLATEAU® HERBICIDE – Update July 26, 2006.

would have a higher percentage of mature tissue. After direct treatment with an imidazolinone herbicide, mature leaves of perennial susceptible plants will remain green for a long period of time, several months, prior to desiccation. Leaves continue to photosynthesis, although amino acid production is arrested. In treated susceptible species, photosynthesis translocation can be disrupted, depriving roots of an energy supply (Shaner 1991). Susceptibility of well-established shrubs may take up to two years to determine.

Results and Discussion

True Mountain Mahogany Tolerance

True mountain mahogany (*Cercocarpus montanus*) trials were conducted on a post burn site in Douglas, WY. At one year after a wildfire, further loss of mountain mahogany was threatened by competition and additional fine fuel buildup of cheatgrass, tumble mustard (*Sisymbrium altissimum*) and thistle (*Cirsium* spp.) invasion. Plateau treatments were broadcast applied September 4, 2002, prior to cheatgrass emergence. The trial had seven treatments: 6, 9 and 12 oz of Plateau per acre, with and without methylated seed oil (MSO) surfactant at 1 qt/acre, compared to a non-treated plot. Plot size included seven to 10 bushes in a 10 x 50 foot area replicated three times. The same treatments were conducted on an adjacent area in spring 2003. Treatment goals were to reduce the fine fuel load to prevent further loss of the remaining mountain mahogany population in the event of a wildfire. Data were to be used to aid in plans to prepare similar sites for a prescribed burn.

The spring after application, all fall 2002 treatments showed delayed leaf expansion with some yellowing during the first growing season. This response increased as the Plateau rate increased, with a greater negative response from treatments that included the MSO surfactant. All plots were evaluated the first full growing season after applications on August 10, 2004. Fall treated plots at the typical cheatgrass recommended application rates of Plateau at 6 or 9 oz/acre and Plateau at 6 oz + MSO had no adverse effects on the true mountain mahogany. Addition of MSO to the Plateau at 9 oz/acre simulated a burn response by stimulating new shoot growth from the base of the plant. The Plateau at 9 oz/acre plus MSO treatment could be used to simulate a prescribed burn for habitat enhancement when the cheatgrass population is high enough to threaten mahogany mortality during a wildfire or prescribed burn.

Spring applications showed greater variability in response between plants within a treatment. Plateau at 6 oz/acre was the only treatment resulting in mahogany growth similar to the non-treated plot. Plateau at 12 oz/acre + MSO applied in the spring resulted in initial unacceptable stunting of new growth. The observed stunting was viewed as unacceptable due to the decreased amount of vegetation that could be utilized as browse.

New basal growth was evaluated for all treatments as an important source of mahogany regeneration. New basal growth was acceptable for all fall treatments except the Plateau 12 oz/acre + MSO. Results suggest that this treatment affected the overall plant system, inhibiting the ability of the plant to recover. For spring-applied treatments, new

basal growth, at 16 months after treatment, was not affected by Plateau at the 6 or 12 oz rate or MSO plus Plateau at 9 or 12 oz rate. All other treatments had individual plants that elicited variable shoot growth. Differences in basal growth may be due to individual plant genetics or microclimate including soil type and/or depth.

Fall pre-emergence Plateau treatments without surfactant provided the needed cheatgrass control. The addition of MSO was not needed to achieve adequate cheatgrass control to reduce competition and fire hazard. Spring treatments required the addition of MSO to control the cheatgrass post emergence, but spring treatment is not recommended due to variation in brush response and annual brome efficacy.

Antelope Bitterbrush Tolerance

The antelope bitterbrush (*Purshia tridentate*) tolerance research was conducted on a site prior to a prescribed burn, at 8,000 feet east of Laramie, WY. Plateau treatments were broadcast applied September 30, 2003, prior to cheatgrass emergence. The trial had nine treatments: Plateau at 6, 8, 10 and 12 oz/acre, Plateau at 6 and 8 oz/acre plus non-ionic surfactant (NIS) at 0.25 percent v/v, and Plateau at 10 and 12 oz/acre with MSO surfactant at 1 qt/acre, all compared to a non-treated plot. Plot size included 10 bitterbrush plants in a 10 x 50 foot area replicated three times. Treatment goals were to prevent cheatgrass domination after a prescribed burn.

At the beginning of the first growing season after application, June 24, 2004, bitterbrush showed little response from most treatments. Exceptions were Plateau at 12 oz/acre alone and Plateau 10 and 12 oz/acre plus MSO. The response elicited by these herbicide treatments was a delay in leaf expansion, smaller mature leaves and shortened internodes of new stems (typical imidazolinone symptomology). First year results indicated that later ratings were needed to evaluate long-term herbicide effect on bitterbrush.

At 2.5 years after treatment, May 23, 2006, bitterbrush mortality was evaluated. The 6 and 8 oz/acre rates of Plateau with and without surfactant had no mortality and no evidence of treatment effect (table 1). The two high rates of Plateau with surfactant resulted in 28 to 43 percent mortality. Surviving plants had no new stem growth and spring leaf growth was severely delayed with the few new leaves displaying typical imidazolinone symptomology, indicating these plants were still under severe stress from the Plateau herbicide. The second and third replications of 10 and 12 oz/acre rate of Plateau without surfactant, showed little to no injury on recovered plants. However, the first replication, located on a drought prone slope, had mortality of 80 percent for both treatments. This response to adverse environmental factors in combination with a Plateau treatment indicates marginal tolerance of bitterbrush to Plateau at high rates. Of the recovering plants in the second and third replications, first year growth after application was a fifth of the second year growth. Wildlife managers would need to assess bitterbrush recovery potential and browsing demands on these plants to determine if high rates of Plateau were acceptable for their program goals. Rates of 10 and 12 oz of Plateau per acre is rarely needed to achieve acceptable cheatgrass control, allowing managers to adjust rates to achieve antelope bitterbrush selectivity.

Table 1—Antelope Bitterbrush tolerance, leaf expansion and mortality.

Treatment	Evaluation June 24, 2004	Evaluation May 23, 2006
	% Injury by leaf expansion reduction ^a	% Mortality ^a
Plateau 6 oz + NIS	7	0
Plateau 8 oz + NIS	8	0
Plateau 10 oz + MSO	90	28
Plateau 12 oz + MSO	90	43
Plateau 6 oz	0	0
Plateau 8 oz	0	0
Plateau 10 oz	0	27 ^b
Plateau 12 oz	22	33 ^b
Non-treated	0	0

^a Average over three replications.^b First replication, located on slope with drought tendency had 80% mortality.

Sagebrush Species Tolerance

Sagebrush (*Artemisia* spp.) steppe communities have been severely impacted by fire carried by annual brome species. Restoration of fire-scarred land can be unsuccessful due to competition from annual brome; therefore, a selective herbicide that can be used to preserve remaining sagebrush steppes as well as aid in restoration is very important. Plateau herbicide has been applied over the top of several sage species through research and commercial applications. Table 2 is a summary of tolerance research results and commercial observations made across the Western United States sage steppe areas.

Sagebrush Case Study—The Johnson Creek Unit of Sybille Canyon, WY, suffered the loss of critical bighorn sheep winter habitat in August of 2001. An escaped campfire

resulted in a 448-acre wildfire. During the fall of 2001 cheatgrass dominated the area, out competing the native vegetation. A rescue/release treatment of Plateau at 8 oz/acre plus MSO was applied in August of 2002. Prior to treatment, 100 foot transects were installed on the Wyoming Game and Fish treated area and on an adjacent non-herbicide-treated, burned Bureau of Land Management section. In 2003, post application, belt density transects and nested frequency quadrants were added. Measuring relative cover at one year after treatment, cheatgrass increased by 8 percent in the non-treated area to 75 percent, while native vegetation decreased a corresponding amount to 25 percent of the cover (table 3). In the Plateau treated area, cheatgrass decreased from 84 percent to 0 percent with a corresponding increase in native vegetation to 100 percent.

Table 2—Tolerance summary of sage species to Plateau herbicide at 2 to 12 oz/acre with or without MSO.

Silver sagebrush (<i>A. cana</i>) ^a	No injury
Fringed sagebrush (<i>A. frigida</i>) ^a	No injury, new growth greater than in non-treated areas, possibly due to elimination of annual brome competition
Wyoming big sage (<i>A. tridentate</i>) spring applied	No injury
fall applied	No injury, new leader growth often increased compared to non-treated areas, possibly due to elimination of annual brome competition
Seedling Wyoming Big Sage ^a	No injury

^a Fall applied Plateau herbicide treatment.**Table 3**—Percent relative cover of the Johnson Creek Unit at Sybille Canyon, WY^a.

Treatment	<i>Bromus tectorum</i>		Native flora	
	Pre-treatment	Post treatment	Pre-treatment	Post treatment
Non-treated area	67%	75%	33%	25%
Plateau 8 oz/acre + MSO	84%	0%	16%	100%

^aPreliminary data compiled by Wyoming Game and Fish (data on file with the Wyoming Game and Fish, Casper, WY).

Conclusion

Fall Plateau treatment, prior to cheatgrass emergence, remains the best program for true mountain mahogany tolerance in addition to best cheatgrass control at the lowest herbicide rates. Results indicated that an alternative to fire for mahogany regeneration is Plateau at 9 oz/acre plus MSO. This treatment would give wildlife managers a treatment option when annual brome populations prohibit burning due to the increased fire temperatures threatening mahogany survival. A cheatgrass control program in an antelope bitterbrush community should not exceed Plateau at 8 oz/acre with or without surfactant. Higher rates can increase the possibility of unacceptable injury to bitterbrush. *Artemisia* spp. exhibited the greatest tolerance with no negative treatment response to the highest label rate of Plateau with or without surfactant.

Plateau has proven to be an effective fire mitigation, release and restoration tool for grass/shrub landscapes. The selective ability of the product gives wildlife and land managers options for improving shrub communities. Specific species tolerance to Plateau is important when choosing rate, timing, and additive.

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