Native Grass Establishment using Journey® Herbicide

Authors: Bahm, Matt A., Barnes, Thomas G., and Jensen, Kent C.

Source: Natural Areas Journal, 35(1) : 69-73

Published By: Natural Areas Association

URL: https://doi.org/10.3375/043.035.0109

RESEARCH NOTE

•

Native Grass Establishment Using Journey® Herbicide

Matt A. Bahm[1,4,5]

[1]Department of Wildlife and Fisheries Sciences
South Dakota State University
Brookings, SD 57006

Thomas G. Barnes[2]
Kent C. Jensen[3]

[2]Department of Forestry
University of Kentucky
Lexington, KY 40546

[3]Department of Natural Resource Management
South Dakota State University
Brookings, SD 57006

•

ABSTRACT: We initiated a study to determine the necessary rates of Journey® herbicide applied pre-emergence to reduce competition and allow establishment of native grasses. Native grasses are important components of prairie ecosystems that provide habitat for wildlife and quality forage for livestock. Spring application of 0.07 kg ai/ha imazapic + 0.18 kg ai/ha glyphosate, 0.09 kg ai/ha imazapic + 0.25 kg ai/ha glyphosate, and 0.11 kg ai/ha imazapic + 0.31 kg ai/ha glyphosate, commercially available as Journey® herbicide, and an untreated control were randomly assigned at each site. Plots were seeded within two weeks following herbicide application with a mixture of native warm- and cool-season grasses. Our results indicate that a pre-emergent application of 0.07 kg ai/ha imazapic + 0.18 kg ai/ha glyphosate can improve establishment of planted native grasses.

Index terms: diverse planting, establishment, native grass, pre-emergent herbicide, weed control

INTRODUCTION

Native grasses are important components of prairie ecosystems that provide habitat for wildlife and quality forage for livestock. US Department of Agriculture (USDA) land retirement programs, such as the Conservation Reserve Program, provide payments to landowners that convert highly erodible croplands to perennial grass cover and have the potential to provide habitat for early successional and grassland bird species (Ryan et al. 1998; McCoy et al. 1999). Introduction and establishment of competitive native plants is critical for the sustainable management of weed infestations and the rehabilitation of desirable ecosystems (Jacobs et al. 1999). Seeding perennial grasses following herbicide application can increase establishment and provide sustained weed control through grass competition (Bornman et al. 1991; Sheley et al. 2002; Barnes 2004; Bahm et al. 2011).

Competition with broadleaf and fast-growing annual weeds is thought to be a major factor limiting success of grassland restoration. Historical attempts at restoration or creation of perennial native grasslands have been difficult (Barnes 2004). While no-till drills have helped solve seeding problems, weed control remains one of the biggest obstacles to establishing native grasses. The most critical part of the native grass life cycle is the seedling stage, with events during this life stage having profound effects on competition and community structure (Potvin 1993). McKenna et al. (1991) found that many native grasses are slow to establish and are vulnerable to weed competition during the seedling stages. To be successful at converting existing vegetation to native plant communities, managers must obtain near eradication of existing vegetation and provide weed control until the seedlings have developed strong root systems (Barnes 2004).

Herbicides, such as glyphosate, have been used successfully to increase the density of native seedlings compared to untreated areas (Wilson and Gerry 1995). The imidazolinone family of herbicides controls a wide range of grassy and broadleaf weeds (Little and Shaner 1991; Shaner and Mallipudi 1991). Imazethapyr has been used to establish native warm-season grasses and wildflowers in the Great Plains (Masters et al. 1996; Beran et al. 1999; Beran et al. 2000). Imazapic has also been used to successfully establish native grass and forb species in Nebraska, Ohio, Kentucky, and South Dakota (Masters et al. 1996; Beran et al. 2000; Washburn and Barnes 2000; Bahm and Barnes 2008; Bahm and Barnes 2011; Bahm et al. 2011), and is widely used as a pre-emergent treatment in conversion of former agricultural fields to native plant communities (Barnes 2004). Land managers commonly combine imazapic and glyphosate for weed control prior to planting native species (T. Barnes, pers. comm.). The commercial mixture of imazapic + glyphosate available as Journey® herbicide could allow greater establishment of native grasses by reducing weed competition, while reducing costs and increasing safety by reducing the need for tank mixing of products. The objective of the study was to determine the necessary rates of Journey® herbicide, which combines the pre-emergent properties of imazapic with the broad spectrum control of glyphosate, applied pre-emergence to establish native grasses.

---

[4] Corresponding author:
bahm.matt@gmail.com; (509) 869-2249

[5] Current address:
Conservation Research Program, Institute for Applied Ecology, Corvallis, OR 97333

Natural Areas Journal 35:69–73

MATERIALS AND METHODS

The experiment was conducted on two Game Production Areas with varying soil characteristics in eastern South Dakota. Soybeans (*Glycine max* (L.) Merr.) were grown on the sites for three consecutive years prior to initiation of the study. The East Lake Vermillion site (43°35'39" N, 97°9'33" W) was located on Egan-Ethan complex soils and had a pH of 6.1, 3.5% OM (organic matter), and 10.0, 67.2, and 22.8% sand, silt, and clay, respectively. The Cut-Off Bend site (42°56'14" N, 96°31'35" W) was located on Kennebec silty clay loam and had a pH of 7.1, 4.4% OM, and 9.8, 67.9, and 22.3% sand, silt, and clay, respectively. Soil taxonomy information was obtained from the Natural Resource Conservation Service's Web Soil Survey (Soil Survey Staff 2008) and soil properties were determined from collected samples analyzed by the University of Kentucky Soils Laboratory. No soil tillage was required prior to planting.

Three herbicide treatments and an untreated control were randomly assigned and applied to an area approximately 3 × 10 m in a completely randomized design at each site. Within each treatment, eight 1 m^2 subplots were monitored for total vegetation cover, percent bare ground, percent unplanted grasses, percent unplanted forbs, percent planted grasses, and number of planted grass seedlings. Vegetation measurements were recorded for each 1 m^2 plot after 45 days, 90 days, and at the end of the first, second, and third growing seasons following herbicide treatments. Specific herbicide treatments included 0.07 + 0.18 kg ai/ha imazapic + glyphosate, 0.09 + 0.25 kg ai/ha imazapic + glyphosate, and 0.11 + 0.31 kg ai/ha imazapyr + glyphosate, commercially available as Journey® herbicide. Herbicides were applied with an ATV mounted unit, delivering 224 L/ha (24 gal/ac) spray volume at 241 kPa (35 psi) through TeeJet 8003 flat fan nozzles. No surfactant or other additives were used. Environmental conditions during herbicide application were: air temperature 12–15 °C, relative humidity 62–70%, and winds ≤19 km/h. Plots were seeded within two weeks following herbicide application with a mixture of native warm- and cool-season grasses. The species and rates included in the mixture were *Panicum virgatum* L. at 2.80 kg PLS (pure live seed)/ha, *Andropogon gerardii* Vitman at 2.52 kg PLS/ha, *Sorghastrum nutans* (L.) Nash at 2.52 kg PLS/ha, *Schizachyrium scoparium* (Michx.) Nash at 0.73 kg PLS/ha, *Bouteloua curtipendula* (Michx.) Torr. at 1.12 kg PLS/ha, *Elymus trachycaulus* (Link) Gould ex Shinners at 1.12 kg PLS/ha, and *Elymus canadensis* L. at 1.12 kg PLS/ha (Andy Gabbert, South Dakota Department of Game, Fish and Parks, pers. comm. with M. Bahm). Plots were mowed once during July of the first and second growing season to limit seed production of noxious weed species, primarily thistles (*Cirsium* and *Carduus*).

Numbers of planted species were ranked and analyzed using a Kruskal-Wallis One-Way Analysis of Variance (Daniel 1990). If a difference ($P < 0.05$) was detected, multiple comparisons were made using the procedure described by Dunn (1964), using an experimentwise error rate of $\alpha = 0.15$.

RESULTS

Pre-emergent application of Journey® herbicide increased native grass number and percent cover compared to the untreated control at the end of the first, second, and third growing seasons. All herbicide treatment areas had less cover of vegetation ($P < 0.0001$) compared to the untreated areas 45 and 90 days post-treatment. Herbicide treated areas averaged 33%, 29%, and 20% cover after 45 days, and 24%, 23%, and 20% after 90 days. Herbicide treated plots also had greater amounts of bare ground ($P < 0.0001$) compared to the untreated plots 45 and 90 days post-treatment. There was no difference in vegetation cover, bare ground, unplanted grass cover, or planted grass cover between herbicide treatment areas 45 and 90 days post-treatment (Bahm 2009).

At the end of the first growing season, vegetation cover remained lower ($P < 0.0001$) in herbicide treated plots compared to the untreated plots (Table 1). Bare ground was higher in herbicide treated plots ($P < 0.0001$) compared to the untreated plots after the first growing season (Table 1). There was no difference in vegetation cover or bare ground among herbicide treatments after the first growing season. Unplanted grass ($P < 0.0001$) and unplanted forb ($P = 0.0020$) cover was lower in herbicide treated plots compared to the untreated plots after the first growing season (Table 1). Planted grass cover ($P = 0.0004$) and number ($P = 0.0003$) were higher in herbicide treated plots compared to the untreated plots (Table 1). There were no differences among herbicide treatments in plant grass cover or number after the first growing season.

At the end of the second growing season, there was no difference ($P = 0.1128$) in the amount of vegetation cover in any of the plots. Bare ground remained higher ($P < 0.0001$) in herbicide treated plots compared to the untreated plots after the second growing season (Table 1). Unplanted grass cover was lower ($P < 0.0001$) in herbicide treated plots compared to the untreated plots after the second growing season. There were no differences in bare ground or unplanted grass cover in herbicide treatment areas (Table 1). Unplanted forb cover did not vary ($P = 0.0871$) among treatments after the second growing season. Planted grass cover and number did not differ among herbicide treatments after the second growing season (Table 1).

At the end of the third growing season, there was no difference ($P = 0.4583$) in the amount of vegetation cover in any of the plots. Bare ground remained higher ($P < 0.0001$) in herbicide treated plots compared to the untreated plots after the third growing season (Table 1). Unplanted grass cover was lower ($P < 0.0001$) in herbicide treated plots compared to the untreated plots after the third growing season. There were no differences among herbicide treatments for bare ground or unplanted grass cover (Table 1). Unplanted forb cover varied ($P = 0.0064$) among treatments at the end of the third growing season. Cover of unplanted forbs was lower in the 0.07 kg imazapic + 0.18 kg glyphosate and 0.11 kg imazapic + 0.31 kg glyphosate than in the 0.09 kg imazapic + 0.25 kg glyphosate treatment after the third growing season (Table 1).

Planted grass cover and number did not differ among herbicide treatments after the third growing season (Table 1).

DISCUSSION

All herbicide treatments were effective at reducing cover of unplanted grasses. The most common unplanted grasses in the untreated control area at each site after the first two growing seasons were bristlegrasses (*Setaria* spp.), and imazapic is known to be effective at controlling this genus (Senseman 2007). By the end of the third growing season, bristlegrasses were still the most common at Lake Vermillion, but smooth brome (*Bromus inermis* Leyss.) was the dominant unplanted grass species at Cut-off Bend. The most common unplanted forbs in the untreated control at Cut-off Bend were Canadian horseweed (*Conyza canadensis* (L.) Cronquist), burningbush (*Bassia scoparia* (L.) A.J. Scott), and velvetleaf (*Abutilon theophrasti* Medik.), while sweetclovers (*Melilotus* spp. Mill.), nodding plumeless thistle (*Carduus nutans* L.), and field bindweed (*Convolvulus arvensis* L.) were the most common in the untreated control at Lake Vermillion.

The decrease in unplanted forb cover over the duration of the study is likely due to the effects of mowing. Many of the unplanted species were annuals or biennials and mowing likely damaged or killed many plants, allowing an increase in grass cover. The increase in unplanted forb cover in the 0.09 kg ai/ha imazapic + 0.25 kg ai/ha glyphosate treatment after the third growing season was due to an increase in dandelion (*Taraxacum officinale* F.H. Wigg.) and Canada thistle (*Cirsium arvense* (L.) Scop.) at Cut-off Bend and Lake Vermillion, respectively. Canada thistle is a perennial species capable of vegetation spread and the low stature of common dandelion would have been below the effective height of mowing equipment.

Increasing herbicide amounts did not improve weed control or native species establishment by the end of the third growing season. Our results are similar to those obtained by researchers in Kentucky,

Table 1. Mean (± SE) percent cover of total vegetation, bare ground, unplanted grasses, unplanted forbs, planted grasses, and number of planted grass seedlings following herbicide treatment at two Game Production Areas in southeastern South Dakota, 2005–2008.

			Vegetation Cover (%)		Bare Ground (%)		Unplanted Grass (%)		Unplanted Forb (%)		Planted Grass (%)		Planted Grass (#)	
Treatment	Rate (kg ai/ha)	N	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
1st Growing Season														
Untreated	n/a	16	89a	3.7	8a	2.7	21a	6.3	74ab	8.1	0a	0.9	0a	0.3
imazapic + glyphosate	0.07 + 0.18	16	52b	7.1	48b	7.1	0b	0	49bc	7.5	4b	0.7	2b	0.3
imazapic + glyphosate	0.09 + 0.25	16	39b	8.8	61b	8.8	0b	0	38c	9	3b	0.7	2b	0.5
imazapic + glyphosate	0.11 + 0.31	16	33b	7.8	67b	7.8	0b	0	31c	8	2b	0.5	2b	0.4
2nd Growing Season														
Untreated	n/a	16	77a	3.9	14a	2.8	37a	6.7	46a	5	1a	0.6	0a	0.2
imazapic + glyphosate	0.07 + 0.18	16	68a	3.1	36b	5.6	1b	0.3	32a	4.8	39b	4.3	5b	0.7
imazapic + glyphosate	0.09 + 0.25	16	66a	3.7	45b	5.2	2b	0.7	38a	3.6	26b	3.2	4b	0.6
imazapic + glyphosate	0.11 + 0.31	16	65a	4.4	44b	6.6	1b	0.3	32a	5.1	29b	3.7	4b	0.7
3rd Growing Season														
Untreated	n/a	16	93a	1.8	14a	6	59a	9.1	32a	8.5	1a	0.8	0a	0.2
imazapic + glyphosate	0.07 + 0.18	16	89a	3.3	61b	8.7	1b	0.6	9b	2.6	70b	5.9	4b	0.8
imazapic + glyphosate	0.09 + 0.25	16	91a	3.1	68b	6.2	3b	1.5	27a	7	57b	6	3b	0.5
imazapic + glyphosate	0.11 + 0.31	16	86a	3	66b	7.5	1b	0.5	9b	2.1	66b	7.2	3b	0.5

Note: Means with the same letter, within the same column and within the same growing season, are not significantly different ($P = 0.05$).

Nebraska, and Texas, who found that 0.07 kg ai/ha imazapic provided adequate weed control in restoration attempts (Masters et al. 1996; Beran et al. 1999, 2000; Washburn and Barnes 2000; Mittelhauser 2002;). Establishment of native grasses in our study supports other researchers who found increased establishment of native grass and forb species after pre-emergent application of imazapic (Masters et al. 1996; Beran et al. 1999, 2000; Washburn et al. 1999; Washburn and Barnes 2000). This research shows that Journey® herbicide can be utilized to reduce weed competition and increase establishment of native grasses on former agricultural lands.

The lowest rates of herbicide (0.07 kg ai/ha imazapic + 0.18 kg ai/ha glyphosate) used during the study provided similar control to higher rates and can be recommended for native grass establishment on former agricultural fields. Establishment of desirable vegetation has the potential to limit further management actions required for less stable plant communities. Increasing desirable plant cover also has the potential to limit erosion, and is necessary to maintain or increase soil and water quality. This research shows that Journey® herbicide can be used effectively to establish native perennial grass species, while eliminating the need to tank mix the products and reducing costs.

ACKNOWLEDGMENTS

We thank A. Gabbert and the South Dakota Game, Fish and Parks Department for allowing us access to the site. K.B. Bahm provided field assistance. Funding was provided by Federal Aid in Wildlife Restoration administered by South Dakota Department of Game, Fish and Parks, Study No. 75108, University of Kentucky Cooperative Extension Service, and South Dakota State University Department of Wildlife and Fisheries Sciences. The manuscript has been assigned number 09-09-116 by the office of the Associate Dean for Research, UK College of Agriculture.

Matt Bahm received a BS in Wildlife Ecology from Oklahoma State University and an MS in Biology from Sul Ross State University. He completed his PhD in Wildlife Science from South Dakota State University and is now the Conservation Research Program Director at the Institute for Applied Ecology in Corvallis, OR. His research interests include invasive species (both plant and animal), native habitat restoration, threatened and endangered species conservation, land-use change, and wildlife responses to restoration practices.

Tom Barnes is an extension professor and extension wildlife specialist at the University of Kentucky. His research interests focus on creation and restoration of native grassland habitats in North America. He is also an author and has published three books including Kentucky's Last Great Places, which showcases the state's natural areas and nature preserves in both words and photographs, and which was nominated for the KY Literary Award.

Kent C. Jensen (KC) is an Associate Professor at South Dakota State University. His research interests are in the areas of avian ecology and habitat management throughout North America and in the Andes of Bolivia in South America. Dr. Jensen also has extensive experience in wildlife and natural resource education with Native American tribes and Tribal Colleges throughout the Northern Great Plains.

LITERATURE CITED

Bahm, M.A. 2009. Conversion of exotic cool-season grasslands to restored native plant communities utilizing herbicide treatments. PhD diss., South Dakota State University, Brookings.

Bahm, M.A., and T.G. Barnes. 2008. Response of Native Forb Species to Pre-emergent Imazapic Treatment. Proceedings of the 6th Eastern Native Grass Symposium [Clemson, SC].

Bahm, M.A., and T.G. Barnes. 2011. Native grass and forb response to pre-emergent treatment of imazapic and imazapyr. Natural Areas Journal 31:75-79.

Bahm, M.A., T.G. Barnes, and K.C. Jensen. 2011. Restoring native plant communities in smooth brome (*Bromus inermis*)-dominated grasslands. Invasive Plant Science and Management 4: 239-250.

Barnes, T.G. 2004. Strategies to convert exotic grass pastures to tall grass prairie communities. Weed Technology 18:1364-1370.

Beran, D.D., R.E. Gaussoin, and R.A. Masters. 1999. Native wildflower establishment with imidazolinone herbicides. HortScience 34:283-286.

Beran, D.D., R.A. Masters, R.E. Gaussoin, and F. Rivas-Pantoja. 2000. Establishment of big bluestem and Illinois bundleflower mixtures with imazapic and imazethapyr. Agronomy Journal 92:460-465.

Bornman, M.M., W.C. Krueger, and D.E. Johnson. 1991. Effects of established perennial grasses on yields of associated annual weeds. Journal of Range Management 44:318-322.

Daniel, W.W. 1990. Applied Nonparametric Statistics, 2nd ed. Duxbury, Pacific Grove, CA.

Dunn, O.J. 1964. Multiple comparisons using rank sums. Technometrics 6:241-252.

Jacobs, J.S., M.F Carpinelli, and R.L. Sheley. 1999. Revegetating weed infested rangeland. Pp. 133-144 *in* R.L. Sheley and J.K. Petroff, eds., Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis.

Little, D.L., and D.L. Shaner. 1991. Absorption and translocation of the imidazolinone herbicides. Pp. 53-70 *in* D.L. Shaner and S. O'Connor, eds., The Imidazolinone Herbicides. CRC Press, Boca Raton, FL.

Masters, R.A., S.J. Nissen, R.E. Gaussoin, D.D. Beran, and R.N. Stougaard. 1996. Imidazolinone herbicides improve restoration of Great Plains grasslands. Weed Technology 10:392-403.

McCoy, T.D., M.R. Ryan, E.W. Kurzejeski, and L.W. Burger, Jr. 1999. Conservation Reserve Program: Source or sink habitat for grassland birds in Missouri. Journal of Wildlife Management 63:530-538.

McKenna, J.R., D.D. Wolf, and M. Lentner. 1991. No-till warm-season grass establishment as affected by atrazine and carbofuran. Agronomy Journal 83:311-316.

Mittlehauser, J.R. 2002. Blackland prairie restoration in central Texas. MS thesis, Southwest Texas State University, San Marcos.

Potvin, M.A. 1993. Establishment of native grass seedlings along a topographic/moisture gradient in the Nebraska sandhills. American Midland Naturalist 130:248-261.

Ryan, M.R., L.W. Burger, Jr., and E.W. Kurzejeski. 1998. The impact of CRP on avian wildlife: A review. Journal of Production Agriculture 11:61-66.

Senseman, S.A., ed. 2007. Herbicide Handbook, 7th ed. Weed Science Society of America, Champaign, IL.

Shaner, D.L., and N.M. Mallipudi. 1991. Mechanisms of selectivity of the imidazolinone herbicides. Pp. 91-102 *in* D.L. Shaner and S. O'Connor, eds., The imidazolinone herbicides. CRC Press, Boca Raton, FL.

Sheley, R.L., T.D. Whitson, V. Carrithers, J.S. Jacobs, and J. Gehrett. 2002. Grass response to picloram and clopyralid applied before seeding. Weed Technology 16:645-650.

Soil Survey Staff, USDA Natural Resources Conservation Service, 2008. Web Soil Survey, USDA, Natural Resources Conservation Service, Soil Survey. Accessed 17 May 2009. <http://websoilsurvey.nrcs.usda.gov/>.

Washburn, B.E., and T.G. Barnes. 2000. Native warm-season grass and forb establishment using imazapic and 2,4-D. Native Plants Journal 1:61-69.

Washburn, B.E., T.G. Barnes, and J.D. Sole. 1999. No-till establishment of native warm-season grasses in tall fescue fields. Ecological Restoration 17:144-149.

Wilson, S.D., and A.K. Gerry. 1995. Strategies for mixed-grass prairie restoration: Herbicide, tilling, and nitrogen manipulation. Restoration Ecology 3:290-298.