Georgia Forages:
Grass Species



UNIVERSITY OF GEORGIA
EXTENSION

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Contents

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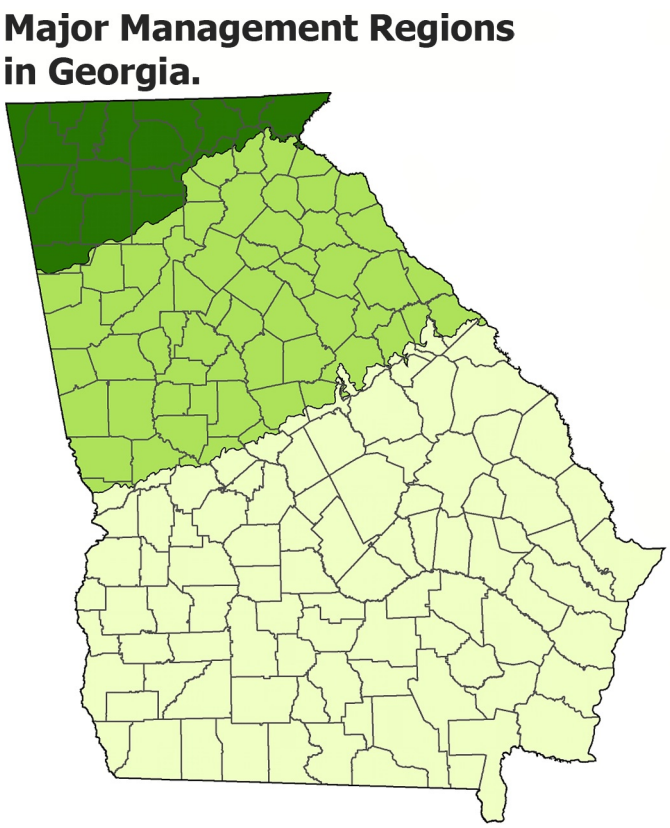
Introduction

The ecological term "grasslands" aptly describes most forage systems in Georgia. This is appropriate because the grasses dominate most pastures and hayfields. This is not by happenstance. Grasses have a tremendous ability to regrow following defoliation because they have a growing point that remains low (often below the soil surface) and an ability to put up new tillers (shoots).

The geographic and environmental diversity of Georgia allows for the extensive use of both cool and warm season grass species (Figure 1). In general, cool season grass species provide higher nutritional quality than warm season grasses. In contrast, warm season grasses generally yield more than cool season grasses. Each type and species, however, offers its own unique qualities and benefits to the forage system. In this section, the most important grass species in Georgia are introduced and discussed.



I) Limestone Valley/Mountains Region

Pasture	Hay
Tall Fescue*	Tall Fescue*
Cool season annuals**	Seeded Bermudagrasses*
Warm season annuals**	Hybrid Bermudagrasses**
	Warm season annuals**

II) Piedmont Region

Pasture	Hay
Tall Fescue*	Hybrid Bermudagrass*
Common Bermudagrass*	Tall Fescue**
Cool season annuals*	Warm season annuals**
Warm season annuals**	

III) Coastal Plain Region

Pasture	Hay
Common Bermudagrass*	Hybrid Bermudagrass*
Hybrid Bermudagrasses*	Warm season annuals**
Bahiagrass*	
Cool season annuals*	
Warm season annuals*	

* Very common practice.
** Not a typical practice, but possible.

Figure 1. Pastures and hayfields are generally grass-based. Georgia's geographic and environmental diversity contributes to a wide range of grasses used for pasture and hay production.

Cool Season Annual Grasses

Cool season annual grasses are productive in late fall and spring and are widely grown throughout Georgia. They provide high quality grazing either overseeded in permanent pastures or on a prepared seedbed.

New varieties of cool season annual grasses are released periodically, so it is important to examine the yield comparison trials in UGA's Statewide Variety Testing Program (http://www.caes.uga.edu/commodities/swvt/). The data are published annually in the "Small Grains Performance Tests." These reports are available on the Variety Testing program's Web site or through your county Extension office.

Annual Ryegrass

Annual ryegrass (commonly referred to as simply "ryegrass" in Georgia) is a well-adapted winter annual that can be planted in prepared seedbeds or overseeded onto perennial grass sods for late winter and spring grazing. Some newer varieties may even provide some late fall grazing if planted early and/or into a prepared seedbed. Ryegrass is also often seeded in mixtures with a small grain and/or clover. It is a prolific seed producer and will reseed in pastures (if allowed to go to seed). Ryegrass has a later grazing season than the small grains and can be grazed until early May in south Georgia and late May or early June in north Georgia when moisture is adequate.

Ryegrass is one of the highest quality forages that can be grown in Georgia, often providing more than 70 percent TDN and 18 percent CP if grazed in the late vegetative stage. High quality (56 to 64 percent TDN and 10 to 16 percent CP) can also be expected in the early stages of seedhead development. However, quality and palatability of late season forage can be low due to disease (mainly rust) and maturity.

Since it can produce at such high quality when properly managed, it often is planted for high quality hay or silage cuttings (usually one or two) in the spring. It is also commonly planted into dormant bermudagrass hayfields. This is a recommended practice, but the ryegrass should be mowed, cut for hay, or grazed before the bermudagrass comes out of dormancy. Ryegrass harvesting should be timed (usually late March in south Georgia and late April in north Georgia) to prevent it from suppressing the spring emergence of bermudagrass.

Hay harvests in late April or May are often difficult because of rainfall. Care should be taken to ensure that ryegrass is dried to a moisture level that is appropriate for safe storage of hay (15 percent moisture for round bales; 18 percent moisture for square bales). Alternatively, ryegrass haylage and baled silage can be used to conserve this high quality forage when rainfall is of concern.

Annual Ryegrass *(Lolium multiflorum)*

Rye

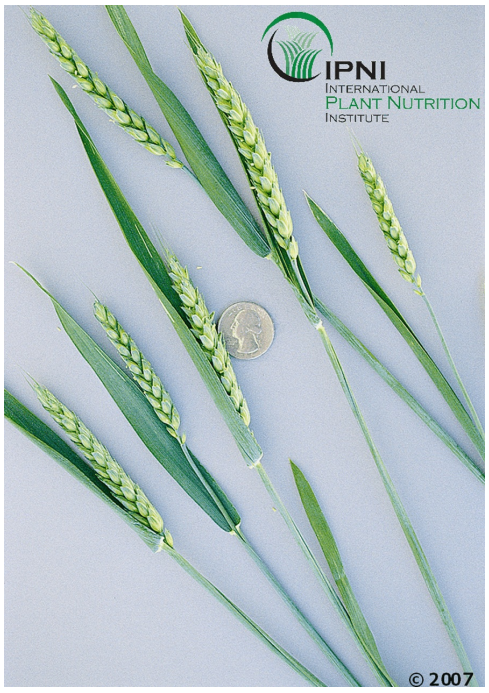
Rye is the most drought-tolerant and winter-hardy small grain grown in Georgia. It is also more tolerant of soil acidity than other winter annual grasses. It can be planted in early fall and usually produces good grazing by late fall. Rye produces more forage in late winter than the other small grains. Since it matures earlier than any other winter annual, it is well-suited for early grazing or haylage production on crop land that must be prepared in early spring for summer row crops. Forage quality declines rapidly in spring as the plants become stemmy and leaf production decreases. Varieties differ in maturity and some will begin seedhead production as early as mid-January in south Georgia. Mixing rye varieties will enable more even production of high-quality forage. However, blending rye with ryegrass or annual legumes will extend the grazing period.

Rye *(Secale cereale)*

Oat

Oat is a small grain often used for winter forage production in Georgia. When seeded in mid-fall, it furnishes forage in late fall and spring. Oat is not as cold hardy as rye and can winter-kill during harsh winters. This crop produces more forage in spring than rye and can be cut for hay or silage; however, it is not as productive as ryegrass in the spring and is not very grazing tolerant. Planting oat in a mixture with ryegrass and/or a winter annual legume will produce more total forage over a longer grazing season than oat alone.

Oat *(Avena sativa)*



Wheat

Wheat is a winter-hardy small grain that provides forage in late fall (some varieties), early winter, and spring and is well-suited to grazing or silage. When ensiling wheat, cut the crop in the late boot to early bloom stage of growth. For best results, wilt the crop to 65 to 75 percent moisture (25 to 35 percent dry matter) before chopping and ensiling.

Wheat that has been planted for grain production can be grazed in late fall and winter without substantial losses in grain production; however, it is critical that animals are not allowed to graze (cut) the growing point. Animals should be removed before the wheat starts to joint (usually early March in south Georgia and mid- to late March in north Georgia). Wheat works well in mixtures with other small grains, ryegrass, and clovers.

Wheat *(Triticum aestivum)*

Triticale

Triticale (pronounced trit-ih-KAY-lee) is a hybrid of wheat and rye that has been evaluated for grain and forage production. It grows tall like rye, but matures later like wheat. It has a relatively wide leaf and can produce high-quality forage if it is grazed or cut in vegetative or early reproductive stages.

Unfortunately, triticale yields have historically been less than wheat. It matures fast like rye, and its forage quality declines rapidly after seedhead development. Until recently, triticale has been bred for grain production. However, newer varieties have better forage production and, when harvested correctly, can provide excellent quality. Some of these newer varieties work well as single-cut silage or haylage crops, particularly for use in dairy rations. Triticale does not perform well under grazing in Georgia.

Barley

Barley is a small grain that is occasionally used on fertile sites in north Georgia but is not widely grown in south Georgia. It is winter-hardy but produces less forage and is more susceptible to disease than the other small grains. Thus, barley is not a recommended forage species in Georgia.

Establishment of Cool Season Annual Grasses

Establish winter annuals on well-drained, fertile soils when possible. If the sites are somewhat poorly-drained, ryegrass will be a better choice than the small grains. Treat small grain seed with an approved fungicide prior to planting. Seedling diseases such as *Phytophthora*, *Rhizoctonia*, *Pythium*, and others reduce stands when planted in the warmer months of September and October, especially in south Georgia.

These crops can be seeded between late August and early October in the Limestone Valley/Mountains region, early September and mid- to late October in the Piedmont region, and late September to late October in the Coastal Plain region. If late fall and early winter grazing is desired (lower Piedmont and Coastal Plain regions only), plant at the earlier dates of these ranges and into a prepared seedbed. Do not overgraze these pastures during the late fall or early winter. For best results, maintain at least 2 1/2 inches of stubble height.

If practical, prepare seedbeds two to three weeks before planting. This will allow the soil to settle and firm, thus improving seed germination and seedling development. Although deep soil preparation is not necessary for the grazing crop, deep tillage may benefit row crops planted in the spring.

Seed can be placed more precisely with a drill or cultipacker seeder than by broadcasting and disking. When seed are broadcast, increase the seeding rate by 25 to 30 percent to allow for variable seed placement. Plant **small grain seed one to 1 1/2 inches deep** in moist soil. **Do not plant ryegrass seed deeper than 1/2 inch.** When planting mixtures of ryegrass and small grains, it may be easier to control the seeding depth by broadcasting ryegrass seed and then drilling the small grain seed into the seedbed. Seeding rates for winter annual crops are shown in Table 1.

Table 1. Seeding rates for annual cool season grass species.

Species	Seeding Rate*	
	Grown Alone	Mixture
	——— lbs/acre ———	
Ryegrass	20 - 30	15 - 25
Rye	90 - 120	60 - 90
Wheat	90 - 120	60 - 90
Oats	90 - 120	60 - 90
Triticale	90 - 120	60 - 90

* Use higher seeding rates when seed is broadcast and lower seeding rates when planting into a prepared seedbed or no-tilled into existing sod (overseeding pasture).

Apply 40 to 50 lbs. of nitrogen (N) per acre at planting or soon after the plants emerge to increase growth, tillering (thickening of the stand), and provide earlier grazing. A second application of 40 to 50 lbs. of N per acre should be applied in mid-winter to increase winter and spring forage production. Because ryegrass is longer-lived, a third application of 40 to 50 lbs. of N per acre may be needed in early spring when ryegrass is used for late spring grazing, hay, or as a silage crop. Rates of N in excess of these amounts may result in substantial N losses to leaching and excessive growth during the winter. Fresh, tender growth that occurs when N is in excess could be damaged by extremely cold weather.

Grazing Cool Season Annual Grasses

Grazing is one of the best uses for cool season annual grasses; however, the species differ somewhat in their tolerance of grazing. Ryegrass and rye are generally very tolerant of repeated grazing, while triticale generally does not regrow quickly. Barley, wheat, and oats have poor grazing tolerance.

Grazing can begin as soon as the plants are well-established and have accumulated four inches (or more) of growth. Begin with a light stocking rate and gradually increase as the growing conditions improve and forage growth rate increases. Consider the forage quality, nutritional needs of the animals, amount of forage present, availability, and the cost of other feed items when deciding how many animals to graze. Restricting the animal's time on the paddock, rotating animals between paddocks, or using strip grazing techniques will improve utilization and reduce damage to the stand. Grazing when the soil is too wet (when animals' hooves can bog in the soil) can severely damage winter annuals and will decrease potential production.

Consider the need for conserved forage, crop rotations that may follow, and the value of available forage when deciding when to terminate grazing. If ryegrass and legumes are permitted to produce mature seed, a volunteer crop will often develop the following fall.

Cool Season Perennial Grasses

Tall Fescue

Tall Fescue is a cool season perennial that is well-adapted to areas north of the Fall Line/Sand Hills area. Over one million acres of tall fescue are used for pasture in north Georgia. Under irrigation and managed grazing, tall fescue is also productive in the Coastal Plain.

Fescue is a deep-rooted bunch grass that is productive during fall, late winter, and spring (Figure 2). More than half of the total yearly production occurs in spring. It does not grow well in mid-summer unless moisture conditions are favorable.

A substantial flush of tall fescue growth will occur in the fall with sufficient moisture and an application of up to 60 lbs. of N per acre (Figure 2). This high quality forage can be stockpiled (allowed to accumulate) in pastures and hay fields from August through October and then grazed later in the fall and early winter. This deferred grazing (grazing after forage has been allowed to accumulate) of stockpiled forage can be an effective method for reducing winter feed costs.

Fescue produces its highest yields along creek bottoms in north Georgia. Production declines on hillsides and ridges as moisture becomes limited. Tall fescue does not persist well in the Coastal Plain region under normal growing conditions.

Tall Fescue *(Lolium arundinaceum)*

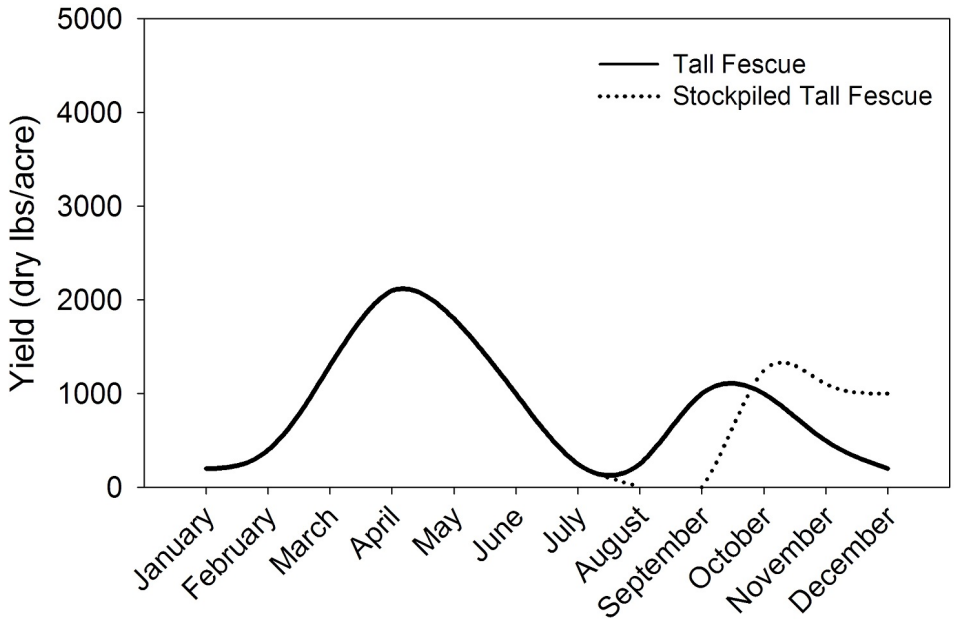


Figure 2. Approximate distribution of available forage (dry lbs./acre) of tall fescue and tall fescue that has been stockpiled for deferred grazing.

Use tall fescue for grazing and hay production. Forage quality and feed distribution are improved when an adapted legume (such as white clover or red clover) is grown in association with fescue. Close grazing (three to six inches) keeps forage quality high and helps keep clover in the stand. Unlike bermudagrass, fescue does not respond to exceptionally high N rates. Tall fescue pastures that are on productive sites can benefit from up to 100 lbs. of N per acre and support a high stocking rate. However, most fescue pastures in north Georgia are moderately stocked and are on marginal sites that will receive no benefit from N applications in excess of 50 lbs. of N per acre. If clover comprises less than 15 percent of the stand, treat it as a grass stand. Reduce N rates to 20 to 30 lbs. per acre if the stand contains 15 to 35 percent legumes. If the stand contains more than 35 percent legumes, no supplemental N is needed.

Tall Fescue Toxicosis

The vast majority of tall fescue that survives in pastures in Georgia is infected with a fungus that grows inside the plant and is transmitted in the seed. This fungus (*Neotyphodium coenophialum*) is called an endophyte. "Endo" (within) and "phyte" (plant) together mean an organism that lives within a plant (Figure 3). The terms “fescue fungus,” “fungal endophyte,” and “fescue endophyte” are common terms used to describe this same fungal organism that grows within endophyte-infected tall fescue.

The wild- or native-type endophyte (E+) produces toxins called ergot-alkaloids. Highest concentrations of the toxins occur in the stems, leaf sheaths, and seeds. These alkaloids adversely affect livestock that graze infected pastures or consume hay cut from infected stands.

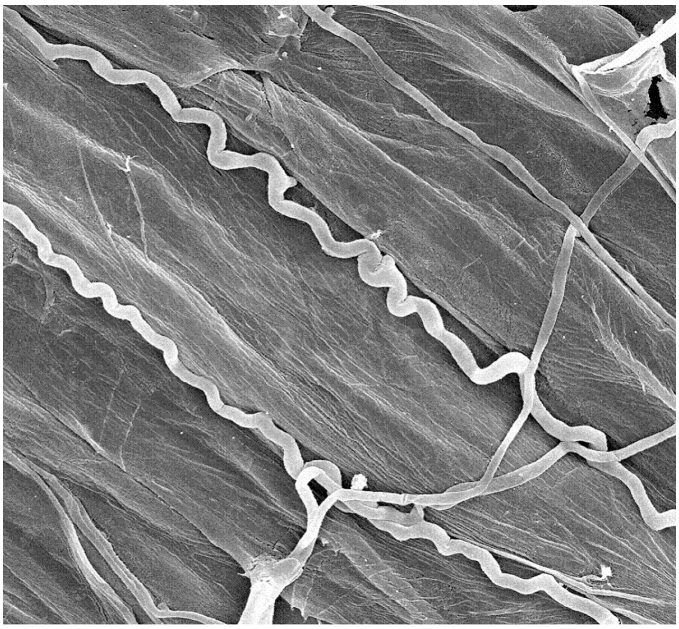


Figure 3. The slender tubes of the endophytic fungus (Neotyphodium coendophialum) in the inter-cellular spaces of tall fescue. Photo Credit: Dr. Nick Hill, UGA.

Livestock that consume E+ tall fescue may suffer reduced conception rates, decreased weight gain, decreased milk production, constricted blood flow (especially to extremities), slightly elevated body temperature, heat intolerance (animals stand in the shade more than normal), excessive nervousness, and failure to shed winter hair coats in the spring. These problems are collectively referred to as “fescue toxicosis.” (See http://www.caes.uga.edu/commodities/fieldcrops/forages/questions/fescuetoxicosis.html for more on fescue toxicosis.)

The E+ infection level within a fescue pasture can range from low to very high. Research at the USDA-ARS Research Station at Watkinsville has shown a direct negative correlation between E+ infection level and animal gains. A 10 percent increase in E+ infection level reduces animal gains by about 0.1 lbs. per day.

The first step in developing a strategy to deal with fescue toxicosis is to determine the severity of the problem in your operation. Animal performance is the best indicator. Problems are minimal in operations where the calving percentage is more than 90 percent and calf weaning weights exceed 500 lbs. On the other hand, lower calving percentages and low weaning weights indicate a significant problem with either the fescue or the cow management program.

In pastures that have low levels of E+ tall fescue (less than 30 percent), the toxins can by diluted by interseeding legumes (usually white clover or red clover) or planting other grasses (e.g., bermudagrass, orchardgrass, etc.). These practices will be less effective when E+ tall fescue occupies more than 30 percent of the pasture. Renovation is the best option for pastures that are predominantly E+ tall fescue (60 percent or greater).

It was found that the endophyte imparts some very positive characteristics in the tall fescue plant that it infects (pest resistance, drought tolerance, persistence under grazing, etc.). Endophyte-free (E-) varieties are sold and have been used in Georgia since the 1990s. Unfortunately, research has shown that E- varieties fail to persist well under less-than-ideal growing conditions. As a result, E- tall fescue varieties are not recommended in Georgia.

Figure 4. Cattle on E+ tall fescue pastures (foreground) spend less time grazing, while cattle continue to graze NE tall fescue (in background). Photo Credit: Dr. Jane Parish.

More recently, tall fescue varieties have become available that are infected with a "novel" or "friendly" endophyte (NE). This novel-endophyte imparts essentially all the positive agronomic characteristics of a wild-type endophyte, but without producing any of the ergot alkaloid toxins (Figure 4). Although the cost per lb. of NE tall fescue is substantially greater than other tall fescue types, the investment is well worth it. Economists from UGA have closely examined this practice and have found that replacing E+ tall fescue with NE tall fescue is a cost-effective strategy for nearly all forage-based livestock systems in Georgia. As a result, NE tall fescue is recommended for all new plantings of tall fescue pasture or hay.

When purchasing NE tall fescue seed, care should be taken to ensure that the product is fresh (less than one year old) and has been stored in a cool, dry place. Seed that is old or has been stored in hot, humid conditions will cause some or all of the endophyte to die.

Information about recommended tall fescue varieties may be found on the "Forage Species and Varieties Recommended for Use in Georgia" web page (http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html).

Renovating Infected Fescue Pastures

Completely renovating an E+ tall fescue pasture to establish an NE tall fescue variety is a major operation. The renovated pasture will be out of production for eight to nine months. Make plans to supply extra feed or reduce cattle numbers during this period. There are four steps in this renovation program: preventing seedhead production in the existing E+ infected stand, destroying the existing stand, seeding the new variety, and managing the new planting.

Step 1: Preventing Seedhead Production.

The endophyte in tall fescue is spread via seed. If seed is produced by the existing stand of E+ tall fescue, then the chances are high that E+ plants will regenerate in the new stand. Therefore, it is critical to prevent the existing stand of tall fescue from producing a seedhead. Stands should be mowed when seedheads begin to develop but before they fully emerge. Two such mowings prior to viable seed production are normally required to prevent seed formation. Heavy grazing may prevent some seedhead production, but it may merely delay seedhead emergence. Therefore, it is likely that mowing will be required.

Step 2: Destroying Old Stands.

There are two methods for destroying an existing stand of E+ tall fescue. The first method is generally referred to as the "spray-smother-spray" method. This involves preventing seedhead formation as described above, spraying the existing stand with a moderate to heavy rate of glyphosate (commonly known by the trade name Roundup), growing a smother crop (usually a warm season annual grass, such as pearl millet) during the summer, and then spraying surviving tall fescue plants and weeds again in the fall with a moderate to heavy rate of glyphosate before planting the new stand. Unfortunately, this method is very expensive and more problematic for most small producers than the "spray-spray-plant" method.

The "spray-spray-plant" method was developed by researchers at UGA who showed that spring seedhead suppression and an application of glyphosate (Roundup) in late summer and a second application made four to six weeks later (followed by planting within one day of the second application) will successfully kill the existing fescue. The timing of this application protocol is critical, as sufficient regrowth by the survivors of the first application is needed to get a complete kill.

Destroying the stand with an herbicide in either of these two methods will be faster, cheaper, and much more effective than multiple tillage operations. Plowing alone will not provide sufficient kill of the existing stand and is not recommended. However, there may be some cases where the preparation of a tilled seedbed is desirable. In this case, the same protocol of two herbicide applications (regardless of method) is recommended prior to seedbed preparation.

Step 3: Seeding the New Variety.

Planting with a no-till drill should follow immediately (within one day) after the second application of glyphosate has been made (Figure 5). Killing fescue pastures with an herbicide and sod-seeding into the killed sod is advantageous for pastures with severe slopes. Plantings can also be made into a firm, prepared seedbed. In the Piedmont region, successful plantings can be made between mid-September and late October. Plantings in the Limestone Valley/Mountains region should occur between early September and early October. Spring seedings are generally not successful and are not recommended. Regardless of region, a planting rate of 15 to 20 lbs. per acre is required for successful stand establishment.

Drought and insects frequently cause problems with fall seedings. Dry weather can reduce germination and delay seed emergence. Stands that are not well-established by December can winter-kill. Insects (grasshoppers and pygmy mole crickets) that inhabit the fescue sod can damage new seedlings. Planting fescue into a prepared seedbed is often more successful than sod-seeding with a no-till drill. Seedlings emerge faster from a prepared seedbed, are more mature by late fall, have more cold tolerance, and are resilient to insect damage.

Figure 5. Planting a NE tall fescue into a suppressed sod with a no-till drill. Photo Credit: Di Hodges.

Step 4: Managing NE Tall Fescue.

Like all tall fescue plantings, new plantings need special treatment. Do not cut or graze new plantings until they have grown at least six inches. Even then, only a light grazing is recommended to avoid stand damage. A light mowing can help control weeds and encourage the tall fescue to grow and thicken-in (i.e., tiller); however, care should be taken not to cut tall fescue below a height of six inches in the spring following establishment. An early cutting of hay (prior to May) should not be taken from new seedings of tall fescue. If the NE tall fescue has been clipped to control weeds in early spring, a late cutting of hay (after mid-May) can be successfully made if the planting resulted in an acceptable stand.

Soon after the stand has been established (April or May following a fall seeding), NE tall fescue should be tested for the extent of novel endophyte infection. This will ensure that the NE is present in the tall fescue, that at least 80 percent of the tall fescue contains the NE, and that little or no E+ tall fescue is present. More information on testing the endophyte status of tall fescue stands can be found on this web page: http://www.caes.uga.edu/commodities/fieldcrops/forages/questions/testingtallfescue.html.

Although NE tall fescue generally is as persistent as E+ tall fescue, some management differences are worth noting. Like all tall fescues, at least 2 1/2 to three inches of growth should be maintained on NE tall fescue stands at all times. Unlike E+ tall fescue, livestock may continue to graze NE varieties during tall fescue's summer dormancy or in periods of drought (Figure 4). Therefore, it is critical to reduce the stocking rate to avoid overgrazing when pastures are dormant or under moisture stress.

Orchardgrass

Orchardgrass is adapted to the more fertile soils in the Limestone Valley/Mountains Regions and some upper Piedmont sites. However, orchardgrass is not recommended for the lower Piedmont or Coastal Plain regions.

Orchardgrass is a bunch grass that produces an open sod and excellent quality forage. It is not as persistent as tall fescue. Even under ideal conditions, stands usually thin after two to three years and will need to be renovated. Though it can be grazed, orchardgrass stands will generally thin more rapidly in pastures and are easier to maintain if they are cut for hay.

Orchardgrass *(Dactylis glomerata)*

Figure 6. Orchardgrass hay field in Bartow Co.

Mixtures of tall fescue and orchardgrass are widely used in hayfields in the upper Piedmont and Mountain regions (Figure 6). Orchardgrass is also a great companion crop with a legume, such as red clover or alfalfa. A common use of orchardgrass is to seed it into alfalfa stands that have thinned.

Orchardgrass is best established on a prepared seedbed, though no-till establishment into an alfalfa or red clover stand will result in satisfactory results. Orchardgrass should be established in the fall. Plant 10 to 15 lbs. of orchardgrass per acre when using a grain drill or sod seeding drill. When seed are broadcast and incorporated by disking or dragging, increase the seeding rate to 15 to 20 lbs. per acre.

Minor Cool Season Perennial Grasses

Bluegrass

Kentucky bluegrass is sometimes found in pastures in the Limestone Valley/Mountains region. However, it furnishes very little grazing during late winter and spring and goes dormant during the summer. Though it produces a very solid sod that holds up to traffic exceptionally well, Kentucky bluegrass is a low-yielding species that does not persist well in Georgia. It is not recommended for planting.

Perennial Ryegrass

Perennial ryegrass is a high-quality pasture species, but it usually does not survive through the summer in Georgia. It can be grown as a long-lived annual, but its use is generally not recommended in Georgia.

Timothy

Timothy is commonly grown for horse hay in northern states. It matures much later than most other perennial cool season grasses. Often, it does not begin reproductive stages until late spring in the regions in which it is grown. This late maturity aligns better with hay-making weather in those states. Like perennial ryegrass and bluegrass, however, it does not persist well in Georgia and will often succumb to a hot, dry summer in the year of establishment. Therefore, timothy is not recommended for plantings in Georgia.

Rescuegrass

Rescuegrass is a short-lived bunch grass closely related to bromegrass and cheat or chess. It garnered the name “rescuegrass” for its propensity for quick growth following a drought. It is productive in late winter and spring, but it matures quickly and generally is not a highly palatable forage. It also is a prolific reseeder. As a result, areas that commonly have volunteer rescuegrass should not be planted to crops that will be harvested for seed in spring. Rescuegrass is a common weed that can be utilized when found in pastures, but it is not recommended for new plantings in Georgia.

Warm Season Perennial Grasses

Warm season perennial grasses grow during the warmer part of the year and persist for several years when well managed. These grasses are dormant during the winter.

Bermudagrass

Bermudagrass is a high-yielding, sod-forming grass that is well-suited for grazing or hay production. It grows best on well-drained, fertile soils where ample moisture is available. Bermudagrass does not persist on poorly-drained Flatwoods soils but can be successfully grown on deep sandy soils because of its deep root system.

Georgia has played important roles in the history of forage bermudagrass in the U.S. and around the world. Common bermudagrass was reportedly introduced into the U.S. (probably from either India or Africa) in 1751 by Georgia's second royal governor, Henry Ellis, in Savannah. Researchers and plant breeders from Georgia have also made significant advances that resulted in improved bermudagrass yields and forage quality. During his career, Dr. Glenn Burton, plant geneticist at the Georgia Coastal Plain Experiment Station (GCPES) in Tifton from 1936-1997, developed several hybrid bermudagrasses for southern forage programs. His most successful releases (e.g., "Coastal," "Tifton 44," and "Tifton 85") continue to be recommended throughout the southeastern U.S. and in similar climates around the world. The warm season grass breeding program at the GCPES has continued this legacy of significant improvement in forage bermudagrass, with new and improved cultivars on the horizon.

Bermudagrass *(Cynodon dactylon)*

Several varieties of bermudagrass are grown in Georgia. Improved hybrid bermudagrasses that are recommended for Georgia will consistently provide higher yields and superior quality relative to other varieties (Figure 7). Hybrid bermudagrasses respond to high N levels (200 to 400 lbs. per acre) in a hay production program. These grasses produce well over four to six tons of hay per acre when moisture is not limiting. Under hay production, hybrid bermudagrasses can be cut four to five times per year. When used for grazing, these grasses provide high yields of good quality forage when the stocking rate is managed to keep the grass closely grazed (two to six inches) to maintain good forage quality.

Common bermudagrass quickly became widespread throughout Georgia following its introduction. Common bermudagrass produces viable seed and also spreads by stolons and rhizomes, so once it is established in a pasture, it is difficult to eradicate. Consequently, common bermudagrass often serves as a default species in many pastures in Georgia. It usually will fill in where other species or varieties thin out.

Common bermudagrass grows on more than 400,000 acres in Georgia. Although common does not provide high yields (only 50 to 60 percent as much hay per acre as Coastal) it can be effectively used in forage programs to provide summer grazing. In north Georgia, it commonly invades tall fescue but can be effectively utilized in the pasture, especially when combined with clover.

Figure 7. Common bermudagrass (left) produces lower yields and quality than Tifton-85 (right), an improved hybrid bermudagrass.

Improved seeded bermudagrasses are becoming more popular, particularly when sprigging an improved hybrid bermudagrass is not feasible. However, care should be exercised when selecting a seeded variety, as some relatively inexpensive seeded varieties may merely be unimproved common varieties from other regions.

Detailed information about vegetatively-propagated and improved seeded varieties of bermudagrass is provided in UGA Cooperative Extension Circular 919: "Selecting a Forage Bermudagrass Variety." Varieties that are currently recommended are listed on the "Forage Species and Varieties Recommended for Use in Georgia" web page (http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html).

Vegetative Establishment of Bermudagrass

Hybrid bermudagrasses produce few viable seed in a pure stand and must be established from vegetative plant material. Freshly dug sprigs (rhizomes or stolons) are the best source of planting stock for hybrid bermudagrasses. Although mature top growth (clippings or "tops") can be used to establish stands of some varieties, growing conditions must be favorable for top-growth plantings to succeed.

There are two generalized methods recommended for sprigging bermudagrass: dormant sprigging or spring sprigging. Dormant sprigging can occur in the winter (February to early March) when the plants have not yet emerged from dormancy (i.e., before spring green-up). This method has generally been very successful throughout most of Georgia. Excessive moisture in winter limits dormant sprigging plantings. However, this method generally allows for quicker coverage in the establishment year. Spring sprigging is recommended in mid- to late-spring (May to June). Sprigging can be successful even as late as mid-summer (late July in north Georgia and late August in south Georgia); however, plantings after late June tend to be more likely to encounter moisture deficit, heat stress, and weed competition.

Plant hybrid bermudagrass sprigs into a moist, well-prepared seedbed at a sprigging rate of at least 40 to 70 bushels of sprigs per acre. Commercial sprigging machines generally result in the best results (Figure 8). These machines plant sprigs two to three inches deep and firm the soil around the sprigs. Broadcast applications of sprigs can also result in successful establishment if 70 to 90 bushels of sprigs per acre are spread on a prepared seedbed and immediately lightly-disked into the soil. Regardless of establishment method, it is important to firm the soil around the sprig to maintain sprig/soil contact, retain soil moisture, and improve sprig survival. The sprigs should not be covered with more than about one to two inches of soil. Sprigs that are covered too deeply may not survive, especially on heavy clay soils that crust over after a rain.

Figure 8. A commercial sprigging machine simultaneously creates a furrow, drops sprigs, covers and firms the furrow, and smooths the soil.

Prior to planting, apply lime, phosphorus (P) and potassium (K) according to soil test recommendations. Apply 35 to 50 lbs. of N per acre after the sprigs start to grow. With early planting dates, a second application of 50 to 75 lbs. of N per acre will be necessary to promote rapid coverage. Good weed control during the establishment phase is essential. Newly-established bermudagrass cannot compete with rapidly growing annual grasses and broadleaf weeds. A thick cover of weeds slows stand establishment by shading the emerging bermudagrass plants and preventing the bermudagrass stolons from pinning down.

Application of diuron, a pre-emergence herbicide, will help reduce weed competition in newly-sprigged bermudagrass. Diuron applications provide fair to good control of crabgrass, crowfootgrass, and goosegrass and provide residual control of certain annual broadleaf weeds. Diuron should be applied immediately after sprigging before weeds emerge. Bermuda sprigs should be planted two inches deep to lessen the chance of injury. Emerged bermudagrass at the time of treatment may be temporarily injured. Do not graze or feed treated foliage for 70 days after diuron application. After emergence, most broadleaf weeds can be controlled with 2,4-D. See the Georgia Pest Management Handbook (http://www.ent.uga.edu/pmh/) and check with your county Extension agent for additional information and current recommendations.

Establishment of Seeded Bermudagrass

Plant 5 to 10 lbs. of bermudagrass seed (hulled) per acre into a moist, well-prepared seedbed in spring to early summer. Seed can be drilled or broadcast and cultipacked to firm the soil. Do not graze or harvest for hay until the plants are well-established. With good growth conditions, spring plantings can be grazed in late summer.

Weeds can be a major problem in new plantings of seeded bermudagrass. No pre-emergence herbicides are labeled for seeded bermudagrass establishment. Broadleaf weeds can be controlled with 2,4-D after the bermudagrass is four to six inches tall. Crabgrass and other annual grasses will not be controlled with 2,4-D or other herbicides. Thus, mowing may be necessary to keep crabgrass from dominating the stand.

Bahiagrass

Bahiagrass is a deep-rooted perennial adapted to a wide range of soils in the Coastal Plain region. It spreads by short, stout stolons and is a prolific seed-producing plant. Bahiagrass will grow on soils too poorly-drained for bermudagrass, is more shade tolerant than bermudagrass, and can be used in woodland pastures (silvopasture). Though it responds to proper fertility, it does not respond to high fertility as well as improved bermudagrasses and will persist in pastures with a low level of management.

Bahiagrass forage is slightly lower in quality than Coastal bermudagrass. Close grazing is necessary to obtain good utilization. Bahiagrass can become a pest in hybrid bermudagrass hay fields. Keep this in mind when rotating cattle, because seed will germinate after passing through cattle. Bahiagrass introduced to a field (through seed in cattle droppings) can crowd out already-established bermudagrass.

Information about varieties of bahiagrass that are currently recommended may be found on the "Forage Species and Varieties Recommended for Use in Georgia" web page (http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html).

Bahiagrass *(Paspalum notatum)*

Bahiagrass Establishment

Bahiagrass is best established on a well-prepared seedbed in early spring on upland soils or in late spring on low, moist soils. Bahiagrass can be successfully seeded in early fall in extreme south Georgia. Broadcast or drill 10 to 15 lbs. of seed per acre and cover seed 1/4 to 1/2 inch deep. A cultipacker-seeder works well. Apply 40 to 50 lbs. of N per acre after the seedlings start to grow. Allow the seedling plants to become well-established before grazing. If crabgrass becomes a problem, grazing or mowing may be necessary to prevent the crabgrass from shading the bahiagrass seedlings.

Native Warm Season Perennial Grasses

Native warm season (NWS) grasses are, as the name implies, native to much of Georgia and North America. Their primary use in Georgia has been for wildlife and conservation purposes. Some have gained favor as potential biomass and bioenergy crops because they are very productive and require few inputs compared to other species. However, their use in pastures and hayfields in Georgia is limited because the introduced species (e.g., bermudagrass, bahiagrass, tall fescue, etc.) are more easily managed for high yields and forage quality.

Switchgrass

Switchgrass is a bunch-type NWS grass that produces short rhizomes. Switch-grass has gained a lot of attention as a biomass and bioenergy crop because it produces high yields (often above eight tons per acre) and requires few inputs once established. Switchgrass can be grown in nearly all well- or moderately well-drained sites in Georgia. However, switchgrass can be slow to establish due to seed dormancy issues and poor seedling vigor. Furthermore, the forage quality is generally low when harvested for hay and the bunch-grass ("clumpy") nature of the switchgrass plant can damage tractor and equipment tires.

Eastern Gamagrass

Another NWS bunchgrass, eastern gamagrass, forms large, circular clumps as stands age. Unfortunately, these large clumps make hay production difficult. Yields are often not as high as switchgrass or other warm season perennial grasses. One advantage of eastern gamagrass is that its seeds can be more easily planted. In fact, a corn planter is often used to establish eastern gamagrass. Eastern gamagrass also has the advantage of providing more late fall and early spring growth than most other perennial pasture grasses.

Big Bluestem

Big bluestem has a very stemmy but tall growth habit that makes it an excellent species to provide wildlife habitat. However, its yield potential is generally less than switchgrass and eastern gamagrass. Big bluestem matures later than other NWS grasses but is more tolerant of drought and poor growing conditions.

Indiangrass

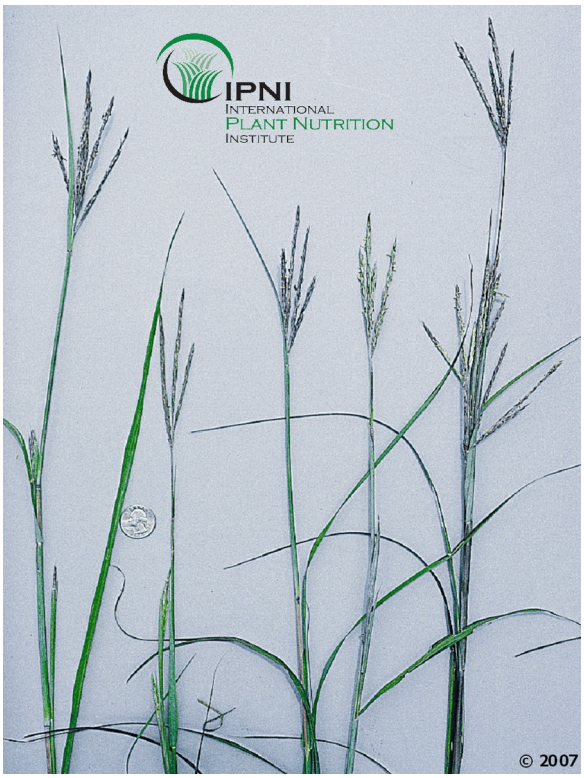
Though very different in appearance, indiangrass shares many of the characteristics of big bluestem. It is very stemmy, tall growing, excellent for wildlife habitat, low yielding, late maturing, and tolerant of drought and poor growing conditions. Indiangrass, however, is relatively easy to establish and is much more vigorous and competitive.

Little Bluestem

Little bluestem is less productive than the other NWS grasses but performs well on marginal soils. It provides excellent habitat for quail and other grassland birds. Though it is easier to manage for hay, low yields prevent it from being recommended as a forage crop in Georgia.

Switchgrass *(Panicum virgatum)*

Eastern Gamagrass *(Tripsacum dactyloides)*



Big Bluestem *(Andropogon gerardii)*

Indiangrass *(Sorghastrum nutans)*

Establishing and Managing Native Warm Season Perennial Grasses

Though the usefulness of NWS perennial grasses in forage systems in Georgia is limited, these grasses may fit goals for wildlife habitat improvement, riparian area protection, or biomass for bioenergy production. The goal for the planting dictates the management and inputs required.

Broadcasting NWS grass seed over a prepared seedbed and using a cultipacker to firm the soil around the seed will result in a good stand. However, because of the potential for erosion at most sites where NWS grasses will be established, no-till establishment is the most common establishment method.

Regardless of seed dispersal method, indiangrass and the bluestems will require a specialized seed box agitator (Figure 9). This is because the seed of these NWS grass species have "fluffy" appendages that make them prone to clogging the seed box. Though these seed box agitators aren't commonplace, some wildlife agencies and USDA - Natural Resources Conservation Service and Soil Conservation Districts may have NWS grass drills available for rent.

Figure 9. A seed box agitator is necessary to prevent the fluffy seeds of some NWS grasses from clogging openings in the seed box.

Seeding rates for NWS grasses vary only slightly between species, with switchgrass being the notable exception (Table 2). If wildlife habitat is the primary goal, seeding rates can generally be reduced by 50 to 60 percent. Like most other forage species, careful attention should be paid to planting depth. With the exception of eastern gamagrass, NWS grasses will not survive being planted deeper than 1/2-inch.

Table 2. Seeding rates of selected native warm season perennial grass species.[†]

Species	Wildlife Habitat	Forage Stand	Planting Depth
	—— lbs. of PLS/acre ——		— inches —
Switchgrass	2–4	5–6	1/8–1/2
Eastern gamagrass	4–6	8–10	1/2–1
Big bluestem	3–5	8–10	1/8–1/2
Indiangrass	3–5	8–10	1/8–1/2
Little bluestem	3–5	8–10	1/8–1/2

[†] Adapted from Ball et al., 2007 and Harper et al., 2007.

In general, NWS grasses have seed dormancy issues, poor seedling vigor, or both. As a result, the NWS grasses often take several months (sometimes as much as two years) to become well-established. Weed control during this time is limited because of a lack of herbicides labeled for use. Thus, NWS grasses should be planted into areas that have had low weed pressure in the past.

Most NWS grasses must not be cut shorter than eight to 10 inches to avoid reduction of regrowth or having negative effects on the stand's persistence. Furthermore, NWS grasses often become very stemmy as they mature, and forage quality declines rapidly after the boot stage. As a result, good harvest management is critical when NWS grasses are managed as a hay crop (occasionally the stand may need to be burned to remove residue). This characteristic also makes them a poor pasture species unless grazing is well-managed. These management problems make NWS grasses difficult to recommend for forage production in Georgia.

Minor Warm Season Perennial Grasses

Dallisgrass

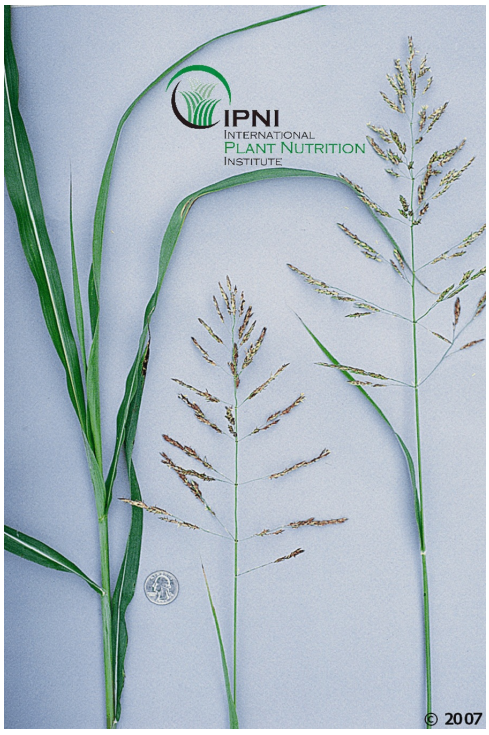
Dallisgrass is a fast growing perennial used primarily for pasture. Yields of dallisgrass are similar to Argentine or common bahiagrass. It has smooth leaves, a deep root system and grows in clumps of few to many stems. Numerous leaves occur at the base of the plant, but few leaves are found on the slender stems, which tend to droop when seedheads develop.

Dallisgrass *(Paspalum dilatatum)*

Dallisgrass is adapted to low, moist areas and produces well on fertile uplands. Though dallisgrass is not recommended for new plantings, it is a common species in pastures and can be managed for forage production. A legume, such as one of the recommended white clovers, can be grown with this grass to improve forage production and quality.

Another management concern is dallisgrass's susceptibility to an ergot infection of the seedheads. Livestock that consume dallisgrass infected with ergot can develop dallisgrass staggers (dallisgrass poisoning). Dallisgrass staggers is common in pastures that contain large amounts of dallisgrass.

Animals afflicted by dallisgrass staggers have uncontrolled twitching, make sudden movements, are easily spooked, and will often run when startled. In many cases, the animals will become so spooked that they will attempt to run through or jump fences or panels and may hurt themselves or people who happen to be in the wrong place at the wrong time. Death from dallisgrass staggers is rare but it can cause death indirectly (e.g., drowning in a pond, falling off of a steep slope, etc.). In the most severe cases, the animals will go down, convulse, and even die. The only treatment is to remove the animals from the affected areas and provide them with an alternative forage/feed source. Usually, if the toxins are removed from the diet and the animals are safely confined, recovery from the poisoning can be complete.



Johnsongrass *(Sorghum halepense)*

Johnsongrass

Like dallisgrass, Johnsongrass is not recommended for new plantings, but it can be utilized in the forage production system. Johnsongrass is a tall-growing, perennial that very aggressively spreads by rhizomes and seed. The rhizomes (underground stems) send up shoots from the joints to produce new plants, and seed dispersal can cause Johnsongrass to become a very invasive weed in hay fields. Johnsongrass is best adapted to moist, fertile soils and can be grazed or harvested for hay or silage. Though common in many pastures, Johnsongrass does not tolerate close grazing. Johnsongrass belongs to the sorghum family, and when stressed by dry weather or cold temperatures it can contain high levels of prussic acid, which is toxic to livestock. Johnsongrass is also an accumulator of nitrates and may develop toxic concentrations of nitrate during periods of drought.

Warm Season Annual Grasses

Warm season annual grasses are established from seed and are productive during spring and summer. These plants are frequently used as temporary forage for stocker cattle and mature cows. They can be used for grazing, hay, and silage. Under stress conditions, these species may contain nitrate and/or prussic acid concentrations that are toxic to livestock. Careful management is necessary to ensure that these forage species are well-utilized and free of toxins.

New varieties of warm-season annual grasses are released periodically, so it is important to examine the yield comparison trials in UGA's Statewide Variety Testing Program (http://www.caes.uga.edu/commodities/swvt/). The data are published annually in the "Soybean, Sorghum Grain & Silage, Summer Annual Forages, and Sunflower Performance Tests." These reports are available on the Variety Testing program's website or through your county Extension office.

Pearl Millet

Pearl millet originated in Africa and is the most widely-planted summer annual grass in Georgia. This tall growing, erect annual grass produces several stems from a central plant. As a result, it requires at least six to eight inches of stubble to regrow. Improved varieties can produce more than six tons per acre. Even under moderate drought conditions, these varieties will rarely yield less than four tons per acre.

Pearl Millet *(Pennisetum glaucum)*

Pearl millet can be grazed or harvested as hay or silage. Researchers at Tifton have found that pearl millet grazing should begin when plants reach 20 to 24 inches, but regrowth rate and animal performance is best if a nine to 12 inches stubble height is maintained. Pearl millet can make good quality hay if cut when plants reach two to three feet tall. This prevents the forage from maturing beyond the boot stage and therefore being too mature to provide high quality. The drying rate of millet hay can be sped up by the use of a roller/crimper-style conditioner.

If harvested prior to advanced maturity stages, the range of total digestible nutrients (TDN) can be expected to be 52 to 58 percent, while crude protein (CP) will range from eight to 11 percent. There is some evidence to suggest that seeding rates at the high end of the recommended ranges will promote a higher leaf:stem ratio. This may improve forage quality, but these gains may not compensate for the expense of the higher seeding rate.

Since pearl millet does not produce prussic acid, this species has a distinct advantage over sorghum, sudangrass, and sorghum x sudangrass hybrids. This allows pearl millets to be grazed or harvested at any growth stage and during droughts without the risks associated with prussic acid poisoning. However, pearl millets can have high nitrate levels.

Millet produces good quality forage and supplies grazing from June through August (Figure 10). Millet planted in spring (April) should be ready for grazing 30 to 40 days after planting and should be productive for 80 to 110 days. The crop is most productive during the first 60 days of the life of the stand. Well-fertilized millet should carry three to four stocker cattle or two to three mature cows per acre during the first 60 days. Lower the

stocking rates during the last part of the grazing season. Even out the grazing supply over the summer by making multiple plantings. Plantings made in early June will be in peak production when April plantings are starting to decline.

Several hybrid millets are marketed in Georgia. Some hybrids are tall-growing and produce high yields. Other hybrids are dwarf, low-growing millets that are excellent for grazing. Dwarf millets produce leafy forage and will provide higher average daily gains than the taller hybrids. Newer dwarf millet varieties are also resistant to *Pyricularia* leafspot, which can reduce millet yields in late summer. Currently, no millet varieties are available with the brown mid-rib (BMR) trait.

Figure 10. Cows grazing a pearl millet pasture in Tift Co.

Information about recommended varieties of pearl millet may be found on the "Forage Species and Varieties Recommended for Use in Georgia" web page (http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html).

Sorghums

Members of the Sorghum family are often used for forage in Georgia. These warm season grasses are also of African origin and may contain toxic levels of nitrates and prussic acid under stress conditions (drought, frost/freeze, etc.). As such, they are not preferred choices for grazing or hay production (unless irrigated). Sorghums are generally more difficult to cure for hay than pearl millet or other summer annual forage crops. Therefore, they are best adapted to use as a silage crop. The ensiling process results in the dissipation or breakdown of prussic acid and high nitrate levels after two to three weeks, reducing the toxicity problem for livestock.

In addition to the potential for prussic acid toxicity, the presence of an unidentified toxin in sorghum, particularly in sorghum x sudangrass hybrids has been reported. This toxin or factor appears to cause spinal cord degeneration and, in extreme cases, paralysis in horses (sorghum cystitis ataxia syndrome). The potential for this problem and the lack of an effective treatment or cure for this syndrome has led to a general recommendation that horses should NOT be fed forage from the sorghum family.

Sorghum x Sudangrass hybrid

Sorghum x sudangrass hybrids

Hybrids of forage sorghum and sudangrass are commonly grown as a warm season annual crop in Georgia. These hybrids have the highest yield potential of any of the summer annuals, if adequate rainfall is received or irrigation is provided. However, sorghum x sudan yields are more severely affected by drought than pearl millet, and are less tolerant of poor soil conditions and soil pH values less than 5.8. Sorghum x sudans can be used for grazing or silage, but like other annual sorghums, their forage is difficult to dry to moistures suitable for hay production. Sorghum x sudan hybrids should be rotationally grazed, allowing the

forage to reach 24 inches before grazing (i.e., managed like sudangrass). At this stage, sorghum x sudans will generally have TDN values in excess of 53 to 60 percent and CP concentrations of nine to 15 percent. Brown midrib (BMR) varieties are usually preferred varieties for grazing since they have less lignin and higher digestibility than other varieties. Research in Texas has indicated that BMR varieties may improve animal gains by as much as five to eight percent relative to non-BMR varieties.

Forage Sorghum *(Sorghum bicolor)*

Forage sorghums

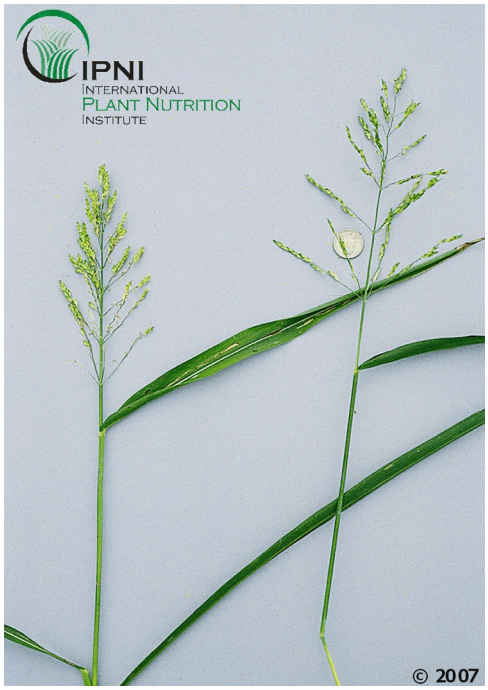
Forage sorghums are high yield producers that may have from zero to 50 percent grain in the forage, depending upon the hybrid and stage of maturity at harvest. As plants mature, lignification increases sharply, reducing digestibility and quality. BMR hybrids can improve digestibility, but this trait has increased lodging in some varieties. Careful selection of BMR hybrids and timing of harvest are necessary to get the highest total digestible nutrients (TDN). Highest crude protein and digestibility will usually be obtained by harvesting in the vegetative growth stage, while dry matter production will be increased from more mature plants. Harvesting in the late grain dough stage will result in a lower average TDN value, but will maximize the amount of TDN harvested per acre.

Grain sorghums, as the name suggests, are prolific grain producers and are best used for that purpose. Grain sorghums are dwarfed cultivars of the same species as forage sorghums. Though they may also produce substantial forage yields, the quality of the forage from grain sorghum varieties is generally much lower than forage sorghums.

Sudangrass

Sudangrass has finer stems, tillers more profusely, and is leafier than forage sorghums. It produces very little seed. Its rate of regrowth after cutting or grazing is superior to that of sorghums. For this reason, it is sometimes used for temporary rotational grazing. However, sudangrass usually produces lower yields than pearl millet or the sorghum x sudan hybrids and requires fertile soils with a pH of 5.8 or higher. Sudangrass tends to have less prussic acid accumulation than forage sorghums, and the levels decrease with maturity. For this reason, care should be taken to let sudangrass accumulate to at least 24 inches of regrowth before grazing.

Information about varieties of sorghum x sudan hybrids, forage sorghum, and sudangrass that are currently recommended may be found on the “Forage Species and Varieties Recommended for Use in Georgia” web page (http://www.caes.uga.edu/commodities/fieldcrops/forages/species.html)



Sudangrass *(S. Bicolor ssp. drummondii)*

Planting Warm Season Annual Grasses

Plantings of warm season annual grasses can be made in the spring as soon as the soil temperature (at a two-inch depth) warms to 65º F and can be planted as late as July without a yield penalty (Table 3). Seed can be broadcast or drilled in narrow (more than 15 inches) or wide (up to 36 inches) rows. Seed should be planted at a soil depth of 1/2 to one inch. Ideally, summer annual grasses should be established on well-drained, fertile soils with good water-holding capacity.

Higher seeding rates may help to decrease stem size, but it is unlikely that this will be valuable enough to compensate for the expense of the higher seeding rate. Further, sorghums that have been seeded at higher rates will often have more lodging problems, especially relative to dwarf pearl millet stands.

Table 3. Planting dates and seeding rates for selected warm season annual grasses.

Species		Planting Dates*	Seeding Rate	
			Drilled	Broadcast
			—— lbs. of PLS/acre ——	
Pearl Millet	LV:	May 1 – July 1	10–15	20–25
	P:	April 15 – July 15		
	C:	April 1 – August 1		
Sorghum x Sudan Hybrids	LV:	May 1 – July 15	15–20	25–30
	P:	April 15 – August 1		
	C:	April 1 – August 15		
Sudangrass	LV:	May 1 – July 1	10–15	20–25
	P:	April 15 – July 15		
	C:	April 1 – August 1		
Forage Sorghum	LV:	April 25 – May 15	6-8	NR
	P:	April 15 – May 15		
	C:	April 15 – June 1		

* LV = Limestone Valley/Mountains Region; P = Piedmont Region; C = Coastal Plain Region; NR = Not recommended

Even out the grazing supply over the summer by making multiple plantings. Two plantings made four to six weeks apart provide good quality forage throughout the summer. Plantings made in early June will be in peak production when April plantings are starting to decline in productivity. If plants become stemmy from selective grazing, mechanically clip them to a height of 10 to 12 inches and fertilize with N. With good grazing management, clipping may not be necessary.

Photoperiod-sensitive sorghum x sudan and forage sorghum cultivars are available. These varieties are capable of sustaining more consistent growth over a longer growing season because they remain in a vegetative stage late into September (until daylength is less than about 12 hours and 20 minutes). This trait may negate or lessen the need for staggered plantings. Otherwise, these varieties are generally managed (planted, fertilized, etc.) in the same way as conventional cultivars. However, some research indicates that the quality of photoperiod-sensitive varieties is lower than the conventional cultivars. Reports from other states indicate that some companies are claiming their cultivars are photosensitive when they merely mature later.

Pest Management for Warm Season Annual Grasses

It is important to prevent yield damage from pests. Though options are limited for weed control in summer annual grasses, pearl millet and the sorghums are typically fast growing and competitive with weeds. However, insect damage to summer annual grasses can be very problematic. For example, chinch bugs often limit yields during a drought year and reportedly are more severe when the summer annuals are planted into small grain stubble. Additional details on weed control options and treatment thresholds for insect pressure are presented in the Georgia Pest Management Handbook's (http://www.ent.uga.edu/pmh/) section on "Temporary Grazing."

Fertilization of Warm Season Annual Grasses

Summer annual forages must be fertilized to reach their yield potential. As with all crops, fertilization and lime application should be done according to recommendations based on the results of a soil test. Warm season annual grasses generally perform well on sites with soil pH values around 6.0 or higher. However, pearl millet is less sensitive to soil acidity than the sorghums. Nitrogen is needed in large quantities and is most often the least-limiting nutrient. When used for grazing, apply 40 to 60 lbs. of N per acre for establishment and 50 to 60 lbs. of N per acre each month during the grazing season. When harvested for hay or silage, apply 40 lbs. of N per acre at planting and 40 to 60 lbs. of N per acre after the first two cuttings. Reduce N rates after the crop growth rate slows down. Summer annuals grown under irrigation should receive N rates on the upper end of these ranges.

Other Summer Annual Forages

Corn

Corn (or maize) originated in southern Mexico and is notable for its tremendous forage yields (eight to 12 tons of DM per acre) and high energy content. In Georgia, corn is primarily grown for grain (225,000 acres), but a substantial acreage (40,000 acres) is planted for silage each year, as well. Management of corn for silage is practically identical to corn grown for grain, with the exception of plant populations (for some hybrids) that are up to 10 percent higher than corn grown for grain. For more information on corn management, visit the "Georgia Grains" web site (http://www.caes.uga.edu/commodities/fieldcrops/gagrains/index.html).

Browntop Millet

Browntop millet (or dixie signalgrass) originated in Southeast Asia. Browntop is grown for several purposes, Including wildlife attraction (dove fields), erosion control, straw production, and forage production (Figure 11). Because it is commonly used for a variety of purposes, many farm supply stores carry browntop millet varieties. As a result, it is occasionally used for grazing or hay production. Browntop typically grows only to two to five feet tall and produces only 60 to 70 percent of the dry matter of pearl millet or sorghum x sudan hybrids.

Browntop Millet *(Urochloa ramosa)*

Browntop millet can be planted from mid-April until mid-August in most locations, though later plantings will result in lower yields. To establish browntop millet, broadcast 20 to 25 lbs. of seed per acre on a prepared seedbed in spring. Seed should be covered to a depth of 1/2-inch in a firm seed bed.

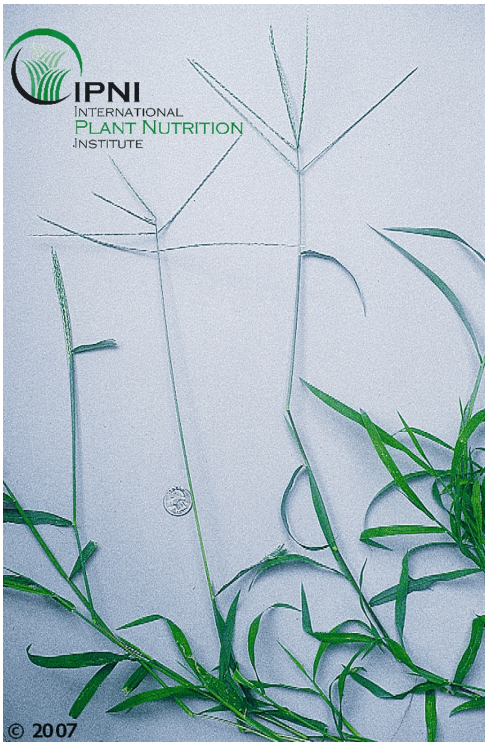
Browntop millet is a nitrate accumulating crop. Because of this nitrate accumulation and low yield potential, browntop millet often will contain nitrate concentrations that are toxic (or lethal) to livestock. Browntop should not be planted if a drought is anticipated or forecasted.

Browntop millet is a good reseeding plant and the seed may remain viable in the soil for many years. It can become a pest in cultivated crops.

Figure 11. Browntop millet in Walker Co. being grown for straw (mulch hay) production.

Crabgrass

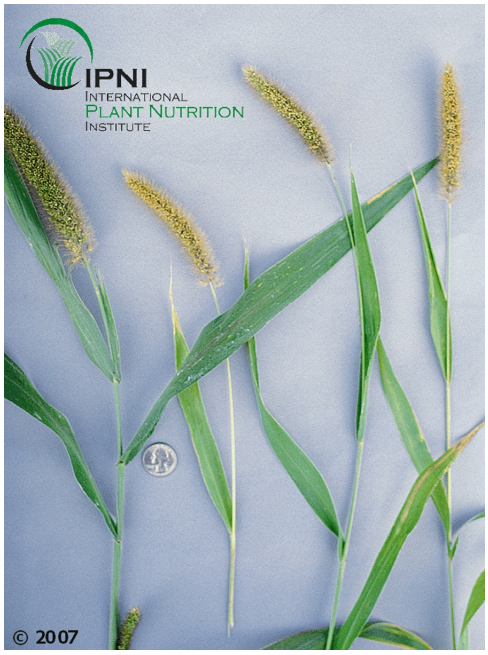
Crabgrass is a low-growing annual grass that is present in most cultivated fields and pastures in the state. It is a good reseeding plant that can furnish summer grazing following winter annual grazing mixtures or legumes harvested for seed. Crabgrass is not drought tolerant and grows best when soil moisture conditions are good. Cattle will usually selectively graze crabgrass in preference to fescue, bahiagrass, or bermudagrass. Forage from crabgrass is very palatable, highly digestible, and generally the highest quality of all the summer annuals. The productive season is from May until October, though most of the forage will be produced in late summer. Red River crabgrass, a productive collection from an upland site north of the Red River in southern Oklahoma, is the only commercially-available variety and has not been adequately evaluated in Georgia.



Crabgrass *(Digitaria sanguinalis)*

Foxtail Millet

Foxtail millet is an annual warm season grass that can grow two to four feet tall, if properly managed. Foxtail millet was cultivated in China as early as 2000 BC, and later introduced to Europe. It was brought to the U.S. in about 1850, and is often used as emergency summer grazing or hay. More commonly, however, it is used for stabilization of construction and disturbed soil sites. Foxtail millet may have a place in pasture systems where the primary grass fails or is in short supply. Foxtail millet has been largely replaced by other summer annuals that are typically superior in quality and yield. When used, foxtail millet should be broadcasted at a rate of 20 to 25 lbs. of seed per acre, at a soil depth of 1/4- to 1/2-inch, and on a firm seed bed.



Foxtail Millet *(Setaria italica)*

Teff

Like many other warm season annuals, teff originates from Africa, where it has been grown extensively as a grain crop. In fact, teff grain is considered a staple of the Ethiopian diet. However, its use as a forage crop in the U.S. has been a relatively recent phenomenon. The use of teff as a forage crop in the Southeast is still being evaluated.

It is much finer-leaved and stemmed than most other warm season annual grasses, and often provides relatively high quality forage (RFQ exceeding 120, if harvested prior to the boot stage). In some northern states, teff yields have been about 90 percent of pearl millet and sorghum x sudan yields. In preliminary studies in Georgia, however, the forage productivity of teff has been less than 1/3 that of most other summer annual forages. Furthermore, teff has had very weak seedling vigor in studies performed in Athens and weed competition has been problematic. As a result, teff is not recommended as a forage crop in Georgia.

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