

## Bahiagrass (*Paspalum notatum*): Overview and Management<sup>1</sup>

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Bahiagrass is the most common and widely used warm-season perennial grass in Florida. It is planted to over two million acres in the state and over four million acres in the Southeastern United States. This grass is popular in Florida because of its adaptation to low soil fertility and low input management. Bahiagrass can be established by seed and thus provides easy propagation. It is used mainly for pasture and hay production with intermediate yield and acceptable animal performance. Additional uses include wildlife habitat, erosion control, phytoremediation of phosphorus-impacted soils, and integrated pest management of nematodes and fungal diseases when used in rotation with annual crops.

This publication provides an overview of the grass and details of management and production.

Originally from South America, bahiagrass is well adapted to coastal areas in Florida and the Coastal Plains in the Southern U.S., including Georgia, Alabama, Mississippi, Louisiana, and East Texas. It establishes well in sandy soils with low



water retention and low fertility, and tolerates drought, sporadic flooding, and continuous grazing.

Bahiagrass is a dense, tufted grass with leaves that are crowded at the base and shallow, but sturdy, underground stems (rhizomes). It can grow 12 to 25 inches tall in a prostrate habit, and the seedhead is a two-branched raceme with protruding anthers for pollen production with characteristic purple coloration (Fig. 2). Reproduction is by seed, and bahiagrass spreads vegetatively by short, heavy

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runners (stolons). Genetically, there are two types: diploids and tetraploids, and these will be discussed in the next section.



**Figure 2.** Bahagrass seedhead. The purple anthers can be observed covering each raceme. (Photograph by Carlos Acuna, IFAS/UF.)

Bahagrass is best adapted to sandy loams and tolerates low fertility and low pH. It grows well on soils with acidic pH from 4.5 to 6.5, and the target soil pH is 5.5. At pH greater than 6.5, the grass shows chlorosis and stunted growth. It survives well on droughty soils where it presents a more open stand to compensate for the low moisture available.

Bahagrass grows vigorously under high temperature and long days, and herbage production is greatest from April to October. More than 85% of the production occurs during the six warmest months (April through September).

## History and Released Cultivars

The center of origin of this grass is subtropical South America. It is abundant in northern Argentina, Brazil, Eastern Bolivia, and Paraguay. In Florida, bahagrass has a century-long history as "common" bahagrass. It was first introduced by the Bureau of Plant Industry and grown by the Florida Agricultural Experiment Station in 1913.

Since the initial release, new cultivars have been adopted. The most popular cultivars are the diploid ones including Pensacola, Tifton 9, TifQuik, and UF-Riata. The tetraploids are Paraguay, Argentine, and "common."

## Bahagrass Introductions:

**Pensacola**—Thought to originate from the Santa Fe Province of Argentina, this grass arrived in the Pensacola area of Florida as ship ballast in the 1920s. This variety was identified in 1938 by E. H. Finlayson, Escambia County Extension Agent. He collected and distributed seed of this bahagrass and promoted it for pastures and land conservation. Pensacola bahagrass has narrow leaves, good seed production, and high persistence under grazing. It is more cold tolerant than most tetraploid types. Most bahagrass pastures in the Southeastern U.S. today are Pensacola bahagrass, and 60% of the bahagrass acreage in Florida is estimated to be Pensacola.

**Tifton 9**—This cultivar was developed and released by the University of Georgia and the U.S. Department of Agriculture (USDA) in 1989 by Glenn Burton. Tifton 9 is a selection from Pensacola that was found to have superior yields in early spring and late fall. Tifton 9 is estimated to occupy 10% of the bahagrass acreage in Florida.

**TifQuik**—This cultivar, recently released by the USDA and the University of Georgia, has fewer hard seeds and results in a more rapid or "quick" stand establishment. In the spring, it grows faster than Tifton 9 or Pensacola because of increased seedling emergence.

**UF-Riata**—The University of Florida released this cultivar in 2008. UF-Riata was selected from Pensacola for further improvement in early spring and late fall production, improved frost tolerance, and improved disease resistance.

**Common**—This bahagrass has prostrate growth habit, is cold sensitive, good at spreading, and is persistent under grazing.

**Paraguay and Paraguay 22**—These ecotypes from Paraguay are more upright than common bahagrass but are not routinely used in pastures. Very few acres planted to Paraguay remain in Florida.

**Argentine**—This ecotype from Argentina is highly productive with excellent spreading, lower seedhead production, but it has less frost and cold tolerance than Pensacola. It is estimated that

Argentine makes up 25% of total bahiagrass acreage in Florida.

**Wilmington**—Collected in coastal North Carolina, it has more narrow leaves than typical tetraploid bahiagrass introductions, darker green color and is adapted to higher latitudes. It has turf potential.

## Yield

Bahiagrass herbage production is greatest under the combination of high temperature, moisture, and long days. Annual production ranges from 3,000 to 10,000 lb/acre, depending on soil fertility and moisture conditions. Under highly fertilized management, yields of 12,000 to 14,000 lb/acre may be obtained. In South Florida—under warmer conditions and a mild winter—production is usually 30% or more than that reported in Central and North Florida.

As stated previously, bahiagrass growth is affected by temperature and rainfall. During the months of March, April, and May, the temperatures may be adequate for bahiagrass, but the herbage mass is limited by rainfall. The production will be more limited in areas where soils are predominantly composed of fine sands.

Research reports have shown that rotational grazing will result in greater productivity than continuous stocking (approximately 60 vs. 40 lb/acre of dry matter per day). However, nutritive value is not affected by grazing method.

## Nutritive Value

Energy concentration of bahiagrass—which is reflected in digestibility of the herbage—declines considerably as the season progresses, regardless of fertility or defoliation management. Different studies show that well-fertilized bahiagrass remains at 10 to 12% crude protein (CP).

As a result, bahiagrass is not well suited to support demands of livestock with high nutritional requirements, such as growing animals or lactating dairy cows.

Concentrations for phosphorus (P) in leaf tissue may range from 0.15 to 0.4%, and for potassium (K), may range from 1.2 to 2.5%. If the leaf concentrations of phosphorus drop below 0.15%, or 1.2% for potassium, the addition of fertilizer will be necessary to maintain adequate herbage production.

## Animal Performance

Average daily gains (ADG; lb of live weight gained per day) of bahiagrass are usually lower than other warm-season perennial grasses such as limpograss or bermudagrass. Studies on continuously grazed (continuous stocking) bahiagrass pastures have ADG of crossbred yearling heifers ranging from 0.3 to 1.2 lb/day. However, these numbers generally decline from summer to fall. The ADG in summer will often range from 1.2 to 1.3 lb/day in June to July, 0.4 to 0.3 lb/day in August–September and lower (0.2) in September. When pastures are understocked in the summer, daily gains are usually low, associated with overmature growth.

## Planting

Bahiagrass planting is by seed. Areas selected for planting should have good soil moisture and be well drained. Renovation and replanting of pastures is common, but if planting new sites to Tifton-9 bahiagrass, the ideal planting site would be one that has not already been planted with bahiagrass, such as a bermudagrass or crop field.

In Florida, it is best to establish bahiagrass during the rainy season (June–August). However, if irrigation is available, bahiagrass can be planted as early as March and possibly earlier in South Florida if warm temperatures are present. Better results are obtained if planting in March since bahiagrass will come up before crabgrass and other summer annuals. When planting without irrigation, late March through early May in Florida should be avoided as these are usually drier months compared to those in the summer. If targeting establishment with only summer rains, seedbed preparation should be initiated two months prior to planting (April–May). Control weeds first (see "Weed Control" section), and once weeds are controlled and seedlings emerged, apply fertilizer following the soil test recommendations as detailed below.

After the seedbed is prepared and before broadcasting the seed, pack the soil with a roller to seal in the moisture. Next, plant the seed 1/4 to 1/2 of an inch deep. Beware that a common mistake with bahiagrass planting is burying the seed too deep. Using a cultipacker planter, or any precision seeder, helps in placing the seed at a uniform depth.

**Table 2.** Bahiagrass Seeding Rates

	Seeding Rates (lb/acre)
Pensacola	20–30
Argentine	20–30
Tifton 9	15–20
UF-Riata	15–20
Data from Newman et al. 2008, University of Florida	

Use sufficient seed. The higher the seeding rate, the quicker the stand will close, and the opportunity for weeds to fill in the open areas will be minimized. After seeding, pack the soil with a roller to seal the moisture in the soil.

The weed control in bahiagrass at seedling stage needs to be done mechanically by mowing. From emergence to approximately six inches in height (seedling stage), bahiagrass does not tolerate most herbicides.

Light fertilization of bahiagrass will generally be necessary within 7 to 10 days after seedling emergence. The initial application should consist of 30 lb nitrogen (N)/acre, all of the recommended  $P_2O_5$ , and 50% of the recommended  $K_2O$ . Approximately 40 to 50 days after initial application, an additional 50 lbs of nitrogen and the remaining  $K_2O$  should be applied. If manure or biosolids are used as the main source of nutrients, apply the entire annual application at one time after the plants are large enough to withstand physical damage from the application.

Well-fertilized plants will form a dense stand in 60 to 90 days, at which time a light grazing or mowing can be done.

## Management

### A. Fertilizer and Liming Recommendations

Liming is needed only when soil pH is below the recommended target pH of 5.5. Lime as needed three to six months prior to fertilization to allow for the lime to react with the soil. Test your soil pH every two to three years.

#### 1. Fertilization for Grazed Pastures

##### **Phosphorus Fertilization**

In Florida, special attention should be given to phosphorus fertilization in order to avoid environmental problems associated with phosphorus losses. A soil test in combination with tissue analysis should be used to determine if phosphorus fertilization is needed. A soil test alone is not adequate to determine bahiagrass phosphorus needs, and producers are encouraged to submit both a soil test and a tissue sample. For information on how to submit a tissue sample, see IFAS publication SL 252, *Tissue Analysis as a Nutrient Management Tool for Bahiagrass Pastures* (<http://edis.ifas.ufl.edu/ss475>).

##### **Established Pastures**

Nitrogen is the nutrient that is most limiting to bahiagrass growth, so producers should first consider needs and how much nitrogen they can afford. A medium nitrogen option for grazed, established stands is to apply 100 lb N/acre. The application should be split in two, and the first 50 lb N/acre and all of the soil-test recommended  $P_2O_5$  and  $K_2O$  levels should be applied in early spring. The second 50 lb N/acre should be applied in early summer. For a minimum fertilization alternative, apply 50 to 60 lb N/acre in the early spring to maximize much-needed forage. Do not apply K since N will be the limiting nutrient that the bahiagrass is dependent upon in this low-cost option. Apply 25 lb  $P_2O_5$ /acre if your soil tests "Very Low" or "Low" in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests "Very Low" or "Low" in P. For "Medium" and "High" soil P levels, neither P application nor tissue analysis is recommended since there will be no added benefit of P fertilization on bahiagrass yields.

## 2. Fertilization for Hay Production Only

Apply 80 lb N/acre in early spring. Also in spring, apply 80 lb  $K_2O$ /acre if your soil tests "Very Low" or "Low" in K and 40 lb  $K_2O$ /acre if it tests "Medium." Apply 40 lb  $P_2O_5$ /acre if your soil tests "Very Low" or "Low" in P and tissue P concentration is below 0.15%. Apply an additional 80 lb N and 40 lb  $K_2O$ /acre after each cutting, except the last in the fall. Include 20 lb of  $P_2O_5$ /acre after each cutting if the soil tested "Very Low" or "Low" in P.

## 3. Fertilization for Seed Production

Apply 60 to 80 lb N/acre in February or March. At the same time, apply 80 lb  $K_2O$ /acre if your soil tests "Very Low" or "Low" in K and 40 lb  $K_2O$ /acre if it tests "Medium." Apply 40 lb  $P_2O_5$ /acre if your soil tests "Very Low" or "Low" in P and tissue P concentration is below 0.15%. Graze until May, June, or July, depending on variety. Remove cattle before seedheads start to emerge, and apply an additional 60 to 80 lb N/acre.

If the bahiagrass is not grazed, do not apply fertilizer in February or March since this may stimulate excessive top growth. Mowing from February to April may be needed to remove excessive top growth. Apply 60 to 80 lb N/acre before seedheads first appear. Apply 25 lb  $P_2O_5$ /acre if your soil tests "Very Low" or "Low" in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests "Very Low" or "Low" in P. For "Medium" and "High" soil P levels, neither P application nor tissue analysis is recommended. Apply 50 lb  $K_2O$ /acre if your soil tests "Very Low" or "Low" in K and none if it tests "Medium" or "High." Fertilize Pensacola and Tifton 9 in March/April and Argentine in May/June.

For additional information about bahiagrass fertilization, see IFAS publication SL 129, *UF/IFAS Standardized Fertilization Recommendations for Agronomic Crops* (<http://edis.ifas.ufl.edu/ss163>).

## B. Weed Control

Bahiagrass seedlings are susceptible to phenoxy-type herbicides (2,4-D, dicamba, others),

and they should not be applied until seedlings are at least six inches tall.

Another caution: Pensacola bahiagrass will be severely injured by the herbicide metsulfuron. When Pensacola bahiagrass is a weed in a bermudagrass pasture, metsulfuron will selectively and effectively remove bahiagrass without harming bermudagrass.

Bahiagrass pastures that are well fertilized and growing under optimal conditions will be competitive with weeds. However, many ranchers in Florida use low fertility management, which may require additional intervention for weed control. Most broadleaf weeds can be controlled with dicamba (brand names are Banvel, Clarity, or Vanquish), 2,4-D (several brands) or a combination of the two. Sulfosulfuron (brand name: Outrider) can be applied to established pastures for control of annual or perennial sedges. Hexazinone (brand name: Velpar) is used for smutgrass control, but sprays of this herbicide will need to be kept away from desirable trees, especially oaks. To control specific weeds there are many options. For more information, see IFAS publication SS-AGR-08, *Weed Management in Pastures and Rangeland* (<http://edis.ifas.ufl.edu/wg006>).

## C. Grazing Management

Bahiagrass is a highly persistent grass that has high tiller, rhizome, and root density. Because of its rhizomes, bahiagrass is able to withstand close defoliation. The stubble height in midsummer season should be approximately two inches for hay production, three inches if rotational grazing, and five inches if under continuous stocking. There is plenty of evidence that shows that when pastures are overgrazed and close grazing continues, the bahiagrass will become weak and stand loss will eventually occur.

On the other hand, rapid growth of bahiagrass is associated with rapid decline in nutritive value. By increasing the stocking during rapid growth of bahiagrass, excess old growth would be avoided. Also, the improvement of forage crude protein and digestibility, as well as the better performance of cows and calves will likely occur.



## D. Association with Legumes

In late fall, bahiagrass can be overseeded with annual ryegrass, small grains or clovers. In North and Central Florida, annual ryegrass, small grains, crimson, white, and red clover, and medics are recommended, while berseem clover can be used in Central and South Central Florida. Because of the dense nature of bahiagrass sod, competition from bahiagrass needs to be suppressed or minimized before overseeding with the legumes. A common practice is to graze it very short as the fall season approaches and afterwards do a light disking of the soil to suppress bahiagrass competition with legume seedlings. Another practice is to burn the pasture with herbicide (chemical mowing), but this practice is risky and often results in stand loss.

During the summer, companion legumes to bahiagrass are *Aeschynomene* and carpon desmodium since these species are well adapted to moist, flatwood soils. Other possible companion legumes are alyceclover, cowpeas, hairy indigo, stylo, and perennial peanut; these require good moisture and adequate soil drainage.



**Figure 3.** Bahiagrass and perennial peanut association. (Photograph by Joseph Walter, IFAS/UF.)

## Utilization

### A. Hay

Bahiagrass that is well fertilized and cut prior to seedhead production will make good quality hay. The quality of the grass drops dramatically once the seedheads are present.

Tifton 9 and UF-Riata have a more upright growth and are recommended for producers who want to grow bahiagrass exclusively as a hay crop. These two varieties produce long leaves and a lot of herbage mass.



**Figure 4.** Round bales and square bales of bahiagrass hay. (Photograph by Yoana Newman, IFAS/UF.)

### B. Phytoremediation

Intensively managing bahiagrass for hay or sod production is an option for remediating P-impacted soils due to the increased yields that can be achieved with N fertilization. Studies have shown that yield increases about 70% with N applications at the IFAS recommended rate of 60 lb/acre/harvest. Research reports also show that application of N fertilizer increases bahiagrass P uptake and consequently decreases P losses to groundwater.

Cumulative P removals by bahiagrass under hay production management for a two-year period have been reported at 16 lb  $P_2O_5$ /acre (with no nitrogen fertilizer application) to 50 lb  $P_2O_5$ /acre when bahiagrass was fertilized at the recommended IFAS rate of 60 lb N/acre/harvest. If plant tissue phosphorus is at a high of 0.35% and eight tons of dry matter is produced, approximately 50 lb of phosphorus/acre/year would be removed. Well-managed bahiagrass supplied with adequate N fertilizer for hay production could offer a practical and cost-effective alternative for reducing offsite phosphorus losses from phosphorus-impacted soils.

When managed for sod production, significant P removal can be obtained. For information about P removal from sod, see IFAS publication SL 309, *Phosphorus Removal Rates from Sod Production Systems* (<http://edis.ifas.ufl.edu/ss521>).

### C. Turf and Conservation (Sod)

Bahia grass can make excellent low-maintenance lawns. It forms an extensive and deep root system that makes this grass drought tolerant and desirable for sod production. With escalating urbanization in Florida, many ranches are increasing their acreage for commercial sod production.

Argentine bahia grass is a preferred variety and used broadly for turf production because of its low height, wide leaves and dark green color but mainly because it produces less seedheads than other bahia grasses. For additional information, see IFAS publication BUL 260, *Sod Production in Florida* (<http://edis.ifas.ufl.edu/lh066>).



**Figure 5.** Peanut crop after bahia grass. (Photograph by David Wright, IFAS/UF.)

### D. Seed Production

Bahia grass seed is produced regularly by some ranches to generate additional income. Frequently, seed companies harvest, process and market the seed. Bahia grass is an obligate, long-day plant that will produce the most inflorescences (seedheads) with long days. Argentine bahia grass will flower only at day length greater than 13.8 hours in Florida.

Highest seed yields are obtained when herbage residue from the previous growing season is removed between late April and May and immediately fertilized. If residue is removed early or high N fertilizer is applied, more vegetative growth will occur with less flowering stems developing. Usually, the management of pastures for seed production requires fertilization in early spring and grazing until

the longest days approach or the first signs of flowering occur in early June.

### E. Sod-based Rotation with Agronomic Crops

A recommended sod-based rotation with row crops is a four-year cropping system that includes two years of bahia grass, followed by peanut and then cotton. This sod-based rotation, which replaces the traditional peanut/cotton rotation, has positive impacts on soil health, pest reduction, water use, and sustainable farm production. Studies conducted in North Florida have shown that this is a viable system for farms that are in the 100 to 800 acre range. More specifically, the suggested crop rotation is to grow two years of bahia grass followed by an oat cover crop. Afterwards, the bahia grass is killed off in the second year, next oat is planted into it, and then peanuts are strip-tilled the following warm season. Then oat is again used as a cover crop, and next cotton is planted before going back into bahia grass. Cotton is not recommended right after bahia grass because of reported excessive juvenile (rank) growth. Bahia grass in the rotation can be grazed by cattle, sold as seed, or baled as hay.

Bahia grass' extensive root system penetrates the natural compaction zone that exists at a depth of six to eight inches in most Southeastern coastal-region soils. The roots of the subsequent crop use the channels created by the bahia grass sod. After bahia grass, there can be a four- to six-fold increase in crop roots down to a soil depth of five feet. Nutrient extraction, especially nitrates, is also greatly enhanced when rooting depths are increased. When included in the peanut/cotton rotation, bahia grass reduces nematode infestation since most nematodes will not feed on bahia grass. With a limited food source, nematode levels decline to a point that will not cause economic damage when the host crop is planted.

For additional information, see IFAS publication SS-AGR-126, *Sod/Livestock-Based Peanut/Cotton Production System: Why We Recommend It!* (<http://edis.ifas.ufl.edu/ag258>).

**Table 3.** Peanut yield for two crop rotations in FL during 2003 and 2004.

Rotation	2003	2004
	lbs/acre	
Bahia grass-Bahia grass-Peanut-Cotton	2783	3281
Peanut-Cotton-Cotton	1958	2415

## Insects and Plant Diseases

Mole crickets can cause serious damage to bahia grass pastures in Florida. There are three pest mole crickets (*Scapteriscus* spp.) found in Florida: the southern, tawny, and short-winged mole cricket. Of these three, the tawny is the most damaging. Fortunately, insecticidal-nematode control (*Steinernema scapterisci*) and biological control with a wasp (*Larra bicolor*) are available for controlling these mole crickets.

Bahia grass is susceptible to "dollar spot" (*Sclerotinia homoeocarpa*) and "ergot" (*Claviceps paspali*) diseases in hot, damp weather conditions (July–early September). These diseases will affect seed and production yield, but in general, none of these diseases are toxic or a problem to livestock. However, if grass is heavily infected, pregnant mares may experience abortion, and cattle under stress might have some behavioral impact. If ergot is present, it can be managed by mowing the seedheads or by keeping pregnant horses confined. Dollar spot seems to have more severity in Pensacola bahia grass and Tifton 9 than in Argentine.

## Summary

- Bahia grass is a warm-season plant adapted to areas of low soil fertility typical of Florida's deep, sandy soils. It does not grow well in pH 6.5 and higher.
- Bahia grass production is highest during midsummer when days are long.
- Bahia grass is low to medium in crude protein and digestibility.
- Pensacola and Argentine are recommended cultivars for grazing, Tifton 9 and UF-Riata are recommended for hay production, and UF Riata

is recommended for extending the production season in the fall.

- Mole crickets are a serious pest to bahia grass, but biological control through nematodes and wasp parasites are effective.

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## Additional Information

Bahagrass—Forages of Florida Web site:  
<http://agronomy.ifas.ufl.edu/ForagesofFlorida/detail.php?sp=Bahagrass&type=G>

**Table 1.** Pasture Nutritive Value (Digestibility and Crude Protein) and Herbage Mass of "Pensacola" Bahagrass Pastures During the Grazing Season.

	Digestibility (%)		Crude Protein (%)		Herbage mass (lb DM/acre)	
	2007	2008	2007	2008	2007	2008
May	49	54	10	11	3,400	4,090
June	58	54	16	12	1,500	4,890
July	58	57	15	14	2,500	4,270
Aug	41	53	13	12	3,380	4,312
Sep	48	53	11	11	3,290	4,450

Data from Inyang et al. 2010, University of Florida