Establishing Native Warm-Season Grasses using Conventional and No-till Technology with Various Applications of Plateau® Herbicide

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Abstract

Native warm-season grasses (NWSG) provide habitat for a wide variety of wildlife species associated with early successional habitats. Efforts to establish these grasses have not always been successful. We sowed big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*); each at 8 pounds Pure Live Seed (PLS) per acre in separate, replicated plots using conventional tillage with top-sowing and no-till technology to compare establishment success at 2 locations in Tennessee. Further, we evaluated the effectiveness of Plateau® herbicide (8 ounces per acre pre-emergence) with both planting methods in a split-plot design. More big bluestem (12.9 : 3.8 per m^2), little bluestem (8.1 : 2.8 per m^2), and indiangrass (15.5 : 4.5 per m^2) seedlings were established when planted via no-till than by top-sowing ($P \leq 0.001$) at 1 location; however, there was no difference in number of seedlings established at the other site. In a follow-up study using conventional tillage and irrigation, we compared pre- and post-emergence applications of Plateau® at 8- and 12-ounce rates on big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama (*Bouteloua curtipendula*), which were top-sown at 10 pounds PLS. Both pre-emergence applications of Plateau® eliminated competition by various annual grasses and forbs on all plots, but also reduced the number of switchgrass seedlings. However, even when reduced by Plateau®, adequate cover remained for wildlife in the switchgrass plots (1 – 2 bunches per m^2). When sowing big and little bluestem and indiangrass, we recommend an 8-ounce pre-emergence application of Plateau®. If sown for wildlife habitat, a rate of 4 – 6 pounds PLS should create favorable structure at ground level for upland game birds, rabbits (*Sylvilagus* spp.), and several species of songbirds. When sowing NWSG for forage, a rate of 10 pounds PLS should establish a suitable stand. If adequate moisture is available and seed are not planted too deep, both top-sowing and no-till drilling can be used to establish NWSG successfully.

Introduction

Changing land-use practices have had a detrimental effect on several wildlife species dependent upon early successional habitats (Heard et al. 2000). As escalating costs and reduced profit margins have forced producers to adopt “clean” farming practices, available wildlife habitat for these species has diminished. In Tennessee, the small family farms of yesteryear that once supported rowcrops have converted fields to tall fescue (*Festuca arundinacea*), drastically reducing food and cover available for wildlife (Barnes et al. 1995). Although other factors have contributed, loss of native grassland and early succession/scrub-shrub habitats has precipitated a 70% decline of northern bobwhite (*Colinus virginianus*) populations in the last 30 years (Dimmick et al. 2002). Other wildlife species (especially several songbird species) associated with early successional habitats are experiencing significant long-term population declines as well (Nicholson 1997).

NWSG provide excellent habitat for those species of concern, as well as many others. Recent studies have illustrated the importance of NWSG to enhance farm-wildlife habitat (Burger 2000; Washburn et al. 2002). NWSG are particularly recommended when converting fields of tall fescue to wildlife-friendly

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plantings and establishing streamside buffer strips and irrigation-ditch buffers to reduce erosion and siltation (Reay 1997; Washburn et al. 2000). These buffers have led to increased numbers of northern bobwhites and several species of songbirds on selected farms in Tennessee (Mike Hansbrough, Natural Resources Conservation Service, unpublished data). Finally, livestock producers in the mid-South have begun using NWSG to increase forage production during the mid-summer months when cool-season forages are dormant and unproductive (Lang 1995; Wolf and Fiske 1995; Capel 1998; Kidwell 2002).

The positive benefits of NWSG, however, cannot be realized until establishment is successful. Unfortunately, many previous attempts to establish NWSG have failed and it is widely acknowledged that establishing NWSG is difficult and may require repeated attempts (Fribourg and Waller 1997; Ball et al. 2002). Reasons for establishment failure vary, but include inadequate equipment for sowing the fluffy seed of big bluestem, little bluestem, and indiangrass, drilling the seed too deep (> ¼ inch), inadequate weed control, and planting too late in the growing season. Recent equipment innovations and information concerning the use of various herbicides when planting NWSG have helped increase the success of establishment efforts (Washburn and Barnes 1999; Washburn and Barnes 2000; Washburn et al. 2000). Nonetheless, discrepancies in establishment techniques still exist and further investigation is warranted. Specifically, the effectiveness of top-sowing vs. no-till drilling remains in question as well as timing of herbicide application (i.e., pre- or post-emergence). We compared planting techniques (conventional tillage with top-sowing and no-till drilling) along with various applications of Plateau® herbicide to determine effective strategies for establishing NWSG.

Methods

Establishment Technique—In June 1999, 64 plots (6- by 25-feet each) were planted to big bluestem, little bluestem, indiangrass, and switchgrass in a split-plot design at 2 Experiment Stations (Middle Tennessee and Highland Rim). Plot sites had been in Roundup-Ready® soybean production (Middle TN) or winter wheat (Highland Rim) prior to planting. Existing weeds were sprayed with Roundup® at a rate of 2 quarts per acre before preparing the seedbed. Four replicates of each grass species were sown per treatment at a rate of 8 pounds PLS per acre. Half the plots were planted using conventional tillage with top-sowing; the other half were planted using a Truax® no-till drill. Half of each block received Plateau® (8 ounces per acre) 1 to 2 weeks after planting. Because the plots had received no precipitation prior to spraying, the plots were effectively treated pre-emergence. All plots were burned prior to the third and fourth growing season using prescribed fire in March 2001 and 2002. NWSG “bunches” were counted within 3 randomly-located meter-square quadrants in April 2001 and 2002 to estimate establishment success.

Plateau efficacy—In June 2002, 80 plots (6- by 15-feet each) were planted to big bluestem, little bluestem, indiangrass, switchgrass, and sideoats grama at 2 Experiment Stations (Knox and Highland Rim). Plot sites had been in tall fescue (Knox) or winter wheat (Highland Rim) prior to planting. At the Knox Experiment Station, tall fescue was killed prior to planting by spraying Roundup® at a rate of 2 quarts per acre 6 weeks prior to planting and again 2 weeks prior to planting. All plots at the Knox Experiment Station were top-sown after the seedbed had been plowed, tilled, and cultipacked. All plots at the Highland Rim Experiment Station were planted via no-till drill. Three replications of each grass species were sown per the following treatments: pre-emergence application of Plateau® at 8 ounces per acre; pre-emergence application of Plateau® at 12 ounces per acre; post-emergence application of Plateau® at 8 ounces per acre; post-emergence application of Plateau® at 12 ounces per acre; no treatment (control). All post-emergence applications were applied when the NWSG seedlings reached the 4 – 5 leaf stage (30 days after planting), which followed recommendations per the BASF Plateau® Herbicide Label. Visual evaluation of percent weed control was made at approximately 30 and 90 days after pre-emergence application and 30 days after the post-emergence application. Several weed species were present within the research plots, including crabgrass (*Digitaria sanguinalis*), spotted spurge (*Euphorbia maculata*), fall panicum (*Panicum dichotomiflorum*), stinkgrass (*Eragrostis cilianense*), prickly sida (*Sida spinosa*), and goosegrass (*Eleusine indica*). Establishment success was estimated in each plot by counting NWSG seedlings in 2 randomly-located half-meter-square quadrants 90 days after planting (15 September 2002).

A randomized split plot design was used in the establishment technique study. A randomized complete block design was used in the Plateau® efficacy study. The treatment means were separated using Fisher's Protected LSD at an alpha level of 0.05. Treatment means were separated by treatments (planting technique and herbicide application) and year within each species.

Results

Establishment Technique (Middle Tennessee Experiment Station)—In 2001, plots of big bluestem, little bluestem, and indiangrass planted via no-till drilling contained more plants than those plots top-sown (Table 1). There was no difference between plots with or without Plateau® for those species. Plots sown to switchgrass via no-till without Plateau® contained more bunches than the other switchgrass plots. Plateau® reduced the number of switchgrass plants in plots planted via no-till and those top-sown. From 2001 to 2002, an increase in plant density was observed in most plots. Differences among planting methods were much less pronounced; however, there were a few differences between Plateau® treatments among grass species, which were not consistent for either planting method.

Establishment Technique (Highland Rim Experiment Station)—In 2001, there were no differences between planting methods or herbicide treatment for big bluestem, little bluestem, or indiangrass (Table 2). Switchgrass plots that received Plateau® contained fewer plants than those without. There was no difference between switchgrass plots planted via no-till and those top-sown. From 2001 to 2002, there was an increase in plant density in most plots. There were a few differences between Plateau® treatments among grass species; most notable, switchgrass plots receiving Plateau® contained fewer switchgrass plants than those that did not receive the herbicide.

Plateau® efficacy (Knoxville Experiment Station)—Plots of big bluestem that received pre-emergence applications of Plateau® contained more seedlings than plots treated post-emergence and control plots (Table 3). There was no difference in big bluestem establishment between the 8- and 12-ounce treatments. There were no differences in seedling densities between pre- or post-emergence or 8- or 12-ounce treatments for little bluestem, indiangrass, or switchgrass. Fewer switchgrass seedlings were found in plots treated with 12 ounces of Plateau® pre-emergence than control plots. Plots of sideoats grama that received pre-emergence applications contained more seedlings than those treated post-emergence.

Weed control was greater in those plots treated pre-emergence than post-emergence. There was no difference between the 8- and 12-ounce pre-emergence rates (Table 4).

Plateau® efficacy (Highland Rim Experiment Station)—There were no differences in seedling establishment between any of the treatments among the 5 species (Table 5). Switchgrass and sideoats grama were the only species that exhibited injury symptoms from the pre-emergence and post-emergence applications.

Weed control was greater in those plots treated pre-emergence than post-emergence (Table 6). Among plots treated post-emergence, weed control was greater at the 12-ounce rate.

Discussion

The plots sown for the establishment technique study were not counted until early in the third growing season. At that point, it appeared clear that NWSG establishment was much more successful via no-till. And, initially, it was. Nonetheless, by the fourth year, most of the top-sown plots had "caught-up" with the drilled plots. More enlightening, establishment success for the Plateau® efficacy study was much greater at the Knox Experiment Station than at the Highland Rim Experiment Station. All plots at Knox were top-sown, while those at Highland Rim were planted via no-till. Because these studies were planted later in the growing season (mid-June), the top-sown plots at Knox were irrigated. Undoubtedly, this helped germination and growth. The seed at Highland Rim might have been drilled too deep (>¼ inch) and the plots were not irrigated. Regardless of why the drilled plots were less successful, it is clear that NWSG

can be established both by top-sowing and via no-till. Seed should not be covered or drilled deeper than ¼ inch and an earlier planting date (e.g., April in the South) will ensure adequate moisture before hot, dry periods, which are typical in June and July.

Our plots were sown in areas where row crops had been grown previously, or, at Knox, where tall fescue was the dominant cover type. When planting where tall fescue exists, it is critical to control fescue before planting NWSG (Washburn and Barnes 1999; Washburn and Barnes 2000; Washburn et al. 2000). We killed tall fescue using 2 applications of Roundup® prior to planting and saw no fescue re-growth. Washburn et al. reported success with a spring burn followed by a pre-emergence application of Plateau® before sowing NWSG.

It is not surprising our switchgrass plots that received Plateau® were less successful. The BASF Plateau® Herbicide Label clearly states Plateau® is not recommended for pure stands of switchgrass and stand thinning or loss may be realized at a rate of only 2 – 4 ounces per acre. Nonetheless, some switchgrass plants did survive on the plots where Plateau® was applied. In fact, the density of switchgrass on most plots would provide adequate cover for nesting and brooding upland game birds, especially when complemented with the appropriate forbs and other early successional vegetation, which would be consistent with desired structure described by previous researchers (Peoples et al. 1996; Puckett et al. 2000; Taylor and Burger 2000; Guthrey et al. 2001). When establishing switchgrass using Plateau®, we recommend a post-emergence application of 8 ounces per acre (or less) at the 4 – 6 leaf-stage, following the BASF Plateau® Herbicide Label. Although weed pressure is greater with a post-emergence application, it may provide increased survival of switchgrass (and sideoats grama) seedlings when annual weeds, which are much taller than switchgrass and sideoats seedlings, absorb most of the herbicide. Approximately 60 days after planting (at post-emergence herbicide application), the annual weeds on our study sites were 12 – 18 inches tall.

We did not record additional seedlings of big and little bluestem and indiangrass in most of the plots that received Plateau®; nonetheless, we highly recommend a pre-emergence application of 8 ounces per acre when establishing these grasses because of weed control. Plots that received pre-emergence applications were “clean” at the ground level, which would provide excellent habitat for brood-rearing upland game birds. Thick growth at ground level inhibits mobility of wild turkey poults and bobwhite chicks and makes finding seed from preferred forbs [e.g., ragweed (*Ambrosia artemisiifolia*), partridge pea (*Chamaecrista* spp.), beggar’s lice (*Desmodium* spp.), and blackberry (*Rubus* spp.)] more difficult.

Although we recorded 60 – 80 seedlings per m^2 in some of the plots at Knox, many of these were very small and probably will succumb to competition by the second growing season. To create favorable conditions for nesting and brooding upland game birds, we recommend a seeding rate of 4 – 6 pounds PLS per acre. Fields planted at this rate typically resemble over-grown fallow fields, but are very productive for wildlife. Depending upon bunch size, 1 – 10 bunches per m^2 provide adequate cover. Upon maturity, >10 bunches per m^2 create a dense structure at ground level, reducing mobility of poults and chicks and precluding development of desired forbs. Dense, mature NWSG stands (>10 grass bunches per m^2), however, can be important sources of escape and thermal cover for quail, rabbits and other small mammals, white-tailed deer (*Odocoileus virginianus*), and many songbirds. Deer commonly use these fields for hiding fawns and for bedding and loafing in the middle of the day. If escape cover or thermal cover during winter is the objective, we recommend a planting rate of 8 – 10 pounds PLS per acre. If haying is the objective, we recommend a planting rate of 10 pounds PLS per acre.

Conclusions

NWSG can be established successfully by using either conventional tillage with top-sowing or no-till drilling, provided adequate moisture is present and the seed are not covered or drilled too deeply. Pre-emergence applications of Plateau® provided better weed control than post-emergence applications and an 8-ounce rate per acre was just as effective on most plots as a 12-ounce rate. Seeding rates should be matched with management objectives. Four to 6 pounds PLS per acre are recommended for creating

quality nesting and brooding cover for bobwhites, while 8 – 10 pounds PLS per acre is recommended for escape and thermal cover for a variety of wildlife species.

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Table 1. Native warm-season grass stand counts (per m^2) at the Middle Tennessee Experiment Station, 2001 and 2002.

Treatment	Species[1]		
		2001	2002
Conventional	BB	2.3 B[2]	11.0 BC
Conventional + Plateau®	BB	2.8 B	6.3 C
No-Till	BB	12.0 A	21.3 A
No-Till + Plateau®	BB	13.8 A	14.8 B
Conventional	LB	2.3 B	5.3 B
Conventional + Plateau®	LB	3.2 B	16.7 A
No-Till	LB	7.3 A	12.0 AB
No-Till + Plateau®	LB	9.0 A	11.5 AB
Conventional	IG	3.8 B	6.8 B
Conventional + Plateau®	IG	5.3 B	12.3 A
No-Till	IG	14.0 A	13.3 A
No-Till + Plateau®	IG	17.0 A	11.8 A
Conventional	SG	3.3 B	6.8 BC
Conventional + Plateau®	SG	0.0 B	2.3 C
No-Till	SG	8.0 A	9.5 A
No-Till + Plateau®	SG	3.8 B	3.5 B

[1] BB=big bluestem, LB=little bluestem, IG=indiangrass, and SG=switchgrass

[2] Mean differences within each species and year followed by the same letter are not different at the 0.05 probability level.

Table 2. Native warm-season grass stand counts (per m^2) at the Highland Rim Experiment Station, 2001 and 2002.

Treatment	Species[1]		
		2001	2002
Conventional	BB	4.5 A[2]	7.5 A
Conventional + Plateau®	BB	5.8 A	6.5 A
No-Till	BB	5.0 A	8.3 A
No-Till + Plateau®	BB	6.25 A	8.8 A
Conventional	LB	9.5 A	12.3 B
Conventional + Plateau®	LB	9.0 A	23.3 A
No-Till	LB	5.3 A	10.3 B
No-Till + Plateau®	LB	11.8 A	19.3 B
Conventional	IG	8.5 A	10.8 B
Conventional + Plateau®	IG	9.5 A	16.0 A
No-Till	IG	6.8 A	10.8 B
No-Till + Plateau®	IG	7.0 A	14.5 AB
Conventional	SG	7.3 A	9.5 A
Conventional + Plateau®	SG	1.3 B	1.5 C
No-Till	SG	6.8 A	7.3 B
No-Till + Plateau®	SG	2.0 B	1.3 C

[1] BB=big bluestem, LB=little bluestem, IG=indiangrass, and SG=switchgrass

[2] Mean differences within each species and year followed by the same letter are not different at the 0.05 probability level.

Table 3. Influence of Plateau® on native warm-season grass seedling density at the Knoxville Experiment Station, 2002.

Plateau Treatment	Seedling density (plants/m^2)				
	BB[1]	LB	IG	SG	SO
PRE 8 oz	81 A[2]	60 AB	54 A	12 AB	15 B
PRE 12 oz	72 A	45 B	58 A	6 B	18 B
POST 8 oz	48 B	73 A	50 A	20 AB	38 A
POST 12 oz	36 B	63 AB	47 A	19 AB	38 A
Untreated	29 B	47B	43 A	39 A	23 AB

[1] BB=big bluestem, LB=little bluestem, IG=indiangrass, SG=switchgrass, and SO=sideoats grama
[2] Mean differences within each species followed by the same letter are not different at the 0.05 probability level.

Table 4. Influence of Plateau® on control of crabgrass, spotted spurge, and fall panicum at the Knoxville Experiment Station, 2002.

Plateau Treatment	Weed control (%)		
	Crabgrass	Spotted spurge	Fall panicum
PRE 8 oz	100 A[1]	99 A	99 A
PRE 12 oz	100 A	99 A	99 A
POST 8 oz	62 C	68 B	38 B
POST 12 oz	69 B	76 B	44 B
Untreated	0 D	0 C	0 C

[1] Mean differences within each weed species followed by the same letter are not different at the 0.05 probability level.

Table 5. Influence of Plateau® on native warm-season grass seedling density at the Highland Rim Experiment Station, 2002.

Plateau Treatment	Seedling density (plants/m^2)				
	BB[1]	LB	IG	SG	SO
PRE 8 oz	15.7 A[2]	8.3 A	20.3 A	0.0 A	4.3 A
PRE 12 oz	10.0 A	12.7 A	22.7 A	1.0 A	2.3 A
POST 8 oz	9.3 A	5.7 A	12.7 A	0.7 A	4.3 A
POST 12 oz	7.7 A	6.7 A	6.3 A	0.0 A	4.0 A
Untreated	8.0 A	1.7 A	9.0 A	5.3 A	5.0 A

[1] BB=big bluestem, LB=little bluestem, IG=indiangrass, SG=switchgrass, and SO=sideoats grama
[2] Mean differences within each species followed by the same letter are not different at the 0.05 probability level.

Table 6. Influence of Plateau® on control of annual grasses and prickly sida at the Highland Rim Experiment Station, 2002.

Plateau Treatment	Weed control (%)	
	Annual grasses[2]	Prickly Sida
PRE 8 oz	92 A[1]	98 A
PRE 12 oz	97 A	99 A
POST 8 oz	31 C	57 B
POST 12 oz	40 B	65 A
Untreated	0 D	0 C

[1] Mean differences within each weed group or species followed by the same letter are not different at the 0.05 probability level.
[2] Annual grasses consisted primarily of stinkgrass and goosegrass.