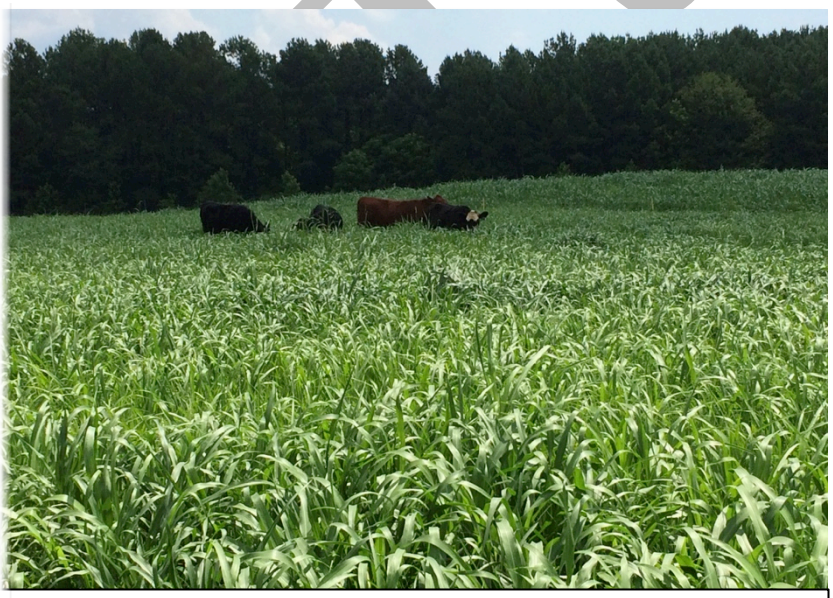
Warm Season

Annual Grasses



Warm Season Annual Grasses

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Warm Season Annual Grasses

In the Southeast, it is important to have both cool and warm season forages in one's production system. Cool season annuals and perennials produce substantial amounts of high-quality forage when temperatures stay between 60 - 80° F (Fig. 1). Unfortunately, as the temperatures in the late spring, summer, and early fall months exceed 80° F, these species are incapable of producing adequate amounts of forage. Warm season annual and perennial grasses are capable of substantial forage yields when the temperatures are above 80° F.

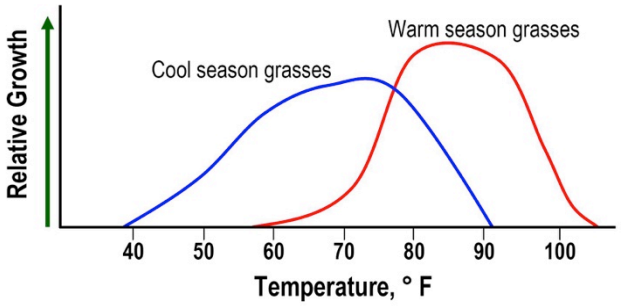


Figure 1. The relative effect of temperature on the growth of cool and warm season grasses.

Fortunately, there are several warm season forage grasses that can be used to fill that void (Fig. 2). Commonly, we use bermudagrass or bahiagrass. However, there are many occasions where having a warm season annual forage is helpful. Warm season annuals 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 or as a smother crop for renovating perennial pastures. They can be used for grazing, hay, and silage (Fig. 3).

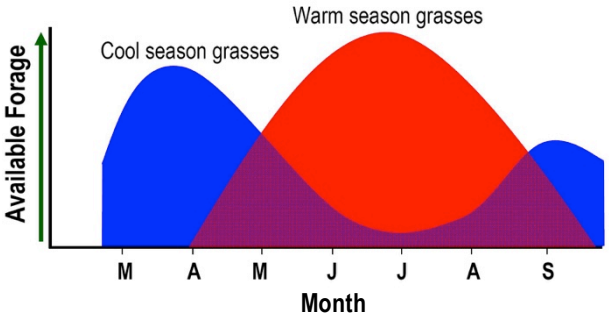


Figure 2. Cool season grasses have a "summer gap" in production. Warm season grasses can be used to fill this void.

Table 1 lists the major warm season grasses that are commonly used to fill the summer gap and make a well-rounded forage system. As with most issues, each of these species has positive and negative attributes. Many of these attributes are summarized in Table 1. In deciding to use a warm season forage, one must first determine if the need is temporary or more chronic (i.e., there is a need each year). If a more permanent solution is needed, the perennial warm season species are more cost effective over the long run. For filling the short-term gaps in forage production, annual forage species will be more productive and cost effective. For example, some annuals (pearl millet and sorghum x sudangrass

hybrids) are quick to establish and quite productive under mild to moderate drought conditions. Warm season annuals are also helpful as a smother crop in renovating pastures or hayfields and some make excellent summer cover crops when temporary erosion control measures are needed.

Unfortunately, warm season annuals may contain nitrate and/or prussic acid concentrations that are toxic to livestock if grown under stress conditions (e.g., drought, nutrient deficiencies, frost, etc.). In general, warm season annual grasses are more prone to accumulating toxic levels of nitrates in the forage during stress conditions than warm season perennial forages. Members of the sorghum family (Johnsongrass, sorghum, sudangrass, and sorghum x sudangrass hybrids) can also produce toxic levels of prussic acid in severe droughts or following frost damage. Careful management is necessary to ensure that these forage species are well-utilized and free of toxins.

Figure 3. Whether finishing steers on pearl millet pastures (left), using sorghum x sudangrass as a smother crop (right), or simply for producing additional forage for hay, baleage, or grazing, warm season annual grasses have many uses.

Table 1. Key characteristics of common warm season forage grasses.

		Quality‡			Cost of§		Ease of Use For¶	
Forage	Yield†	RFQ	CP	TDN	Establishment	Production	Grazing	Hay
Annuals	(tons/a)		(%)	(%)				
Browntop Millet*	1 - 3	85-115	9 - 12	50 - 56	V. Low	Low	3	2
Crabgrass	2 - 5	100-140	9 - 12	58 - 62	Low	Medium	1	2
Forage Sorghum	4 - 8	90-135	9 - 12	52 - 60	Medium	V. High	5	5
Pearl Millet	4 - 6	90-125	8 - 12	52 - 58	Medium	High	2	3
Sorghum x Sudangrass	4 - 10	95-135	9 - 12	53 - 60	Medium	V. High	3	5
Sudangrass	4 - 10	90-125	9 - 12	52 - 58	Medium	V. High	3	4

† Typical range in yields of recommended varieties, but highly dependent on growing season and conditions.
‡ Assumes harvest or grazing occurs at late vegetative – early reproductive stages of growth.
§ Based on 2015 seed, fertilizer, and fuel costs and assuming moderate soil fertility.
¶ Ratings are 1 – 5: 1 = relatively easy and 5 = quite difficult, impractical, or requires high level of management.
* Generally not recommended for forage production in the Southeast because of relatively poor yields.

Pearl Millet

AT-A-GLANCE:

Adaptation:	Warm climates of the southeastern U.S. Best on sandy soils. Drought tolerant.
Establishment:	Seed should be drilled ¾ - 1 in. deep at 12 – 15 lb/acre or broadcast at 25 – 30 lb/acre in April (i.e., whenever soil temperatures at 2" depth reach 65° F) – June.
Varieties recommended in Georgia:	Tifleaf 3, SS635

Pearl Millet (*Pennisetum glaucum*)

Pearl millet originated in Africa and is the most widely planted summer annual grass in Georgia. It is a deep rooted, drought-tolerant, and erect bunchgrass that grows 3-8 feet tall, and has a production season from late May to September. Improved varieties can produce over six tons per acre under good conditions (Fig. 4). Even under moderate drought conditions, these varieties will rarely yield less than four tons per acre.

Pearl millet has become the most popular summer annual in Georgia, likely due to its high forage quality, regrowth potential, and heavy tillering (several stems). There are two main types of pearl millet: tall and dwarf varieties. Dwarf varieties tend to be leafier and are well suited for grazing, while tall varieties better suited to being harvested for hay, baleage, or green chop. Most commercial varieties sold in the Southeast are dwarf varieties. Initiation of grazing should begin once the plant reaches a height of 20-24 inches. Pearl millet produces several tillers (stems) from basal buds located at the base of the central plant (Fig. 5). As a result, cutting and grazing height can be as low as 4 – 6 inches but regrowth rate and animal performance is best if a 9 – 12 in. stubble height is maintained.

Pearl millet performs best in well-drained soils. Though it can tolerate soil pH as low as 5.5, the target soil pH for pearl millet should be 6.0-6.2. Pearl millet also tolerates moderate to low soil P and K.

Pearl millet can make good hay if cut when it reaches 2 – 3 ft tall. This prevents the forage from maturing beyond the boot stage and therefore being too mature to provide high quality forage. Impeller (flail) conditioners can speed the drying rate relative to no conditioning, but the use of a roller/crimper-style conditioner will maximize drying. If harvested in the pre-boot to early bloom stages, the total digestible nutrients (TDN) can be expected to be 52-58%, while crude protein (CP) will range from 8-12%.

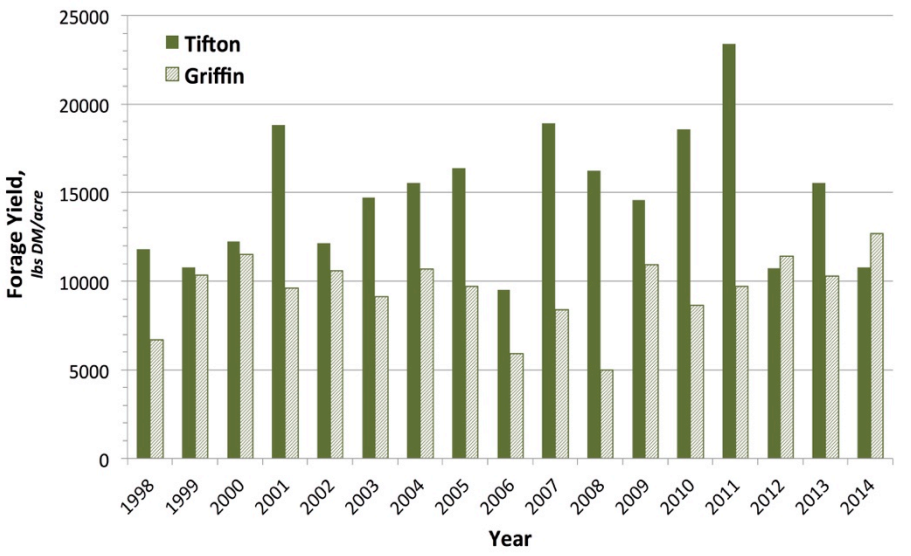


Figure 4. Average forage yield in the pearl millet variety trial in Tifton and Griffin from 1998-2014.

Figure 5. Pearl millet produces several tillers (new shoots) at the base of the plant (left). After pearl millet is cut or grazed, new tillers emerge from basal buds at the base of the plant (right). As a result of this anatomical trait, pearl millet can be grazed to within 4 – 6 inches and still recover relatively quickly (e.g., 12-18 days of rest before grazing again or 22-35 days for being cut for hay or baleage again.)

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. Millet planted in spring (April) should be ready for grazing 30 – 40 days after planting and should be productive for 80 – 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 that are staggered by 2 – 4 weeks. Plantings made in early June will be in peak production when April plantings are starting to decline in productivity.

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. There are now a few millet varieties available with the low-lignin, brown mid-rib (BMR) trait. However, these varieties have not been evaluated in Georgia and are not officially recommended.

Producers should take caution when planting varieties that haven't been evaluated in our area. New varieties of pearl millet 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. A list of recommended varieties of pearl millet may be found on the web page devoted to pearl millet that is linked from the "Forage Species and Varieties Recommended for Use in Georgia" (http://www.caes.uga. edu/commodities/fieldcrops/forages/species.html) web page.

Sorghums

Members of the Sorghum family are often used for forage in Georgia. These warm season grasses are also of African origin. These grasses 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 2 – 3 weeks, reducing the toxicity problem for livestock. In contrast, hay made from these crops may retain high nitrate levels. But, like silage, prussic acid will dissipate from hay.

In addition to the potential for prussic acid toxicity, some have reported the presence of an unidentified toxin in sorghum, particularly in sorghum x sudangrass hybrids. 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.

Forage Sorghum (*Sorghum bicolor*) **Sudangrass** (*S. bicolor ssp. drummondii*) **Sorghum x Sudangrass hybrid**

Forage sorghum

AT-A-GLANCE:	
Adaptation:	Warm climates of the southeastern U.S. Best on well-drained, sandy soils. Drought tolerant.
Establishment:	Seed should be drilled 1 – 1 ½ in. deep at 6 – 8 lb/acre or broadcast at 10 – 12 lb/acre in April (i.e., whenever soil temperatures at 2" depth reach 65° F) – June.
Varieties Recommended in Georgia:	4Ever Green, Grabow 86S, AF7401

Forage sorghum is a high yielding warm season annual that may have from 0 – 50% grain in the forage, depending upon the hybrid and stage of maturity at harvest. Forage sorghum is drought tolerant, performs well under limited moisture, and its ability to produce a rattoon crop (i.e., regrowth potential yielding multiple harvests during the growing season, depending on the variety) and result in significant yields. Improved varieties can produce over 6 –

7 tons per acre under good conditions (Fig. 6). Under moderate drought conditions, the best varieties rarely yield less than 5 tons per acre. Most varieties are usually late maturing and have sweet and juicy stems with relatively small grain heads.

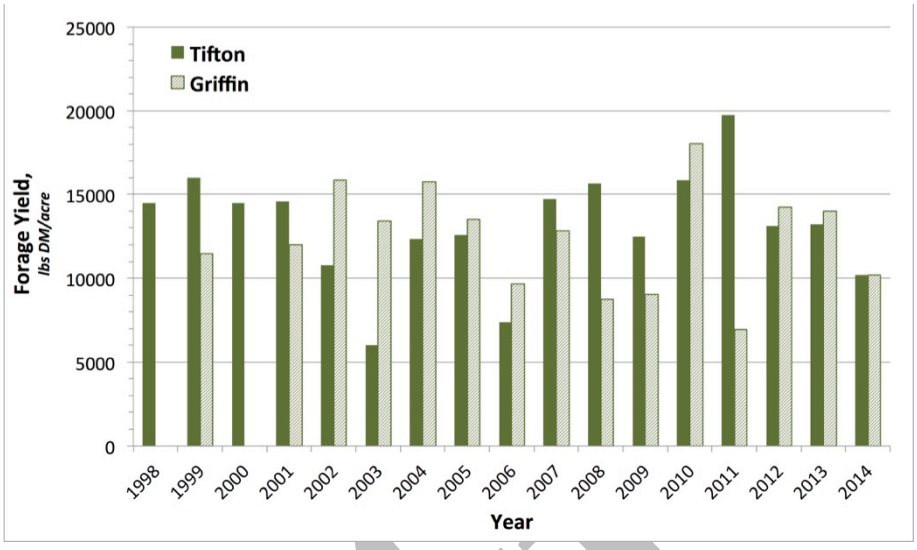


Figure 6. Average forage yield in the forage sorghum variety trials in Tifton and Griffin from 1998-2014.

Silage is the major use of forage sorghums, but the crop can also be cut for baleage. Because of their thick stems (Fig. 7), forage sorghum is slow to dry even when a mower-conditioner is used. So, making hay from forage sorghum is difficult. 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. For maximum yield potential of one cut varieties, harvesting should occur during the early to late dough stage. 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.

Careful selection of forage sorghum hybrids is also necessary to get high digestibility and yield. As plants mature, lignification increases sharply, reducing digestibility and quality. The BMR hybrids have less lignin and greater digestibility (Fig. 8). In earlier BMR hybrids, the low-lignin trait was associated with increased lodging. This is less of an issue in most varieties currently on the market.

Figure 7. A plot of forage sorghum (left), sudangrass (center), and sorghum x sudangrass (right). Notice the thick, prominent tillers (stems) in forage sorghum compared to the thinner sudangrass tillers. The tillers of sorghum x sudangrass hybrids are intermediate.

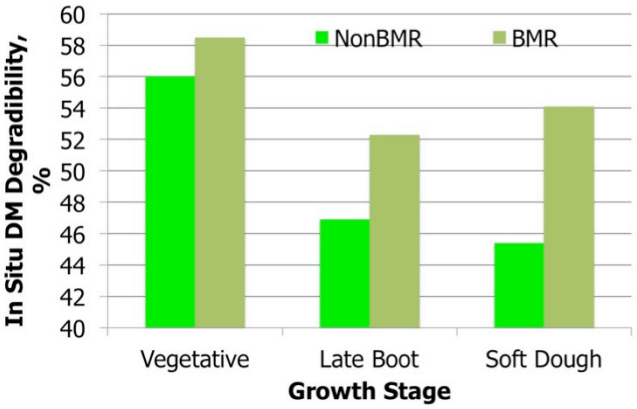


Figure 8. The digestibility of sorghum x sudangrass declines as the crop matures, but digestibility of the nonBMR varieties are generally always lower than the BMR hybrids and the BMR hybrids do not decline at as rapid of a rate. Adapted from Beck et al., 2007 J. Anim. Sci. 2007. 85:545–555.

Table 2. Comparison of the crude protein (CP), neutral detergent fiber (NDF), lignin, and in vitro true digestibility (IVTD) of silage made from nonBMR and BMR forage sorghum hybrids and corn.

Measure of Quality		Forage Sorghum NonBMR	Forage Sorghum BMR	Corn
CP, %	Avg.	8.3	9.2	9
	Range	*(6.3-10.8)*	*(6.9-10.5)*	*(8.4-9.7)*
NDF, %	Avg.	49.1	45.9	41.2
	Range	*(33.9-67.5)*	*(40.7-60.1)*	*(33.7-45.8)*
Lignin, %	Avg.	4.4	3.6	3.5
	Range	*(2.7-6.4)*	*(2.8-4.5)*	*(2.7-4.2)*
IVTD, %	Avg.	75.5	81.3	82.7
	Range	*(60.9-83.6)*	*(75.1-84.2)*	*(78.3-88.1)*

Adapted from McCollum et al. 2001. Brown midrib forage sorghums and sorghum X sudangrass hybrids for summer grazing and silage production. Texas A&M Univ. AREC-Amarillo.

Silage made from forage sorghum with the BMR trait has proven to be a good alternative to corn, especially in rainfed fields or the dry corners of irrigated fields. With attention to good silage harvest and management, BMR forage sorghum can be high enough in quality to sustain milk production and beef cattle gains that approach levels seen when feeding corn silage (Table 2).

Grain sorghums, as the name suggests, are prolific grain producers and 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

AT-A-GLANCE:	Sudangrass
Adaptation:	Warm climates of the southeastern U.S. Best on well-drained, sandy soils. Moderate drought tolerance.
Establishment:	Seed should be drilled 1 – 1 ½ in. deep at 10 – 15 lb/acre or broadcast at 20 – 25 lb/acre in April (i.e., whenever soil temperatures at 2" depth reach 65° F) – June.
Varieties Recommended in Georgia:	AS9301, Sudan Headless, Trudan Headless

Sudangrass has more, finer tillers and is leafier than forage sorghums. They produce very few seed. Their rate of regrowth after cutting or grazing is superior to that of sorghums. For this reason, they are sometimes used for temporary rotational grazing. However, sudangrass usually produces lower yields than pearl millet or the sorghum x sudangrass 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. Nonetheless, care should be taken to let sudangrass accumulate to at least 24 inches of regrowth before grazing.

Sorghum x sudangrass hybrids

AT-A-GLANCE:	SORGHUM-SUDANGRASS
Adaptation:	Warm climates of the southeastern U.S. Best on well drained soils. Drought tolerant.
Establishment:	Seed should be drilled 1 – 1 ½ inches deep at 15 – 20 lb/A or broadcast at 25 – 30 lb/A in April (i.e., whenever soil temperatures at 2" depth reach 65° F) – June.
Varieties in Georgia:	AS5201 (S), AS6401 (P), AS6402 (P), Extra Graze bmr (P), SDH 2942BMR (P), SS-220BMR (S), Super Sugar (S), Sweet Six BMR Dry Stalk (S)

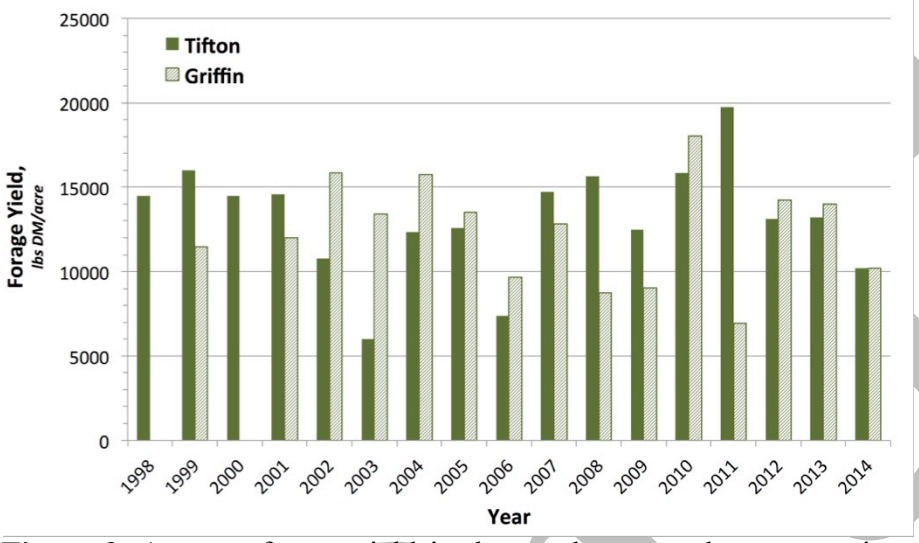


Figure 9. Average forage yield in the sorghum x sudangrass variety trials in Tifton and Griffin from 1998-2014.

Sorghum x sudangrass is a hybrid cross between forage sorghum and sudangrass. Stems and leaves of the hybrid are generally taller and thicker than sudangrass. Plants grow erect, 5 – 12 ft. tall. As a result, sorghum x sudangrass is the highest yielding summer annual forage crop. Improved varieties can produce over 8 – 10 tons per acre under good conditions (Fig. 9). Like most other summer annuals, sorghum x sudangrass is drought tolerant and can do well in relatively low pH soils. However, sorghum x sudangrass yields are more severely affected by drought than pearl millet, are less tolerant of poor soil conditions, and soil pH values less than 5.8. Establishment should occur once soil temperatures reach 65°F at a planting depth of 1 – 2 inches.

Sorghum x sudangrass varieties should not be grazed or cut short. Unlike pearl millet (where regrowth occurs at the basal buds at

Figure 10. Sorghum x sudangrass paddocks (left) grazed to 8 – 12 inches will optimize regrowth rate. This is because sorghum x sudangrass grows back from axillary buds at the node where the leaf blade connects with the stem.

the base of the plant), regrowth in sorghum x sudangrass occurs at the nodes where leaf blades join the stem (Fig. 10). At least one node should remain following grazing or harvest to ensure regrowth rates are optimized. Grazing should be managed to avoid clipping the stem below 8 – 12 inches so that these growing points (called axillary buds) and enough carbohydrate reserves (stored in the lower stem) remain intact. Initiation of grazing should not begin until plants have reached at least 24 inches tall. It is best to rotationally graze sorghum-sudangrass to allow for adequate rest and regrowth. As plants mature, they can grow tall and the stalk can become lignified. Therefore, it is best to graze or clip the forage when plants become 3 – 4 feet tall to promote vegetative regrowth, tillering, and deeper root penetration. Sorghum-sudangrass can also be used for silage, baleage, and green-chop, but the large stems can make hay curing difficult and a mower-conditioner is recommended to speed drying time. Harvesting or grazing plants in a vegetative stage produces forage that is expected to contain 53 – 60% TDN and 9 – 15% CP. 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 5 – 8% relative to non-BMR varieties.

New varieties of forage sorghum, sudangrass, and sorghum x sudangrass 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. A list of recommended varieties can be found on "Forage Species and Varieties Recommended for Use in Georgia" (http://www.caes.uga. edu/commodities/fieldcrops/forages/species.html) web page.

Other Summer Annual Forages

Corn

Corn (or maize) originated in Southern Mexico and is notable for its tremendous forage yields (8 - 12 tons of DM/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 to corn 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% 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 South East Asia. Browntop is grown for several purposes, including wildlife attractant (dove fields), erosion control, straw production, as well as forage production (Fig. 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 2 - 5 ft tall and produces only 60 - 70% of the dry matter of pearl millet or sorghum x sudangrass 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 – 25 lbs of seed/acre on a prepared seedbed in spring. Seeding depth should be ½ inches in a firm seed bed.

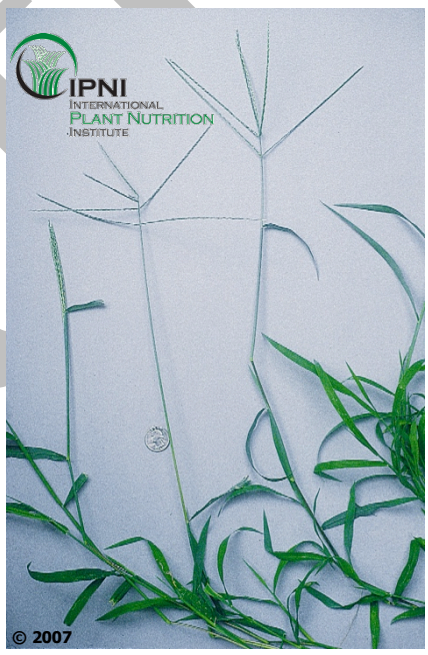
Browntop millet is a nitrate accumulating crop. Because of this nitrate accumulation and low yield potential, browntop millet often will contain nitrate concentrations that are toxic (or lethal) to livestock. Browntop should not be planted if a drought is anticipated or forecasted.

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. Improved varieties of crabgrass can produce 2 – 4.5 tons/acre, though yields on the high end of this range will occur only in years when frequent rainfall is received or in irrigated fields. 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. Crabgrass forage ranges from 11 - 15.5% CP and 58 - 63% TDN. 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 that has been evaluated in the Southeast. Crabgrass should be drilled or broadcast seeded at a rate of 4 – 6 lbs/acre in March – May. Care should be taken when planting crabgrass to ensure that the seed flows through the drill or spreader. Crabgrass seed often builds up static electricity and clings to metal or plastic surfaces. Mixing lime, sand, or some other carrier that is uniform and of similar size to the seed in a 2:1 ratio with crabgrass seed can help to ensure it will flow satisfactorily.



Crabgrass (*Digitaria sanguinalis*)

Foxtail millet

Foxtail millet (sometimes called German millet) is an annual warm season grass which can grow 2 - 4 ft 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 US in about 1850 and is occasionally used for 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, though, by other summer annuals as they are typically superior in quality and yield. When used, foxtail millet should be broadcasted at a rate of 20 – 30 pounds of seed per acre, at a soil depth of ¼ to ½ 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 USA 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% of pearl millet and sorghum x sudangrass 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. Consequently, weed competition has been very problematic. As a result, teff is not recommended as a forage crop in Georgia.

Planting Warm Season Annual Grasses

Ideally, summer annual grasses should be established on well-drained, fertile soils with good water-holding capacity. Plantings of warm season annual grasses can be made in the spring as soon as the soil temperature (at 2 in. depth) warms to 65º F. Plantings of pearl millet and members of the Sorghum family that are made after early June will fail to reach their full yield potential because of their sensitivity to daylength. As the days begin to get shorter, these summer annuals tend to partition more growth toward reproductive tillers at the detriment of leaves and vegetative growth. In contrast, browntop millet can be planted as late as July without a yield penalty.

Seeding rates and depths for each warm season annual grass species are listed in the previous discussion of the respective species. It has been a long held belief that higher seeding rates (i.e., tighter spacing within a row) would increase forage yield, decrease stem size, and increase the leafiness and digestibility of the forage. Research as shown that seeding rates at the high end of the recommended seeding rate will maximize forage yield and minimize the diameter of the main stem. However, planting at the high end of the recommended seeding rates decreases leafiness; reduces the number of the smaller, secondary tillers; and increases the digestibility of the forage relative to seeding rates at the low end of the recommended range or lower. Seeding rates above the recommended ranges are likely to be less economical and detrimental to forage quality.

Warm season annual grass seed can be broadcast, but it is most commonly drilled in narrow (< 15 in.) or wide (up to 36 in.) rows (Fig. 12). Research as shown there is no substantive difference in forage productivity

Figure 12. Warm season annual grasses can be successfully drilled in narrow (< 15 in.; left) or wide (up to 36 in.; right) rows.

between plantings of narrow or wide row spacings. Research in Tifton found that animal performance was nearly identical between steers grazing pearl millet in paddocks that had been established by drilling in narrow (10 in.) or wide (36 in.) row spacings. The researchers observed that the steers grazing in the wide row spacings walked between the rows. They found that there was no practical difference in animal performance between the row spacings because the advantage of having quicker ground cover in the narrow row spacing was compensated by reductions in hoof damage done in wide row spacing plantings.

Since most of the warm season annual grasses produce more forage within 45 – 60 days after planting than in the 60 days thereafter, one should try to even out the grazing supply over the summer by making multiple plantings. Two or more plantings made two to six weeks apart can help to provide good quality forage throughout the summer. Plantings made in late May will be in peak production when April plantings are starting to decline in productivity. If plants become stemmy from selective grazing or the majority of the available forage is reproductive tillers, mechanically clip the forage to a height of 10 – 12 inches and fertilize with N. With good grazing management, clipping may not be necessary.

Photoperiod-sensitive sorghum x sudangrass 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 or minimize warm season annual grass yield and/or quality reduction from pests. Specific 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."

Weeds

Pearl millet and members of the Sorghum family are typically fast growing and competitive with weeds. This is helpful, since options for weed control are limited in warm season annual grasses. Most of the common broadleaf weeds that are problematic in warm season annual grass plantings can be controlled with products that contain 2,4-D and/or dicamba. In forage sorghum plantings, the use of metolachlor (Dual) or atrazine can effectively minimize broadleaf and grassy weeds.

Insects

Chinch Bug

Insect damage to warm season annual grass crops is often quite problematic. Chinch bugs are a common pest in warm season annual grasses, particularly pearl millet (Fig. 13). Chinch bugs are a particular problem in hot, dry weather and in fields with a heavy infestation of either crabgrass or Texas panicum. Chinch bugs can cause damage at any time from the seedling stage to the soft dough stage, but are most damaging when infestations occur early. Damaged plants have a drought-stressed appearance and the withering of lower leaves.

Figure 13. Chinch bug infestation in pearl millet.

Chinch bugs have different stages (nymphs and adults) that differ in color, size and appearance (Fig. 14). They can be difficult to spot. Look for chinch bugs low in the canopy, between the stem and leaves. Chinch bugs are often knocked off stems by grazing or movement through the field, so they are often spotted on the ground around the base of the plants. Because of the damage they cause, fields that have a history of chinch bug damage should receive preventive applications of beta-cyfluthrin (Bathyroid) or zeta-cypermethrin (Mustang Max) insecticide 14 – 21 days after seedling emergence to control early infestations in dry weather. Sprays must penetrate the canopy to effectively control chinch bug, and canopy closure by 30 days after planting limits the effectiveness of later applications. Applications soon after cutting or grazing in rotational grazing systems will improve canopy penetration and efficacy.

Figure 14. Growth stages of chinch bug. From left to right, the egg, first – fifth nymphal stages, long-winged, and short-winged adult forms.
Photo credit: David Shetlar, Ohio State University, Bugwood.org

White Sugarcane Aphid

The white sugarcane aphid (SCA) has occurred in Florida since 1977 and Louisiana since 1989 feeding on sugarcane. In 2012, the SCA shifted its host preference to grain and forage sorghums, sudangrass, sorghum x sudangrass (and even Johnsongrass). First found in Texas, this new strain has rapidly spread eastward across the southern United States in 2014 and is now widespread throughout the Southeast. It is important to scout any fields planted to members of the Sorghum family starting in early June through the remainder of the season. As of this writing, no other warm season annual grass (including pearl millet) is damaged by SCA.

The white sugarcane aphid is fairly easy to identify (Fig. 15). Wingless forms are a uniform pale cream to yellow with black feet and black cornicles (the small tubes present on the end of the back). The aphid sucks plant fluid from the underside of the leaves. When in large populations, serious injury to the plants can occur including death of leaves and, sometimes, the whole plant. The aphids remain present in field until harvest. It produces large quantities of honeydew, a sugary substance that sticks to the plants. Large quantities of honeydew can make the crop difficult to harvest and may damage harvest equipment. Entomologists have reported 20 – 50% yield loss in hand-harvested plots, which could translate to a total loss of the crop from harvest damage in practice.

Figure 15. The white sugarcane aphid (left) feed on the bottom side of the leaves of forage sorghum (center) and other members of the Sorghum family, including Johnsongrass (right).

Preliminarily, the threshold has been set for treatment whenever 25% of infested leaves have 50 or more aphids per leaf at the pre-boot maturity stage or later. If the treatment threshold is exceeded, treat with Sivanto (flupyradifurone) at a rate of 4.0-7.0 oz./acre, which seems to be about 90% effective at control, assuming the product is applied with enough water and accuracy to penetrate into the canopy. Sivanto has a 7-day grazing restriction and a 14 day harvest interval (silage or grain). Attempts to suppress the SCA with pyrethroids are not recommended, as this can kill beneficial insects and cause the SCA population to flare. Additional control recommendations 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 – 60 lbs of N/acre for establishment and 50 – 60 lbs of N/acre each month during the grazing season. When harvested for hay or silage, apply 40 lbs of N/acre at planting, 60 lbs of N/acre after stand establishment, and 60 lbs of N/acre after each harvest except the last. Summer annuals grown under irrigation should receive N rates on the upper end of these ranges.

To reduce the risk of toxic concentrations of nitrates accumulating in the forage crop, do not apply more than 40 lbs of N/acre when drought conditions appear likely or the growth of the crop is expected to be slow. Summer annuals damaged by drought stress should receive no N when the growth of the crop has slowed remarkably or stopped.

The concentration of nitrate in the forage will vary by plant part and location (Table 3). Even in the most severe cases, the nitrate concentrations of the leaves of the crop will be lower than the stems. Furthermore, nitrate concentrations in the stem will be greatest in the half closest to the soil surface. Grazing animals usually preferentially graze the leaves first, then the top of the stem, and then the bottom part of the stem. Therefore, animals allowed enough forage to select only leaf material are less likely to encounter toxic nitrate concentrations than animals who's forage allowance forces them to graze the leaves and stem.

Table 3. The concentration of nitrate in the plant parts of pearl millet plant parts as affected by fertilization[1].

	Nitrate Conc., ppm	
Plant Part	**Fertilized**	**Not Fertilized**
Whole Leaf	3,689	398
Top 1/4 of stem	8,750	391
Second 1/4 of stem	9,762	501
Third 1/4 pf stem	11,173	555
Bottom 1/4 of stem	10,292	597

[1] Observations from a field in Lee Co., AL in 1985 where the "fertilized" area received N at a target rate of 60 lbs N/acre, but there was poor distribution over approximately 1/2 of the land area. It is supposed that the remainder of the field received 100-120 lbs N/acre. "Not fertilized" areas were apparent skips.
Adapted from Rymal et al. 1986. Auburn Univ. Highlights of Agric. Res. 33(4):1

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