The Management and Use of Bahiagrass

UNIVERSITY OF GEORGIA
EXTENSION

Lisa L. Baxter, UGA Forage Specialist, Crop and Soil Sciences Dept.
R. Lawton Stewart, Extension Beef Nutritionist, Animal & Dairy Science Dept.
R. Scott Tubbs, Cropping Systems Agronomist, Crop & Soil Sciences Dept.
Jeremy Kichler, County Extension Coordinator, Colquitt County
William Secor, Extension Livestock Economist, Agricultural and Applied Economics Dept.

Bahiagrass (*Paspalum notatum* Flugge) is a long-lived, perennial warm season grass that is grown extensively in the Southeastern U.S. (Figure 1). It is most commonly used as a pasture species, but can be used for hay production, erosion control, and wildlife habitat. Bahiagrass can also be used in "sod-based rotation" sequences that have been found to suppress pest problems (nematode and disease issues) in crops such as peanuts.

Bahiagrass is a deep-rooted, sod-forming species that is well adapted to a wide range of soils and conditions in this 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).

Bahiagrass has many desirable characteristics such as: (1) tolerance to close grazing, (2) general freedom from severe disease and insect infestations, (3) good drought tolerance, (4) adequate forage quality, and (5) a low to moderate fertility requirement for the maintenance of good stands. Though it persists in pastures with a low level of management, it responds well to proper fertility and management.

Bahiagrass is particularly well suited for use in pastures (Table 1). It produces forage earlier in the spring and later in the fall than bermudagrass since it is less affected by decreasing day lengths and cool temperatures. Unfortunately, bahiagrass forage is less digestible than 'Coastal' bermudagrass of the same age (maturity). The use of good grazing management to keep the bahiagrass between 2 and 6 in. will keep the quality relatively high (54 to 56% TDN and 10 to 11% CP) and allow for better utilization.

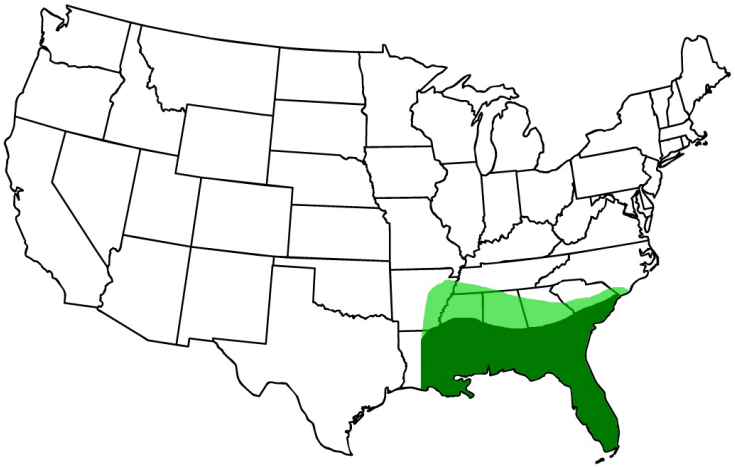

Figure 1. Bahiagrass is well-adapted in the dark green area and can be successfully grown in the light green area.

Bahiagrass *(Paspalum notatum L.)*

Table 1. Typical fertilizer and lime recommendations, and the approximate forage quality, carrying capacity, and stocker gains that can be expected when recommended varieties of bahiagrass, bermudagrass, and tall fescue are used as the primary pasture species.

	Fertilizer Recommendations†			Annual Lime Needed	Typical Forage Quality‡	Range in Forage Quality	Carrying Capacity	Average Daily Gains - Stocker Cattle
	N	P_2O_5	K_2O					
	-------- (lb/acre) --------			(tons/acre)	-------- (RFQ) --------		(AU§/acre/yr)	(lb/head/day)
Bahiagrass	75-175	40	40	0.3-0.5	85-90	75-110	0.75-1.25	0.7-1.0
Bermudagrass	150-250	30	65	0.3-0.5	90-100	80-140	1.00-1.50	1.5-1.8
Tall Fescue¶	50-100	40	40	0.3-0.5	100-120	80-150	0.50-1.00	1.8-2.5

† Assumes medium levels of phosphorus and potassium in the soil test.
‡ The forage quality values here are estimated based on NDF and digestibility estimates in the published literature. (RFQ = Relative Forage Quality)
§ AU = Animal Unit. One animal unit is equivalent to 1,000 lb.
¶ Tall fescue is not recommended for pastures in the Coastal Plain. Approximations for animal performance for tall fescue in this table assume the use of a recommended novel-endophyte infected variety.

Origin and Types

Bahiagrass is native to South America and is widely distributed in Argentina, Brazil, Paraguay and Uruguay. Several types of bahiagrass have been introduced into the United States since 1913 and differ in cold tolerance, growth characteristics, and forage production.

Common bahiagrass was first introduced into Florida in 1913. It has short, broad leaves and stout stolons. Common is relatively slow to establish and less productive and cold hardy than the later introductions. Common may be found growing in old pastures in some areas, but is no longer planted.

Pensacola bahiagrass was introduced into the United States from South America in the late 1930s (probably in ballast discarded from ships visiting the port at Pensacola, Florida). E. H. Finlayson, a county Extension agent, found this cultivar growing in streets and vacant lots near Pensacola's docks. It is now the most widely grown variety in the United States. Compared to common and other varieties, it has longer and narrower leaves, taller seed stalks, and produces seed earlier. It is more winter hardy than the common and Argentine varieties. Growth begins early in spring and continues until mid-summer when the seedheads mature. Late summer growth is slow and low quality. Pensacola is fairly resistant to ergot, a smut disease affecting the seedheads of some grasses and causing health problems in cattle. Use Pensacola on less fertile soils and in pastures that will not be well managed. Once Pensacola is established, it can be maintained more easily than most pasture grasses.

Argentine was introduced from Argentina in 1944. It has wider and darker green leaves than Pensacola (Figure 2). It is also less cold tolerant and a poorer seed producer than Pensacola. Argentine starts growth later in spring but produces more forage in late summer and early fall than Pensacola. Argentine may also be better adapted to poorly-drained soils than some other introductions. It is less frost tolerant than Pensacola and is very susceptible to ergot.

Paraguay 22 is so named because it is believed to have been introduced from Paraguay. It is a short, coarse, narrow-leaved variety and is less productive than Pensacola. It has been used as a general-purpose turfgrass but seed are no longer available. It is similar to Argentine in growth habit but slightly more upright and more productive than Paraguay. It is not as cold tolerant as Pensacola.

Tifton-9 was a selection from Pensacola that was released in 1987 by the Georgia Coastal Plain Experiment Station. Compared to Pensacola, it is less tolerant of close grazing. However, Tifton-9 has much greater seedling vigor, a more upright growth habit and generally produces up to 25% more forage with digestibility equal to Pensacola. Tifton-9 does not develop a dense sod like the other bahiagrasses and can be established with 8 to 10 lb of seed per acre if drilled. A higher seeding rate may result in quicker stand development.

AU Sand Mountain was developed and released by Auburn University. It was originally selected from a patch of Pensacola that had been planted in the early 1960s on what later became the Sand Mountain Research and Extension Center in northeast Alabama. This variety is more winter hardy than any other bahiagrass variety evaluated in Georgia. It performed and persisted well in yield trials at the Northwest Georgia Research and Education Center near Calhoun. When planted farther south, AU Sand Mountain has forage production between Pensacola and Argentine.

Figure 2. Pensacola bahiagrass (L) has much narrower leaf blades than Argentine (R).

TifQuik, a variant of Tifton-9, is a newly released variety that has proven to have superior seedling vigor and quicker stand formation. The yield potential and other characteristics of TifQuik are essentially the same as Tifton-9.

UF-Riata was developed and released by the University of Florida. It is more cold tolerant in Florida and tends to grow later in the fall and earlier in spring. In central and south Florida, UF-Riata stays green much of the year and may provide slightly better disease resistance than other varieties. It has matched the

yield of Tifton-9 and TifQuik in trials at Tifton and has been observed to stay green a few days longer than the other varieties in the trial. However, UF-Riata has not yet been well studied in more northern locations in Georgia.

Other varieties that have been used or previously studied but are currently of minor importance include Tifhi-1, Tifhi-2, Paraguay 22, Riba, and Wilmington.

Information about currently recommended varieties of bahiagrass may be found on the Forages: Species and Varieties web page (https://georgiaforages.caes.uga.edu/species-and-varieties.html).

Establishment Recommendations

Timing

The best time to plant bahiagrass is in the early spring on upland soils or in late spring on low, moist soils. Plantings made later in the summer can be successful but weed competition (primarily aggressive summer annual grasses, such as crabgrass, goosegrass, and crowsfootgrass) can be a problem. Dry weather can also slow bahiagrass establishment. Bahiagrass can be successfully seeded in early fall in south Georgia.

Seed Size and Dormancy

Bahiagrass seed are small and should be planted shallowly, no more than ¼- to ½-in. deep. This will allow for quicker emergence and promote seedling vigor.

Bahiagrass seed have variable germination rates. Some seeds germinate quickly after planting while others may not germinate until the following year. Generally, 50 to 60% of the seed will germinate within 30 days. TifQuik is the exception, as most of its seed will germinate readily within 1 to 2 weeks after planting if soil conditions are favorable.

Variable germination is the result of a waxy seed coat that limits potential uptake of water. The seed coat has a germination flap through which the seed absorbs moisture for germination. The opening of this germination flap depends on soil temperature, seed production conditions, seed storage conditions, and other factors. In many cases, seed stored for a year have a higher germination percentage than when the seed are first harvested. Seed scarification improves germination for common bahiagrass, but it is usually not necessary for the other bahiagrass varieties.

Seed dormancy is often much lower in some varieties than in others. As a result, seeding rates are higher for some varieties than others (see "Seeding Rates" section).

Planting Methods

Bahiagrass may be planted in several ways. No-till planting methods should be employed if there is a risk of soil erosion (e.g., sloping land). Many local conservation districts or similar organizations may have a no-till drill that can be rented or borrowed. No-till establishment methods can result in an acceptable stand of bahiagrass, but often require high seeding rates (see "Seeding Rates" section) and control of existing vegetation. It is critical that the existing stand/crop and any weeds are destroyed. Sometimes this requires two applications of a non-selective herbicide (4 to 6 weeks apart).

If the risk of soil erosion is minimal, conventionally tilled seedbed preparation can be used to establish bahiagrass. When conventional seedbed preparation and establishment techniques are employed, it is recommended that the "stale-seedbed" method be used. In this method, the first step is to destroy the existing vegetation by spraying with a non-selective herbicide. Next, recommended levels of lime and/or nutrients (based on soil test results) should be added so that they can be incorporated into the soil during the tillage phase. The land can then be tilled, disked, and packed. This also allows for any leveling or smoothing of the soil surface that may be necessary.

The tillage and packing steps should be completed at least 1 month prior to planting so that the soil can settle/firm before planting. Properly packing and firming of the soil is necessary to prevent the seed from being planted too deeply. As a rule of thumb, footprints left in prepared soil that are approximately ¼-in. deep indicate a firm seedbed. In addition to allowing the soil to become firm, this will allow many of the weeds in the disturbed soil to germinate and emerge. These weeds can then be destroyed using a non-selective herbicide within a few days of planting.[1]

Once the seedbed is prepared, seeds may be drilled into the soil or broadcast on top of the soil. When broadcasted, the seed must be covered with soil (no more than ¼- to ½-in. deep) with either a light disking or a cultipacking. Seeding and cultipacking at the same

[1] Check the herbicide label for restrictions on how quickly bahiagrass can be planted after application.

time using a cultipacker-seeder (e.g., Brillion seeder) also works quite well. Seeds can be more precisely placed into the seedbed when drilled. However, the small seedbox attachment must be used to plant bahiagrass because the seed are too small to be accurately measured in the grain drill seed cups.

Seeding Rates

Seeding rates vary with variety and planting method. When using Pensacola or a Pensacola-type variety, the seeding rate should be 12 to 15 lb of seed per acre when the seed are drilled into a prepared seedbed. When broadcasting seed onto a prepared seedbed or using no-till methods, increase the seeding rate of Pensacola-type varieties to 18 to 20 lb per acre.

Tifton-9 and TifQuik have much better seedling vigor than other Pensacola-type varieties and lower seeding rates can be used for these varieties. As a result, the seeding rate for Tifton-9 and TifQuik is 8 to 10 lb per acre on prepared seedbeds and 12 to 15 lb per acre when broadcasting or planting with a no-till drill.

Fertility at Establishment

Prior to planting, apply any needed lime, P, or K (according to soil test recommendations). Avoid applying N before or at planting, as this may increase annual grass emergence before bahiagrass. Apply 35 to 50 lb of N per acre after the seedlings emerge and start to grow. With early planting dates, a second application of 50 to 75 lb of N per acre in early- to mid-summer may be necessary to promote rapid coverage.

Weed Control During Establishment

Good weed control during the establishment phase is essential. Newly established bahiagrass may be less competitive with annual grasses and broadleaf weeds. A thick cover of weeds slows stand establishment by shading the emerging bahiagrass seedlings. Weak stands due to poor seedling establishment can thicken over time. If plants are well distributed over the field, managing the stand to reduce weed competition will increase the opportunity for stand improvement.

Once the bahiagrass seedlings reach a height of 8 in., broadleaf weeds can be controlled with 2,4-D. Care should be taken when using 2,4-D in new plantings since this herbicide does have some pre-emergence activity on grass seed germination and may adversely affect bahiagrass seeds that have not yet germinated.

Currently, there are no herbicides that selectively control annual grasses in newly established bahiagrass. Mowing is the only option when these grasses are a problem in a newly-established field. The mowing height should be adjusted such that little (if any) of the bahiagrass foliage is cut. Mowing once a month (or more frequently) may be necessary, depending on the level of grass competition. Once established, bahiagrass can suppress most weeds and mowing may or may not be necessary.

Carefully managed rotational grazing can accomplish a similar effect, but the animals must be managed to minimize grazing pressure put on the bahiagrass. Cattle should not be allowed to graze new plantings of bahiagrass in the spring months. Heavy trampling may result in destruction of the young plants.

See the *Georgia Pest Management Handbook* (https://ipm.uga.edu/georgia-pest-management-handbook/) and check with your county Extension agent for additional information and current recommendations.

Fertility Management

Though it will persist in low-fertility soils, bahiagrass is responsive to good soil fertility. When it is used in a livestock operation, a good liming and fertility program is essential to the production of good forage yields and to economic returns.

Bahiagrass is very responsive to N fertility (Table 2). After establishment, annual applications of 100 to 200 lb N per acre should be used for good forage production. For better distribution of forage growth, divide the N into two or more applications during the growing season. Higher rates of N per acre should only be used in very intensive grazing or hay production systems.

As in all good fertility programs, soil testing should be the basis for making amendment decisions. Apply lime, P, K, or any other needed soil amendments based on soil test recommendations. All of the P can be applied at any time during the year. Apply half of the K in the early spring and the other half in the summer to prevent luxury consumption of this nutrient by the plant.

Bahiagrass is less sensitive to soil pH than many crops. Applying lime to maintain the soil pH at 6.0 ensures that pH will not be a limiting factor for the bahiagrass, any crops that are overseeded into the bahiagrass, and any crop that may follow bahiagrass in the rotation.

Using Bahiagrass in Sod-based Rotations with Agronomic Crops

Improvements in nearly all facets of crop production have been reported when row crops are grown after bahiagrass compared to following other row crops (Figure 3). This includes the most important factors to producers—yield and crop quality. Yet, there are other proven improvements that result from such rotations. In terms of soil environment, which greatly contributes to the sustainability of agricultural systems, factors such as reduced erosion, build-up of soil organic matter, root growth and depth of penetration by the succeeding crop, water infiltration, earthworm population, and soil tilth all change for the better.

From a row crop standpoint, the most important benefit is usually from reduced incidence of numerous pests. Research results have shown a reduction in early and late leaf spot (*Cercospora arachidicola* and *Cercosporidium personatum*, respectively) diseases in peanut, decreased southern blight/stem rot/white mold (*Sclerotium rolfsii*) in peanuts and cotton, and fewer thrips (*Flankliniella fusca*), leading to less tomato spotted wilt virus (Tospovirus) in peanuts and tobacco.

In addition, it is reported that peanut and soybean root-knot nematode (*Meloidogyne* spp.), reniform nematode (*Rotylenchulus reniformis*), and soybean cyst nematode (*Heterodera glycines Ichinohe*) infestations may decline following bahiagrass since it is a non-host to these pests (McGlohon et al., 1961; Rodriguez-Kabana et al., 1988; Rodriguez-Kabana et al., 1989; Johnson et al., 1999; Katsvairo et al., 2006). Collectively, these factors can result in savings from reduced inputs such as a less frequent need for irrigation, elimination of one or more fungicide spray events, and potentially reduced applications of expensive specialty herbicides due to bahiagrass outcompeting weeds.

In addition to the potential for improved yields and reduced inputs for the row crop enterprise, the inclusion of livestock can be a very successful capital venture that diversifies the farm operation and may serve as a profit center. This can buffer and insulate the farm operation from market fluctuations and, perhaps, catastrophic weather events. Even operations that do not wish to incorporate ownership of livestock could still benefit from similar systems (e.g., contract grazing, selling hay/seed of pasture grasses to nearby cattlemen, etc.). Though an economic analysis should be conducted to determine if a sod-based rotation using bahiagrass is economically feasible in a specific scenario, this may be a profitable rotation system for some farms in the Southeast.

If bahiagrass is to be used in the rotation, it is recommended that it stay in stand for 2 years, followed immediately by peanuts or soybeans, then by a subsequent cotton crop (do not plant cotton immediately after bahiagrass, since there are reports of excessive and rank vegetative growth in cotton that followed bahiagrass).

Figure 3. Peanuts that have been sod-seeded into a field that was formerly in bahiagrass. *Photo: Dr. David Wright, University of Florida.*

Utilization

Bahiagrass has many uses, but it is most commonly used as a pasture species or as a hay crop. Bahiagrass is also an excellent grass species for erosion control and wildlife habitat. Bahiagrass also been increasingly used in "sod-based rotation" sequences (see inset, "Using Bahiagrass in Sod-based Rotations with Agronomic Crops").

Grazing

Well-managed pastures can carry about one animal unit (e.g., a cow-calf pair) per acre from April to mid-October under typical growing conditions. The quality of grazing is highest during the early spring and begins to decline during mid-summer.

Improved varieties such as Tifton-9, TifQuik, and UF-Riata produce 10 to 15% more total forage and provide a slightly higher carrying capacity than Pensacola. However, bahiagrass varieties do not differ substantially in forage quality (Muchovej & Mullahey, 2000).

All bahiagrass varieties produce most of their forage close to the soil surface, regardless of fertilization (Table 3). In fact, approximately 60% of the total forage produced is within 2 in. of the soil surface. Thus, bahiagrass pastures should be grazed close for best forage production and animal performance.

Though overgrazing is undesirable, most bahiagrass varieties can withstand intense, close grazing pressure. Bahiagrass generally grows more prostrate under close grazing and becomes even more compact. Under extremely high grazing pressure, bahiagrass will produce almost all of its leaf area so close to the soil surface that the animals cannot defoliate it (i.e., below the level at which the animals can graze). As a result, bahiagrass is the most grazing-tolerant species used for forage production in Georgia.

By overseeding winter annual grasses and legumes into bahiagrass, the grazing season can be extended and the quality of the forage can be increased. Unfortunately, the compact and dense nature of bahiagrass sods is generally not as good for overseeding as bermudagrass sods. Overseeding with winter annuals such as rye, oats, annual ryegrass, crimson, and arrowleaf clovers can be successful if the soil fertility and weather provide a favorable environment for winter annual growth. However, it is necessary for the bahiagrass sod to be mowed or grazed as short as possible in early October and lightly disked prior to establishment. Winter annuals should not be overseeded until late fall, just prior to the first frost.

During the spring transition, when bahiagrass begins to regrow, winter forages should be removed either by grazing, haying, or mowing. This reduces the competition from winter forages for light, moisture, and soil nutrients when bahiagrass begins its spring growth.

Table 2. Average yield (over 2 years) of Pensacola bahiagrass at different nitrogen (N) levels and clipping frequencies.

Clipping Frequency	N Rate (lb N/acre)			
	0	50	100	200
	Forage Yield			
(week)	(lb of dry matter/acre)			
1	960	1580	2020	3500
2	1220	1940	2560	4260
3	1340	2080	3080	5520
4	1320	2160	3120	5600
6	1400	2460	3580	6420
Avg.	1240	2040	2860	5060

Source: Beaty et al., 1963.

Table 3. Forage availability from Pensacola bahiagrass at various heights as affected by N rate.

Cutting Height	N Application Rate (lb N/acre)			
	0	75	150	300
	Percent of Forage at Cutting Height			
(in.)	(%)			
5+	9.4	10.3	14.7	16.3
4-5	8.1	7.6	8.4	9.1
3-4	9.8	8.5	8.9	9.1
2-3	11.9	10.6	12.2	9.4
1-2	18.0	18.2	17.2	16.3
0-1	42.7	44.8	38.6	39.7

Source: Beaty et al., 1963.

Conserving as Hay

Bahiagrass can make moderate quality hay (50 to 56% TDN and 9 to 11% CP) if it is cut before it becomes overly mature (cut on less than 5-week intervals). Since the majority of bahiagrass forage is located below the typical 1.5- to 2-in. cutting height of most hay harvesting equipment, bahiagrass is generally not considered a good species for hay production (Gates et al., 2004). If hay is a goal, the newer or improved

varieties will provide higher hay yields than Pensacola since they grow more upright and more of the available forage can be harvested. Still, bahiagrass may not be able to produce the high yields that improved bermudagrass varieties are capable of producing, even if it is well fertilized (Figure 4). Therefore, bahiagrass is not recommended for new plantings when hay production is planned.

Commercial hay producers should be aware that bahiagrass is often invasive in bermudagrass stands. When dry, bahiagrass is darker in color than bermudagrass, which may reduce the value of the hay. However, the bahiagrass contamination is typically of little nutritional significance. Thus, such mixed hay can still be fed as part of a balanced ration. Producers seeking to remove bahiagrass from bermudagrass need to first identify the type of bahiagrass that is present. Pensacola bahiagrass and varieties derived from Pensacola (which tend to be more aggressive and, therefore, most commonly found as a contaminant in bermudagrass stands) can be selectively removed from bermudagrass using metsulfuron.

Seed Production

Bahiagrass seed production can be another source of income in addition to hay or grazing. Some of the newer varieties are plant variety protected (PVP) and seed harvested from these varieties cannot legally be sold. However, seed harvested and sold from varieties like Pensacola and Argentine often help cover fertilizer or other annual production costs.

Seed yields may range from 150 to 400 lb per acre. Growth of tillers (which later develop seed heads) is stimulated by removing accumulated forage either through grazing or mowing in the spring and the application of up to 100 lb of N per acre (Gates & Burton, 1998). It is difficult to judge the best time to harvest seed since all the seed do not mature at the same time. A good technique to determine timely seed harvest is to grasp the stem below the seed head and strip the head through moderately tight-closed fingers. Mature seed will easily release from the head. Check multiple heads. When the majority of seed are mature, begin harvest. Do not determine seed harvest by color since many seed are fully mature while still green.

Combined bahiagrass seed are of various stages of maturity, so dry seed as quickly as possible to avoid heat development that reduces germination and quality. In most cases, only one seed harvest is obtained. The time of harvest varies by season, fertility program, rainfall, and utilization or management prior to stem development. Generally, bahiagrass seed can be harvested as early as mid- to late June in the Coastal Plain of Georgia.

Economics

Bahiagrass can be an economical forage, especially for cow-calf producers with limited capital. It can work especially well for cattlemen who are leasing land for pasture production that was previously in agronomic crops. Also, if silvopasture production is a possibility, then bahiagrass will perform better than bermudagrass once the trees produce a canopy.

Bahiagrass is relatively inexpensive to establish and maintain (Tables 4 and 5). Some cattlemen considering which type of grass to plant may compare bahiagrass and bermudagrass. Based on the forage production information in Table 1, annual maintenance costs were estimated using the low, mid-point, and high values for nitrogen fertilization as recommended in Table 1, while keeping the P and K fertilization values constant (Figure 5). These values were then used to calculate annual cow carrying costs at various stocking rates (Figure 6), assuming the low, mid-point, and high stocking rates reported in Table 1.

For example, the mid-range nitrogen fertilization for bahiagrass is 125 lb and the corresponding carrying capacity is 1.0 AU per year. In this instance, the annual variable cost of the bahiagrass will be $223 per acre and the annual cow cost for bahiagrass pasture would be

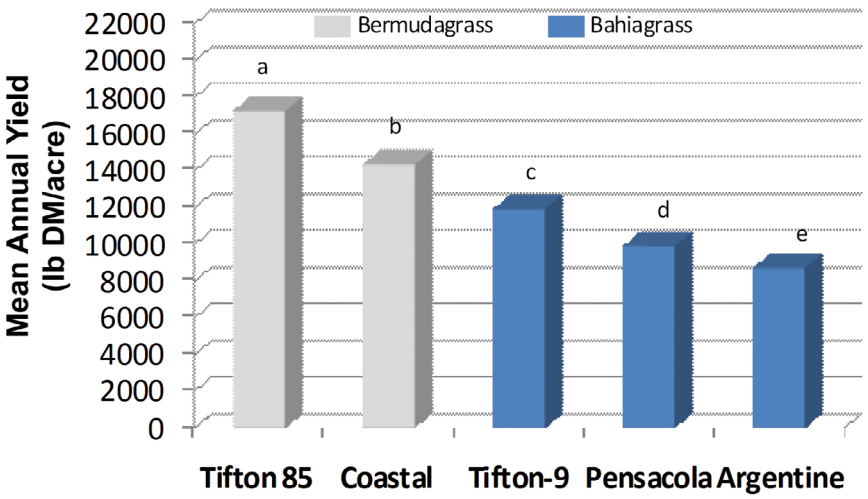

Figure 4. Average forage yield from two bermudagrass and three bahiagrass varieties grown in Tifton, GA, over 3 years (2003–2005). Treatments labeled with different letters were significantly different ($\alpha = 0.05$).

$223 per cow. In contrast, at the higher rate of 175 lb of nitrogen per acre and a carrying capacity of 1.25 AU per acre, bahiagrass has annual variable costs of $258 per acre but the annual cow cost for bahiagrass pasture would be $206 per cow.

Pest Management

Weeds

The best defense against weeds is to implement cultural practices that promote dense, vigorous bahiagrass growth. Once it is well-established, properly maintained bahiagrass is an excellent competitor with weeds due to its thick, dense sod (for weed control recommendations during establishment, see the "Weed Control during Establishment" section). Occasionally, broadleaf weeds can become problematic.

Broadleaf weeds are easily controlled in bahiagrass with several different herbicides. During establishment, bahiagrass seedlings can easily be injured by 2,4-D, so delay applications until the bahiagrass is several inches tall (at least 8 in.) and has formed tillers. At this time 2,4-D can be used at rates of 0.5 to 0.75 lb a.i. per acre. If tall-growing broadleaf weeds develop prior to the time that 2,4-D can be used, mowing can prevent shading of small bahiagrass seedlings. In established bahiagrass, many broadleaf herbicides are now available. A complete list of herbicides that are labeled for

Table 4. Estimated per acre bahiagrass establishment costs.

Variable Cost Item	Unit	Units Per Acre	Total Quantity	Unit Price	Total Amount
			(units)	($/unit)	
Lime (spread)	ton	1	1	$55.00	$55.00
Fertilizer — Preplanting[a]					
Nitrogen	lb	0	0	$0.67	$0.00
Phosphate[b]	lb	40	40	$1.04	$48.80
Potash[b]	lb	40	40	$0.61	$31.60
Fertilizer — Postemergence[a]					
Nitrogen	lb	105	105	$0.67	$77.55
Phosphate[b]	lb	0	0	$1.04	$0.00
Potash[b]	lb	0	0	$0.61	$0.00
Herbicides — Preplant					
Roundup	quart	1	1	$14.00	$14.00
Gramoxone	pint	1.5	1.5	$4.48	$6.72
Herbicides — Postplant					
2,4-D Ester	pint	1.5	1.5	$2.40	$3.60
Seeding[c]	lb	18	18	$3.50	$63.00
Machinery					
Fuel	gallon	2	2	$4.20	$8.40
Repairs & maintenance	acre	1	1	$7.66	$7.66
Land Rental	acre	1	1	$0.00	$0.00
Labor	hr	1	1	$13.50	$13.50
Other	USD	0	0	$0.00	$0.00
Interest on Operating Capital	USD	164.91	164.91	7.5%	$12.37
				Total Variable Cost	**$329.83**
				Machinery Fixed Costs	**$18.97**
				Total Costs	**$348.80**

Note. Input prices from mid-May 2023.
[a] Total includes per acre custom rate of $7.20/acre.
[b] Assumes medium levels of phosphorus and potassium in the soil test.
[c] This is based on a 15 lb per acre pure, live seed seeding rate. It is adjusted to account for germination rate, purity, and other factors.

Table 5. Estimated per acre bahiagrass maintenance costs.

Item	Units	Units		Cost		
		Per Acre	Total Units	$/Unit	$/Acre	$/Ton
Variable Costs						
Fertilizer[a]						
Nitrogen	lb	125	125	$0.67	$90.95	$30.32
Phosphate[b]	lb	40	40	$1.04	$48.80	$16.27
Potash[b]	lb	40	40	$0.61	$31.60	$10.53
Lime (spread)	ton	0.33	0.33	$55.00	$18.15	$6.05
Crop Protection						
Herbicide	apps.	1	1	$3.60	$3.60	$1.20
Other	apps.	0	0	$0.00	$0.00	$0.00
Machinery						
Fuel	gallons	1	1	$4.20	$4.20	$1.40
Repairs & Maintenance	acre	1	1	$4.47	$4.47	$1.49
Land Rental	acre	1	1	$0.00	$0.00	$0.00
Labor	hr	1	1	$13.50	$13.50	$4.50
Other	USD	0	0	$0.00	$0.00	$0.00
Interest on Operating Capital	USD	$107.64	$107.64	7.5%	$8.07	$2.69
				Total Variable Cost	**$223.35**	**$74.45**
Fixed Costs						
Amortized Establishment Costs[c]	year	1	1	$36.13	$36.13	$12.04
Annual Machinery Fixed Costs	year	1	1	$4.47	$4.47	$1.49
General Overhead	% of VC	1	223.35	5.0%	$11.77	$3.72
Management	% of VC	1	223.35	5.0%	$11.77	$3.72
Land	acre	1	1	$0.00	$0.00	$0.00
				Total Fixed Cost	**$62.94**	**$20.98**
				Total Annual Costs	**$286.29**	**$95.43**

Note. Input prices from mid-May 2023.
[a] Total includes custom rate of $7.20/acre for nitrogen, phosphate, and potash applications.
[b] Assumes medium levels of phosphorus and potassium in the soil test.
[c] Establishment costs are amortized over 20 years at a 9% interest rate.

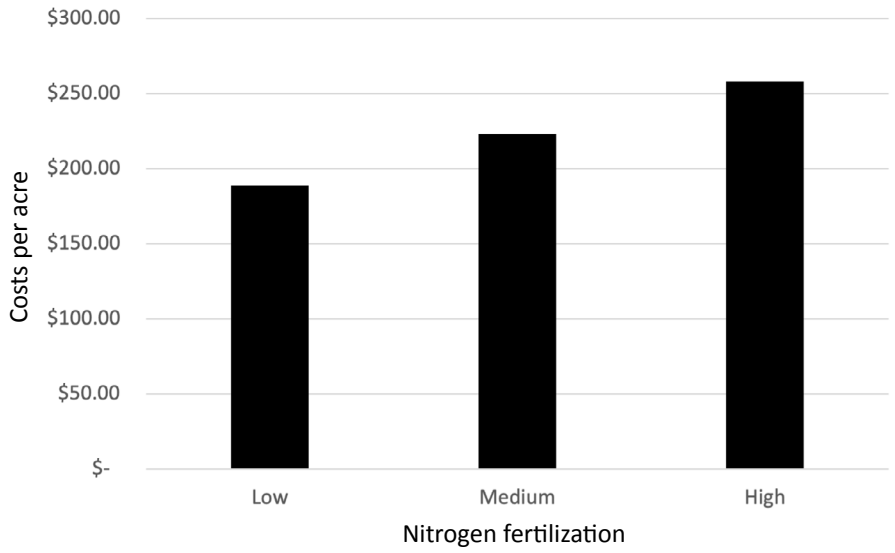

Figure 5. Estimated annual variable costs per acre for bahiagrass at various levels of nitrogen fertilization (using input prices from mid-May 2023).

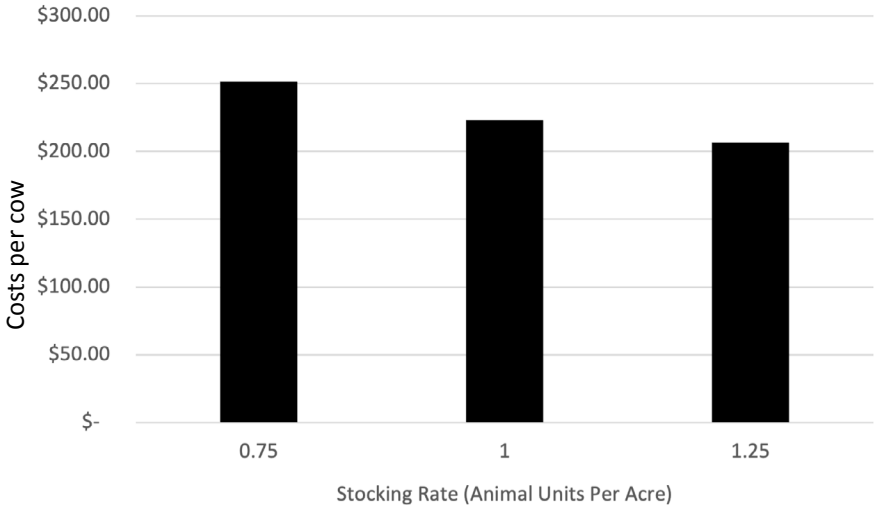

Figure 6. Estimated forage costs per cow per year for bahiagrass at various stocking rates (using input prices from mid-May 2023).

use in bahiagrass can be found in the current *Georgia Pest Management Handbook*.

Weedy grasses, particularly vaseygrass and smutgrass, occasionally cause problems in bahiagrass. If vaseygrass or smutgrass become a problem, an application of hexazinone (Velpar) can be made from April to late July at a rate of 0.67 to 1.12 lb of a.i. per acre. Applications should only be applied when soil moisture is sufficient for good growth (i.e., translocation of the herbicide), humidity is high, and when air temperatures are above 80 °F. Best results occur when 1/2-in. of rainfall occurs within 2 weeks of application. Hexazinone will moderately injure bahiagrass, but it will recover from temporary burn and yellowing within 2 to 4 weeks of application. Hexazinone should only be used on bahiagrass that has been established for 1 year or more.

For more information on the effectiveness of these herbicides on problem weeds, refer to the *Georgia Pest Management Handbook* and check with your county Extension agent for additional information. Always read the herbicide label to determine application rate information, specific weed control recommendations, and any grazing and haying restrictions that pertain to the herbicide.

Insects

While several insects, such as white grubs and spittlebugs, may occasionally cause problems in bahiagrass, the most serious threats are fall armyworms and mole crickets. Fall armyworms feed on all aboveground parts of grass plants. Most severe outbreaks occur in early fall following periods of dry weather. Fall armyworm feeding can result in significant reduction in hay yield or available grazing, but these pests usually do not threaten the grass stand in established fields. Late-season infestations may not cause enough loss to justify treatment.

While fall armyworms may be found throughout the state, mole crickets cause problems only in the Coastal Plain region of south Georgia. Of the species of mole crickets that may be found in bahiagrass, the tawny mole cricket is the most serious pest. This insect feeds on all parts of the plant. Severe infestations can eliminate bahiagrass and any other pasture grass from a field, leaving only the toughest weeds. The release of a parasitic nematode that attacks the mole cricket has helped to reduce the problems from this pest, but the risk of damage is still present.

Current recommendations for insect control (biological and chemical) and insecticide rates for permanent pastures are listed in the current *Georgia Pest Management Handbook*. Again, read the insecticide label to determine application rate information, specific control recommendations, and any grazing and haying restrictions following application.

Diseases

Diseases can occasionally cause significant problems in bahiagrass. Root diseases, leaf blights, or leaf spots have been cited as occasional problems. Generally, well-managed bahiagrass fields are relatively free from most disease problems. There are no cost-effective pesticides for the control of disease in bahiagrass, and none are labeled for use in such an application.

Summary

Bahiagrass is a well-adapted, warm season perennial grass widely used for grazing and hay throughout the Coastal Plain and into the lower Piedmont. It is also an excellent rotation crop for other agronomic or horticulture crops. By selecting the best variety, establishing a uniform stand, fertilizing properly, and controlling weeds, bahiagrass will persist and provide forage for many years.

References

Beaty, E. R., Powell, J. D., Brown, R. H., & Etheredge, W. J. (1963). Effect of nitrogen rate and clipping frequency on yield of Pensacola bahiagrass. *Agron. J., 55*, 3–4. https://doi.org/10.2134/agronj1963.00021962005500010002x

Beaty, E. R., Stanley, R. L., & Powell, J. D. (1968). Effect of height of cut on yield of Pensacola bahiagrass. *Agron. J., 60*(4), 356–358. https://doi.org/10.2134/agronj1968.00021962006000040007x

Gates, R. N., & Burton, G. W. (1998). Seed yield and seed quality response of Pensacola and improved bahiagrasses to fertilization. *Agron. J., 90*, 607–611. https://doi.org/10.2134/agronj1998.00021962009000050007x

Gates, R. N., Quarin, C. L., & Pedreira, C. G. S. (2004). Bahiagrass. In L. E. Moser, B. L. Burson, & L. E. Sollenberger (Eds.), *Warm-season (C4) grasses* (pp. 651–680). https://doi.org/10.2134/agronmonogr45.c19

Johnson, A. W., Minton, N. A., Brenneman, T. B., Burton, G. W., Culbreath, A. K., Gascho, G. J., & Baker, S. H. (1999). Bahiagrass, corn, cotton rotations, and pesticides for managing nematodes, diseases, and insects on peanut. *Journal of Nematology, 31*, 191–200. https://pubmed.ncbi.nlm.nih.gov/19270889/

Katsvairo, T. W., Rich, J. R., & Dunn, R. A. (2006). Perennial grass rotation: an effective and challenging tactic for nematode management with many other positive effects. *Pest Management Sci., 62*, 793–796. https://doi.org/10.1002/ps.1253

McGlohon, N. E., Sasser, J. N., & Sherwood, R. T. (1961). *Investigations of plant-parasitic nematodes associated with forage crops in North Carolina.* North Carolina Ag. Exp. Station Tech. Bul. 148.

Muchovej, R. M., & Mullahey, J. J. (2000). *Yield and quality of five bahiagrass cultivars in Southwest Florida.* Soil and Crop Sci. Soc. of Florida Proc., 59, 82–84.

Rodriguez-Kabana, R., Weaver, C. F., Garcia, R., Robertson, D. G., & Carden, E. L. (1989). Bahiagrass for the management of root-knot and cyst nematodes in soybean. *Nematropica,* 19, 185–193.

Rodriguez-Kabana, R., Weaver, C. F., Robertson, D. G., & Ivey, H. (1988). Bahiagrass for the management of Meloidogyne arenaria in peanut. *Annals Appl. Nematol.*, *2*, 110–114.

Acknowledgements

The authors gratefully acknowledge the use of the copyrighted (2007) bahiagrass photograph on page 1, which is used with permission from the book *Southern Forages* (4th ed.). The photograph has been adapted for use by the authors of this publication, who wish to acknowledge and express their appreciation to Drs. Don Ball, Carl Hoveland, and Garry Lacefield, authors of *Southern Forages* (4th ed.), and Don Armstrong of the International Plant Nutrition Institute for their willingness to allow the use of this photograph. Parts of this publication consist of revised portions of University of Georgia Extension Bulletin 1145 *Bahiagrass Production and Utilization* and the University of Georgia Agronomy Department Leaflet 258 *Bahiagrass*.

We gratefully recognize the contributions of these former contributing authors:
Dennis W. Hancock, former Forage Extension Specialist
R. Curt Lacy, former Extension Economist
T. Wade Green, former Twiggs County Extension Coordinator
Ray Hicks, former Screven County Extension Coordinator

The permalink for this UGA Extension publication is extension.uga.edu/publications/detail.html?number=B1362

Bulletin 1362 **Revised July 2023**

Published by the University of Georgia in cooperation with Fort Valley State University, the U.S. Department of Agriculture, and counties of the state. For more information, contact your local UGA Cooperative Extension office. *The University of Georgia College of Agricultural and Environmental Sciences (working cooperatively with Fort Valley State University, the U.S. Department of Agriculture, and the counties of Georgia) offers its educational programs, assistance, and materials to all people without regard to race, color, religion, sex, national origin, disability, gender identity, sexual orientation or protected veteran status and is an Equal Opportunity, Affirmative Action organization.*