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Establishing Native Grass Forages in the Southeast

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Chapter One — Introduction

Native warm-season grasses are bunch grasses indigenous to North America that actively grow during the warm months of the year, April through September (Figure 1). Native grasslands once covered most of North America, providing forage and habitat for native animals. Prior to European settlement, native grasses were the dominant component of prairie grassland ecosystems. Naturalized grasses, which differ from native grasses, are those that originated outside a particular region but are able to exist in the wild. The majority of naturalized grasses in the southeastern U.S. were introduced to North America from Europe (e.g., tall fescue, orchardgrass), Africa (e.g., bermudagrass, crabgrass), or South America (e.g., dallisgrass, bahiagrass) as forage crops.

Figure 1. Native warm-season grasses, like this 23-year-old switchgrass stand, thrive in hot weather, providing good, drought-resilient forages for summer grazing.

Grasses are typically classified as either C3 or C4 based on their photosynthetic pathways. Grasses that capture carbon dioxide in the first steps of photosynthesis by creating molecules that have three carbon atoms are referred to as C3 species. Grasses that capture carbon dioxide for photosynthesis by initially creating molecules that have four carbon atoms are classified as C4. There are additional physiological differences between these two types of grasses, but taken together, the photosynthetic potential of C4 grasses is much greater than that of C3 grasses when temperatures are relatively high. This is why C3 grasses are considered cool-season species, producing most of their growth in spring and fall, and C4 are considered warm-season species, producing most of their growth during summer. Although C4 grasses begin active growth as minimum daily temperatures reach approximately 60 F and soil temperatures reach 55 F, the optimum temperature for warm-season grass production is 85-95 F. Warm-season grasses are dormant during autumn and winter. By comparison, cool-season grasses make most of their active growth once minimum daily temperatures reach approximately 40 F; the optimum temperature for cool-season grass production is 60-80 F. In practice, this means warm-season grasses grow rapidly during a relatively short period, while cool-season grasses grow more slowly over a longer period.

In the Southeast, weather patterns have required livestock producers to reevaluate their grazing management plans. Introduced forage species, especially C3 grasses, are typically not well adapted to prolonged drought. In contrast, once established, native grasses' deep root systems (as deep as 8-12 feet) and their C4 photosynthesis allow them to remain productive and survive prolonged drought events. These native grasses also have lower nutrient requirements and can grow in more acidic and less fertile soil conditions than most introduced forage species.

It is also important to understand that these grasses have the potential to grow quite tall (4 feet) and, if allowed to become fully mature, produce rigid stems that can remain standing throughout the winter. A positive aspect to this is that they can provide good winter cover for various species of wildlife including wintering songbirds, quail, rabbits and even deer. However, managing these grasses for livestock production requires a different approach from introduced grass species systems.

Throughout this bulletin, you will learn management practices to assist with establishment including species selection and establishment planning (Chapter Two), the planting process itself (Chapter Three), and key steps for follow-up during the seedling and second years of the stand (Chapter Four). Four case histories, outlining actual producer establishment experiences in a variety of settings, are also provided (Chapter Five). Finally, this publication provides an appendix that includes photos and identification tips that assist with seedling identification. The native grasses, other summer annuals and perennials, and grass weeds can look very similar as young, immature plants. Being able to identify native grass seedlings will help you better assess the success of emergence. After the establishment year, other grasses need to be identified to properly manage this competition. Once established, native grasses work well for grazing and wildlife habitat and can provide high-quality summer grazing for decades if managed correctly.

Chapter Two — Species Selection and Establishment Planning

Overview

Even though the warm-season grasses discussed in this publication are native to the region and are well adapted to the soils, climate and conditions of the southeastern U.S., these grasses have a reputation for being difficult to establish. This reputation is largely undeserved, as it is built upon comparisons with domesticated agronomic forage and row crops. Most agronomic crops are annuals and have been through numerous plant-breeding cycles over many decades and, as a result, germinate and emerge within a matter of a few days, and establish a thick canopy within weeks. By comparison, the native grasses considered here are perennials and, with few exceptions, have not been improved through plant breeding. Consequently, they are slower to germinate, to emerge and to become fully established. That does not mean that the native grasses are difficult to establish (Figure 2). But it does mean that you must consider the characteristics of native grasses, factor in a relatively slower rate of seedling growth and development, and make management decisions that foster conditions that allow for successful establishment (Figure 3). Selecting the right species and the right site, then developing a sound establishment management plan are crucial.

Figure 2. A first-year stand of big bluestem and indiangrass planted May 22 (picture taken August 20 the same summer). Although successful establishment requires attention to detail, stands like this are not uncommon.

(Photo courtesy of John Jennings)

Species Selection

Within this publication, we focus primarily on big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), eastern gamagrass (*Tripsacum dactyloides*), indiangrass (*Sorghastrum nutans*) and switchgrass (*Panicum virgatum*). This focus is driven by the fact that seed of each of these species are commonly available (albeit often through specialized seed suppliers); available in cultivars that have been screened for desirable traits; and most widely useful to achieve goals for forage, wildlife habitat improvement, and/or biomass production.

Selecting the right species for each operation depends upon the end use, the time of the season maturity occurs, management effort planned during and after establishment, tolerance to the sites wherein the crop will be planted, and ease of establishment. Table 1 provides a brief summary of the relative traits of each of these primary native warm-season grasses. Typically, switchgrass and eastern gamagrass are recommended to be planted as single species plantings. This is because these two species mature earlier than the others and, in terms of palatability, are less compatible — cattle will preferentially graze the other species allowing these to become overmature. Also, in the case of switchgrass, it can be more aggressive and begin to dominate a pasture. The bluestems and indiangrass may also be planted as single species, but are often planted together in blends. This is because their growth habits and maturity dates and therefore, grazing management, are more compatible. It is worth noting that in native grasslands of the region, these three species commonly grew in mixed swards.

Figure 3. Native grasses can be slow to germinate and their seedlings are quite small initially. For these reasons, it is important to have a good quality seedbed as seen here.

Table 1. Relative comparison of key attributes of five important native warm-season grass species.[1]

Attribute	Big bluestem	Little bluestem	Eastern gamagrass	Indiangrass	Switchgrass
Establishment	Moderate-easy	Easiest	Moderate	Easiest	More difficult
Long-Awned Seed[2]	Yes	Yes	No	Yes	No
Wet Site Tolerance	Moderate	Low	High	Moderate — Low	High
Dry Site Tolerance	Moderate	High	Low	Moderate — High	Moderate
Grazing Management	Easier	Easier	Moderate	Easier	More difficult
Maturity	Middle	Late	Earliest	Late	Early
Palatability	Highest	High	Moderate	High	Moderate
Yield	High	Moderate	Very high	High	Very high

1 Adapted from Keyser et al., 2015 (UT Extension publication SP 731-B Establishing Native Warm-season Grasses for Livestock Forage in the Mid-South).

2 Seed from these species have long awns, which causes the seed to be "fluffy" and impedes proper flow of the seed through standard seed drills. If possible, purchase "debearded" or cleaned seed that has had the long awns removed.

Seed Characteristics

It is important to note that the bluestems and indiangrass have seed that have long appendages at the end called awns (Figure 4). These awns make the seed "fluffy," which can interfere with normal seed flow through a seed drill's box, seed metering units and tubes. Usually, seed suppliers can provide "debearded" or cleaned seed that does not have the long awns, and can flow normally through standard seed drills. However, if only fluffy seed is available, a drill equipped with a specialized "native grass box" will be required for planting (Figure 5). These drills' native grass boxes contain agitators, picker wheels and oversized drop tubes that allow for proper seed flow of these long-awned species. These specialized drills are often available for rent from local Soil Conservation Districts and state fish and wildlife management agencies.

Figure 4. Seed of native grasses. Note the long awns (top left, indiangrass) and "fluffy" appendages (bottom center, little bluestem), which can make proper flow in a drill difficult.

Variety Selection

Each of the five species of native grasses considered in this publication have a number of varieties available. It is important to note that these varieties were not developed through plant breeding. Instead, they were the result of evaluation of and selection among wild-origin plants for various traits such as seedling vigor and forage quality. Therefore, they are not improved per se, but selected from among wild types.

When selecting a variety to plant, it is better to use one with an origin close to the planting site. Those from an origin farther south than the planting site will normally perform better than those from substantially (greater than 200 miles) farther north. On the other hand, southern origin plant material moved too far north has increased risk of winter-kill under extreme conditions. Varieties developed from sources in drier climates, such as the Great Plains, tend to have greater problems with rust when grown in humid southeastern environments than do those developed in the Southeast. Eastern varieties also

Figure 5. Agitators in the bottom of native grass hopper boxes ensure that the fluffy appendages (awns) on the seed of some native warm-season grasses do not prevent properly metering seed.

tend to have broader leaves and produce more forage than those from drier climates.

In recent years, many native grass seed growers have been developing "local ecotypes," which is simply plant material collected from a specific, local ecological area and adapted to those conditions. There can be a great deal of variability in these local ecotypes because they have been through either a limited selection process or none at all. Therefore, how they will perform in any given situation is something that must be determined on a case-by-case basis. Given their adaptation to a particular area though, they can be a good choice, particularly those based on southeastern genetic material.

When considering switchgrass varieties, be aware that unlike other native grasses, they fall into one of two distinct categories, lowland or upland types. As these names suggest, they are associated with wetter sites, typically floodplains, or upland prairie sites, respectively. Lowland varieties are considerably larger and more robust than the upland types and thus produce more forage. They are also stemmier, and because of their rapid late spring growth, they can more readily become overmature with inadequate grazing pressure. On the other hand, they are more resilient to abusive grazing than upland types. Although lowland switchgrasses have exceptional tolerance to flooding and prolonged soil inundation, they are widely adapted and also perform well on upland soils.

If planting into — or even nearby — fields with a long history of no-till crop production, some attention must be paid to the potential for glyphosate-resistant weeds to be present. Burn-down applications may need to include a tank mix that will control resistant strains of many broadleaf (e.g., marestail, Palmer amaranth) or grassy (e.g., goosegrass) weeds. This will typically require either a broadleaf herbicide such as the blend of metsulfuron methyl and chlorsulfuron or a grass-selective herbicide such as clethodim. Be aware of herbicides that have residual soil activity (e.g., 2-4,D amine/ester and flauzifop), which can have up to two weeks of residual activity that could impact the establishment process.

Site Selection

Selecting the right site for native grasses is a critical first step in establishment. Because native grass seedlings are slow to establish relative to other crops, new plantings are very susceptible to weed pressure, particularly from other grasses. Therefore, one of the biggest concerns in site selection is the level of expected weed competition. Newly cleared forests normally make for ideal candidate fields because there is rarely a substantial risk of competition from grassy annual weed species. Similarly, land that is being taken out of row crop production, particularly those sites that have had an uninterrupted history of row crops for many years, are also at low risk of substantial grassy weed competition. Though slightly more challenging, the next best candidate fields would be areas that have become covered with brush and small woody species. Though these fields may be difficult to clear and prepare, they usually have relatively minor levels of competition from grassy weeds.

Old hayfields or pastures are often very challenging sites in which to establish native grasses. Old hayfields and pastures commonly have significant levels of annual grass weed competition, such as crabgrass, broadleaf signalgrass, foxtail, or panicum that would threaten to drastically reduce stand uniformity in native grass plantings. Furthermore, there is the matter of destroying the remnant stand of perennial species such as tall fescue in these hayfields or pastures. Some of the most challenging sites for establishing native grasses are those dominated by warm-season perennial grass weeds (e.g., johnsongrass, broomsedge, etc.) or forages (e.g., bermudagrass, bahiagrass, dallisgrass, etc.).

One other consideration for selecting a site to establish native grasses is its current value for forage production. Marginal sites, those that are very wet (e.g., floodplains, areas with seeps) or very droughty (e.g., thin, stony soils), and have not been productive are good candidates. Most introduced forage species will not do well on such sites. Conversely, native grasses, depending on species and/or variety, can be productive on these extreme sites. Poor, degraded pastures are another good alternative for establishing native grasses. Such sites will need to be renovated or reestablished to become productive regardless of what grasses are planted. Finally, as mentioned above, sites that have not recently been in grass (e.g., newly cleared or former crop ground) are good candidates because of the marginal cost of selecting natives over introduced species and the limited impact on current forage production.

Controlling Competition from Weeds

In general, native grasses have seed that are small, slow to germinate and emerge, and grow slowly during the early stages of establishment. These plants may look spindly and less vigorous than other forage species with which the producer may have experience or the weed species that may be competing with the seedlings. Native grasses generally put most of their energy into growing strong root systems early in their development rather than substantive amounts of top growth. Consequently, these plants may look spindly and weak, but the advantage of a stronger root system and more stored carbohydrate and nitrogen (N) reserves sets these plants up to be more competitive over the long run.

Weed control during native grass establishment can be challenging because there are relatively few herbicides that can control broadleaf weeds and even fewer that can control grassy weeds within the developing stand. Significant weed competition can hinder the growth and development of native grasses during establishment. For example, research in Georgia and Oklahoma showed weeds severely reduce stand development in switchgrass three months after planting, and some weed species had lingering effects even at the end of the establishment year (Figure 6).

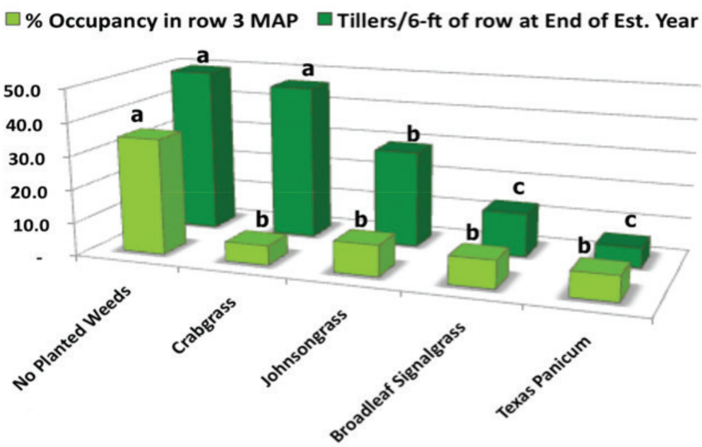


Figure 6. Switchgrass establishment can be hampered severely by weed competition. In this experiment, switchgrass was planted with seeds of crabgrass, johnsongrass, broadleaf signalgrass or Texas panicum in the same row. Light green bars indicate the percent of the planted row occupied by switchgrass three months after planting (MAP). Dark green bars indicate how many switchgrass tillers were present at the end of the establishment year. Data are averaged over two sites (North Georgia and Central Oklahoma). Within a category, columns sharing the same letter are not significantly different (P < 0.05).

(Photo courtesy of Dennis Hancock)

In fact, warm-season annual grasses, such as crabgrass, broadleaf signalgrass, foxtail and panicum, are among the worst weeds and account for many establishment failures. One strategy is to go through a summer crop rotation that allows for control of these grasses the year prior to seeding. Another strategy is to allow the initial flush of these warm-season annual species to occur and then apply 1.0-1.5 quarts of glyphosate per acre once these annual seedlings are 3-4 inches tall. This will normally occur once soil temperatures have warmed to at least 70 F, typically in late April or mid-May, depending on the local climate. Once this flush of annuals has been controlled, planting of the native warm-season grasses should take place within approximately one week. In fields where severe pressure from these annual grasses is expected, consider allowing a second flush of these summer annual weeds followed by a second application of this rate of glyphosate prior to planting.

If establishing a stand into a site with existing cool-season perennial grass species (e.g., tall fescue, orchardgrass, etc.), spray the area in October or November with 1.5-2.0 quarts of glyphosate per acre (assuming a 4 pound active ingredient per gallon formulation). Follow this up with another application at the same rate when these cool-season grasses begin significant growth in the spring (usually March or early April, depending on local climate). Alternatively, you could plant a cool-season annual (e.g., wheat or triticale) one week after the fall herbicide application to help suppress the cool-season perennial grasses, prevent erosion and provide a forage crop. In this situation, the cool-season annual growth should be managed to leave only minimal residue. Therefore, these fields should be grazed aggressively in late winter/early spring or harvested for a hay, baleage or silage crop by mid-April. A second application of glyphosate at a rate of 1.0-2.0 quarts per acre (depending on how many perennial competitors remain on the field) should still be applied to the grazed or harvested field after seven-10 days of regrowth to kill the cool-season annual and any cool-season perennials that may have escaped during the previous fall's spraying. If the site has a mix of cool-season perennials and warm-season perennials, initiate this weed control regimen in August rather than October/November in the year prior to establishment.

If the site contains appreciable amounts of bermudagrass, bahiagrass or dallisgrass, spray the area in August-September (with adequate soil moisture to ensure plants are actively growing) with 4.0 quarts of glyphosate per acre (assuming a 4 pound active ingredient per gallon formulation). If there is any regrowth of these warm-season competitors prior to fall dormancy, retreat these, perhaps with only spot spraying. If there are any of these grasses apparent the next spring, apply another application at the same rate they begin significant growth (usually May, depending on local climate). You should consider planting a cool-season annual (e.g., wheat or triticale) in early October following the August/September application. Residue left by killing the existing vegetation could be cut and removed from the field as mulch or burned (if permitted by weather and local ordinances) prior to establishing the cool-season annuals. Manage the cool-season annual as previously described to ensure only the minimal amount of residue remains.

Current herbicide options are summarized in Table 2. The limited number of herbicide options may also influence the native grass species selected for new plantings. For example, herbicides containing imazapic (Plateau, Panoramic and Impose) provide very good control of many of the most problematic grassy weeds and can be used prior to establishment and on newly established stands of big bluestem, little bluestem and indiangrass. However, it is very injurious to switchgrass. No other herbicide works as selectively on grassy weeds for switchgrass establishment. Therefore, growers may consider planting big bluestem, little bluestem, and/or indiangrass rather than switchgrass, if heavy grassy weed pressure is anticipated.

Care should also be taken to ensure that herbicides are applied uniformly, at the recommended rate, and only applied in conditions that minimize the risks of physical drift or volatilization so as to avoid damaging or killing non-target species or crops. It is best to use boomed sprayers for these applications whenever possible. Post-emergence applications may require the use of boomless sprayers, but uniformity of application (Figure 7) and risks of off-target movement of the herbicides are a greater concern. Regardless of sprayer type, it is crucial to ensure that the equipment is calibrated appropriately so that the correct rate is applied.

Figure 7. A native grass planting project where a boomless sprayer created an irregular spray pattern (note green strips across field) where herbicide application was missed. As a result, heavy weed pressure developed, leading to poor stand establishment within the unsprayed strips.

Table 2. Application rates, timing restrictions and classes of weeds controlled for herbicides labeled for use in native warm-season grasses and beneficial during establishment. See also, UT Extension publication SP 731-F Competition Control in Native Warm-season Grasses Grown for Livestock Forage in the Mid-South for additional information

Active Ingredient	Herbicide	Rate per acre	Timing Restrictions	Weeds Controlled[1]
2,4-D Amine	2,4-D Amine 4L	1-1.5 pts	> 4 leaf	BL
metsulfuron methyl + chlorsulfuron	Cimarron Plus	0.6-1.5 oz.	> 4 leaf	BL
aminopyralid+2,4-D	GrazonNext HL	1.5-2.6 pts	tillering[2]	BL
aminopyralid	Milestone	4-7 oz.	tillering[2]	BL
triclopyr+fluroxypr	PastureGard	2-3 pts	tillering[2]	BL
triclopyr+2,4-D	Crossbow	2-4 qts	tillering[2]	BL
imazapic[3]	Plateau, Impose, Panoramic	2-12 oz.	PRE, Established	G, *BL*
sulfosulfuron	Outrider[4]	0.75-2.0 oz.	Well-established	G, *BL*
nicosulfuron	Accent 75DF[5]	0.67 oz.	> 4- leaf stage	G, *BL*

Note: Check label to ensure it is recommended for the species of native grass(es) in the planting.

[1] BL=broadleaf, G=grass. If italicized, control is very select or marginal.

[2] Only apply on vigorous seedlings that have developed multiple tillers.

[3] Will cause severe damage or death of switchgrass during establishment and substantial stunting mature switchgrass.

[4] CRP or non-forage or non-crop uses.

[4] Labeled for native grasses in only some areas of Tennessee.

Chapter Three — Planting

Native grasses can be effectively established by either no-till or conventional methods. In both cases, the key to success is ensuring a high-quality seedbed with a minimum amount of thatch and weed competition. Competition control is the single most important factor in successfully establishing native grasses. Therefore, care must be taken to ensure it has been conducted thoroughly regardless of which approach to establishment you choose.

No-till Establishment of Native Grasses

No-till is the preferred method of establishing native grasses because of the benefits to soil conservation (reduced threat of erosion), soil health (preventing loss of soil organic matter), and conservation of soil moisture during the seedling year. Of course, it will be necessary to use a no-till drill to plant the seed when using this approach. No-till may be necessary on sites on steeper slopes or where rock at or near the soil surface makes tillage impractical. Another advantage of no-till is that it can effectively control perennial grasses that compete aggressively with native grass seedlings. Examples of this include common bermudagrass, johnsongrass and tall fescue.

The first step in implementing no-till planting is to manage the existing vegetation through grazing, haying, burning or mowing to remove excessive cover or thatch prior to spraying the first time (Figure 8a). This process will ensure that the existing plants are not over-mature (and, therefore, less susceptible to herbicide); will encourage new, rapid growth (that is more susceptible to herbicide); and will ensure that old residue will not interfere with good spray coverage. Reduction of cover will also prevent large amounts of thatch that can interfere with proper seeding, germination and early seedling development (Figure 8b). In some cases, past management of the site may have left a minimum of thatch and residue, allowing the initial spraying to occur without any preliminary steps.

Figures 8a and b. Excessive thatch can interfere with seedling emergence and development for native grasses. The heavy thatch (left) here must be removed by burning, be allowed to decompose over time, or be lightly disced to reduce the amount of ground cover before planting. In the image on the right, note the heavier thatch to the left of the seedling. Such thatch can preclude recruitment of seedlings.

(Photo courtesy of Kevin Rose)

The next step is to kill existing vegetation with a series of herbicide applications. Starting early (the summer or fall preceding the planting) is always preferable and provides more effective competition control. Whether you spray in fall and again in spring (preferred approach) or spring only, you need to be prepared to make multiple treatments, typically two or three, to ensure adequate competition control. The timing and application rates of these applications are provided in detail in the previous chapter (see "Site Selection").

Establishing Native Grasses Using Conventional Seedbeds

If there are site limitations (e.g., steep slopes, presence of rock), rough ground that requires smoothing, or a preference to avoid or limit use of herbicides, conventional tillage can be a good choice for planting native grasses. To be effective at suppression of existing perennial grasses, deep tillage is preferred. If plowing is not an option, the site will need to be disced repeatedly. The timing of each subsequent pass with a disc will depend on how quickly the existing vegetation recovers and/or new seedlings develop. In spring, or when moisture is abundant, four to five-week intervals would be typical. As mentioned in the previous chapter regarding the timing of a final spray treatment, the last tillage pass should be timed to ensure that summer annual seedlings are destroyed.

Another critical issue in using tillage is ensuring that the seedbed is fine textured and firm (Figures 9a and b). A good rule of thumb is that the imprint of your boot should be no more than one-quarter inch deep (Figure 10).

Figures 9a and b. Coarse-textured seedbeds are not acceptable for small-seeded native grasses (left). Instead, they must be fine textured as shown on the right.

(Photo courtesy of JC Raines)

Figure 10. This high-quality, conventional seedbed is both fine textured and firm. Note the shallow impression created by the boot print, only about ¼ inch deep. This is ideal for planting small-seeded native grasses.

To achieve this firmness, you may need to use a cultipacker, possibly two or more passes, prior to seeding. Allowing rainfall to firm up the tilled ground may be effective as well.

Conventional seedbeds allow more flexibility in planting equipment than in a no-till setting. Conventional drills, no-till drills (which may need to be adjusted to keep them from being too aggressive in opening furrows in the absence of a sod), or drop-type seeders can all be used. In addition, seed can be sown with cyclone-type spreaders. However, when sowing, increasing the seeding rate by 25 percent (see “Seeding Rates” below) will be necessary. Also, to ensure a more uniform distribution of seed when sowing, consider cross-seeding (at a 90-degree angle) and/or blending the seed with a carrier, such as pelletized lime.

Calculating Pure Live Seed (PLS)

Pure Live Seed (PLS) refers to the proportion of a particular seed lot that is viable, germinable seed. It will always be expressed as a percentage and is calculated as follows:

(Germination % x Purity %) x 100 = PLS

A shipping tag or the tag on the bag (Figure 11) contains the percent germination and purity. You should note the percent germination is made up of two types of seed, that which is ready to germinate immediately (“quick germ”) and that which will germinate when stratified (“dormant” or “hard”). Purity is 100 percent minus the sum of the percent inert matter and the percent weed seed. Because native grass seed traditionally could be quite chaffy and/or can naturally be quite high in dormancy, this calculation is very important. PLS rates for most switchgrass will run in the 80s and 90s, while for bluestems and indiangrass, they will typically range from the 40s to the 80s in most cases.

Example calculation based on seed tag shown in Figure 11:

Germination	**61.00%**
Hard or dormant seed	**25.00%**
Inert matter	**1.16%**
Other crop	**0.02%**
Weed seed	**0.03%**

Total Germination = 61.00 + 25.00 = 86.00%

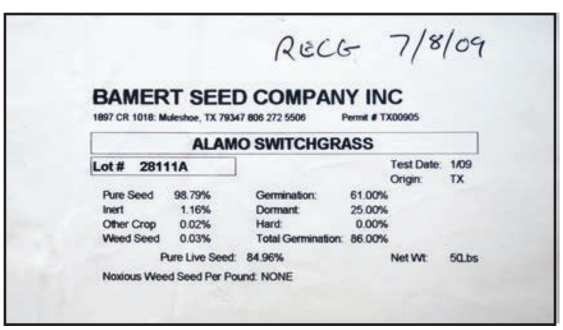
Purity = 100 – (1.16 + 0.02 + 0.03) = 98.79%

0.8600 x 0.9879 = 0.8496 x 100 = 84.96% PLS

Thus, to plant 1 acre at the recommended 6 PLS lb, you would need

6 lb ÷ 0.8496 = 7.1 bulk lb

of the seed from that bag to be planted to achieve the desired seeding rate.


RECG 7/8/09

BAMERT SEED COMPANY INC

1897 CR 1018: Muleshoe, TX 79347 806 272 5506 Permit # TX00905

ALAMO SWITCHGRASS

Lot # 28111A

Test Date: 1/09
Origin: TX

Pure Seed	98.79%	Germination:	61.00%
Inert	1.16%	Dormant:	25.00%
Other Crop	0.02%	Hard:	0.00%
Weed Seed	0.03%	Total Germination:	86.00%

Pure Live Seed: 84.96% Net Wt: 50Lbs

Noxious Weed Seed Per Pound: NONE

(Photo courtesy of Kristy Keel-Blackmon)

Figure 11. Example of a seed tag with germination information used to calculate pure live seed (PLS).

Planting Depth

As is the case with most perennial grasses, native grasses have small seed, which makes planting depth critical. For instance, switchgrass has approximately 260,000–400,000 seed per pound, depending on variety. Larger seeded plants, such as corn (approximately 2,000 seed per pound), have much more available energy stored within the seed itself and, therefore, can be planted at greater depths. In such cases, miscalculating by one-half inch or more from the target depth may be of little concern. On the other hand, with the smaller seeded natives, miscalculating by more than one-quarter inch can negatively impact planting success. If they are planted too deep, germination and emergence can be reduced, and being too shallow can result in poor seed-soil contact and desiccation of seed and/or emerging seedlings.

Target depth for natives is one-eighth to one-quarter inch. Achieving these shallow planting depths reliably will require careful attention to drill settings. A good rule of thumb is that when you walk behind a drill, you should see about 15-20 percent of the length of that drill row, on average, with seed visible on the surface of the ground (Figure 12), indicating that your seeding depth is appropriate.

Sowing (i.e., broadcasting) will keep seed shallow — as long as the seedbed is firm — but typically will require covering with very light drag and/or a cultipacker to ensure good soil coverage. One exception to these shallow seeding depths is for eastern gamagrass, which has a larger seed (approximately 7,000 seed per pound) and should be planted 1.0-1.5 inches deep.

Figure 12. Some seed should be visible within the drill rows behind the drill when planting depth is correct (about ¼ inch deep). Note switchgrass seed in this drill row to left of knife blade. About 15 percent (on average) of the length of the rows should have seed visible on the soil surface.

Table 3. Recommended seeding rates for native warm-season grasses established for forage production in the Southeast. All rates are expressed in PLS pounds per acre.

Species	Pure Stand		Blends (drilled)			
	Drilled	Sowed	Two-way	Two-way	Two-way	Three-way
Big bluestem	9	12	6	8	-	6
Little bluestem	7	10	-	1	1	1
Indiangrass	7	10	3	-	6	3
Switchgrass	6	8	nr	nr	nr	nr
Eastern gamagrass	12	nr[1]	nr	nr	nr	nr

[1]nr = Not recommended. Blends of either eastern gamagrass or switchgrass with the other three species are not recommended.

Seeding Rates

Seeding rates for native grasses vary by species and desired use of the stand. For forage production purposes, recommended seeding rates are listed in Table 3.

Seed Dormancy

Dormancy is a natural adaption of many native grasses. With seed shattering out in natural stands during fall, dormancy prevents seed from germinating prior to spring. Although any native grass could show some level of dormancy, it is most common for eastern gamagrass (all varieties) and switchgrass (notably, 'Cave-in-Rock' and 'Kanlow' varieties). Other switchgrass varieties such as 'Alamo' and 'Blackwell' typically do not demonstrate high rates of dormancy. It is rarely a concern for bluestems or indiangrass.

Growers should be aware that dormancy rates on native grass seed tags include seed that requires stratification to induce germination. Thus, a seed lot may be 80 percent PLS but be 70 percent dormant, still viable seed, but will require a period of cold and wet to break dormancy. Planting such seed in the spring once soil temperatures have warmed and any chance of stratification is past will result in very poor stands.

Always inquire about dormancy when purchasing native grass seed and be prepared to treat seed with high-dormancy rates before planting. While there is no particular threshold that requires treatment, dormancy rates above 50 percent are a concern, as they could potentially cut your effective seeding rate by up to one-half. On the other hand, if seeding rates are adjusted upward to offset the high dormancy rate, establishment costs could be increased substantially.

High-dormancy seed can be "treated" by storing it until the following spring. Dormancy normally drops markedly after such "after-ripening" of the seed. You can often purchase year-old seed from vendors if you encounter this problem. Otherwise, seed can be cold-stratified (about 45 F) for two weeks following soaking in water for 24 hours. Be sure to drain the seed before placing it in the cooler and ensure it has dried sufficiently before putting it into the drill. Also, once removed from the cooler, it is important to plant within a day or two to avoid premature germination or reversion to dormancy. Another effective strategy for breaking dormancy is planting during winter or early spring (January–March).

Seeding Dates

Native grass seed begins to germinate at soil temperatures above 60 F with more rapid germination beginning at soil temperatures above 65 F, which typically corresponds to dates in early to mid-April in the Deep South and late April to early May in the Upper South. However, seeding can be successful across a wide range of dates, from January through early July, as long as soil moisture is adequate.

Recent research at the University of Tennessee Institute of Agriculture showed the most consistent seedling-year stand densities for switchgrass were achieved by March plantings compared to those planted in December, February and May (Figure 13). However,

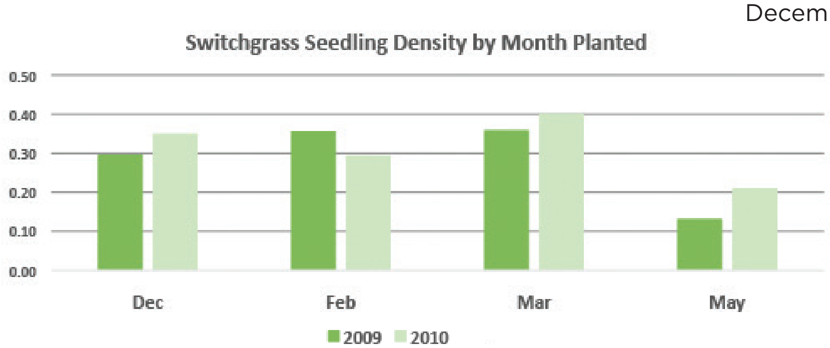


Figure 13. Mean density of switchgrass seedlings planted across two study locations for four planting dates and two years. March planting dates produced the most reliable stands in terms of seedling density. Adapted from: Keyser, P.D., A.J. Ashworth, F.L. Allen, and G.E. Bates. 2016. Dormant-season planting and seed-dormancy impacts on switchgrass establishment and yield. Crop Science. 56: 1-10.

by the end of the second year, there were no differences in yield. In a second study, seedling-year plant densities from March plantings always equaled or exceeded those from May plantings; those in June were also somewhat more reliable than those planted in May (Figure 14). The lower stand densities in May were likely the result of substantial competition from annual grasses that germinated and grew quickly following seeding of the switchgrass. Such aggressive annuals rapidly outgrow the slow-germinating switchgrass and the small, slow-growing seedlings it produces. This should reinforce the importance of timing plantings to enable a final round of weed control for these annuals — or planting either before annual grasses are a problem (March) or after they are well controlled (June).

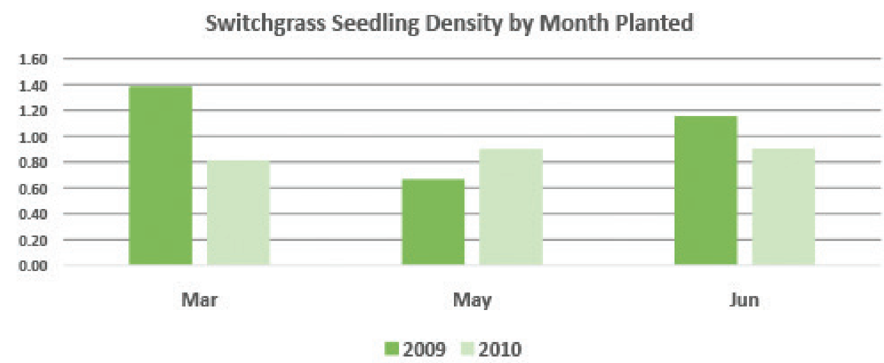


Figure 14. Mean density of switchgrass seedlings planted across three locations for three planting dates and two years. March planting dates produced similar (2010) or greater (2009) seedling densities than those planted in May. Adapted from Keyser, P.D., A.J. Ashworth, F.L. Allen, and G.E. Bates. 2016. Evaluation of small grain cover crops to enhance switchgrass establishment. Crop Science. 56: 2062-2071.

For stands planted during winter, control of cool-season weeds during spring must be addressed. Winter weeds can become abundant by early spring, forming dense canopies that restrict germination and limit seedling development of native grasses (Figure 15). Spraying with 1 quart per acre of glyphosate will normally provide adequate control for these weeds. However, timing is critical, and spraying must take place before emergence of native grass seedlings (late March-early April), which occurs as soil temperatures exceed 60 F. On the other hand, spraying too soon may allow time for a new flush of cool-season weeds that can then compete with the native grass seedlings. Because of the shallow planting depth of the native grass seed, tillage is not an option for controlling these cool-season weeds.

Although successful stands have been established with seeding dates as late as early to mid-July, such late plantings are riskier with soil moisture being the main concern. However, if you have a high-quality seedbed and are prepared to plant at this time of year, it can be quite successful as long as soil moisture is adequate and weather patterns are still favorable.

Figure 15. Winter annuals can become thick and will preclude good germination if not controlled following winter seeding of native grasses. They should be sprayed before soil temperatures are warm enough to allow for germination of the native grass seed (> 60 F), which typically occurs in mid-April in the Upper South.

Eastern gamagrass, with its very high dormancy rates (more than 90 percent is common), has been planted successfully as early as January. Dates into early or mid-March also have been successful, but may be too late for the Deep South. Planting at this time of year avoids the need for any sort of seed treatment.

The wide range of acceptable seeding dates underscores the importance of planting when soil moisture is good but also when competition has been adequately controlled. Put another way, do not get into a rush to plant. Instead, wait to plant until you have done a **thorough** job of weed control.

Chapter Four — Follow-Up During the Seedling Year

Once seed has been planted, it is critical that you follow up with additional weed control during the first summer. You may have very little weed pressure during that summer, but that is the exception rather than the rule. In most cases, despite aggressive preplanting measures to control weeds, additional problems will arise. This is particularly true with average to above average summer rainfall and on sites that had been in degraded pastures or hayfields.

Seedling Year Weed Management

Be prepared to control weeds that form a canopy above native grass seedlings (Figure 16a). Conversely, scattered or thin weeds may not be an issue — other than perhaps preventing them from going to seed to decrease future problems (Figure 16b). Clipping with a rotary mower is often the best way to control these weeds. When clipping, make every effort to keep the mower above the seedlings. As seedlings grow through the summer, controlling them will become more difficult. However, for larger seedlings, such as those greater than 18 inches tall, limited defoliation as a result of clipping is not a problem — removing the weed canopy is more critical. If clipping results in a heavy thatch, you may need to remove the thatch through raking and baling. By mid to late August,

Figures 16a and b. Small native grass seedlings are quite vulnerable to competition from weeds that form dense canopies above the seedlings. In this stand (left), a dense canopy of broadleaf weeds is outcompeting the seedlings (note small seedling to left of knife, additional small seedlings behind knife, and a large seedling above knife), and if left uncontrolled, would lead to a thin stand or even an establishment failure. Scattered weeds (right) are not a serious problem for stand development, although it can be beneficial to control them to prevent additional weed seed from developing. These seedlings are large, vigorous and will compete well.

Figure 17. On the left side of image, there is an indiangrass seedling that has developed multiple tillers. By comparison, in the lower right is a smaller seedling in the four-leaf stage. Also, just above and slightly to the left of the bill of the hat are two newly emerged seedlings at the two-leaf stage. Tillered seedlings are considered well established, can withstand substantial drought, and are tolerant of a number of broadleaf herbicides. The smaller seedlings (two-leaf) are still very vulnerable to drought and can be injured or killed by broadleaf herbicides.

unless weed problems are especially severe, it is better to avoid defoliating the seedlings and allow them to conserve their energy for fall dormancy. At this point, stop clipping — the stand is basically done growing by this time of summer.

A second option is using grazing to suppress weeds. If you choose this option, stock at rates high enough that you can graze off the weed canopy within 24 hours, 48 hours at most, minimizing damage to the native-grass seedlings. Grazing will be an effective weed control tool only where the plants to be grazed are palatable, such as crabgrass and seedling johnsongrass. Even then, it will be important to catch these species before they become mature and palatability decreases, thus limiting the effectiveness of grazing for weed control.

A third option for weed control is herbicides (see Table 2 in Chapter 2 for a list of herbicides labeled for use on native grasses). Herbicides should be used only when seedlings are large enough to not be injured by spraying. This threshold varies by the herbicide in question, but in all cases will occur after the four-leaf stage. Once seedlings have developed tillers, a stage of development that also corresponds to development of adventitious roots, seedlings are much less susceptible to injury (Figure 17). Herbicide options during the seedling year include products that contain the active ingredients 2,4-D, a blend of metsulfuron methyl and chlorsulfuron (CimarronPlus), and imazapic (except on switchgrass and eastern gamagrass). Formulations containing triclopyr or aminopyralids should only be used on large (more than 24 inches tall and well-tillered) seedlings. However, one downside to using these herbicides during the seedling year is that they may arrest germination of viable seed that remains in the ground. Because natives may continue to germinate and recruit seedlings into the stand even into late summer, applying a herbicide should be avoided unless plant populations are acceptable — or the weed pressure is threatening the success of the planting.

If none of the other options listed above will work, taking a hay harvest could also be considered. This approach is less desirable because of the height at which the native grass seedlings will be cut. Setting the mower to cut to an 8-inch residual height will help (see UT Extension publication SP 731-I Adjusting Mowing Equipment for Increased Stubble Heights When Harvesting Native Grasses for additional information), but may still result in heavy defoliation of the seedlings, thus weakening them considerably.

Seedling Year Fertility Management

Because native grasses are adapted to low-fertility soils, their demand for nutrients is not as high as it is for many other common forage grasses. Furthermore, because of the small size of native grass seedlings, their nutrient demands are quite low. In fact, where soil fertility is high, establishment can be more challenging due to increased weed pressure. Therefore, soil amendments are rarely needed for successful establishment of native grasses. As long as levels of phosphorous and potassium are in the “medium” range or higher per soil test, there is no need to amend soils. Likewise, elevated N levels are counterproductive — do not add any supplemental N either prior to or following planting during the seedling year.

Finally, native grasses are not as sensitive to acidic soils as many other common forage grasses. Therefore, as long as the pH is above 5.2, lime does not need to be applied.

Evaluating Success

How do you know if you have been successful in establishing a good stand of native grasses? Achieving a plant population of at least one plant per square foot is the target. However, for eastern gamagrass, a population of only one plant per 2 to 3 square feet will be adequate. Do not be concerned so much about the size of the seedlings the first season. As long as the plants have tillered, they will survive the first winter and produce a good stand (Figure 18). So even seed that does not germinate until early August can produce viable plants that will survive the winter and contribute to the stand.

Figure 18. This switchgrass stand has many larger seedlings, a few of which have already developed tillers. Despite the late date (photo taken on August 13), these seedlings still have ample time to continue to develop before a frost and will be large enough at that time to survive the winter and become part of a productive stand.

Because native grasses may not germinate in any appreciable numbers for three to five weeks after planting (or, in the case of dormant-season plantings, after soil temperature thresholds have been reached), do not be concerned during this early stage in the process if seedlings are not evident. Instead, check the field at the four to five-week mark and again over the next two to three weeks to determine what sort of stand is developing (Figure 19). Seedling numbers should increase during this period (i.e., four to seven weeks post-planting) and, if all goes well, by the eighth week clear drill rows should be apparent (Figure 20). Many producers have given up too quickly on perfectly good stands because they are not prepared for this slow germination and the initial small size of the seedlings. Even if seedlings are not completely apparent in late summer due to weed pressure, the quality of the stand will normally be quite evident following the first frost in the fall.

Second-year Management

Native grass stands are normally ready to graze the second spring (i.e., approximately 12-13 months after

Figure 19. A native grass stand 31 days post-planting. Note very small seedlings (near sunlight patches at bottom), which have just started emerging and are still mostly at the two-leaf stage. This is typical of the slow germination and small initial seedling size of native grasses.

Figure 20. In this seven-week-old planting, rows are now clearly visible. With good weed control, soil moisture and soil temperatures above 65 F, this level of development should be expected in most native grass planting projects.

planting). However, you should take into account some considerations. First, as a part of a conversion project, you will have opened up the seedbank, which may be full of a wide variety and large amount of weed seed. Consequently, additional weed control measures are often needed in April (cool-season weeds) and/or May (warm-season weeds) for second-year stands. Refer to Table 2 and UT Extension publication SP 731-F Competition Control in Native Warm-season Grasses Grown for Livestock Forage in the Mid-South for additional information on herbicide options. Another approach is to use prescribed fire, which eliminates existing weeds, destroys exposed weed seed, and enhances growth of the native grasses through increased nutrient availability and elevated soil temperatures (Figure 21). Timing of the prescribed fire should correspond to dormancy break of the native grasses, typically late March in the Deep South or early April in the Upper South.

Application of N during the second year can boost yields but should occur only if weed pressure is low and the

Figure 21. A big bluestem-indiangrass stand three to four weeks following a late March burn. Note the dark-green color of the new growth, lack of weeds and minimal thatch. Native grasses are well adapted to burning and respond vigorously to late March/early April burns.

native grasses dominate the site. Do not apply N until the grasses are actively growing and are at least 10-12 inches tall, which typically will occur in April. Application of more than 60 units of N during the second year will not be cost effective and can lead to increased weed pressure.

Native grasses continue to develop during the second year. In fact, they will achieve only about 70 percent of their potential yield by the end of the second growing season. For this reason, it is critical to be diligent in maintaining minimum canopy heights during grazing (no lower than 14-18 inches, depending on species and variety) and hay harvest (8-inch residual height; see UT Extension publication SP 731-I Adjusting Mowing Equipment for Increased Stubble Heights When Harvesting Native Grasses). Take only a single hay harvest during late May (switchgrass or eastern gamagrass) or late June (bluestems and indiangrass) and end grazing for all species by early August to allow ample rest and enough energy for the stand to complete its maturation process. Excessive pressure, beyond what has been described above, can be very detrimental to the development and long-term productivity of the stand.

Chapter Five — Case Histories

Case History One — Tennessee

Two fields were planted during 2016, one (9 acres) to a blend (10 PLS pounds per acre) of big bluestem (‘OZ 70’; 70 percent), indiangrass (‘Cheyenne’; 20 percent), and little bluestem (‘Cimarron’; 10 percent), and the other (16 acres) to lowland switchgrass (‘Alamo’; 6 PLS pounds per acre). Both fields had been in soybeans for two years prior to planting the native grasses.

For the three-way blend, two planting dates were used, March 18 and April 23, to demonstrate dormant-season and spring planting scenarios. Although the original plan had been to plant a winter annual (cereal rye) on the side of the field to be planted during the dormant season, wet weather during fall 2015 prevented the soybeans from being harvested until December. Therefore, no rye was planted and the dormant seeding for the blend was directly into soybean stubble. To control cool-season weeds (e.g., white clover, annual bluegrass and buttercup), the entire field was sprayed on April 7 with 3 quarts per acre of glyphosate. Following the April 23 seeding of the second half of the field, 4 ounces per acre of Plateau (imazapic) was applied to the entire field.

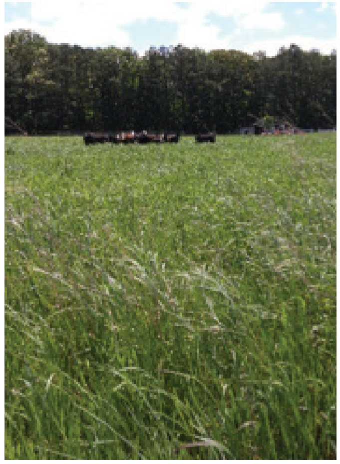
Germination and early stand development were good for both the dormant and spring planting dates, although the latter was a stronger stand initially. A major concern in the development of both stands was the heavy competition from glyphosate-resistant marestail that began to develop during June (Figure 22).

In late July, the competition had become severe and the stand was clipped (10 feet residual height) with a rotary mower. The strong regrowth required spraying with a broadleaf herbicide (Cimarron Plus) in August; the treatment was very effective. By spring 2017 (second year), stand establishment on both sides of the field was very successful. One exception was some small patches (less than 0.1 acre in all cases) where the native grasses were thin due to aggressive growth of goosegrass in 2016. This species is not well-controlled by imazapic.

Figure 22. Glyphosate-resistant weeds, such as this marestail, can be a serious problem in fields with no-till cropping histories. Although an excellent stand developed in this case, it required additional weed control measures including clipping and spraying with a broadleaf formulation.

The switchgrass was planted in a very wet site that had previously produced only limited and moderate to poor-quality forage. Switchgrass was chosen for this field because of its adaptation to very wet sites. The switchgrass was drilled on April 24 following an application of 2 quarts per acre of glyphosate on April 7. Because switchgrass is not imazapic-tolerant, no additional weed control was implemented. Despite the history of soybeans and associated weed control, heavy weed pressure developed in this field.

In wet areas, abundant Virginia buttonweed developed along with sedges (Figure 23a); on the dry side of the



Figures 23a and b. Lowland switchgrass can perform very well on sites that are quite wet. In this case, despite being wet enough to grow an abundance of Virginia buttonweed and sedges (left), an excellent stand developed by the second year (right).

field, heavy pigweed developed. The field was clipped with a rotary mower during July 2016 (10 inch residual height). Despite weed pressure, a very good stand developed on this site by 2017 (Figure 23b).

Case History Two — Tennessee

Two small adjacent fields (2.5 and 5.4 acres) that had been in low-quality pasture and/or hay production were converted to native grasses in spring 2016. The seeding used 10 PLS pounds per acre of a three-way blend of big bluestem ('OZ 70'; 70 percent), indiangrass ('Cheyenne'; 20 percent), and little bluestem ('Cimarron'; 10 percent). Initial weed control was implemented on October 14, 2015, with an application of 4 quarts per acre of glyphosate product. The higher rate was used in an attempt to kill a large number of smaller patches (50-100 feet across) of common bermudagrass that comprised about 30 percent of the field (Figure 24a).

Figures 24a and b. Perhaps the worst-case scenario for establishing native grasses is where bermudagrass occurs. Despite an application of a heavy rate of herbicide in late fall, a second treatment was required the following spring and the residual sod needed to be disced to allow for proper drill function and seed placement (left). The green strip (right) was the result of a skip in the spray pattern and led to a stand failure within the strip. Good herbicide coverage is essential for no-till planting of native grasses.

On November 4, 2015, a portion of the field was planted to wheat for a demonstration of dormant-season planting of native grasses into a winter annual. However, because of wet weather and availability of a drill, the dormant-season planting was not possible. Therefore, the 2.5-acre field was planted on April 20 following an application of 2 quarts per acre of glyphosate tank mixed with 4 ounces per acre of Plateau (imazapic) on April 19. On May 6, the remaining 5.4 acres were planted following light discing (completed April 18) to break up the dense bermudagrass sod to facilitate proper drill operation; normally, drills do not penetrate bermudagrass sods, and seed-soil contact is poor in such circumstances. In addition, these 5.4 acres were resprayed with glyphosate (4 quarts per acre) tank mixed with imazapic (4 ounces per acre) on April 19. Success across the field was mixed. Portions without bermudagrass generally established well; those with bermudagrass patches were thinner. Another portion (0.8 acres) of the field had a weak stand — in this case, as a result of a skip in the application of herbicide (Figure 24b). All plantings were impacted negatively by drought conditions, causing the plantings to develop very slowly. Portions of the field where weed canopies were strongest were clipped with a rotary mower in early August 2016.

Because of poor establishment, the 0.8 acres seeded in 2016 were replanted (drilled) on May 15, 2017, along with an additional 3.5 acres that expanded the total planted area to 11.4 acres. Areas that were replanted in 2017 were sprayed with 2 quarts of glyphosate per acre in October 2016 and again with a tank mix of 2 quarts of glyphosate and 4 ounces of imazapic per acre in April 2017. The seed mix and seeding rate for the 2017 replants were the same as those used in 2016. With the additional weed control provided by the second round of treatments, the 2017 plantings were all successful. With the exception of some light grazing earlier in the year, the producer elected not to use the 2016 plantings in 2017 to allow them to become better established (Figure 25).

Figure 25. August 9, 2017 (2016 planting) showing a very successful stand, despite drought conditions and weed pressure from remaining bermudagrass and summer annuals.

Case History Three — Alabama

Nine acres of Miller Farms near Collinsville, Alabama, on Lookout Mountain was recently cleared from being in a timber stand. Most of Miller Farms is in KY-31 tall fescue, so the owner wanted a pasture to rotate into during the summer months when tall fescue exhibits “summer slump.” Danny and Johnny Miller used a site preparation strategy of preparing a seedbed and spraying any emerged weeds with 16 ounces per acre of Select Max to attempt to decrease competition for emerging native grass seedlings, as well as eliminate the bermudagrass present. The seeding used 10 PLS pounds per acre of a three-way blend of big bluestem (‘OZ 70’;70 percent), indiangrass (‘Cheyenne’; 20 percent), and little bluestem (‘Cimarron’; 10 percent). Initially, the field was drilled with a Great Plains drill, but the seed would not flow properly. A Brillion seeder was used to allow for better seed flow, but also proved unsatisfactory due to awns on the seed. Eventually, the field was sown with broadcast application to ensure proper seed placement. Planting was not implemented July 5, 2016, due to severe drought and lack of soil moisture. The plants emerged over the next few weeks as well as some undesirable weeds such as common purslane, which was treated with a broadleaf herbicide (Cimarron Plus) at the beginning of August. Plants emerged evenly and in good numbers across the field, considering the drought impacting the area. During the second year, clipping was performed to help control weeds and better visualize stand density. Grazing was not implemented to give the native warm-season grass more time to better establish and develop root systems due to the later planting date and drought of the previous year. Grazing was not implemented due to loss of rental property joining the field. There are future plans to use the stand for grazing or hay (Figure 26).

Figure 26. Conventional seedbed at Miller Farm. Former patch of bermudagrass can be seen on right side of field. Remainder of the field was new ground that had been cleared of timber earlier in the spring. Note the high-quality seedbed: fine-textured, clean and firm.

Case History Four — Georgia

Ten acres of James Burton’s farm near LaFayette, Georgia, needed some improvements. His farm was predominantly tall fescue, so he considered using native warm-season grasses to fill the summer forage slump. Burton established a blend (10 PLS pounds per acre) of big bluestem (‘OZ 70’; 70 percent), indiangrass (‘Cheyenne’; 20 percent), and little bluestem (‘Cimarron’; 10 percent) on those 10 acres in 2017. He split the pasture into two paddocks of 5 acres each. The field had been killed with a nonselective herbicide in 2016 with plans to establish that year, but severe drought prevented successful establishment. Wheat had been planted in fall 2016, and the same native grass blend was planted again on May 11, 2017, the following year.

Figure 27. As is so often the case when converting old pastures, weeds remain a serious challenge throughout the seedling year. Here, horsenettle, marestail and goosegrass are creating heavy competition for the native grass seedlings. Although difficult to see, an adequate number of large native grass seedlings are above the weed canopy (note lower right of image and among horsenettle) and, despite the weeds, contributed to a good quality stand.

Figure 28. Abundant, vigorous native grass seedling in foreground with a strip of heavy annual grass competition in the background. The summer of 2017 was well above average rainfall leading to heavy competition from fall panic grass and goosegrass. This is common during very wet summers. Regardless, this developed into a robust stand.

Before planting, an application of 4 quarts per acre of glyphosate was made on April 20, 2017 to control bermudagrass. After planting, an application of 2 quarts per acre of glyphosate tank mixed with 4 ounces per acre of Plateau (imazapic) was made on May 18. By June 9, seedlings could be spotted enough to locate the rows, and those seedlings were 3 inches tall by June 17. Broadleaf weeds were present through late June and July (Figure 27), so the fields were mowed to 10 inches (just above the native grass seedlings on July 24). By August 10, the native grasses had grown to a height of about 18 inches (Figure 28). No grazing ocurred in 2017, and the field was not managed until spring 2018.

On March 27, 2018, both paddocks were burned to remove the residue, suppress weeds and release the native grasses. Just a few days later, they had greened back up and were productive enough to be lightly grazed on April 10 by five cow-calf pairs in each paddock for a few hours each day. To control weeds (notably, horsenettle), an application of 1.5 pints/acre of Grazon HL (aminopyralid and 2,4-D) and 10 ounces per acre of Plateau (imazapic) was made on April 14. By April 27, the native warm-season grass stand was around 18 inches tall, so 40 cow-calf pairs were run on each paddock for four hours, leaving a 10-inch residual when the cattle were removed. On May 14, the native warm-season grassstand had already recovered to 18 inches and was fertilized with 75 pounds of urea per acre (35 pounds N/acre). The stand was again grazed on May 30 in the same way with 40 cow-calf pairs on each paddock for four hours, but the forage was 3 to 4 feet tall at this point, and the residual was 18 inches. Five days later, the 40 cows and calves managed to break into the native warm-season grasspaddocks, and after a full day revisiting the pasture, the cattle were removed and the grazing residual was 6 to 8 inches. On July 25, the stand had recovered to be 3 to 4 feet tall and the 40 cow-calf pairs were rotated again through the paddocks for four hours on each paddock, leaving an 18-inch residual. By August 15, the stand had grown to be nearly 5 feet tall, so 32 calves were run on the pasture for approximately six hours, rotating between the two paddocks each day for six days. The stand became fully established in 2018 and continues to be used in a manner similar to its management in 2018.

Summary

Native grasses require attention to detail for establishment to be successful. Competition control is the single biggest challenge. As described in this publication, be prepared to select sites that are likely to have less weed pressure, begin weed control measures the summer or fall prior to expected seeding, and continue to address weed canopies through the summer of the seedling year. Other important factors are seeding depth and seed dormancy. All of these are issues that can be handled simply by paying attention to the process and being timely in implementation. Weather is easily the other biggest factor in determining the success of planting projects. Drought or excessive rainfall are problems, but in both cases, are out of our control. Notwithstanding, experience has shown success rates of greater than 90 percent if the factors producers can control are addressed. For the remaining 10 percent, the failures — weather extremes — which affect any crop similarly, are the most common problem. Given the long life, high productivity, and other benefits of diversifying a forage program, the investment in getting a good stand of native grasses can pay dividends for years to come.

PRECAUTIONARY STATEMENT

To protect people and the environment, herbicides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store, or dispose of a herbicide. According to laws regulating herbicides, they must be used only as directed by the label.

DISCLAIMER STATEMENT

This publication contains herbicide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the herbicide applicator's responsibility, by law, to read and follow all current label directions for the specific herbicide being used. The label takes precedence over the recommendations found in this publication. Use of trade or brand names in this publication is for clarity and information; it does not imply approval of the product to the exclusion of others which may be of similar, suitable composition, nor does it guarantee or warrant the standard of the product. The author(s), the University of Tennessee Institute of Agriculture and University of Tennessee Extension assume no liability resulting from the use of these recommendations.

Appendix — Seedling Identification Guide

Native Warm-Season Grasses

Bluestem, Big (*Andropogon geradrdii*)

Figure 29. Big bluestem seed.

Figure 30. Big bluestem seedling (two-leaf stage).

Figure 31. Big bluestem seedling (four-leaf stage).

Figure 32. Big bluestem vegetative state.

Bluestem, Little (*Schizachyrium scoparium*)

Figure 33. Little bluestem seed.

Figure 34. Little bluestem seedling (two-leaf stage).

Figure 35. Little bluestem seedling (four-leaf stage).

Figure 36. Little bluestem vegetative state.

Indiangrass (*Sorghastrum nutans*)

Figure 37. Indiangrass seed.

Figure 38. Indiangrass seedling (two-leaf stage).

Figure 39. Indiangrass seedling (four-leaf stage).

Figure 40. Indiangrass vegetative state.

Sideoats grama (*Bouteloua curtipendula*)

Figure 41. Sideoats grama seed.

Figure 42. Sideoats grama seedling (two-leaf stage).

Figure 43. Sideoats grama seedling (four-leaf stage).

Figure 44. Sideoats grama vegetative state.

Switchgrass (*Panicum virgatum*)

Figure 45. Switchgrass seed.

Figure 46. Switchgrass seedling (two-leaf stage).

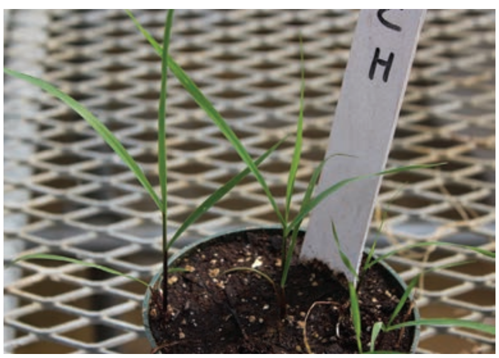


Figure 47. Switchgrass seedling (four-leaf stage).

Figure 48. Switchgrass vegetative state.

Annual Warm-Season Grasses and Weeds

Barnyardgrass (*Echinochloa crus-galli*)

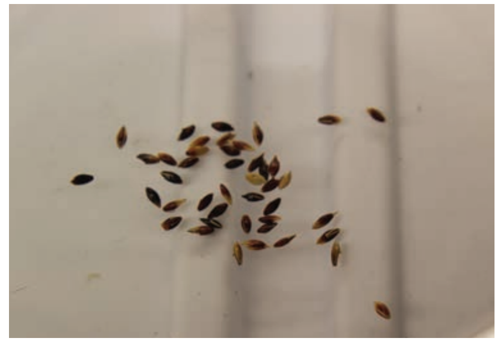


Figure 49 Barnyardgrass seed.

Figure 50. Barnyardgrass seedling (four-leaf stage).

Figure 51. Barnyardgrass vegetative state.

Crabgrass, Large (*Digitaria sanguinalis*)

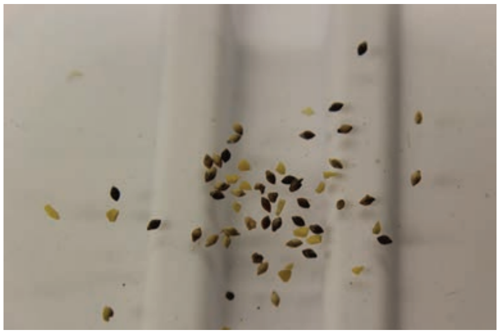


Figure 52. Large crabgrass seed.

Figure 53. Large crabgrass seedling (two-leaf stage).

Figure 54. Large crabgrass seedling (four-leaf stage).

Figure 55. Large crabgrass vegetative state.

Foxtail, Giant (*Setaria faberi*)

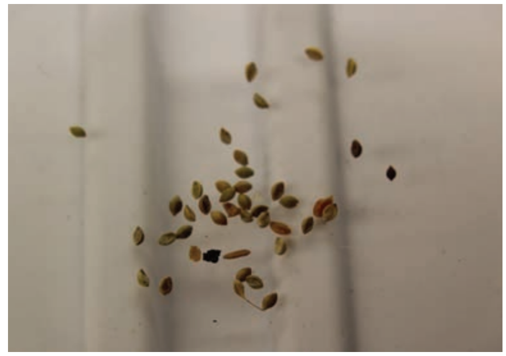


Figure 56. Giant foxtail seed.

Figure 57. Giant foxtail seedling (two-leaf stage).

Figure 58. Giant foxtail seedling (four-leaf stage).

Figure 59. Giant foxtail vegetative state.

Perennial Warm-Season Grasses and Weeds

Bahiagrass (*Paspalum notatum*)

Figure 60. Bahiagrass seed.

Figure 61. Bahiagrass seedling (two-leaf stage).

Figure 62. Bahiagrass seedling (four-leaf stage).

Figure 63. Bahiagrass vegetative state.

Bermudagrass, Common (*Cynodon dactylon*)

Figure 64. Common bermudagrass seed.

Figure 65. Common bermudagrass seedling (four-leaf stage).

Figure 66. Common bermudagrass vegetative state.

Dallisgrass (*Paspalum dilatatum*)

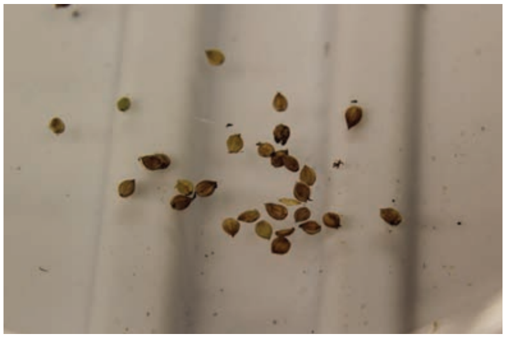


Figure 67. Dallisgrass seed.

Figure 68. Dallisgrass seedling (two-leaf stage).

Figure 69. Dallisgrass seedling (four-leaf stage).

Johnsongrass (*Sorghum halepense*)

Figure 70. Johnsongrass seed.

Figure 71. Johnsongrass seedling (two-leaf stage).

Figure 72. Johnsongrass seedling (four-leaf stage).

Figure 73. Johnsongrass vegetative state.

Vasey's grass (*Paspalum urvillei*)

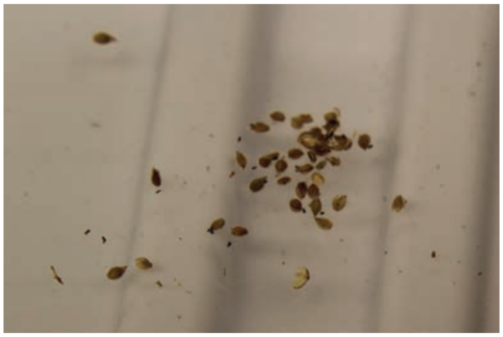


Figure 74. Vasey's grass seed.

Figure 75. Vasey's grass seedling (two-leaf stage).

Figure 76. Vasey's grass seedling (four-leaf stage).

Figure 77. Vasey's grass vegetative state.

Non-Forage, Native Warm-Season Grasses

Foxtail, Knotroot (Setaria parviflora)

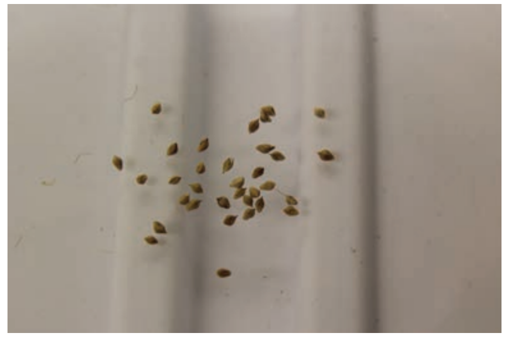


Figure 78. Knotroot foxtail seed.

Figure 79. Knotroot foxtail seedling two-leaf stage).

Figure 80. Knotroot foxtail seedling (four-leaf stage).

Purpletop (*Tridens flavus*)

Figure 81. Purpletop seed.

Figure 82. Purpletop seedling (two-leaf stage).

Figure 83. Purpletop seedling (four-leaf stage).

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