UF | IFAS Extension
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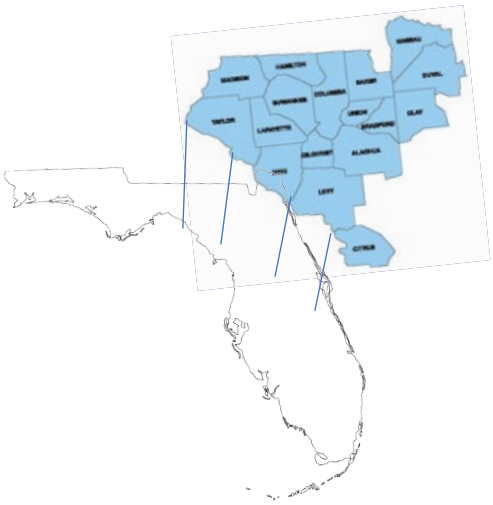
Our "22th Annual"

Livestock & Forages Field Day

July 22, 2021
Santa Fe River Ranch



Presented by:

NORTH FLORIDA
LIVESTOCK AGENTS GROUP

8:30	**Registration**
9:00	**Welcome & Introductions- Dr. Kevin Korus, NFLAG Chair**
9:15	**Florida Department of Ag Office of Agricultural Water Policy- BMP Update, Barton Wilder**

Concurrent Sessions (Pick only 3)

Round 1 9:50-10:10
Round 2 10:15-10:35
Round 2 10:40-11:00

- **Heifer Development**
- **Forage Fertilization**
- **Forage Quality & Nutrition**
- **Heat Synchronization in Cattle**
- **Pasture Weeds**

11:00 – 11:30	**Equipment Demos & Sponsor Break**
11:45	**Lunch**
12:15	**Direct Marketing of Meat Products – Panel Discussion**
1:00	**Adjourn**

Dear Producer:

Welcome to our Annual Livestock & Forages Field Day, hosted by UF/IFAS Extension Agents representing 13 north Florida Counties! We hope you will enjoy the educational activities planned for you today and that you take away new ideas or maybe a slight twist on an old one. Either way our goal is to help you to be more informed and better able to remain sustainable and profitable in all of your agricultural endeavors!

I want to take a moment and ask you to help us thank all of our industry supporters. Please visit their displays and when the time comes for a new purchase, perhaps one of them may be able to help. I want to also again thank you for supporting our efforts, not just today but throughout the year! Whether you attend this event or any of our local programs we appreciate your support and look forward to hearing from you about how we can better meet your educational needs.

Two of our biggest supporters that also need to be thanked are:

> **Alan Hitchcock & his Family** for providing us with this beautiful ranch as a venue each year – Thank you Alan and crew!
> And for always being there to provide us a great meal at this event –
> **Farm Credit of Florida**!

Thank you all for your generosity and support!

Again on behalf of all of us in the North Florida Livestock Agents Group (NFLAG), we appreciate you coming, please let us know if we can help! There are plenty of us.

Sincerely,

Dr. Kevin Korus

NFLAG - Chair

Know Your Heifer

Optimizing Replacement Beef Heifer Development in Florida

In Florida, developing the yearling heifer to generate a successful pregnancy is a major challenge in beef operations. Delayed attainment of puberty and failure to conceive leads to a short term financial burden estimated in $193.00/heifer. Late conception brings further challenges, such as weaning a calf up to 100 lb lighter and breeding late in the next season. The **Know Your Heifer** program is an extension service to beef producers that will enable you to make **cost-effective management decisions**, based on the evaluation of heifers. The objective is to establish a statewide system to generate information on the reproductive potential and performance of replacement beef heifers.

Florida producers can enroll starting October 2020 and will receive two technical visits to the ranch.

First Visit: 30 days before breeding season; heifers evaluated for reproductive potential

Assesment of Age · Breed Composition · Body Weight (if scale is available)
Body Condition Score (BCS) · Reproductive Tract Score (RTS)

RTS is a powerful and accurate indicator of individual heifer's reproductive potential. Based on the RTS and other assessments, ranchers will be equipped to make informed management decisions based on the reproductive potential of heifers.

Second Visit: 90 days after breeding season begins; heifers evaluated for reproductive performance

Heifers will receive a Pregnancy Diagnostic Exam

Producers will know which heifers became pregnant in the first 60 days of the breeding season (Alternative dates for pregnancy diagnostic exam are possible)

The cost-recovery fee for this program is based on our travel expenses and a per-animal fee:

Travel (total for two trips):
<150 miles: U$100.00
>150 miles: U$250.00

Heifer Work (for the two visits)
up to 20 heifers: $15.00/heifer
between 21 and 50 heifers: $12.00/heifer
between 51 and 100 heifer: $10.00/heifer
between 101 and 200 heifers: $8.00/heifer
more than 200 heifers: $7.00/heifer

WHAT YOU GET:

- **Analyses and report on individual and herd reproductive potential (RTS) and performance (preg checks)**
- **Recommendations on implementation of reproductive technologies**
- **Opportunity to connect with many ongoing livestock extension programs**
- **Benchmarking through an anonymous comparative analyses to other herds in Florida at the end of the breeding season**

Contact Dr. Mario Binelli or talk to your Livestock County Agent at your local IFAS Extension Office to sign up!
Find more information at :
www. animal.ufl.edu/extension/beef

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Getting the Most out of Bahiagrass Fertilization[1]

C. L. Mackowiak, A. R. Blount, R. O. Myer, E. A. Hanlon, and M. L. Silveira[2]

Introduction

Florida has about 5 million acres of improved pasture. Bahiagrass is the most adapted pasture grass in Florida. Some of its popularity is attributable to its ability to survive and even thrive where other grasses fail due to pests, drought, flooding, or low soil fertility. However, despite its adaptation, it still requires nutrients whether it is used for hay, sod, or in a pasture system. As with other grasses, bahiagrass can remove considerable quantities of nutrients from the soil (Table 1), which need to be replenished based on a soil test report and interpretation.

The Florida Department of Agriculture and Consumer Services (FDACS) and UF/IFAS have partnered through research and outreach to establish agricultural best management practices (BMPs). The BMPs aim to accomplish optimum agro-economic viability and environmental protection through optimum forage fertilization recommendations. The detailed UF/IFAS N, P, and K fertilizer recommendations for bahiagrass can be viewed on-line (Mylavarapu et al. 2007). The historic record of recommendation development is also available (Hanlon et al. 2006). Information on pasture fertilizer options, including waste materials are available (Mackowiak et al. 2008). Additional management information can be found in the FDACS Cow-calf and Vegetable/Agronomic Crop BMP manuals, and the forage hay interim measure BMP recommendations(http://www.floridaagwaterpolicy.com).

Soil Sufficiency Ranges

Plant-available soil nutrients are determined using various acid extracting solutions, such as Mehlich-1 (also called "double-acid") or Mehlich-3. The soil fertilization recommendations provided by UF/IFAS are based on Mehlich-1 extractable nutrients (Tables 2 and 3). Use only the soil-test interpretation that matches your soil extraction method. Nitrogen fertilization recommendations are based on forage use (the University of Florida Extension Soil Testing Lab (ESTL) does not provide soil N analysis).

Soil micronutrient availability for proper bahiagrass growth throughout Florida is usually not a problem. However, a micronutrient soil test is available to detect potential deficiencies. Many soil micronutrient deficiencies can be offset by maintaining an appropriate soil pH regime for bahiagrass. Table 3 provides critical Mehlich-1 soil test values for Florida agricultural lands.

Soil pH

Regardless of soil type or bahiagrass use, maintaining a proper soil pH (5.5–6.5) is essential for adequate nutrient availability and uptake. If the soil is too alkaline, several micronutrient deficiencies may occur. If the soil is too acidic, sulfur and molybdenum (Mo) deficiencies may occur and manganese (Mn) may become toxic. The pH of some southern flatwoods soils can be 4.8 or lower, which can reduce forage yield. Additionally, if these highly acidic

1. This document is SL249, one of a series of the Soil and Water Sciences Department, UF/IFAS Extension. Original publication date April 2008. Reviewed January 2017. Visit the EDIS website at http://edis.ifas.ufl.edu.

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soils receive only N, bahiagrass stand persistence may be compromised. For example, acidic soils in north Florida that received unbalanced N fertilization may have contributed to a dollar spot (*Sclerotinia homoeocarpa*) outbreak in 2001 (Blount et al. 2002) and mole cricket infestations (Adjei and Rechcigl 2004). Fertilizer recommendations for bahiagrass are precluded by a soil liming recommendation when pH is 5.3 or lower in order to reach a target pH of 5.5. This ensures that there will be good fertilizer uptake by the plant.

Materials other than lime can influence soil pH. Inorganic fertilizers containing ammonium (NH_4 will have some acidifying effect, while "lime stabilized" organic fertilizers, e.g., biosolids and litters, will provide a liming effect. Untreated manures and litters tend to have a slight to moderate acidifying effect. Let your soil analysis report be your guide to liming rates. In general, sandy soils (associated with flatwoods and the central Florida ridge) require less lime to raise soil pH, and the change will be short-lived compared with liming a more loamy soil. Lime applied to pasture without mechanical incorporation rarely penetrates more than 2 or 3 inches into the soil over a year or two. If you frequently add lime, be sure that every few years you check the soil pH at the top 2 inches and compare with the lower 6 to 8 inches to verify that the top sample is within a range of pH 5.5 to 6.5. This range helps avoid nutrient deficiencies, particularly in the spring when the soil is cool and bahiagrass shoot growth begins.

Plant Tissue Nutrient Ranges

Forage tissue along with soil can be used to diagnose and address a nutritional concern. UF/IFAS recommendations for bahia fields with low soil P include forage sampling to verify P fertilization requirements (Mylavarapu et al. 2007). When sampling bahiagrass for tissue analysis, cut only actively growing plants and do not sample when dormant. Cut from 3 to 4 inches above the ground and from several places in your pasture and composite the sample. Be sure not to include any topsoil in your sample and avoid manure piles. Silveira et al. (2007) provides details on bahiagrass forage sampling. Additionally, your county extension agent may provide guidance on sampling technique and further explanation of the laboratory interpretation of tissue test results.

Table 4 provides suggested dry bahiagrass (above-ground) nutrient composition values for Florida. These values are guidelines based on forage yield and economic return. Table 4 will be periodically updated as we improve our understanding of bahiagrass nutritional requirements as they relate to forage use, varietal improvements, fertilizer sources, economic return and environmental protection.

Bahiagrass is prone to leaf yellowing (chlorosis) particularly in the spring and whenever leaf growth is rapid. This leaf yellowing is likely due to root uptake not keeping pace with plant micronutrient needs, particularly iron (Fe). Yellowing often occurs in combination with cool soil temperatures. Maintaining the soil pH from 5.5 to 6.5 seems to minimize the problem.

No reports have shown that leaf yellowing reduces forage yield, but in the case of sod, stand integrity may be compromised with time due to increased susceptibility to mole cricket damage. Iron and other micronutrients may be spray-applied to alleviate the chlorosis. A chelated iron source, plus a manganese (e.g. manganese sulfate) source, should be applied in spring and again in fall to correct any observed deficiencies (e.g. excessive yellowing).

Establishment Fertilization

Preplant fertilization of a clean-tilled seed bed is not encouraged since the risk of fertilizer loss is greater at that time compared with waiting until after emergence when the roots can take up the fertilizer. After emergence, apply 30 lbs N/acre, all the recommended P_2O_5 rate, and 50% of the recommended K_2O rate. After another month when the stand has established, apply the remaining K_2O and 70 lbs/acre of N.

Grazing

The current UF/IFAS fertilization recommendations for Florida pastures provide for low, medium, or high N input systems. Bahiagrass fertilized with a low N option does not remove much P or K. Mineralized manure and urine supply additional nutrients, making it unnecessary to apply P or K for several years. Fertilizer applications (if required) should be made in spring to encourage plant nutrient uptake and rapid growth, which is especially important for cattle coming off winter pastures (Table 5). The low N option prevails with an optimum stocking rate of approximately 3 acres per cow. If higher stocking rates are used, then higher forage production (i.e. fertilization) may be needed to sustain the livestock.

A single hay cutting at the end of the growing season does not require any additional fertilizer after August. Omitting fertilization after August will ensure complete fertilizer utilization. If you cut hay once per season using the low or medium N input option, then follow the cutting with 80

lbs N/acre and 50 lbs K_2O/acre if soil tests very low or low in K. Apply 25 lb/acre P_2O_5 if soil tests very low or low and tissue P < 0.15%. The high N option under grazing requires no additional N for a single hay cutting since ample N was supplied during the season. Apply 80 lb/acre K_2O if soil tests very low or low and 40 lb/acre if soil tests medium. Apply 40 lb/A P_2O_5 if soil tests very low or low and tissue P < 0.15%.

There are other nutritional considerations when using bahiagrass in pastures as related to animal nutrition and health. It is recommended that bahiagrass tissue sulfur (S) be kept at or below 0.35%. High forage S can have a negative effect on copper (Cu) availability in cattle.

Hay/Silage

For multiple hay cuts, apply 80 lbs N/acre and recommended rates (based on soil test and tissue results) of P_2O_5 and K_2O in spring. Apply 80 lbs/acre N, 40 lbs/acre K_2O, and 20 lbs/acre P_2O_5 (if soil P_2O_5 test was very low or low) following each cutting, except the final fall cut. Do not apply any fertilizer after mid-August.

As mentioned earlier, bahiagrass removes large quantities of nutrients per ton of forage (Table 1). The removed forage nutrients must be replaced, first from the soil and second from added fertilizer if the soil content is not sufficient. Knowing the fertility of your subsoil (below 8 inches) as well as your topsoil (0 to 8 inches) may help refine your fertilization program. Nitrogen, P, and K tend to be in greatest concentration near the soil surface, but other nutrients like S, Mg, and some trace elements may be found in greater concentrations in the subsoil. Established perennial forages tend to have root systems that grow more than 4 ft deep, and bahiagrass has a great mass of stoloniferous tissue to store nutrients. Therefore, bahiagrass tends to be more tolerant of low-fertility soils. However, fertilizing bahiagrass hay fields, particularly with N, may increase yields by more than 50% compared with fields that are rarely fertilized.

Seed Production

For seed production in pastures, apply 60 to 80 lbs N/acre and soil-test "spring multiple hay cuts" recommended P and K fertilizer rates in February or March to provide for spring grazing. (hay fields do not require this late winter application.) When seed heads appear, remove cattle and apply another 60 to 80 lbs N/acre. Hay fields with excessive dead grass may require burning in January or February and/or mowing through April. Apply 60 to 80 lbs N/acre and soil-test recommended P and K rates before seed heads appear. Seed is usually ready for harvest in July for the Pensacola variety and August for the Argentine variety. After seed harvest, the remaining forage can be grazed or harvested. Ammonification of this hay can improve its nutritive value (Newman et al. 2007).

Sod

In Florida, many bahiagrass pastures are harvested for sod or utility turf. As with any sod operation, fertilizer and seeding rates are generally higher compared with a pasture situation. Most of the following recommendations were taken from McCarty (1994): Apply N at 40 to 45 lbs/acre and K_2O at 20 to 40 lbs/acre following the first hay cutting. The additional K_2O may improve stress tolerance and promote better rooting of the turf. A subsequent fertilizer application should be made following the second cutting. Continue cutting and fertilizing every 4 to 6 weeks until the grass develops a full sod. Total seasonal N input should be on the order of 100 to 200 lbs/acre. Post-sod removal fertilization rates depend upon removal strip size (from 1 ft to the entire field) and reseeding rate (from 12 lbs/acre to 200 lbs/acre) (Chambliss 2002; Trenholm et al. 2003).

Silvopasture

Bahiagrass is often a component of the agroforestry practice that combines trees, forage, and livestock, also known as silvopasture systems. The following fertilization recommendations are adapted from Tyree and Kunkle (2003): In general, current fertilizer recommendations for silvopasture are based on those for an open pasture. Bahiagrass establishment should follow the establishment recommendations mentioned above. After establishment, N and K_2O fertilizers are split-applied according to UF/IFAS bahiagrass pasture recommendations in spring and summer. Annual application rates of 100 lbs N/acre N, 50 lbs P_2O_5/acre and 65 lbs K_2O/acre provided the highest net returns from the system as a whole (forage, cattle and pines) (Tyree and Kunkle 2003).

Crop Rotation

Bahiagrass has been introduced in a crop rotation to interrupt disease cycles and improve soil quality in cash crop systems (Katsvairo et al. 2006). Establishment fertilization recommendations are the same as provided above. Additionally, if grazing will occur during the bahiagrass portion of the rotation, then the grazing fertility guidelines should be followed. If the bahiagrass will be used for hay, then the hay/seed recommendations should be followed. A well-managed bahiagrass rotation (including good fertility management) can provide disease and soil quality benefits

to the succeeding cash crop in only 2 years. The benefits of a bahiagrass rotation might take longer to achieve if the grass is not properly managed or if managed or by using the low N input management option.

Winter Overseeding

Overseeding dormant bahiagrass pastures is a common practice for livestock operations. It provides grazing during the cool season, particularly in north Florida. The fertilization recommendations for winter forages are provided by Mylavarapu et al. (2007). A potential obstacle to good winter forage growth in a bahiagrass pasture is competition from bahiagrass for water and nutrients. Therefore, do not fertilize bahiagrass any later than late summer (approximately mid-August). Do not fertilize the winter forages until bahiagrass growth has stopped or slowed considerably. Since Argentine becomes dormant earlier than Pensacola or Tifton-9, it is the preferred sod for overseeding winter annuals. Overseeding with legumes can provide a source of N for the bahiagrass in the spring. The legume overseeding may be particularly beneficial for bahiagrass pastures receiving the low N input management option. Blount et al. (2007) provides winter forage recommendations for north Florida. The principal overseeding option for central and south Florida is annual ryegrass.

Summer Legume Overseeding

After a 30+ year hiatus, interest in overseeding summer legumes into bahiagrass pastures is returning. Carpon desmodium and perennial peanut (perennials), and aeschynomene and hairy indigo (annuals) are among some of more popular pasture choices (Newman and Chambliss 2007). Legumes seem to perform better in Pensacola or Tifton-9 pastures, which have less prostrate growth, than in Argentine. Fertilizer inputs should be limited to no more than 50 lb/acre N to lessen grass competition with the legume. Further work is required by UF/IFAS researchers to determine the best fertilization schedule for mixed pastures.

Recommended Reading

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Tyree, A.B., and W. E. Kunkle. 2003. Managing pine trees and bahiagrass for timber and cattle production. CIR1154. Gainesville: University of Florida Institute of Food and Agricultural Sciences. (http://edis.ifas.ufl.edu/AN023).

Table 1. Nutrient removal (lbs per acre) by some forages grown for hay in Florida.

Nutrient	Bahiagrass (5 tons/acre)	Bernudagras (5 tons/acre)	Per. Peanut (5 tons/acre)
	lb/A		
Nitrogen (N)	192	240	288*
Phosphate (P_2O_5)	53	60	55
Potash (K_2O)	223	240	229
Magnesium (Mg)	24	23	54
Sulfur (S)	19	26	18
Calcium (Ca)	32	37	145
Manganese (Mn)	1.5	0.8	1.3
Iron (Fe)	0.6	0.6	0.4
Zinc (Zn)	0.31	0.27	0.23
Boron (B)	0.04	0.04	0.28
Copper (Cu)	0.07	0.06	0.04

*Per. peanut = perennial peanut (obtains nitrogen from the air via symbiotic fixation by Rhizobium bacteria).

Table 2. Mehlich-1 soil nutrient interpretation ranges.

Soil Content	P	K	Mg
		ppm	
Very Low	<10	<20	----
Low	10-15	20-35	<15
medium	16-30	36-60	15-30
High	31-60	61-125	>30
Very High	>60	>125	----

Table 3. Critical low Mehlich-1 soil-test values for micronutrients.

Soil pH	Mn	Cu	Zn
		---------- ppm ----------	
5.5–6.0	3–5	0.1–0.3	0.5
6.0–6.5	5–7	0.3–0.5	0.5–1.0
6.5–7.0	7–9	0.5	1-3

Table 4. Plant tissue nutrient requirements (dry basis) for bahiagrass forage grown in Florida.

Element	Sufficiency Range
	(%)
Nitrogen (N)	1.5–2.5
Phosphorus (P)	0.15–0.35
Potassium (K)	1.2–2.5
Magnesium (Mg)	0.16–0.40
Sulfur (S)	0.18–0.40
Calcium (Ca)	0.3–1.0
	(ppm)
Manganese (Mn)	20–200
Iron (Fe)	50–400
Zinc (Zn)	20–100
Boron (B)	5–50
Copper (Cu)	4–20
Molybdenum (Mo)	0.1–4.0

Table 5. UF/IFAS spring fertilizer recommendations for grazing.

Fertilizer	Low Input	Medium Input	High Input
	lb/A		
N	50–60	100	160[†]
K_2O	0	50[‡]	80[‡]
P_2O_5	25[§]	25[§]	40[§]

[†] Split application (1/2 in early spring; 1/2 in early summer).
[‡] Split application and apply only if soil test result is very low or low.
[§] Apply only if soil test result is very low or low AND forage tissue P is < 0.15%.

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SS-AGR-176

Fertilizing and Liming Forage Crops[1]

Y. C. Newman, C. Mackowiak, R. Mylavarapu, and M. Silveira[2]

Plants require many essential nutrients for growth. To be specific, they require 17 of them. Those nutrients required by plants in large quantities are called macronutrients, and they can be either primary or secondary. Primary macronutrients are required in high quantities and they are nitrogen (N), phosphorus (P), and potassium (K). Those required in moderate quantities are called secondary nutrients, and they are calcium (Ca), magnesium (Mg), and sulfur (S). There are also nutrients that are needed in very little amounts but are as essential for plant growth as the macro and secondary nutrients, and they are called micronutrients (iron, copper, zinc, manganese, boron, molybdenum, chlorine, and nickel). The soil can supply the plant with most, if not all, of the macro - secondary, and micronutrients, but often the supply of one or more of the nutrients is insufficient for optimum growth.

Nitrogen is the nutrient that grass pastures use the most, and when used in a balanced fertilization, it often results in increased forage quality and production. Phosphorus may be deficient in some soils, but other Florida soils are high in native P. Some forage crops may extract sufficient P from the subsoil, even when the P level in the surface soil is low. Potassium (K) may be needed by some forage crops. Under intensive hay or silage production where nutrients are removed from the land, annual applications of N, P, and K are typically required. Potassium is fairly mobile in sandy soils and can quickly become deficient. Calcium, magnesium, sulfur, and some micronutrients may also become deficient in the soil if soil fertility is overlooked.

While routine soil tests do not include a micronutrient analysis, it is suspected that in some areas of Florida S deficiency may be seen in some years and on some crops. Sulfur deficiency may be seen under intensive hay or silage production. Sulfur deficiency symptoms are pale green leaves mainly in young leaves, similar to nitrogen deficiency, but nitrogen deficiency symptoms show pale leaves in older and new leaves. If a producer is concerned or suspects a sulfur deficiency, some sulfur may be added by using ammonium sulfate as the nitrogen source in the first spring application (just be aware that ammonium

1. This document is SS-AGR-176, one of a series of the Agronomy Department, UF/IFAS Extension. Original publication date March 2003. Revised January 2008 and March 2014. Reviewed July 2017. Visit the EDIS website at http://edis.ifas.ufl.edu. This publication is also part of the *Florida Forage Handbook*, an electronic publication of the Agronomy Department, originally written by C.G. Chambliss; revised by Yoana Newman. For more information you may contact the editor of the *Florida Forage Handbook*, Y. C. Newman (ycnew@ufl.edu).

2. Y. C. Newman, assistant professor, Agronomy Department; C. Mackowiak, assistant professor, Department of Soil and Water Sciences; R. Mylavarapu, professor, Department of Soil and Water Sciences; and M. Silveira, associate professor, Department of Soil and Water Sciences; UF/IFAS Extension, Gainesville, FL 32611.

sulfate is an acidifying fertilizer). Use of other S fertilizers such as sul-po-mag or gypsum is another option when no additional N is needed or if your pH is moderately acidic.

Under most circumstances, micronutrients are not deficient in pastures and therefore should not be applied until a deficiency of a specific nutrient is confirmed. A suggestion for new plantings of forages on unplanted and unfertilized flatwood soils is to apply 3 lb./acre of copper with the initial fertilization.

Only the nutrients that are needed by the crop should be included in the fertilizer. For example, if a soil test indicates that phosphorous is adequate, no phosphorus should be included in the fertilizer. Banking fertilizer in the soil is not a profitable method for managing the nutrition of crops, plus there is a high risk of environmental pollution.

How does a manager decide if fertilizer or lime should be applied to a pasture or forage crop? Fertilizer and/or lime should be applied if (1) an increase in forage growth can be expected, (2) if the extra forage is needed, and (3) a return on the investment can be expected. The experience of the forage manager, along with soil testing for pH, P, and K, can be used in making a decision about liming and fertilizing with P and K especially for hay or silage production. There is no point in fertilizing to reach maximum yields if the extra forage produced is not used. To make a profit on the investment, the forage must be utilized or harvested, and the product (animal weight gain, milk, hay, or silage) must be marketed.

Fertilizer should usually be applied at the beginning of the growing season. Warm-season perennial grasses should be fertilized in the early spring (February to March). Spring fertilization stimulates production at a critical time. Some pasture grasses may be given an additional application of N in late season (June) if extra forage is needed, but this is usually not the case for a beef cow/calf operation. The June or late season application is recommended as long as there is no standing water or the water table is not near the surface, in which may cause environmental problems. Although bahiagrass gives little, if any, response to a late-summer/fall application, limpograss, rhodesgrass, and stargrass do. These grasses can be fertilized in the late summer or early fall to extend the grazing season or, in the case of limpograss, for stockpiling. Timely application of fertilizer can be used to increase forage yield and quality, improve stand persistence, and provide for better distribution of forage across the growing season. The producer should consider that the response obtained from an application of fertilizer is influenced by other factors, such as solar radiation, temperature, soil moisture, and grazing management. For example, overgrazing or excessive defoliation limits the ability of the plant to respond to the added nutrients and thereby reduces potential yield.

Some grasses, such as the stargrasses and some of the hybrid bermudagrasses, need to be fertilized annually or maintained in a high-fertility environment in order to keep a good stand. On the other hand, some ranch managers with large, extensive operations may only fertilize their bahiagrass once every three years. This grass can persist under minimum fertility if they are not overgrazed or mismanaged.

Fertilization Recommendations for Specific Forages

Fertilizing for Establishment of Perennial Grasses

Applying nutrients on a clean-tilled seedbed before plant roots are present increases the risk of losing the nutrients through leaching. Heavy rainfall events on the sandy soils of Florida can move nutrients downward in the soil profile and out of reach of plant roots that will be developing later. Therefore, it is suggested that, where possible, nutrients (fertilizer) not be applied until plant roots are present to take them up. On the other hand, biosolids, poultry litter, manures, and composts can be lightly incorporated into the seedbed. They have a slower nutrient release than mineral fertilizers and the organic matter may provide some additional tilth and moisture retention to the soil.

For establishment of new plantings, apply 100 lb. N/acre and split application as follows: apply 30 lb. N/acre, all of the soil test recommended P_2O_5, and 50% of the K_2O as soon as plants emerge. Apply the remaining K_2O and 60–70 lb. N/acre 30–50 days later.

When the new plants are small, only a limited amount of N and K_2O are applied, with additional N and K_2O being applied later to encourage the new plants to continue growing, spreading, and developing into a full and complete stand of grass.

Fertilizing Bahiagrass

GRAZED BAHIAGRASS

Phosphorus Fertilization

In order to receive phosphorus fertilizer recommendations for established bahiagrass, soil AND tissue samples should be submitted to the Extension Soil Testing Lab (ESTL) at

the same time. As per the preliminary research findings, soil tests alone are not adequate to determine bahiagrass P needs. A companion tissue test has therefore been added to the testing procedures along with the soil test to determine the P fertilization needs. Producers are strongly encouraged to simultaneously test soil and tissue samples if bahiagrass pastures have not received P fertilization for long periods. Phosphorus should not be applied if tissue P concentrations are at or above 0.15%, even if soil tested Low in P. For Medium and High soil P levels, P application is not recommended since there is no added benefit of P fertilization on bahiagrass yields.

If P recommendations are not desired and the producer is only interested in either the test for soil pH and lime requirement recommendations or the test for soil pH, lime requirement, K, Mg, and Ca recommendations, the soil sample alone can be submitted to the ESTL. In this case, the soil test report will not include P fertilizer recommendations. (Please choose the appropriate test from the Producer Sample Submission Form.)

Both the consolidated representative soil and the tissue samples should be collected simultaneously from each field of up to 40 acres.

ESTL testing procedures and recommendations for P for bahiagrass may be adjusted as and when field research data becomes available.

MAINTENANCE FERTILIZATION

Four fertilization options are presented below for established bahiagrass pastures. Choose the option which most closely fits your fertilizer budget, management objectives, and land capability. If you will be grazing only your bahiagrass, you should carefully consider the potential for economical return on your investment in fertilizer before using the Medium-Nitrogen or High-Nitrogen options described below. The added forage produced for grazing animals may not be worth the added cost.

- *Low-Nitrogen Option*: Do not use this option if you cut hay, since nutrient removal by hay is much greater than by grazing animals. This option results in the lowest cost of purchased fertilizer. Apply 50–60 lb. N/acre in the early spring. Do not apply K, recognizing that N will be the limiting nutrient in this low-cost option. Apply 25 lb. P_2O_5/acre if your soil tests 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 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.
- *Medium-Nitrogen Option*: Apply 100 lb. N/acre in the early spring. Apply 25 lb. P_2O_5/acre if your soil tests 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. Apply 50 lb. K_2O/acre if your soil tests Low in K and none if it tests Medium or High.
- *High-Nitrogen Option*: Apply 160 lb. N/acre in two applications of 80 lb. N/acre in early spring and early summer. Apply 40 lb. P_2O_5/acre if your soil tests 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 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. Apply 80 lb. K_2O/acre if your soil tests Low in K and 40. lb. K_2O/acre if it tests Medium. No K should be applied if your soil tests High in K. The fertilization rates suggested in this option are high enough to allow bahiagrass pasture to achieve well-above-average production. Management and environmental factors will determine how much of the potential production is achieved and how much of the forage is utilized. A single cutting of hay can be made without need for additional fertilization.

BAHIAGRASS CUT SOMETIMES FOR HAY

For a single cut per year from pastures:

- If you used the **Low-N option** of pasture fertilization, apply 80 lb. N/acre no later than six weeks before the growing season ends. Apply 50 lb. K_2O/A if your soil tests Low in K, and none if it tests Medium or High. Apply 25 lb. P_2O_5/acre if your soil tests 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.
- If you used the **Medium-N option** of pasture fertilization, apply an additional 80 lb. N no later than six weeks before the growing season ends. Apply 50 lb. K_2O/acre if your soil tests Low in K, and none if it tests Medium or High. Apply 25 lb. P_2O_5/acre if your soil tests Low in P and tissue P concentration is below 0.15%.
- If you used the **High-N option** of pasture fertilization, you do not need any additional N fertilization to make

one cut of hay. Apply 80. lb. K_2O/acre if your soil tests Low in K and 40 lb. K_2O/acre if it tests Medium. Apply 40 lb. P_2O_5/acre if your soil tests Low in P and tissue P concentration is below 0.15%.

BAHIAGRASS GROWN ONLY FOR HAY

For multiple cuts of hay: Apply 80 lb. N/acre in early spring. Also in spring, apply 80 lb. K_2O/acre if your soil tests Low in K, and 40 lb. K_2O/acre if it tests Medium. Apply 40 lb. P_2O_5/acre if your soil tests 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 Low in P.

BAHIAGRASS FOR SEED PRODUCTION

Apply 60–80 lb. N/acre in February or March. At the same time, apply 80 lb. K_2O/acre if your soil tests 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 Low in P and tissue P concentration is below 0.15%. Graze until May, June, or July, depending on variety. Remove cattle before seed heads start to emerge, and apply an additional 60–80 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 60–80 lb. N/a before seed heads first appear. Apply 25 lb. P_2O_5/acre if your soil tests 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 Low in K and none if it tests Medium or High. Fertilize Pensacola in March/April and Argentine and Paraguay in May/June.

Special Note if Applying Manure or Biosolids

A different set of economic factors are usually considered when waste materials rather than purchased fertilizer are supplying the nutrients. Additionally, it is often impractical to follow the application timings discussed in this publication when using waste materials from other operations.

Fertilizing Established Pastures of Bermudagrass, Stargrass, Digitgrass (Pangola), Rhodesgrass, and Suerte

For grazed stands, apply 80 lb. N/acre, all of the soil test recommended P_2O_5, and 50% of the K_2O in early spring. Apply an additional 60–80 lb. N/acre and the remaining K_2O at midseason. In central and south Florida, the mid-season application can be delayed and applied in September to early October for fall production on stargrass, hybrid bermudagrasses, and rhodesgrass. Under intensive management in central and south Florida, up to 200 lb. N/acre/year may be economically viable for stargrass and bermudagrass. In this situation, apply 80 lb. N/acre, all of the P_2O_5, and 50% of the K_2O in early spring. Follow with 50 lb. N/acre in midseason, and 70 lb. N/acre and the other 50% of the K_2O in mid-to-late September.

Fertilizing Established Pastures of Limpograss

For grazed stands, apply 60 lb. N/acre and the entire soil test recommended P_2O_5 and K_2O in late winter or early spring. Apply an additional 60 lb. N/acre in late summer or early fall. For a minimum fertilization alternative, ignore the P and K recommendation and apply only 60 lb. N/acre/year.

Fertilizing for Hay or Silage Production from Perennial Grasses (excluding bahiagrass)

For multiple cuts: Apply 80 lb. N/acre and all of the recommended P_2O_5 and K_2O in early spring. 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 in the supplemental fertilizer if the soil tested low or medium in P.

For a single, late season cut from pasture: Apply 80 lb. N/acre if you have not applied N in the past two months, and apply the soil test recommended amount of P_2O_5 and K_2O. If you have applied N in the past two months, do not apply any nitrogen now, but do apply the soil test recommended amount of P_2O_5 and K_2O. Any application of fertilizer should be made no later than six weeks before the growing season ends.

Summer Annual Grasses

Species included are sorghum-sudan hybrids, pearl millet, brown top millet, and Japanese millet.

Apply 30 lb. N/acre, 50% of the soil test recommended K_2O, and all of the P_2O_5 fertilizer in a preplant or at-planting application. Apply 50 lb. N/acre and the remaining K_2O after the first grazing period. Apply an additional 50 lb. N/acre after each subsequent grazing period, except the last.

Warm-Season Legumes or Legume-Grass Mixtures

Species included are aeschynomene, Alyce clover, desmodiums, hairy indigo, stylo, perennial peanut, and other tropical legumes. Apply all of the soil test recommended P_2O_5 and K_2O in spring or early summer when seedlings or regrowth are 3–4 inches tall.

Perennial Peanut Hay Production

Apply all of the soil test recommended P_2O_5 and K_2O in early spring. Make an annual application of 20–30 lb. sulfur/acre applied as a sulfate (e.g., gypsum, ammonium sulfate, magnesium sulfate, potassium sulfate, potassium magnesium sulfate). After each hay harvest, apply an additional 15 pounds of P_2O_5 and 40 pounds of K_2O per ton of hay removed, unless the soil tests high or very high.

Cool-Season Annual Grasses

When planting on a prepared seedbed, apply 30 lb. N/acre, 50% of the soil test recommended K_2O, and all of the P_2O_5 fertilizer in a preplant or at-planting application. Apply 50 lb. N/acre and the remaining K_2O after the first grazing period. Apply an additional 50 lb. N/acre after each subsequent grazing period. When overseeding established perennial grasses with cool-season annual grasses, apply 50 lb. N/acre plus all of the P_2O_5 and K_2O after emergence. Apply an additional 50 lb. N/acre after each subsequent grazing period.

Cool-Season Legumes or Legume-Grass Mixtures

Species included are all true clovers (white, red, arrowleaf, crimson, subterranean), vetches, lupines, and sweet clover. If legumes such as white clover are already established, or if reseeding annual legumes such as crimson clover are re-establishing from natural seed, apply all of the soil test recommended P_2O_5 and K_2O fertilizer in late fall. For new plantings, apply the recommended P_2O_5 and K_2O in a preplant or at-planting application. If legumes are planted in combination with oat, rye, wheat, and/or ryegrass, apply 30 lb. N/acre in a preplant or at-planting application plus one additional 50 lb. N/acre application after the grass is well established. These recommendations are made assuming adequate soil moisture is available from either rainfall or irrigation. In southern Florida, lack of adequate rainfall during the cool season frequently causes stand failure or limits growth. Under nonirrigated conditions in southern Florida, the probability of inadequate moisture is high and the likelihood that the crop will benefit from applied fertilizer is low, especially on the drier soils.

Alfalfa

Apply all of the soil test recommended P_2O_5 and 50% of the K_2O fertilizer in late fall. Apply the remaining K_2O in early spring. If the alfalfa is mechanically harvested rather than grazed, apply an additional 30 lb. P_2O_5 and 60 lb. K_2O/acre after each harvest. An additional application of 100 lb. K_2O/acre in June or July may increase summer survival of alfalfa. Apply 3 lb. boron/acre per year to alfalfa in three 1 lb./acre applications. Copper and zinc fertilizer may be needed if soil pH is above 6.5. The lime requirement shown on the soil test report is adequate for established alfalfa. However, if the alfalfa has not yet been planted, apply and incorporate one ton of lime/acre if the soil pH is below 6.6. Lime is especially important for alfalfa establishment. It is not practical to incorporate lime once the alfalfa is planted. Fertilizer should contain 15–20 lb. sulfur/acre; apply as a sulfate (e.g., gypsum, ammonium sulfate, magnesium sulfate, potassium sulfate, potassium magnesium sulfate) since elemental sulfur reacts too slowly to supply the sulfur needs of the current crop and elemental sulfur may decrease soil pH.

Liming

The primary reasons for liming acidic soils are to increase crop yield and to enhance fertilizer efficiency. Lime also affects the solubility of other elements; therefore, some plant nutrients are made more available by liming, while toxicities caused by excessive concentrations of other plant nutrients are reduced. In addition to neutralizing soil acidity, calcitic limestone supplies the plant nutrient calcium, and dolomitic limestone supplies both calcium and magnesium. While a correct liming program is beneficial for plant growth, excessive liming can be detrimental. Deficiencies and imbalances of certain plant nutrients may result from excessive lime application.

To obtain maximum benefit from liming and to determine the type and quantity of lime to apply, soil and plant factors must be taken into account. The first step is to properly collect a soil sample from the area to be limed. Samples are normally taken to a depth of 4–6 inches. The soil sample should be sent to a reputable soil testing laboratory for determination of pH and lime requirements.

Lime should be incorporated into the soil whenever possible since lime reacts with soil that it comes in contact with. However, it has little immediate effect on the soil pH below the top inch or so. Therefore, lime should be applied and incorporated 3–6 months prior to planting. The frequency of lime application will depend on many factors, including fertilization program, soil type, and crop. Typically, lime application should seldom be more frequent than every three years, with the exception of intensive hay fields that receive high ammonium-nitrogen fertilizer application rates.

If the soil is at or above the target pH, soil calcium in the soil should be sufficient for optimum plant growth. If the soil pH needs to be increased and the level of magnesium is low, liming with dolomitic limestone is a relatively inexpensive method for adjusting the pH and supplying magnesium. Magnesium can be added to the fertilizer.

The target pH for various forage crops is listed in Table 1. All of the recommendations shown in Table 1 are part of the standardized fertilization recommendation system of the UF/IFAS Extension Soil Testing Laboratory. Cool-season legumes are pH-specific, and most of them require high pH of 6 or higher. Warm-season perennial grasses, on the other hand, perform well at a lower pH. Appropriate lime recommendations are automatically recorded as part of the soil test report.

Other Important Considerations

When applying manure, biosolids, and waste materials, producers may apply higher rates than those recommended for mineral fertilizers since the nutrients present in the waste materials need to be converted into forms that the plants can use. However, the producer should not go above rates that are environmentally acceptable. Additionally, timing of nutrient application may be different than those previously recommended.

When applying lime-stabilized biosolids, attention should be given to the liming effect of this material. Soil pH should be carefully monitored to avoid pH conditions above 6.5. It has been demonstrated that bahiagrass growing in soil conditions of pH 7.0 or above will, very likely, perform poorly compared to bahiagrass growing at lower pH conditions.

For additional information see:

- EDIS IFAS fact sheet SL179 *Using Waste Products in Forage Production*.
- EDIS IFAS fact sheet SS-AGR-152 *Fertilization of Agronomic Crops* for a more extensive discussion of micronutrients.
- Forages of Florida website at http://agronomy.ifas.ufl.edu/ForagesofFlorida/index.php.

Table 1. Target pH for different forage crops grown on mineral soils.

Crop Category	Crops Included	Target pH
Bahiagrass	bahiagrass	5.5
Other improved perennial grasses	bermuda, star, rhodes, suerte, and digitgrass	5.5
	limpograss	5.0
Warm-season annual grasses	corn, sorghum, sorghum-sudans, and millets	6.0
Cool-season annual grasses	small grains and ryegrass	6.0
Warm-season legumes or legume-grass mixtures	perennial peanut, stylo, desmodiums, aeschynomene, Alyce clover, hairy indigo, and other tropical legumes	6.0
Cool-season legumes or legume-grass mixtures	All true clovers (white, red, arrowleaf, crimson, subterranean), vetches, lupines, and sweet clover	6.0–7.0
Alfalfa	Alfalfa	7.0

Table 2. Interpretation for bahiagrass soil and tissue test.

Soil Test	Tissue Test	Recommendations
P MEDIUM/HIGH	NO TISSUE TEST	0
P LOW	P ≥ 0.15%	0
P LOW	P < 0.15%	25 or 40 lb. P_2O_5/acre[†]

[†] Recommended amount of P_2O_5 depends upon nitrogen option chosen.

Factors Affecting Forage Quality[1]

M.O. Wallau, A. T. Adesogan, L. E. Sollenberger, J. M. B. Vendramini, and J. C. B. Dubeux, Jr.[2]

What Is Forage Quality?

Forage quality, the degree to which a forage meets animal nutritional needs, is expressed in terms of animal production, such as growth, milk, or wool production. Forage quality is affected by forage nutritive value(i.e., chemical composition and digestibility) and intake, and it can be estimated when forage is the sole source of nutrients to the animal and offered without quantity restrictions (*ad libitum*). It is also dependent on animal species and class, in the sense that the same forage can have higher value for one type of herbivore than to another. Animal performance, whether growth or milk production, depends upon the animal's potential for production, as well as on how much dry matter (DM) the animal eats and the nutritive value of the DM the animal consumes. Therefore, the two forage-related factors that determine animal performance are (1) forage intake and (2) forage nutritive value. Collectively, these factors determine the quality of the forage.

Figure 1. Over-mature bermudagrass hay field. Both an increase in fiber and senescent material decrease the forage quality.
Credits: Marcelo Wallau

Factors Affecting Forage Intake

Forage intake is affected by a range of pasture, animal, environmental and management factors. Herbage allowance (amount of forage available per animal) and canopy structure, composition and arrangement are primary plant determinants of intake. Nutritive value, especially crude protein and digestibility are associated with the passage rate of the forage through the gastrointestinal tract. Forages

1. This document is SS-AGR-93, one of a series of the Agronomy Department, UF/IFAS Extension. Original publication date April 2002. Revised July 2015 and June 2018. Reviewed March 2021. Original authors were A. T. Adesogan, professor, Department of Animal Sciences; L. E. Sollenberger, distinguished professor, Agronomy Department; and J. E. Moore, professor emeritus, Department of Animal Sciences. This publication is a part of the *Florida Forage Handbook*, an electronic publication of the Agronomy Department. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

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of low digestibility and protein have slower passage rate, physically limiting intake (gut fill). Intake is also affected by animal body size, performance level, health, genotype, and social hierarchy. Environmental aspects that affect intake include temperature, humidity, and rainfall. Animals out of their comfort zone tend to reduce time grazing. Management factors — such as stocking rate, type, and level of supplementation, feeding frequency, and availability of water and feed — also affect forage intake. Additionally, for stored forage intake is affected by the type of conservation process (i.e., hay or silage), particle size and nutritive value (e.g., fiber, protein, digestibility) and mold contamination, poor fermentation, or any substances that make the forage less acceptable.

"Voluntary forage intake" is used to describe how much forage DM an animal will consume when adequate amounts of forage are available, when no supplements of protein and energy are fed to the animal, and when adequate minerals are available —either in the forage or as supplements. Energy and protein supplements may either increase or decrease livestock forage intake, depending upon the composition of the forage and the composition and amount of supplement being fed to the livestock.

Factors Affecting Forage Nutritive Value

Forage nutritive value is primarily determined by concentrations of crude protein (CP) and "available" energy in the forage. For many years, total digestible nutrients (TDN) has been used as an overall measure of available energy in forages. In the past 20 years, however, measurements of digestible energy, metabolizable energy, and net energy of forage have increasingly been used, especially for more fine-tuned diets. However, TDN is still an acceptable and easily understood measure of nutritive value, particularly for beef cattle. Forage nutritive value is affected most by variations in forage genotype, maturity, season, and management, and presence of "anti-quality" factors.

1. Genotype

Legumes generally have a higher nutritive value than grasses because of higher CP and TDN concentrations at a given age of regrowth. This results in greater intake by livestock, particularly when compared with warm-season (C4) grasses. The TDN concentrations of legumes and cool-season grasses are similar because legumes typically have higher lignin and cool-season grasses are generally low in fiber and high non-structural carbohydrates. Generalizations about the nutritive value of grasses are risky, but temperate or cool-season grasses, such as rye and ryegrass, are nearly always higher in nutritive value than tropical or warm-season grasses such as bermudagrass and bahiagrass. However, there is much variation in forage nutritive value within and among grass genera, and between varieties of the same species.

2. Maturity

The stage of forage regrowth at the time of utilization—whether as hay, haylage, or grazed forage—has a major influence on forage nutritive value. Forage-regrowth stage is determined by the number of days between harvests for hay or haylage and by the rest period in rotational grazing.

There is always a compromise between forage quantity and nutritive value. Forage nutritive value begins to decline during the regrowth period due to the accumulation of stems and deposition of poorly digested lignin in both leaves and stems.

Maturity of legumes and cool-season grasses can be assessed by determining the physiological stage of growth. For warm-season grasses, however, weeks of regrowth are a better indicator of maturity because flowering may begin shortly after regrowth begins. Table 1 shows a decline in the digestibility and crude protein of Coastal bermudagrass after week five (day 35) of regrowth. The information in this table indicates that harvesting Coastal bermudagrass at intervals greater than five weeks will reduce the nutritive value of this forage. Table 2 provides examples of the effects of forage genotype and maturity on the nutritive value of typical forage grasses in Florida. Each value represents several cuttings made from different varieties in different years. These values are a general reference point. These data suggest that digitgrass and limpograss tend to have higher nutritive value than bahiagrass, bermudagrass, and stargrass, especially at later stages of maturity. These differences often affect voluntary intake as well.

With respect to maturity effects on perennial grasses, the most dramatic difference is the decrease in voluntary intake between six and eight weeks. These data and others show that after eight weeks of regrowth, forage nutritive value will generally be less than needed for livestock maintenance. Exceptions are digitgrass and limpograss, which maintain a somewhat higher TDN when mature than do the other grasses. Consequently, limpograss and digitgrass are excellent forages for fall stockpiling. However, those are often are low in CP when mature, and require protein supplementation for optimum utilization.

3. Season

Seasonal effects on forage nutritive value have been noted in grazing trials in Florida where forage regrowth intervals were kept constant. Gains of grazing cattle have been less during the summer than in spring and fall. This problem is called the "summer slump." This summer slump in cattle weight gain is due at least in part to the effect of the environment on forages. Summer slumps in nutritive value of warm-season grasses have been observed with hay harvested after similar regrowth intervals on different dates throughout the growing season (Table 3). Summer regrowth may have lower nutritive value because high temperature increases lignin deposition, and high rainfall increases growth rates and maturation of the forage.

In the case of hay made in Florida, the negative effects of season and maturity on forage nutritive value may be additive. Spring harvests are made generally after short regrowth periods, while summer harvests are made after long regrowth periods because of heavy summer rainfall that delays harvests. Therefore, the nutritive value of bermudagrass hay is greatest when harvested in the spring or early summer.

4. Management

Pre-Harvest Management: Pre-harvest management for maximum nutritive value of hay or silage involves weed control and frequent cutting. (See discussion above under heading 2, Maturity.) Some producers harvest every four or five weeks throughout the season, making either hay or haylage, depending on rainfall.

Post-Harvest Management: The nutritive value of hay or silage can only be as good as the forage from which it was made. However, post-harvest decreases in hay or silage quality can be minimized by careful management. Post-harvest management of hay requires avoiding rain damage and proper curing of hay to less than 15% moisture. Leaching of nutrients from weathering decreases forage nutritive value. Therefore, hay bales should be stored under a barn or a tarp whenever possible. Post-harvest management of silage involves avoiding rain damage, wilting to 60%–70% moisture when necessary, packing to a density of about 40 lb/cubic feet (as fed), promptly sealing silos (or wrapping haylage bales) on the day the forage is harvested, and feeding out the silage at a rate that prevents heating (over 12 inches per day). For more information, check EDIS publication AN266: Comparison of Hay or Round Bale Silage as a Means to Conserve Forage (https://edis.ifas.ufl.edu/an266).

Growth of yeasts and molds may also decrease forage nutritive value and acceptability, and therefore reduce forage intake by livestock. Additionally, molds may produce mycotoxins, which can reduce animal performance and cause diseases in livestock and people. To avoid mold growth, silages should be harvested and stored at the recommended moisture concentration. In addition, silage or haylage plastic should be maintained properly; any holes should be promptly sealed with silage tape. Silage density and feed out rate should follow the guidelines above to prevent mold growth and heating. Application of additives containing propionic acid or *Lactobacillus buchneri* inoculants can also prevent the growth of molds.

Management of Grazed Pastures: Pastures should be managed to maintain a leafy canopy that is free of weeds and not overly mature to optimize forage nutritive value. Proper stocking rate is the most important factor to match forage quantity and animal requirements (see EDIS publication SS-AGR-92: Grazing management Concepts and Practices–https://edis.ifas.ufl.edu/ag160). If forage CP is low in unfertilized grass, then N fertilizer application will increase forage CP and may also contribute to improved forage intake and animal performance.

5. Anti-Quality Factors

Examples of anti-quality factors in commonly grazed or fed Florida forages are noxious weeds, nitrates, prussic acid, ergot alkaloids, and insect infestation

Nitrate or prussic acid accumulation can occur in certain forages after stressful periods, such as drought, frost, hail, and herbicide or fertilizer injury. Nitrate accumulation is most common in drought-stressed grasses including corn, rye, sorghum, sudangrass, and others. Prussic acid accumulates in members of the sorghum family, including sorghum, sudangrass, and the weed johnsongrass. It is very common immediately after a frost event and can be associated with new growth after drought stress. Both of these compounds—nitrate and prussic acid—can limit oxygen transfer in the blood of livestock. Therefore, the accumulation of these compounds in forage is dangerous. If forages have undergone a stressful period as described above, forage samples should be sent for nitrate or prussic-acid testing before the forage is fed to livestock. Proper ensiling may reduce concentrations of these compounds to safe levels, but testing to ensure safe levels is recommended. Volatile toxic gases can be released during the ensiling process, therefore, workers should be careful when handling ensiled forages, particularly within the first month of ensiling.

Ergot alkaloids have also been observed in a few cases on bermudagrass in Florida, as in Mexico, Texas, and Oklahoma. Problems such as tremors associated with ingestion of ergot alkaloids can be avoided by maintaining a 4- to 5-week cutting interval for bermudagrass, interseeding with legumes or other grasses, and diluting the toxin with nontoxic forages and supplements.Ergot alkaloids from *Claviceps* species can also be a problem affecting seed heads of grasses such as rye, ryegrass, *Phalaris spp*., *Sorghum spp*., and some *Paspalum spp* (e.g., bahiagrass), causing reproductive problems in livestock. In some cases, insects can defoliate the leaves of forages, thus decreasing forage quality.

Implications

Forage quality varies widely due to variations in forage genotype, maturity, season, management, and anti-quality components. Because of all these factors and their interactions, tables of forage quality and nutritive value are unlikely—by themselves—to provide useful information about a particular forage. Therefore, be sure to test forages frequently, using forage samples that are taken carefully to ensure that the samples are representative of the forage that will be consumed by livestock.

Additional Information

Vendramini, J. M., M. S. Silveira, J. D. Arthington, and A. R. Blount. 2015. *Forage Testing*. SS-AGR-63. Gainesville: University of Florida Institute of Food and Agricultural Sciences. https://edis.ifas.ufl.edu/aa192.

Table 1. Nutrient Composition of Coastal Bermudagrass as Affected by Maturity.

	Digestibility	Crude Protein	ADF	Lignin
Maturity (Weeks)	----------%----------			
4	60	18	29	4
5	59	18	30	4
6	56	16	31	5
7	53	13	33	6

Source: Adapted from Mandevbu et al. (1999)

Table 2. Effects of Grass and Maturity on Forage Nutritive Value and Quality.

Grass	TDN[a]			Voluntary Intake[b]		
	4 weeks	6 weeks	8 weeks	4 weeks	6 weeks	8 weeks
Bahia	56	55	54	2.3	2.1	1.7
Bermuda	57	52	44	2.3	2.2	1.8
Star	60	53	49	2.4	2.5	2.1
Digit	60	58	57	2.5	2.7	2.2
Limpo	63	63	56	2.5	2.3	2.2

Source: Adapted from W. F. Brown and R. S. Kalmbacher (May 1998), "Nutritional Value of Native Range and Improved Forages: A Perspective from Central and South Florida," in *47th Annual Florida Beef Cattle Short Course*, 79–87.
[a]Total Digestible Nutrients, percentage by dry matter.
[b] Intake of dry matter expressed as percentage of body weight.

Table 3. Quality of Coastal Bermudagrass Hay Harvested at Different Maturities and Seasons.

Item	Weeks of Regrowth	Harvest Date				
		June 14	July 12	August 9	Septmeber 6	October 4
TDN %[a]	4	55	57	52	53	46
	6	52	51	47	49	48
	8	52	51	46	47	44
QI[b]	4	1.4	1.4	1.3	1.3	1.1
	6	1.3	1.4	1.0	1.2	1.2
	8	1.3	1.1	0.9	1.1	0.8
ADG, lb[c]	4	0.57	0.78	0.72	0.63	0.28
	6	0.34	0.48	-0.04	0.42	0.22
	8	0.16	0.07	-0.39	0.07	-0.39

Source: Adapted from Nelson et al. (October 1980), Louisiana Agr. Exp. Stat. Bull. 730.
[a] Total Digestible Nutrients, percentage of dry matter.
[b] Quality index.
[c] Average daily gain, in pounds/day; feeding trial conducted with steers from December through February for all hays.

Perennial Peanut: Forage Nutritional Composition and Feeding Value[1]

Bob Myer, Lori Warren, Juliet Eckert, Dennis Hancock, Ann Blount, and Clay Olson[2]

Perennial peanut (*Arachis glabrata*; also known as rhizoma peanut) is a warm-season legume that grows well in the lower southeastern United States. This legume is grown for hay, silage and pasture, and as ornamental ground cover. Perennial peanut fills a unique niche in this region because there is no other perennial warm-season legume that rivals its forage quality, persistence, and broad spectrum of uses. Presently, it is commercially produced primarily in north Florida and south Georgia. Most of this production is for hay—in particular, for horses.

Temperate perennial forage crops such as alfalfa (*Medicago sativa*) do not grow well in the lower southeastern United States. Yields of 6000 to 11,000 lb of perennial peanut hay per acre are common (Prine and French 1999; Hill 2002). There is a high value market for hay from perennial peanut in the southeastern United States, in particular to horse owners, as an alternative to expensive alfalfa hay that is shipped in from other parts of the country (Degner et al. 2003).

Perennial peanut production acreage is increasing, but it is still a relatively new crop grown on about 30,000 acres in north Florida and south Georgia (Perennial Peanut Producers Assoc.). Limited information is currently available on the nutritional value of this forage. This publication summarizes nutritional composition data and results of animal feeding studies, including studies with horses.

Perennial peanut hay should not be confused with "peanut hay" which is made from the residue after pod/seed harvest of the annual peanut (*Arachis hypogaea*). There is more information available on the nutrient composition of annual peanut hay than perennial peanut forage. However, this annual peanut hay is not desirable for horses as it is dusty, is almost entirely stems, and is relatively low in nutritional value (Hill 2002).

Nutritional Composition of Perennial Peanut Hay

Table 1 below summarizes composition information and quality indices of perennial peanut hay. This summary represents sampling from 31 different farms located in south Georgia and north Florida from 2005 to 2009 (mostly 2007 and 2008). Unfortunately, no information about maturity, cutting, or variety was recorded. It is assumed that the forage was harvested with the intent to produce good quality hay (primarily for horses), and that most of the submissions were the 'Florigraze' cultivar because it is the most widely grown variety. For comparison, the typical composition of pre/early bloom alfalfa hay is also given in the table.

1. This document is AN234, one of a series of the Animal Sciences Department, UF/IFAS Extension. Original publication date February 2010. Reviewed May 2019. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

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As noted in the table, the average composition of perennial peanut hay compares very closely with that of alfalfa hay. However, a wide variation in the composition of perennial peanut hay was noted. This variation is probably the result of many factors including maturity at harvest, time of cut (first cut vs. second), amount of weed and grass contamination, weather conditions prior to and at harvest, soil fertility, etc. Because of this variation, each lot of hay purchased or produced should be analyzed for forage quality.

Nutritional Value for Livestock

In research studies conducted in Florida and Georgia, perennial peanut forage has been found to be highly nutritious for beef and dairy cattle, and goats (Gelaye et al., 1990; Williams et al., 1991; Hammond et al., 1992; Bennett et al., 1995; Staples et al., 1997; Hernández-Garay et al., 2004; and Williams et al., 2004). Gelaye et al., (1990) reported that goats fed perennial peanut hay actually had slightly greater digestibility of dry matter, fiber, and protein than those fed the alfalfa hay control. The goats also voluntarily ate more perennial peanut hay than alfalfa hay. Hammond et al., (1992) found that perennial peanut forage is a suitable protein and energy supplement feed for wintering cattle, especially for those on low protein grass hay. Thus, for ruminant animals (cattle, sheep, and goats) perennial peanut is very nutritious and well liked. The nutritional quality of perennial peanut appears to be as good as alfalfa.

Nutritional Value for Horses

Not much is known, however, about the nutritional value of perennial peanut for horses. To date only two research studies have been conducted—Lieb et al., (1993) and Eckert (2008). These two studies found perennial peanut hay to be very similar to alfalfa in digestible energy, as well as dry matter, crude protein, and fiber (NDF) digestibilities. A summary of the results is presented in Table 2. For comparison, similar studies conducted with alfalfa hay are also summarized in Table 2.

Eckert (2008) also conducted an *in vitro* study to evaluate the potential digestibility of various perennial peanut hays. *In vitro* (Latin for "within the glass") procedures simulate digestion by animals in the laboratory. The most common *in vitro* digestibility procedures were developed to simulate digestion by cattle. There are now procedures to simulate digestion by horses. One such procedure was used to evaluate several perennial peanut hays, including hays of two new perennial peanut varieties. The results of the *in vitro* study are summarized in Table 3. For comparison, good quality alfalfa hay was also included in the *in vitro* study.

The *in vitro* digestibility of all perennial peanut hays was as good as or greater than that of alfalfa. An exception was with 'Arbrook' variety which had a slightly lower digestibility than alfalfa. However, all perennial peanut hays had very good digestibility. A sample of the perennial peanut hay used in the horse digestibility study of Eckert (2008) was saved and included in the *in vitro* analysis. The digestibility determined *in vitro* was very similar to the digestibility determined *in vivo* ("within the animal"; 68% vs. 66%)

Palatability of Perennial Peanut Forage

Perennial peanut forage is well liked by ruminant animals and horses. As noted above, goats actually preferred perennial peanut hay over alfalfa hay. Perennial peanut hay typically has finer stem texture than alfalfa hay. This is desirable from an intake perspective, especially for horses. Lieb et al., (1993) observed that the voluntary intake by horses was greater for perennial peanut hay than for alfalfa hay. However, in a horse preference study by Eckert (2008), no differences were noted for quantity consumed or the time spent eating perennial peanut or alfalfa hays. The reason(s) for the different results between the two horse studies is not known, but may be the result of differences in hay quality and/or hay texture.

Feeding Tips for Perennial Peanut Hay

Perennial peanut is very nutritious and in most cases has more nutrition than what is needed by the animal. Perennial peanut forage is best used where the high nutritional value would be of most benefit such as for developing replacement beef heifers, or where a producer can get a high financial return such as selling hay for horses.

Feeding Tips for Horses

Since perennial peanut hay is very palatable, care should be taken to prevent over consumption by horses. Because of its high nutritional value, there would be few instances in which perennial peanut hay should be self-fed to horses. Perennial peanut hay is best used as a supplemental feed to other feeds such as grass hay. For example, a mature 1,000 pound, light activity horse (two hours or less riding per day) in good condition eating 16 to 20 pounds per day requires about one pound of protein and ten pounds of total digestible nutrients (TDN; energy) per day. This requirement can be met with 14 to 16 pounds of bermudagrass hay plus two to four pounds of perennial peanut hay per day.

Related EDIS Publications:

Perennial Peanut: A Quick Reference: http://edis.ifas.ufl.edu/ag329

Perennial Peanut: Alternative Forage of Growing Value: http://edis.ifas.ufl.edu/AA148

Marketing Opportunities for Perennial Peanut Hay: http;//edis.ifas.ufl.edu/FE424

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Table 1. Typical composition of perennial peanut hay grown in south Georgia and north Florida (100% dry matter basis).[a]

Item	Average[b]	Possible Range[c]	Alfalfa Hay[b]
Crude Protein	14	11–20	19
Neutral Detergent Fiber (NDF)[e], %	42	36–56	40
Acid Detergent Fiber (ADF)[f], %	32	24–38	32
Lignin[g], %	9	7–12	8
Total Mineral Matter (Ash), %	10	8–12	10
Total Digestible Nutrients (TDN)[h,k], %	60	54–68	62
Horse Digestible Energy (DE)[k], Mcal/lb	1.1	0.9 –1.3	1.13
Relative Feed Value (RFV)[i,k]	145	100–190	150
Relative Forage Quality (RFQ)[j,k]	140	100–180	150
Calcium (Ca), %	1.3	1.1–1.7	1.3
Phosphorus (P), %	0.2	0.2–0.3	0.2
Potassium (K), %	1.4	0.6–1.8	1.8
Magnesium (Mg), %	0.5	0.3–0.7	0.4
Copper (Cu), ppm	6	4–12	12
Zinc (Zn), ppm	34	24–52	30

[a]Summary of analyses done by the University of Georgia Feed and Environmental Water Analytical Lab from 2007 to 2009 and analyses done by and for the University of Florida Animal Sciences Dept from 2005 to 2009.
[b]From analyses of 42 hay samples for each item except the minerals which were from 5 hay samples.
[c]The range was based on a combination of deviation analysis of the analyses of each item and what has been reported previously in the literature (summarized by Eckert 2008).
[d]Early bloom; from NRC (1989) tables values and from the feed/forage library of Dairy One Coop. Inc., Analytical Lab., Ithaca, NY.
[e]NDF is a measure of soluble and insoluble fiber concentration in a feed/forage.
[f]ADF is a measure of insoluble fiber concentration.
[g]Lignin is a part of the insoluble fiber fraction that is largely indigestible.
[h]TDN is a measure of the relative energy or feed value of a feed/forage, the higher the number, the higher concentration of energy.
[i]RFV is an index to estimate forage nutritional quality relative to that of full bloom alfalfa hay which is 100; the higher the number, the higher the quality.
[j]RFQ is similar to RFV but takes into account differences in digestible fiber; RFV and RFQ values are usually similar for legume forages of similar nutritional quality.
[k]DE, TDN, RFV, and RFQ are calculated by the labs using composition analyses results.

Table 2. Summary of studies evaluating the digestibility of perennial peanut and alfalfa hays in mature horses (*in vivo* digestibility), % of dry matter.

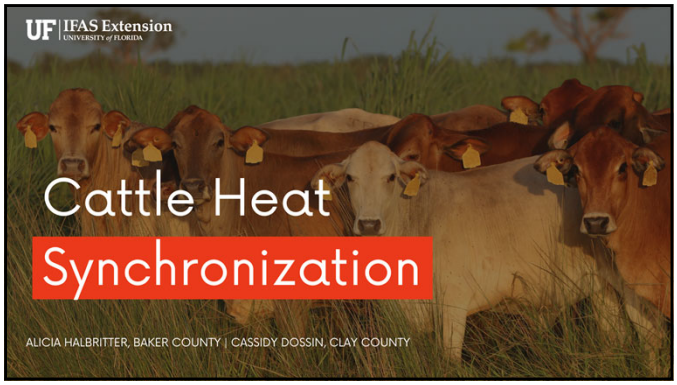
		Apparent Digestibility, %			
Study	Forage	Dry Matter	Organic Matter	Crude Protein	NDF[a]
Eckert 2008	Per. Peanut	65	66	67	45
Lieb et al., 1993	Per. Peanut	56	ND[b]	70	43
Lieb et al., 1993	Alfalfa	62	ND	79	45
Crozier et al., 1997	Alfalfa	58	ND	73	47
LaCaha et al., 1999	Alfalfa	63	74	83	44

[a]NDF = neutral detergent fiber.
[b]ND = not determined.

Table 3. *In vitro* digestibility of perennial peanut and alfalfa hays, % of dry matter.[a]

Species	Variety	Year	IVTD,[b] %
Per. Peanut	Florigraze	2005[c]	68
Per. Peanut	Florigraze	2006	68
Per. Peanut	Florigraze	2006	68
Per. Peanut	Arbrook	2006	66
Per. Peanut	UF-Tito[d]	2006	76
Per. Peanut	UF-Peace[d]	2006	70
Alfalfa[e]	(Unknown)	2006	71

[a]Horse specific *in vitro* procedure used; all samples were done at one time; SE = 2; from Eckert, 2008.
[b]IVTD = in vitro true digestibility (% dry matter disappearance).
[c]Same hay that was used in the *in vivo* horse digestibility study of Eckert (2008) Table2.
[d]Recently released varieties
[e]Hay was purchased locally; early bloom; origin: Iowa.



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CATTLE HEAT SYNCHRONIZATION

Today's Topics

- What is Heat Synchronization
- How Can Heat Synchronization Benefit You
- How to Synchronize Your Cattle

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CATTLE HEAT SYNCHRONIZATION

What Is Heat Synchronization

Restarting the 21 day estrous cycle with medicinal manipulations to tighten the calving season.

3

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CATTLE HEAT SYNCHRONIZATION

Benefits of Heat Synchronization

1. **shorter calving season**
   More females calving within the first 21 days of the calving season.
2. **higher value calves**
   Females calving early in the calving season means larger, higher value calves at weaning.
3. **reduced calf management**
   A more uniform age of your calf crop reduces producer labor in calf processing.

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CATTLE HEAT SYNCHRONIZATION

Protocols: Factors to Consider


Heifers/Cows


Bulls


Facilities & Labor

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CATTLE HEAT SYNCHRONIZATION

Heifers & Cows

Body Condition is a major indicator of potential fertility.

Reproductive Tract Score Assessment completed?

Protocols often are different for heifers. Need longer time to recover after calving.

Early calving cows leads to older calves at weaning.

May not be possible to sync all cows in a herd depdening on bull availability.

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CATTLE HEAT SYNCHRONIZATION

Bulls

Not all bulls are suited to breed synchronized females.

Use bulls that are 2+ years of age with breeding experience, passed a complete breeding soundness exam, and have high libido.

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CATTLE HEAT SYNCHRONIZATION

Bulls

A synchronized herd will require more bulls.

Recommended 1 bull per 10-15 females in the first week of highly synchronized programs.

TABLE 1. EFFECT OF BULL TO HEIFER RATIO ON PREGNANCY STATUS.

	Bull : Heifer Ratio			
	1:50	1:50	1:25	1:16
	Non-Synchronized	Synchronized		
Number of bulls in pasture	2	2	4	6
Pregnancy rate (%)	82	77[a]	83	84[b]

* Each pasture had 100 heifers with different number of bulls present to reach each respective stocking rate.
[a,b] Means within row lacking common superscript differ (P<0.05).
Adapted from Healy et al., 1993.

https://extension.sdstate.edu/how-many-bulls-do-you-need-when-synchronizing-natural-service

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CATTLE HEAT SYNCHRONIZATION

Facilities & Labor

- Labor to round up cattle and manage bulls
- Head Catch Squeeze Chute (2-4 trips)
- Labor to give shots & handle CIDR

Heat Synch Requires handling facilities & available labor to perform protocols. However, it requires less handling than AI.

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CATTLE HEAT SYNCHRONIZATION

Protocols

PGF2 Alfa

$1-$2 / female
One chute trip
Most females need to be cycling for luteolysis

MGA Based

$8- $13 / female
Synthetic Progesterone added to feed for 7-14 days
Can be improved with GnRH (Day 0) & PGF2 Alpha (day 14) dose

CIDR Based

$15-$30 / female
Intravaginal Device that delivers progesterone (better way to ensure accurate dosing versus MGA)
Most popular protocol: 7 days co-synch + CIDR, introduce bull day of removing CIDR. (includes GnRH + PG shot)

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CATTLE HEAT SYNCHRONIZATION

Protocols

PGF2 Alfa

Not ideal for early breeding season
Cheap but will not perform well for heifers, brahman influenced, or cows with poor nutrition.
Prostaglandin will cause abortion & should not be administered to cows who could be pregnant

MGA Based

More expensive than prostaglandin (PGF2 Alpha) but more effective hormone (progesterone). Dietary progesterone not ideal way of administration but can work if handling facilities not availalble.

CIDR Based

Most effective, but most expensive.
Must determine priority (expense or pregnancy rate that tightens calving)

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CATTLE HEAT SYNCHRONIZATION

Resources

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BeefRepro.org

Science-backed protocols & planners.

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Protocols for Synchronization of Estrus and Ovulation

Beef Reproduction Task Force

Introduction

The potential for genetic improvement in beef herds in the US through advances in biotechnology has never been greater. Recent improvements in our understanding of methods of inducing and synchronizing estrus and ovulation in postpartum beef cows and replacement beef heifers creates the opportunity to significantly expand the use of artificial insemination in both purebred and commercial herds. Technology now exists to successfully inseminate beef cows at predetermined fixed times with pregnancy rates comparable to those achieved with heat detection.

While many options exist for synchronization of estrus and ovulation, this short list of protocols was developed based on available research data and field use by the Beef Cattle Reproduction Leadership Team. This group is composed of representatives from the AI and pharmaceutical industries, veterinarians, and reproductive physiologists from the Beef Reproduction Task Force with active research programs in this area.

Selecting a synchronization protocol

Each producer should evaluate available resources and assess the cows or heifers intended for synchronization before selecting a protocol. Key considerations should include time and skill available for heat detection, body condition of the cows or heifers, days postpartum in cows, facilities, experience, and cost.

Amount of Heat Detection

The first step in selecting a synchronization protocol is to determine how much, if any, heat detection is feasible or desired. Some management systems make heat detection and the sorting of animals very simple and effective. In other cases, heat detection can be very difficult. Poor detection efficiency can result in a low AI pregnancy rate. The recommended protocols are divided into three groups based on amount of heat detection required; 1) heat detection for 7 to 8 days, 2) heat detection for 3 days followed by fixed-time AI of all remaining animals not previously detected in heat (clean-up timed AI) or 3) strict fixed-time AI.

Cow factors

Any of the synchronization protocols are recommended for mature cows with a body condition score of 5 or greater that are 50 days or more since calving at the time of AI. Young, thin, and late calving cows are all less likely to have resumed their estrous cycles at the beginning of the breeding season. If a high percentage of cattle are in these categories, consideration should be given to protocols that include a progestin such as a CIDR. The progestin will induce some non-cycling cows to cycle and improve their chance of conceiving to AI. If cows are too thin or have calved too recently, the investment in synchronization of estrus may not be cost effective.

Heifer factors

Age and weight are key factors that influence time of puberty in heifers. Heifers should attain 60% of their mature weight prior to breeding. Because selection pressure on growth has increased mature cow size, producers may tend to underestimate future mature size. Producers that score heifer reproductive tracts at 50 to 60 days prior to breeding have a true measure of physiological maturity and time to adjust rations prior to breeding. If 50% of heifers have a tract score of 3 or greater 50 to 60 days prior to breeding, estrous synchronization programs tend to be more successful. Protocols including a progestin such as MGA or CIDR will induce some prepubertal heifers to cycle.

Other

Length of the protocol, number of times handled, and the ability to successfully deliver treatments such as MGA are other factors that must be considered when choosing a synchronization protocol. Management system, feed resource flexibility, and facilities will play a role in which protocol works best in each particular environment. Success of any protocol is dependent on the proper administration and timing of treatments. For help see the Estrus Synchronization Planner at http://www.iowabeefcenter.org/content/software_estrus%20planner.html

Cost

If labor is available or can be hired, protocols using heat detection are generally lower cost than fixed-timed AI. Treatments, semen and number of handlings will contribute to cash costs of synchronization. Estimated savings from fewer bulls needed for natural service and increased returns from age and weight of AI sired calves should be

considered. Producers that find AI most cost effective are those that capture additional returns from AI sired calves.

Which animals should I synchronize?

When starting an AI program for the first time, replacement heifers probably are the easiest group of animals to work with and first calf heifers the most difficult group to achieve success. Start simple and add more animals as you gain experience.

PRODUCTS USED

Hormones common to many protocols are prostaglandin $F_{2\alpha}$ (**PG**), gonadotropin releasing hormone (**GnRH**) and progestins. They are available in the following commercial products. Follow label directions for dose and route of administration.

Type	Commercial Names
GnRH	Cystorelin®, Factrel®, Fertagyl®, OvaCyst®
PG	estroPLAN®, Estrumate®, In-Synch®, Lutalyse®, ProstaMate®
Progestin	MGA® (melengesterol acetate)
	CIDR® (progesterone)

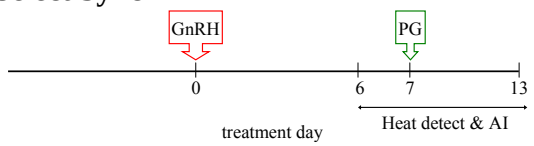
PROTOCOLS

Heat Detection Protocols

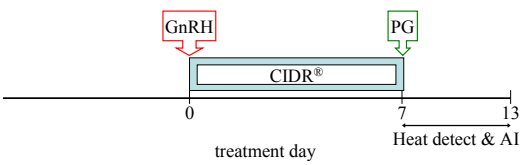
Animals in these protocols should be inseminated 6 to 12 hours after the first observation of standing heat. During peak activity (48 to 72 hours after PG for most systems), heat detection for a total of three hours per day at three or more times would be a minimum and a total of 5 to 6 hours better.

Select Synch and **Select Synch + CIDR®** are protocols for use in cows. Including the CIDR is recommended when more cows are likely to be anestrus and/or when heat detection prior to PG is not feasible. With Select Synch, 5 to 20% of the animals may show heat 1.5 to 2 days before PG. Both protocols could be applied to the same group of cows, with CIDRs selectively placed in young, thin, and/or late calving cows.

Select Synch

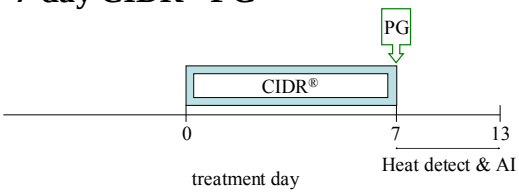


Select Synch + CIDR®



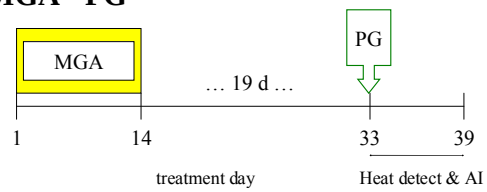
The **7-day CIDR®-PG** protocol is recommended in heifers in contrast to the Select Synch + CIDR® protocol in cows. The difference is that heifers do not require the GnRH injection at the beginning of the treatment. Research has shown pregnancy rates from the CIDR®-PG protocol similar to those from the Select Synch + CIDR® protocol in heifers. Select Synch is not preferred for heifers because a wider range in responses to Select Synch has been reported in heifers perhaps due to inconsistent response to GnRH.

7-day CIDR®-PG



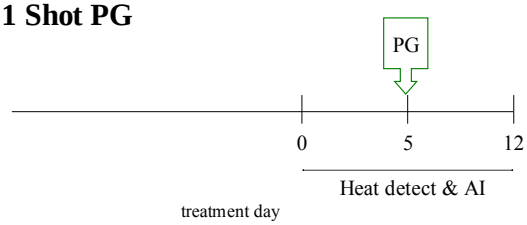
Feeding of MGA is specifically approved for estrus suppression in heifers only. The MGA-based protocol recommended for heifers is **MGA®-PG**. More advance planning is needed as this protocol begins with feeding MGA for 14 days starting 33 days before PG injection. If MGA can be delivered accurately on a daily basis; this is a very effective protocol in beef heifers. The original recommendation for the interval between the last feeding of MGA and PG injection was 17 days. Delaying this interval to 19 days improves synchrony of estrus.

MGA®-PG



A single injection of PG can be used on heifers. This protocol does not provide the degree of synchrony of others and the heat detection period is twice as long. Nevertheless, it is a low cost method that often works well for those just starting to use AI. It could be used on cows but because sorting and heat detection are more complex when the calf is present, other options should be strongly considered. Heifers that have not reached puberty or cows that have not initiated estrous cycles do not have a corpus luteum (CL) and **will not** respond to this treatment. Heifers observed in heat and inseminated before the time of PG injection do not require PG.

1 Shot PG



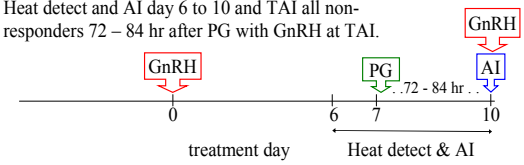
Heat Detection & Timed AI (TAI) Protocols

Heat detection and timed AI protocols involve AI 6 to 12 hours after observed estrus for 3 days then timed AI of all non-responders 72 to 84 hours after PG with GnRH given at TAI. The amount of time spent on heat detection is reduced and early responders have a better chance of conceiving compared to a single fixed-timed AI.

The same protocols recommended for heat detection are also recommended for the combination of heat detection and timed AI in cows. The success of these protocols is still dependent on good heat detection, particularly for early heats in the Select Synch protocol.

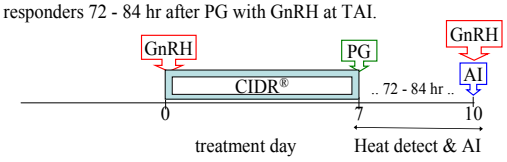
Select Synch & TAI

Heat detect and AI day 6 to 10 and TAI all non-responders 72 – 84 hr after PG with GnRH at TAI.



Select Synch + CIDR® & TAI

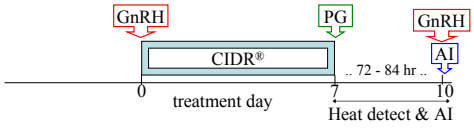
Heat detect and AI day 7 to 10 and TAI all non-responders 72 - 84 hr after PG with GnRH at TAI.



In heifers, the MGA®-PG protocol can be used combining heat detection and timed AI. A second protocol recommended for use in heifers is Select Synch + CIDR®. GnRH is recommended in this protocol as it adds little additional cost and heifers that do respond with a new follicular wave are more likely to conceive at the clean-up timed AI.

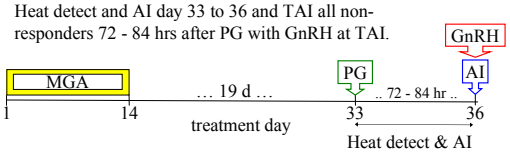
Select Synch + CIDR® & TAI

Heat detect and AI day 7 to 10 and TAI all non-responders 72 - 84 hr after PG with GnRH at TAI.



MGA®-PG & TAI

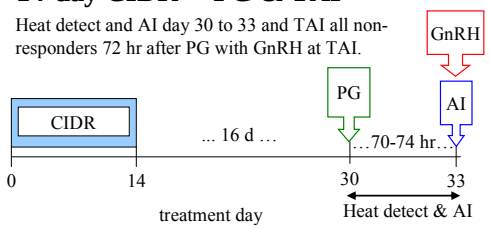
Heat detect and AI day 33 to 36 and TAI all non-responders 72 - 84 hrs after PG with GnRH at TAI.



The third option for combination heat detection and TAI in heifers is **14-day CIDR® – PG**. This protocol appears similar to MGA-PG but the interval between CIDR removal and PG is reduced to 16 days. This is because the progesterone in CIDR treated animals is cleared from the body much faster than melegesterol acetate in MGA-treated animals.

14-day CIDR® - PG & TAI

Heat detect and AI day 30 to 33 and TAI all non-responders 72 hr after PG with GnRH at TAI.



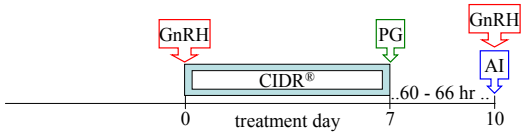
Fixed-Time AI protocols

In fixed-time AI protocols, all animals are inseminated at a predetermined time. For cows, fixed-timed AI can produce similar pregnancy rates as protocols that require 5 to 7 days of heat detection. For heifers, pregnancy rates from current TAI protocols tend to be 5 to 10% lower than using heat detection alone. The times listed for fixed-time AI should be considered as the approximate average time of insemination. This should be based on the number of females to inseminate, labor and facilities.

The **7-day CO-Synch + CIDR®** protocol is recommended for both cows and heifers. Cows should be inseminated between 60 and 66 hours after CIDR removal. Insemination time for heifers is recommended at 52 to 56 hours after CIDR removal. A shortened **5-day CO-Synch + CIDR®** protocol is another option for cows. Two full doses of PG given 8 hours apart are critical for success in the shortened protocol.

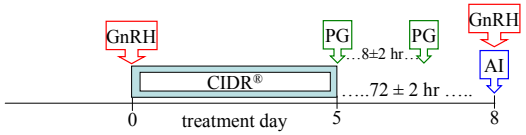
7-day CO-Synch + CIDR® - Cows

Perform TAI at 60 - 66 hr after PG with GnRH at TAI.



5-day CO-Synch + CIDR® - Cows

Two injections of PG 8 ± 2 hr apart are required for this protocol.
Perform TAI at 72 ± 2 hr after 1st PG with GnRH at TAI.

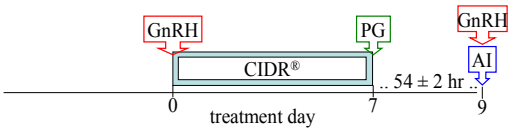


MGA®-PG can be used with fixed-timed AI in heifers; however, pregnancy rate will likely be lower than with the CO-Synch + CIDR® protocol or 14-day CIDR®-PG. For many producers a CIDR-based protocol would be lower risk for fixed-timed AI than

MGA®-PG as they are not reliant on accurate, daily MGA consumption and control of follicular growth should be better. The 14-day CIDR®-PG is the most recent fixed-timed AI protocol for heifers. It is 3 days shorter than MGA®-PG and requires one more handling than CO-Synch +CIDR®.

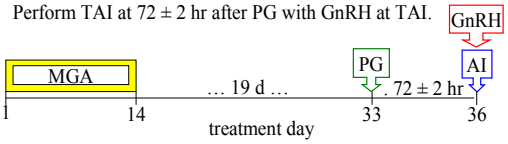
CO-Synch + CIDR® - Heifers

Perform TAI at 54 ± 2 hr after PG with GnRH at TAI.



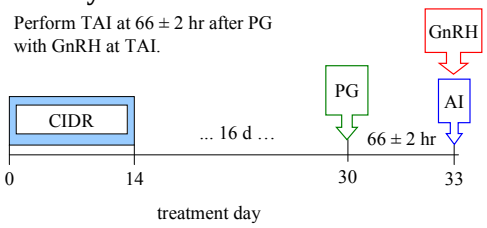
MGA®-PG

Perform TAI at 72 ± 2 hr after PG with GnRH at TAI.



14-day CIDR® - PG

Perform TAI at 66 ± 2 hr after PG with GnRH at TAI.



Concluding Comments

Considerable research and field data support the use of these protocols as described. General comparisons of the protocols are found in Tables 1 and 2. Other protocols should only be considered in unique situations and with the advice of someone with extensive experience with synchronization protocols. Alterations of any protocol should be supported with sound research data.

COMPARISON OF PROTOCOLS

Table 1. Beef Cows

Heat Detection	Cost	Labor	Reports[a]	No. of cows	Pregnancy Rate[b]	
					Range	Avg.
Select Synch	Low	Medium/High	4	678	38-70	46
Select Synch + CIDR®	High	Medium	8	595	42-85	51
Heat Detect & TAI						
Select Synch	Low	Medium/High	6	2048	31-89	51
Select Synch + CIDR®	High	Medium	8	1596	36-77	56
Fixed-time AI						
7-day CO-Synch + CIDR®	High	Medium	23	10,701[c]	32-79	58
5-day CO-Synch + CIDR®	High	Medium	8	2189	49-80	62

[a]Number of reports in published literature
[b]Number pregnant to AI / total number treated
[c]Includes field data from 35 herds (3015 head) in Missouri

Table 2. Beef Heifers

Heat Detection	Cost	Labor	Reports[a]	No. of heifers	Pregnancy Rate[b]	
					Range	Avg.
1 Shot PG	Low	High	1(18 herds)	2700		45
7-day CIDR® - PG	Medium	Medium	1	147	41-59	51
CIDR® - PG (3 days of heat detection)			2	745	33-61	46
MGA® - PG	Low	Low/Medium	6	2746	40-71	60
Heat Detect & TAI						
Select Synch + CIDR®	High	Medium	2	748	31-67	56
MGA® - PG	Medium	Medium	5	1905	48-64	56
14-day CIDR®-PG	Medium	Medium	2	159	50-62	56
Fixed-time AI						
CO-Synch + CIDR®	High	Medium	11	1495	24-68	50
MGA® - PG	Medium	Medium	5	831	36-62	46
14-day CIDR®-PG	Medium	Medium	1	934[c]	58-69	63

[a]Number of reports in published literature
[b]Number pregnant to AI / total number treated
[c]Includes field data from 5 herds (734 head) in Missouri

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SS-AGR-08

Weed Management in Pastures and Rangeland—2020[1]

B. A. Sellers and P. Devkota[2]

Weeds in pastures and rangeland cost ranchers more than $180 million annually in Florida by reducing forage yield, lowering forage quality, and causing animal injury through toxicity or specialized plant organs (thorns and spines). Effective weed management begins with a healthy pasture. Weeds are seldom a serious problem in a well-managed, vigorously growing pasture. Good pasture management involves the proper choice of the forage species and variety, an adequate fertility program, controlled grazing management, and pest management (weeds, insects, and diseases).

If pasture health declines, weeds will become established. Unless the pasture-management problem that caused forage decline is corrected, the grass will not re-establish and weeds will continue to re-infest the area. Bare ground is the perfect environment for establishment of weeds. Once established, weeds must be effectively controlled with mechanical or chemical methods.

Integrated weed management is both an economically and environmentally sound approach to weed management. An integrated approach involves scouting, prevention, and control (biological, cultural, mechanical, and chemical) in a coordinated plan.

Scouting

Scouting pastures periodically, which is often overlooked, is the foundation of a sound weed management program. Scouting involves routinely walking or driving through pastures and identifying a weeds issue. This defines the scope of the problem and allows the best management practices to be implemented in a timely fashion. The number of weeds, the species present, and their locations are important. Note the dominant species as well as uncommon or perennial weeds. The management strategies adopted should focus on controlling the dominant species while preventing the spread of less common species. If not managed proactively, the less common weeds in a pasture may become dominant weed problems.

Proper identification of weeds is the first step toward weed control. A good example is knowing the difference between tropical soda apple (TSA) and red soda apple (cockroach berry). Of the two, only TSA is a troublesome invasive weed that must be controlled. However, these two species can be incorrectly identified. This costly mistake allows TSA to go uncontrolled and results in the weed spreading throughout the ranch and potentially onto neighboring ranches. If you have questions concerning weed identification, contact your local UF/IFAS Extension office for assistance.

1. This document is SS-AGR-08, one of a series of the Agronomy Department, UF/IFAS Extension. Original publication date January 2000. Revised February 2009, February 2010, March 2011, January 2012, January 2013, January 2014, February 2015, December 2015, December 2016, February 2017, January 2018, January 2019, and February 2020. Visit the EDIS website at https://edis.ifas.ufl.edu for the currently supported version of this publication.

2. B. A. Sellers, associate professor, Agronomy Department, UF/IFAS Range Cattle Research and Education Center; and P. Devkota, assistant professor, Agronomy Department, UF/IFAS West Florida REC; UF/IFAS Extension, Gainesville, FL 32611.

Some weeds grow best in wet sites (maidencane ponds, depressional areas, ditches, etc.) while others can be found on dry sites (ditch banks, upland areas, and fence rows). Scout pastures for weeds in conjunction with other activities, such as checking calves, working cattle, and feeding. When you first discover a weed, remove it or spot treat with an appropriate herbicide. Do not allow that one plant to produce seeds and give rise to hundreds of new plants. It is less expensive (in terms of both time and money) to control one plant than to wait and have to control hundreds of plants.

Poisonous plants (e.g., *Crotalaria*, black nightshade, spiny pigweed, lantana, etc.) are commonly found throughout Florida. Animals do not usually choose to graze most poisonous plants when forage is abundant; however, when quality forage is limited due to poor growing conditions or overstocking, they may graze these plants.

Prevention

Prevention is any activity that keeps weeds from infesting a pasture. Most of the weeds are spread by seed. Thus, preventing the movement of weed seeds onto the ranch reduces potential weed pressure. Weed seeds can be transported in hay, harvested grass seed, sod, cattle, and mowing equipment, or dispersed by wind, water, and wildlife. Producers should avoid buying hay or grass seed that is contaminated with weed seeds. Do not purchase hay from someone who cannot provide a weed-free product. Using certified forage seed reduces weed seed contamination and is highly recommended.

Also, consider prevention of TSA while moving cattle to a new location. Cattle have been shown to excrete TSA seeds for at least 7 days after consumption. If cattle are grazing in a TSA-infested pasture, holding them in a clean area for 10 days before moving them to a new pasture is recommended. This will reduce the likelihood of transporting TSA seeds. Remember that an ounce of prevention is worth a pound of cure.

Control

Cultural Control

Cultural practices improve weed control by increasing the competitiveness of the forage. This involves optimizing forage production through monitoring of soil pH, fertility, and, potentially, irrigation management. Generally, a thick sward will prevent weed emergence, outcompete emerged weeds, and capture the majority of environmental resources (light, water, nutrients) necessary for growth. The aim of cultural practices is to modify your management program so that the sward is as competitive as possible.

Soil pH is an important factor for forage growth as well as weed establishment. UF/IFAS forage agronomists and soil scientists have determined the optimum soil pH for most forages grown in Florida. Acidic soils limit plant growth and can result in aluminum and manganese toxicity as well as magnesium, calcium, phosphorus, molybdenum, and potassium deficiency. Soil acidity may also result in poor root growth, which can reduce water and nutrient uptake. Weeds that grow under such conditions can be indicators of low soil pH. For example, crowfoot grass germination is optimum at soil pH levels between 4 and 5, which are too low for optimum forage growth. Thus, the presence of crowfoot grass in your pasture may warrant a soil test and corrective action.

Mechanical Control

Mowing is one of the most often-used weed control methods in pastures. Mowing improves the appearance of a pasture, temporarily increases forage production, and, if properly timed, prevents weeds from producing seed. Mowing is generally more effective on broadleaf weeds than grass weeds and on annual weeds than perennial weeds. Carefully consider the cost of mowing and the anticipated effectiveness. As fuel prices increase, it may be more cost-effective to avoid mowing and use other forms of weed control because other weed control methods may be more effective on a given species.

Mechanical weed control does have drawbacks. Large weeds with extensive root systems will not be controlled by mowing alone. Additionally, mowing misses prostrate-growing weeds such as crabgrass, spurges, and matchweed. Mowing can also spread vegetative plant stems, allowing the plant (e.g., prickly pear) to root elsewhere. If mowing is performed after seed set, seeds can accumulate on the mowing equipment and worsen the weed problem by spreading to other pastures.

Biological Control

Biological control involves the use of biotic agents (e.g., plants, herbivores, insects, nematodes, and phytopathogens) to suppress weeds. Overall, biological control is still in its infancy, but great strides are being made, especially against invasive plants. Two good examples are the tobacco mild green mosaic tobamovirus (TMGMV) and the insect, *Gratiana boliviana*, both used for TSA control. The virus TMGMV can be sprayed to control existing TSA plants, while the beetle is used primarily for suppression.

Most biological control agents rarely provide complete weed control, but they usually suppress the weed population to a manageable level. Additionally, biological control agents are rarely fast-acting, so time is needed for the agent to suppress a given weed population. For example, the effect of *Gratiana boliviana* is often not seen until the year following the release of the beetle.

Chemical Control

Chemical weed control includes the use of herbicides. Herbicides kill weeds by inhibiting plant processes necessary for growth. Herbicides should be selected based on forage species being grown, weed species present, cost, and ease of application. Application method and environmental impact should also be considered.

Proper herbicide choice and application rate are extremely important. Lower-than-recommended application rates will not provide consistent weed control, while excessive application rates may cause injury to the forage or result in only killing the aboveground portion of perennial weeds. Also, herbicides must be applied at the right time to be cost-effective.

Preemergence (PRE) applications are made before weeds germinate and emerge. Understanding the life cycle of the weed is important when using a preemergence herbicide. Some weed seeds germinate in the summer, while others germinate in the winter months. Always refer to the herbicide label for additional information about controlling specific weeds.

Postemergence (POST) applications are made after the weeds emerge. The most effective and cost-efficient applications are made when the weeds have recently emerged and are small (3 to 5 inches tall). For perennial weeds (regrowing from root storage organs), it is advisable to allow them to bloom before spraying. This allows sufficient leaf surface for coverage and ensures that the perennial is transporting photosynthates back to the roots.

Postemergence herbicides may be broadcast over the entire pasture or may be applied as a spot treatment to sparse weed patches. Spot treatment is less costly compared to broadcast spraying. Other application methods include wipers and mowers that dispense herbicide while mowing the weed. In all cases, it is extremely important to carefully read the herbicide label before purchasing to determine if that herbicide controls the weeds in your situation.

PRECAUTIONS WHEN USING PHENOXY OR BENZOIC ACID HERBICIDES

1. For information about growth-regulating herbicides not covered below, see EDIS document SS-AGR-12, *Florida's Organo-Auxin Herbicide Rule—2018* (https://edis.ifas.ufl.edu/wg051).

2. Application of other pesticides from sprayers previously used for 2,4-D, dicamba, or other phenoxy or benzoic acid herbicides to susceptible crops may result in injury.

3. Legumes in pastures or rangelands will be injured or killed by these herbicides.

4. Avoid drift to susceptible crops by applying at low pressures and when wind speeds are low and blowing away from susceptible crops. The use of a drift-control additive is advisable.

5. Clean sprayer thoroughly as described on the herbicide label. If no instructions are provided, you may follow the procedure below using household ammonia:

a. Flush system with water. Drain.

b. Flush the system with ammonia (1 qt ammonia per 25 gallons water); let it circulate for at least 15 minutes, then flush the system again. Drain again.

c. Remove screens, strainers, and tips, and then clean in fresh water.

d. Repeat step 5b.

e. Thoroughly rinse the tank, hoses, booms, and nozzles.

f. Be sure to clean all other associated application equipment.

Forage Tolerance

Not all cultivars of a particular forage species respond similarly to a given herbicide (Table 5). 'Argentine' bahiagrass tolerates most pasture herbicides except Roundup, while 'Pensacola' may be severely injured by metsulfuron-containing products, such as Cimarron and others. All herbicides may be used on stargrass and bermudagrass, with some level of injury from Velpar (hexazinone). *Hemarthria*, also known as limpograss, is the most sensitive to herbicide applications of all forage grasses grown in Florida.

Note that the response observed from an herbicide application can vary. For example, the chance for forage injury can increase or decrease as the rate of herbicide applied either increases or decreases. Additionally, environmental conditions such as high temperature and high relative humidity may increase the potential for herbicide injury. For example, we have observed little or no injury to limpograss from 8 pt/acre 2,4-D amine when applied under cooler conditions, while 4 pt/acre in warmer weather caused moderate to severe injury.

The response of forages in Table 5 is for established forage cultivars. However, 2,4-D + dicamba (2 pt/acre) can be applied to sprigged forage cultivars, except for limpograss, seven days after planting/sprigging. A forage can be considered established when at least three tillers are present on bahiagrass or at least 6 in of new stolon growth are present on sprigged forages.

Summary

Maintaining healthy, productive pastures will minimize the risk associated with weeds. Good pasture management practices such as adequate fertilization, insect control, and controlled grazing will result in healthy pastures. Unfortunately, weeds are present in pastures, and the associated loss in forage production can have serious economic implications. An integrated weed management strategy combining prevention, detection, and control is the most economical and environmentally friendly approach to pasture weed management.

Table 1. Weed control in pastures and rangeland.

Trade Name and Rate of Commercial Product per Acre	Common Name	Remarks
DURING ESTABLISHMENT		
Preemergence (PRE) to Weeds		
2,4-D Several Brands[1] 1.0–2.0 qt of 4 lb/gal formulation	2,4-D amine or LV ester 1.0–2.0 lb.	**Bermudagrass and stargrass only.** Apply after sprigging and before emergence of sprigged bermudagrass. Will not give complete weed control; however, short residual control of seedling broadleaves, sedges, and certain grasses may be noted for 2–3 weeks, if proper environmental conditions exist.
Diuron 4L 1.5–4.5 pt or Diuron 80 1–3 lb	Diuron 0.8–2.4 lb	**Bermudagrass only**. Will provide fair to good control of crabgrass, crowfootgrass, and goosegrass. Plant sprigs 2 inches deep. If sprigs have emerged at time of application, bermudagrass injury will occur. Do not graze or cut hay within 70 days. Before application, ensure that your product has proper labeling, since not all Diuron products are labeled for use in pastures. Do not use this herbicide when planting tops.
2,4-D + dicamba[1] (Weedmaster, others) 2 pt	dicamba + 2,4-D	**Bermudagrass and stargrass only.** Similar to 2,4-D, but often provides greater weed control. Short residual control of seedling broadleaves, sedges, and certain grasses may be noted for 2–3 weeks if proper environmental conditions exist. **Do not apply to limpograss (*Hemarthria*) during establishment.**
Postemergence (POST) to Weeds		
2,4-D Several Brands[1] (0.5–1.0 qt of 4 lb/gal formulation)	2,4-D amine	**Do not apply to bahiagrass until plants are 5–6 inches tall. Do not apply to limpograss (*Hemarthria* sp.) during establishment.** Bermudagrass can tolerate 2,4-D at any growth stage. Controls most seedling broadleaf weeds. Repeat application may be needed.
2,4-D + dicamba[1] (Weedmaster, others) 2 pt	dicamba + 2,4-D	Can be used during establishment of hybrid bermudagrass, stargrass, and pangolagrass. Annual sedges and some grasses will be suppressed if less than one inch at time of application. Best results are seen if applications are made 7–10 days after planting. **Do not apply to limpograss (*Hemarthria*) during establishment.**
Banvel, Clarity, Vanquish 1.5–2 pt	dicamba	Primarily used for establishment of limpograss (*Hemarthria*). Annual sedges and some grasses will be suppressed if less than one inch at time of application. Best results are seen if applications are made 7–10 days after planting.
ESTABLISHED STANDS		
Dormant Pastures		
Gramoxone SL 1–2 pt	paraquat	For **dormant** bermudagrass or bahiagrass. Apply in 20–30 gallons of water in late winter or early spring (probably in January or February) before grass begins spring green-up. Add one pt surfactant (nonionic) per 100 gal spray mix. Do not mow for hay until 40 days after treatment. Can be mixed with 2,4-D or other herbicides for more broad-spectrum control.
Prowl H_2O 1.1–4.2 qt.	pendimethalin	Applications of 3 qt/ac. have provided satisfactory weed control, but late-season escapes should be expected. Provides preemergence control of crabgrass, goosegrass, Texas panicum, sandbur, and other summer annual grasses. Must have activating rainfall or irrigation within two weeks or control will be minimal at best. Does not control plants that have already emerged.
Roundup Weathermax (or other 5.5 lb formulations) 11 fl. oz. or Roundup Ultra (or other 4 lb formulations 16 fl. oz.)	glyphosate	Apply in mid- to late-winter months to bermudagrass or bahiagrass pastures and hayfields for the control of weedy grasses. Apply before new growth appears in the spring. Bermudagrass that is not dormant at the time of application may show a 2–4 week delay in green-up. No restrictions exist between application and grazing or haying.
Nondormant Pastures		
2,4-D Several Brands[1] 2.0–4.0 pt of 4 lb/gal formulation	2,4-D amine or LV ester 1.0–2.0 lb	**Broadleaf weeds.** Annual weeds should be treated soon after emergence for best control with lower rates. Perennial weeds should be allowed to obtain a leaf surface large enough to allow sufficient spray coverage (about 12–18 inches tall). Use amine formulations during warm weather and LV esters during cool weather. Avoid drift. Applications of 2,4-D to limpograss (*Hemarthria* sp.) will cause significant injury during periods of high temperatures and humidity; much less injury has been observed during cool and dry conditions.

Trade Name and Rate of Commercial Product per Acre	Common Name	Remarks
Banvel[1], Clarity, Vanquish 0.5–2.0 qt	dicamba	**Broadleaf weeds.** Rate depends on weed species and size. Refer to the label for grazing restrictions. Avoid drift. *Hemarthria* has generally exhibited more tolerance to dicamba than 2,4-D.
Chaparral 2.0–3.3 oz.	metsulfuron + aminopyralid	Use on bermudagrass, pangolagrass, stargrass, and limpograss. Do not use on bahiagrass. Controls tropical soda apple, pigweed, blackberry, and many other problematic weed species. Will not control dogfennel. Add a nonionic surfactant at 1–2 pt/100 gal of solution. Avoid applications during spring green-up.
Cimarron Plus 0.125–1.25 oz. or Cimarron Xtra 0.5–2.0 oz./ac.	metsulfuron + chlorsulfuron	Use on bermudagrass, pangolagrass, and stargrass. Controls several cool-season broadleaf weeds, pigweeds, and Pensacola bahiagrass. Bermudagrass should be established no less than 60 days prior to application. Add a nonionic surfactant at 1–2 pt/100 gal of solution. Avoid application during spring green-up.
Cimarron Max Part A (0.25–1.0 oz.) Part B (1.0–4.0 pt)	Part A—metsulfuron Part B—2,4-D + dicamba	Cimarron Max is a two-part product that should be mixed at a ratio of 5 oz. *Part A* to 2.5 gallons *Part B*. Depending on the weeds present and the rate range that is selected, this mix will treat between 5 and 20 acres. For specific information on rate selection, consult the product label.
GrazonNext HL[1] 1.6–2.1 pt	aminopyralid + 2,4-D	Excellent control of TSA, horsenettle, and other members of the nightshade family. Also controls pigweeds and other broadleaf weeds including dogfennel shorter than 20 inches. Do not apply more than 2.1 pt/ac./yr. Do not apply to desirable forage legumes or severe injury and stand loss will occur. Do not apply to limpograss. GrazonNext will pass through animals and remain in the waste. Do not mulch sensitive crops with manure if animals have been grazing on GrazonNext-treated pastures. Avoid applications of this product to limpograss pastures during hot and humid conditions.
MSM 60, others 0.3–1.0 oz.	metsulfuron	Use on bermudagrass, pangolagrass, and stargrass. Controls several cool-season broadleaf weeds, pigweeds, and Pensacola bahiagrass. Bermudagrass should be established no less than 60 days prior to application. Add a nonionic surfactant at 1–2 pt/100 gal of solution. Avoid application during spring green-up.
Impose or Panoramic 4–12 fl. oz.	imazapic	DO NOT apply to bahiagrass. DO NOT apply during spring transition or severe bermudagrass or stargrass injury will occur. In summer months, expect 3–4 weeks of bermudagrass stunting after application, followed by quick recovery and rapid growth. This will reduce harvest yields of that cutting by 30–50%. If this yield reduction is not acceptable, do not use these herbicides. Yield reductions of subsequent cuttings have not been observed. For control of crabgrass, sandspur, nutsedges, and vaseygrass, use 4 oz./ac. For suppression of bahiagrass, use 12 oz./ac.
Milestone 3–7 oz.	aminopyralid	Excellent control of tropical soda apple, horsenettle, and other members of the nightshade family. Controls pigweeds and other broadleaf weeds but does not control blackberry or dogfennel. Can be safely applied under trees. Do not apply more than 7 oz./ac./yr. Do not apply to desirable forage legumes or loss of stand will occur. The use of a nonionic surfactant is recommended. Milestone will pass through animals and remain in the waste. Do not mulch sensitive crops with manure if animals have been feeding on Milestone-treated pastures. Safe on limpograss.
Outrider 1.0–1.33 oz.	sulfosulfuron	Safe to apply to established bermudagrass and bahiagrass. Provides excellent control of annual and perennial sedges.
Pastora 1–1.5 oz.	metsulfuron + nicosulfuron	**Established bermudagrass only**. Can be used to effectively control seedling crabgrass, sandbur, vaseygrass**,** and established johnsongrass. Established vaseygrass will require retreatment for long-term control. If sandbur or crabgrass is more than 4 inches tall, only seedhead suppression should be expected. Do not apply more than 2.5 oz.**/**ac./yr. Do not apply to limpograss or bahiagrass due to high injury potential.
PastureGard HL[1] 1–2 pt	triclopyr + fluroxypyr	Provides excellent control of dogfennel, blackberry, teaweed, and other broadleaf weeds. Less effective on tropical soda apple than triclopyr ester (Remedy Ultra, others) alone. Forage legumes will be severely injured or lost if present at time of application. Applications of 2 pt/ac. may result in less than desirable weed control. Do not apply more than 8 pt/ac. per season. Surfactant should be added to spray mixture at 0.25% v/v.

Trade Name and Rate of Commercial Product per Acre	Common Name	Remarks
Prowl H_2O 1.1–4.2 qt	pendimethalin	Apply only to established perennial warm-season grasses including bahiagrass and bermudagrass grown for forage or hay production between cutting or grazing events. DO NOT apply to bermudagrass and other warm-season grasses after green-up in the spring before the first cutting. DO NOT apply when surface water is present. Maximum application per year is 4.2 qt/acre. Provides preemergence control of annual and some perennial grass weeds but does not control existing plants.
Remedy Ultra, others 2 pt	triclopyr ester	Provides excellent control of herbaceous and certain woody plants in pasture and rangeland. For best results, apply in 30 or 40 gallons of water per acre. The addition of a nonionic surfactant at 0.25% v/v will increase control. Applications at air temperatures higher than 85°F may cause moderate to severe bermudagrass injury for 2–3 weeks.
Roundup Weathermax 8–11 fl. oz./ac.	glyphosate	For control of annual grasses in bermudagrass and stargrass. Apply immediately after hay removal, but prior to regrowth. Applications made after regrowth will cause stunting. Application rates as low as 6 oz./ac. are often effective for crabgrass and other small annual grass weeds. Do not apply more than 2 qt/ac./yr. If Roundup Weathermax is applied to a dormant pasture, it cannot be sprayed again that season. Be sure to read the label of the particular brand before purchasing to ensure the product is labeled for use on the application site.
Sandea 0.67–1.33 oz.	halosulfuron	Safe to apply to bahiagrass, bermudagrass, and stargrass for annual and perennial sedge control. Does not control Surinam sedge. Do not apply more than 1.33 oz. per acre in a 12-month period.
Telar 0.1–1.0 oz.	chlorsulfuron	For use on established warm-season forage grass species. Telar will control blackberry, pigweeds, wild radish, and selected winter weeds. Not effective on ragweed, tropical soda apple, and other common weeds. Ryegrasses will be severely injured or killed by Telar. Do not apply more than 1.3 oz./ac./yr. There are no grazing restrictions for any animals.
2,4-D + dicamba[1] (Weedmaster, others) 0.5–4.0 pt	dicamba + 2,4-D amine	See remarks for 2,4-D and dicamba above. This mixture is usually more effective than either herbicide used alone.
Hard-to-Kill Perennial Grasses		
glyphosate 1.3–4.0 oz./gal	glyphosate 1%–3% solution for hand sprayer	**Spot treatment.** Apply when perennial weeds are actively growing. Surrounding forage will be killed if sprayed.
glyphosate 4–8 qt to 2 gal water	glyphosate 33%–50% solution	**Wiper application.** Apply at speeds up to 5 mph. Two passes in opposite directions. No more than 10% of any acre should be treated at one time.
Giant and Small Smutgrass		
Velpar L/Tide Hexazinone 2.75–4.5 pt, Velossa 2.29–3.75 pt, or Velpar DF 0.9–1.5 lb	hexazinone	Apply hexazinone to established stands of bermudagrass or bahiagrass when soil conditions are warm and moist and weeds are actively growing. Best control of smutgrass is usually achieved in late spring to early summer when regular rainfall occurs at an application rate of 3 to 4 pints/acre (Velpar L/Tide Hexazinone). Some yellowing of the bermudagrass or bahiagrass will occur, but plants will soon outgrow this effect. Apply hexazinone by ground equipment only. Only one application is allowed per year. Reducing the application rate to 2 to 3 pints/acre is allowable if a multiyear application smutgrass strategy is being considered. For more information on smutgrass management, see EDIS document SS-AGR-18, *Smutgrass Control in Perennial Grass Pastures* (https://edis.ifas.ufl.edu/aa261). **KEEP SPRAYS WELL AWAY (AT LEAST 100 FT) FROM THE BASE OF DESIRABLE TREES, ESPECIALLY OAKS.** Check the label for further precautions and safe use instructions.
Pensacola Bahiagrass		
MSM 60, others 0.3 oz.	metsulfuron	Apply to bermudagrass hayfields early in the season, after bahiagrass green-up but prior to seedhead formation. Early applications are often most effective; fall applications rarely control bahiagrass. Do not apply with liquid fertilizer solutions, as poor control may occur. Prolonged periods of dry weather prior to application will greatly decrease herbicide effectiveness. Always include a nonionic surfactant at a rate of 0.25% v/v. Common or 'Argentine' bahiagrass will not be effectively controlled. Pasture legumes will be severely injured or killed.

Trade Name and Rate of Commercial Product per Acre	Common Name	Remarks
Cimarron Plus 0.5 oz. or Cimarron Xtra 1.0 oz.	metsulfuron + chlorsulfuron	Same as metsulfuron.
Cogongrass		
Roundup, others 4 to 6 fl. oz./gal	glyphosate 3% to 5% solution for hand sprayer	For spot treatment of cogongrass. For best results, apply in the fall prior to frost. Applications to the entire patch plus an additional 5 ft beyond the patch are beneficial. Late fall treatment is typically better than spring treatments.
Roundup, others 128 oz.	glyphosate	For broadcast treatment of cogongrass infestations. Burning followed by 6 weeks of regrowth tends to improve control over long-established cogongrass stands. Late fall treatment is typically better than spring treatments.
Arsenal, others 1.4 fl. oz./gal	imazapyr 1% solution for hand sprayer	For spot treatment of cogongrass. Do not apply near areas with desirable hardwood trees. Provides longer-term control than glyphosate. Applications to the entire patch plus an additional 5 ft beyond the patch are beneficial. Late fall treatment is typically better than spring treatments. **DO NOT** treat more than 10% of the available area to be grazed or cut for hay.
Arsenal, others 48 oz./ac.	imazapyr	For broadcast treatment of cogongrass. Do not apply near areas with desirable hardwood trees. Provides longer-term control than glyphosate, but plant-back restrictions may limit opportunities to plant forage crops in treated areas with this herbicide. DO NOT treat more than 10% of the available area to be grazed or cut for hay nor apply more than 0.75 lb of imazapyr (48 fl. oz.) per acre per year.
Tropical Soda Apple		
Chaparral 2–3 oz.	metsulfuron + aminopyralid	Excellent control of TSA plants. Provides preemergence control of TSA seedlings for approximately six months after application. There are no grazing or haying restrictions; however, delaying cutting for 14 days will enhance weed control. Not for use on 'Pensacola' bahiagrass.
GrazonNext HL[1] 1.6–2.1 pt	aminopyralid + 2,4-D	Excellent control of tropical soda apple. Provides preemergence control of TSA seedlings for approximately six months after application. The 1.6 pt/ac. rate is highly effective on emerged TSA plants, but the 2.1 pt/ac. rate will provide the greatest length of residual control. Do not apply more than 2.1 pt/ac./yr. Will severely injure desirable forage legumes. Do not apply to limpograss. There are no grazing restrictions, but do not harvest for silage or hay for seven days.
Milestone 5–7 oz.	aminopyralid	Excellent control of tropical soda apple. Provides preemergence control of TSA seedlings for approximately six months after application. The 5 oz. rate is highly effective on emerged plants, but the 7 oz. rate will provide the greatest length of residual control. Do not apply more than 7 oz./ac./yr. Do not apply to desirable forage legumes or loss of stand will occur. Volatility is low. The use of a nonionic surfactant at 0.25% v/v is recommended.
Remedy Ultra, others[1] 1.0 qt	triclopyr ester	Apply in late spring through summer as a broadcast spray for control of this species. Best results will occur when plants are adequately covered with spray solutions. Application of 30–40 gal./ac. of herbicide solution will be more effective than 20 or lower. The addition of a nonionic surfactant at 0.25% v/v will increase control. Retreatment will be required as new seedlings emerge. Spot spray rate is 0.5%–1.0% v/v.
Prickly Pear Cactus		
Remedy Ultra, others[1] 20% + basal oil 80%	triclopyr ester 20% diesel fuel or basal oil 80% (Spot treatment)	Apply as a spot treatment directly to prickly pear pads during spring and summer. Grass will be burned in treated spots but will recover. The addition of diesel fuel drastically enhances herbicide uptake, which will lead to prickly pear control. Prickly pear will die slowly over a period of 6–8 months with a few plants requiring retreatment.
Trump Card 3 pt	fluroxypyr + 2,4-D	Apply Trump Card as a broadcast treatment in water. The use of a surfactant is required. A maximum of 3 pt/acre per growing season is allowed, but 6 pt/ac. is required for effective control. Two applications of 3 pt/ac. over two growing seasons have been shown to be effective.

Trade Name and Rate of Commercial Product per Acre	Common Name	Remarks
Vista XRT 22 oz.	fluroxypyr	Apply Vista XRT at 22 oz./ac. as a broadcast treatment in water. The use of a surfactant is required. For spot treatment, use 0.5 fl. oz. (15 mL) per gallon of water. Control is very slow. It often takes more than one year to see satisfactory results.
Blackberry		
Chaparral 2 oz.	metsulfuron + aminopyralid	Chaparral will provide good to excellent control of blackberry. For best results, apply when moisture conditions are sufficient and blackberry plants are not under drought stress. Late bloom and fall applications of Chaparral are the most effective. DO NOT apply in bahiagrass pastures. Do not mow within six months prior to application or control will be greatly reduced.
Cimarron Plus 0.75 oz. or Cimarron Xtra 2.0 oz./ac.	metsulfuron + chlorsulfuron	Cimarron will provide good to excellent control of blackberry. Results are best when applied at blooming or late in the fall. Do not mow within six months prior to application or control will be reduced. **DO NOT** apply to bahiagrass pastures.
Escort, MSM 60, others 0.3–0.5 oz.	metsulfuron	Metsulfuron will provide good to excellent control of blackberry. Results are best when applied at blooming or late in the fall. Apply to bahiagrass pastures only as a last resort and expect 6–8 weeks of reduced growth and some stand thinning. Mixing with 1 pt/ac. 2,4-D amine will help reduce bahiagrass injury when applying in bahiagrass.
PastureGard HL[1] 2 pt	triclopyr + fluroxypyr	Control similar to Remedy.
Remedy Ultra, others[1] 2 pt	triclopyr	For best control of blackberry, apply 2 pt when blooming and do not mow within one year prior to application. Remedy does not control dewberry. Applications made during prolonged periods of dry weather can greatly decrease control. Fall applications often provide more consistent blackberry control.
Telar 0.75 oz.	chlorsulfuron	Similar to control with Cimarron. Telar can safely be applied to bahiagrass or bermudagrass.
Dogfennel		
2,4-D + dicamba[1] (Weedmaster, others) 2–3 pt	dicamba + 2,4-D	Apply when plants reach a height of 12–18 inches. Weedmaster is most effective approximately one month after dogfennel transition from winter dormancy. Refer to previous comments for dicamba and 2,4-D above.
GrazonNext HL[1] 24 oz.	aminopyralid + 2,4-D	Apply when plants are less than 30 inches tall. If plants are larger than 30 inches, tank-mix GrazonNext with 3 pt/ac. 2,4-D, or 8 oz./ac. PastureGard HL.
PastureGard HL[1] 24 oz.	triclopyr + fluroxypyr	For control of larger dogfennel that has reached 40 inches or more in height.
Trump Card 3 pt	fluroxypyr + 2,4-D	For control of dogfennel that are 18–36 inches.
Mixed Stands: Grass-Clover/*Lespedeza* Pastures		
2,4-D amine[1] 0.5–1.0 pt	2,4-D (0.25 + 0.5 lb)	Apply only one treatment per year to established perennial clover. Slight to moderate injury may occur. See label for specific use information.
Thistles		
2,4-D 2 qt	2,4-D	Highly effective if applied to thistles in the rosette stage. 2,4-D is not effective on thistles that have bolted or flowered. During cool temperatures, the ester formulation of 2,4-D will be most effective.
GrazonNext HL[1] 1.6–2.1 pt	aminopyralid + 2,4-D	Excellent control of thistles at any stage of growth.

Trade Name and Rate of Commercial Product per Acre	Common Name	Remarks
2,4-D + dicamba[1] (Weedmaster, others) 1.0–2.0 qt	dicamba + 2,4-D	Apply late fall to early spring when daytime temperatures are higher than 50°F. Applications are most effective if made before flower stalks elongate. The addition of crop oil will increase herbicidal activity. Refer to previous comments for dicamba and 2,4-D above. For small rosettes, 1 qt/ac. rate is sufficient. For larger rosettes, 1.5–2 qt/ac. will be required.

[1] For state rules pertaining to application of organo-auxin herbicides in Florida, see EDIS document SS-AGR-12, *Florida's Organo-Auxin Herbicide Rule—2018* (https://edis.ifas.ufl.edu/wg051).
Herbicide recommendations in this report are contingent upon their registration by the US Environmental Protection Agency. If an herbicide's EPA registration is canceled, the herbicide is no longer recommended.

Table 2. Estimated effectiveness of herbicides on common broadleaf weeds in pastures and hayfields (2,4-D through Impose/Panoramic).[1]

Weed Name	2,4-D	Chaparral	Cimarron Plus or Xtra	Banvel or others	Vista XRT	Diuron	GrazonNext HL	Metsulfuron	Impose/ Panoramic
Bagpod	F–G	E	E	G	-	-	E	E	-
Bitter sneezeweed	E	E	E	E	-	G	E	E	-
Blackberry	P	G–E	G–E	F–G	F	P	P–F	G–E	P
Bracken fern	P	E	E	P–F	P	P	P	E	-
Brazilian peppertree	P	P	P	P	P	-	P	P	P
Bullrush	G	-	-	G	P	P	P	-	-
Bushmint	P	-	-	F	F–G	-	F	-	-
Butterweed	F–G	E	E	F–G	-	-	E	E	-
Buttonbush	P	-	-	-	-	-	-	-	-
Caesarweed	G–E	G	G	-	G–E	-	G–E	G	-
Camphor weed	F–G	-	-	F–G	-	-	G	-	-
Carolina geranium	P–F	G	G	F–G	G	-	F–G	G	-
Castor bean	F–G	-	-	-	-	-	F–G	-	-
Chickweed	F	E	E	E	-	P	F	E	-
Coffee weed	G	E	E	E	G	-	E	E	-
Coral ardisia	P	P	P	P	P	-	P	P	G
Creeping indigo	G	E	E	G	-	-	E	E	-
Crotalaria, showy	G	G	-	G	G	-	G	-	-
Cudweed	F	G	G	E	-	-	E	G	-
Curly dock	F	E	E	E	-	P	E	E	-
Dayflower	G	F	F	F	-	-	F–G	F	-
Dewberry	P	F–G	F–G	P	-	-	P	F–G	-
Dodder	P	-	-	P	-	P	-	-	-
Dogfennel	F–G	P	F	F–G	G	P	F–G	F	-
Dollarweed	G	G	G	E	F	-	G	G	-
Elderberry	F–G	-	-	F–G	-	-	F–G	-	-
Evening primrose	E	G	G	E	-	G	E	G	-
Florida pusley	P	-	-	P–F	P	E	G–E	-	-
Flat-top goldenrod	G	P	P	F–G	P	-	G	P	-
Gallberry	G	-	-	E	-	P	-	-	-
Goatweed	G	G	G	F–G	P–F	-	-	G	P
Goldenrod	F	P	P	G	-	P	G	P	-
Greenbrier	P	F	F	P	F–G	-	P	F	-
Groundcherry	F–G	-	-	F–G	-	-	E	-	-

Weed Name	2,4-D	Chaparral	Cimarron Plus or Xtra	Banvel or others	Vista XRT	Diuron	GrazonNext HL	Metsulfuron	Impose/ Panoramic
Hairy indigo	F–G	E	E	F–G	F–G	-	E	E	-
Hempvine	F–G	E	-	F–G	E	-	E	-	-
Honeysuckle	-	-	-	E	-	P	-	-	-
Horsenettle	P	E	P–F	G	F	P	E	P–F	-
Horseweed	F	G	F	E	-	P	E	F	-
Kudzu	P–F	G	P–F	G	P	P	G	P–F	P
Lantana	P	P	P	P	F–G	-	P	P	-
Matchweed	G	-	-	G	F–G	-	G–E	-	-
Maypop	P	P	P	P	-	-	-	P	-
Mexican tea	G	E	E	G–E	-	-	E	E	-
Milkweed	F–G	-	-	G	-	-	F–G	-	-
Morning glory	G–E	E	G–E	E	E	-	E	G–E	-
Palmetto	P	P	P	F	G	P	P	P	P
Pawpaw	P	P	F	P	F–G	-	P	F	-
Persimmon	P	-	-	F–G	-	P	P	-	P
Pigweed	F	E	E	E	P	F	E	E	G
Plantains	E	E	E	E	-	-	-	E	-
Pokeberry	G	-	-	E	P	P	P	-	-
Prickly pear	P	P	P	F	G	P	P	P	P
Prickly poppy	G	E	G	G–E	G	-	E	G	-
Ragweed	E	E	G	E	G	G	E	G	F
Red sorrel	P	E	E	E	-	F	-	E	-
Redroot, Carolina	-	P–F	P–F	-	P–F	-	-	P–F	F–G
Rosary pea	F	E	G	G	F–G	-	E	G	-
Sand vetch	F	E	G	G	G	-	E	G	-
Saltbush	P	P	P	P	F	-	P	P	-
Shepherd's purse	E	-	-	E	-	G	-	-	-
Sicklepod	G	G	G	E	G	F	G	G	F–G
Smartweed	G	E	G	G	-	-	E	G	-
Softrush	G	P	P	F–G	P	-	F–G	P	-
Spanish needles	G–E	E	G	E	-	-	E	G	-
Stinging nettle/ fireweed	P	E	-	-	G–E	-	E	-	P
Tall elephant's foot	F	-	-	F–G	-	-	F–G	-	-
Teaweed	P	G	G	G	-	-	G	G	-
Thistles	E	E	F	G	G	F	E	F	-
Toadflax, oldfield	F–G	G-E	G-E	G	-	-	G–E	G–E	-
Tropical soda apple	P	E	P	F–G	F	P	E	P	P
Virginia pepperweed	G	-	-	E	G	G	-	-	-
Wax myrtle	P	P	-	P–F	-	P	P	-	-
Whitehead broom	P	P–F	P–F	P	P	-	P	P–F	-
Winged sumac	F–G	-	-	-	F–G	-	F–G	-	-
Wild garlic	G–E	G	G	E	-	P	-	G	-
Wild radish	G	G–E	G–E	E	-	P	G	G–E	-
Yellow jessamine	-	G	G	-	-	-	-	G	-

Weed Name	2,4-D	Chaparral	Cimarron Plus or Xtra	Banvel or others	Vista XRT	Diuron	GrazonNext HL	Metsulfuron	Impose/ Panoramic
Yellow woodsorrell	P	F–G	F–G	G	F	-	F–G	F–G	-

[1] Weed control symbols: E = 90%–100% control; G = 80%–90% control; F = 60%–80% control; P < 60% control.

Table 3. Estimated effectiveness of herbicides on common broadleaf weeds in pastures and hayfields (Milestone through WeedMaster or others).[1]

Weed Name	Milestone	Outrider	PastureGard HL	Remedy	Velpar	WeedMaster, others
Bagpod	E	-	G	F–G	-	F–G
Bitter sneezeweed	E	-	E	E	-	E
Blackberry	P	P	G–E	G–E	F	P–F
Bracken fern	P	-	P–F	P–F	F	P
Brazilian peppertree	P	P	P–F	G–E	G–E	P
Bullrush	P	-	P	F–G	-	-
Bushmint	P	-	G	G	-	P
Butterweed	G–E	-	G–E	-	-	F–G
Buttonbush	-	-	F–G	G	-	-
Caesarweed	G–E	-	E	E	-	G–E
Camphor weed	-	-	G	F–G	-	G
Carolina geranium	G–E	-	-	-	-	G
Castor bean	-	-	G	G	-	F–G
Chickweed	-	-	F	E	E	E
Coffee weed	E	-	E	E	-	G
Coral ardisia	P	-	F–G	G	-	P
Creeping indigo	E	-	G	G	-	G
Crotalaria, showy	-	-	E	E	-	G
Cudweed	E	-	G	E	-	G
Curly dock	E	-	F	E	P	E
Dayflowers	-	-	G	G	-	G
Dewberry	-	-	F–G	F–G	-	P
Dodder	-	-	P	P	-	P–F
Dogfennel	P–F	P	E	G–E	G	G
Dollarweed	-	-	F–G	F–G	-	F–G
Elderberry	-	-	G	E	-	P–F
Evening primrose	E	-	G	E	E	E
Florida pusley	-	-	G	-	-	F
Flat-top goldenrod	P	-	P	P	-	G
Gallberry	-	-	E	E	P	G
Goatweed	-	-	F	F	F–G	G
Goldenrod	G	-	G	G	-	G–E
Greenbrier	P	P	F	F	-	P
Groundcherry	E	-	G–E	G–E	E	G
Hairy indigo	E	-	G–E	G	-	G
Hempvine	E	-	E	E	-	F–G
Honeysuckle	-	-	P	P	-	E
Horsenettle	E	-	F	F–G	-	F
Horseweed	E	-	G	G	-	E
Kudzu	G	P	F	F	-	F

Weed Name	Milestone	Outrider	PastureGard HL	Remedy	Velpar	WeedMaster, others
Lantana	P	-	P–F	P–F	-	P
Matchweed	G	-	G	G	-	G
Maypop	-	P	G	F	-	P–F
Mexican tea	E	-	E	E	-	E
Milkweed	F–G	-	F–G	F–G	-	F–G
Morning glory	E	-	E	E	-	E
Palmetto	P	P	G	F	P	P–F
Pawpaw	P	-	F–G	G	-	P
Persimmon	P	P	F–G	F–G	F	P–F
Pigweed	E	-	F	E	G	E
Plantains	P	-	-	-	-	E
Pokeberry	F	-	P	P	-	E
Prickly pear	P	P	F	G[2]	P	P–F
Prickly poppy	E	-	E	E	-	G–E
Ragweed	E	-	E	E	F	E
Red sorrel	-	-	F	E	-	G
Redroot, Carolina	-	-	F–G	G	-	G
Rosary pea	E	-	G–E	G–E	-	F–G
Sand vetch	E	-	E	E	-	E
Saltbush	P	-	G–E	E	-	F
Shepherd's purse	-	-	G	E	E	E
Sicklepod	-	-	G–E	E	-	E
Smartweed	E	-	G	G	-	G–E
Softrush	P	-	F	P–F	-	F–G
Spanish needles	E	-	E	E	-	E
Stinging nettle/fireweed	E	P	E	E	-	F
Tall elephant's foot	F	-	F–G	F–G	-	F
Teaweed	-	-	G	G	-	F–G
Thistles	E	-	G–E	E	E	E
Tropical soda apple	E	P	G	G–E	F–G	F–G
Virginia pepperweed	-	-	G	P	E	E
Wax myrtle	P	-	F–G	G	P	P–F
Whitehead broom	P	-	P	P	F–G	P
Winged sumac	-	-	G	G	-	F–G
Wild garlic	P	-	P	-	-	E
Wild radish	P	-	G–E	E	E	E
Yellow jessamine	-	-	G	G	-	-
Yellow woodsorrell	-	-	F	F	-	F

[1] Estimated effectiveness based on rates recommended in this report. Effectiveness may vary depending on factors such as herbicide rate, size of weeds, time of application, soil type, and weather conditions.
[2] When applied as spot treatment in basal oil.
Weed control symbols: E = 90%–100% control; G = 80%–90% control; F = 60%–80% control; P < 60% control.

Table 4. Estimated effectiveness of herbicides on common grass and sedges in pastures and hayfields.[1]

Herbicide	Bahiagrass	Bermudagrass	Broomsedge	Crabgrass	Dallisgrass	Guinea grass	Johnsongrass	Ryegrass	Sandbur	Smutgrass	Vaseygrass	Nutsedge
2,4-D	P	P	P	P	P	P	P	P	P	P	P	P
Banvel or others	P	P	P	P	P	P	P	P	P	P	P	P
Chaparral	G	P	P	P	P	P	-	P	P	P	P	P
Cimarron Plus or Xtra	G	P	P	P	P	P	-	P	P	P	P	P
Diuron	P	P	P	F–G	P	P	P	P	G	P	P	P
GrazonNext HL	P	P	P	P	P	P	P	P	P	P	P	P
Metsulfuron	G	P	P	P	P	P	-	P	P	P	P	P
Impose/Panoramic	P–F	P	P	E	F	-	G	F	F–G	P	P–G	G–E
Milestone	P	P	P	P	P	P	P	P	P	P	P	P
Outrider	P	P	P	P	P	P	E	-	-	P	F–G	E
Pastora	F–G	P	P	F–G	F–G	F–G	G	G	G	P	F–G	P
PastureGard HL	P	P	P	P	P	P	P	P	P	P	P	P
Remedy	P	P	P	P	P	P	P	P	P	P	P	P
Velpar	P	P	P	P	-	-	-	G	-	E	-	P
Vista XRT	P	P	P	P	P	P	P	P	P	P	P	P
Weedmaster or others	P	P	P	P	P	P	P	P	P	P	P	P

[1] Estimated effectiveness based on rates recommended in this report. Effectiveness may vary depending on factors such as herbicide rate, size of weeds, time of application, soil type, and weather conditions.
Weed control symbols: E = 90%–100% control; G = 80%–90% control; F = 60%–80% control; P < 60% control.

Table 5. Tolerance of established (for at least 6 months) forage cultivars to commonly used herbicides.

Forage Species	Cultivar	2,4-D	Aim	Banvel	Chaparral	Cimarron Plus	Cimarron X-tra	Vista XRT	GrazonNext HL	Impose/Panoramic	Metsulfuron (MSM 60, others)	Milestone	Outrider	Pastora	PastureGard HL	Remedy Ultra, others	Roundup/others	Telar	Vista	Banvel + 2,4-D (Weedmaster, etc.)	Velpar
Bahiagrass	Argentine	T	T	T	I	I	I	T	T	S	I	T	T	NL	T	T	S	T	T	T	T
	Pensacola	T	T	T	S	S	S	T	T	S	S	T	T	NL	T	T	S	T	T	T	T
Bermudagrass	Coastal	T	T	T	T	T	T	T	T	I	T	T	T	T	T	T	I–S	T	T	T	T–I
	Florakirk	T	T	T	T	T	T	T	T	I	T	T	T	T	T	T	I–S	T	T	T	T–I
	Jiggs	T	T	T	T	T	T	T	T	I–S	T	T	T	T	T	T	I–S	T	T	T	T–I
	Tifton 85	T	T	T	T	T	T	T	T	I	T	T	T	T	T	T	I–S	T	T	T	T–I
Brachiaria	Mulato	T	I	T	N	N	N	T	T	N	N	T	T	NL	T	T	S	N	T	T	N
Stargrass	Florico	T	T	T	T	T	T	T	T	I	T	T	T	NL	T	T	I–S	T	T	T	NL
	Florona	T	T	T	T	T	T	T	T	I	T	T	T	NL	T	T	I–S	T	T	T	NL
	Okeechobee	T	T	T	T	T	T	T	T	I	T	T	T	NL	T	T	I–S	T	T	T	NL
	Ona	T	T	T	T	T	T	T	T	I	T	T	T	NL	T	T	I–S	T	T	T	NL
Hemarthria	Floralta	I–S	T	T	T	T	T	T–I	I–S	T–I	T	I	T	NL	I	I	S	T	I	I–S	NL
	Gibtuck	I–S	T	T	T	T	T	T–I	I–S	T–I	T	I	T	NL	I	I	S	T	I	I–S	NL
	Kenhy	I–S	T	T	T	T	T	T–I	I–S	T–I	T	I	T	NL	I	I	S	T	I	I–S	NL

T = Tolerant; very little injury, if any
I = Intermediate; slight injury, will regrow in approximately one month
S = Severe injury; more than two months to recover or complete death
N = No current information available
NL = Not labeled

Table 6. Days between herbicide application to forage or pasture and feeding, grazing, or animal slaughter.

Herbicide	Non-lactating Cattle			Lactating Dairy Cattle		Horses
	Grazing	Hay Cutting	Slaughter	Grazing	Hay Cutting	
Banvel (Up to 1 pt)	0	7	30	7	37	0
Banvel (Up to 2 pt)	0	7	30	21	51	0
Banvel (Up to 4 pt)	0	7	30	40	70	0
Chaparral	0	0	0	0	0	0
Cimarron Plus and Cimarron Xtra	0	0	0	0	0	0
Vista XRT	0	7	0	0	7	0
2,4-D	0	7	3	7	7	0
GrazonNext HL	0	7	0	0	7	0
Metsulfuron	0	0	0	0	0	0
Impose or Panoramic	0	7	0	0	7	0
Milestone	0	0	0	0	0	0
Outrider	0	14	0	0	14	0
Pastora	0	0	0	0	0	0
PastureGard HL	0	14	3	0	14	0
Prowl H_2O	0	0	0	0	0	0
Remedy Ultra, others	0	14	3	0	14	0
Roundup Powermax (Dormant application)	0	0	0	0	0	0
Roundup Powermax (Between cuttings)	0	0	0	0	0	0
Roundup Powermax (Pasture renovation)	56	56	56	56	56	56
Sandea	0	37	0	0	37	0
Telar	0	0	0	0	0	0
Trump Card	7	14	2	7	14	7
Velpar	0	38	0	0	38	0
2,4-D + dicamba (Weedmaster, others)	0	7	30	7	7	0

SB 712 and BMP Manual Recordkeeping Requirements

July 22, 2021

Barton Wilder, Environmental Manager
Florida Department of Agriculture and Consumer Services
Office of Agricultural Water Policy

The look when I first sat in a meeting using all the acronyms

SRWMDSJRWMDSWFWMD

BMAP TMDL BMPs NOI IV IA

MFLs

NEPA

OSTDS

TCAA

ERP

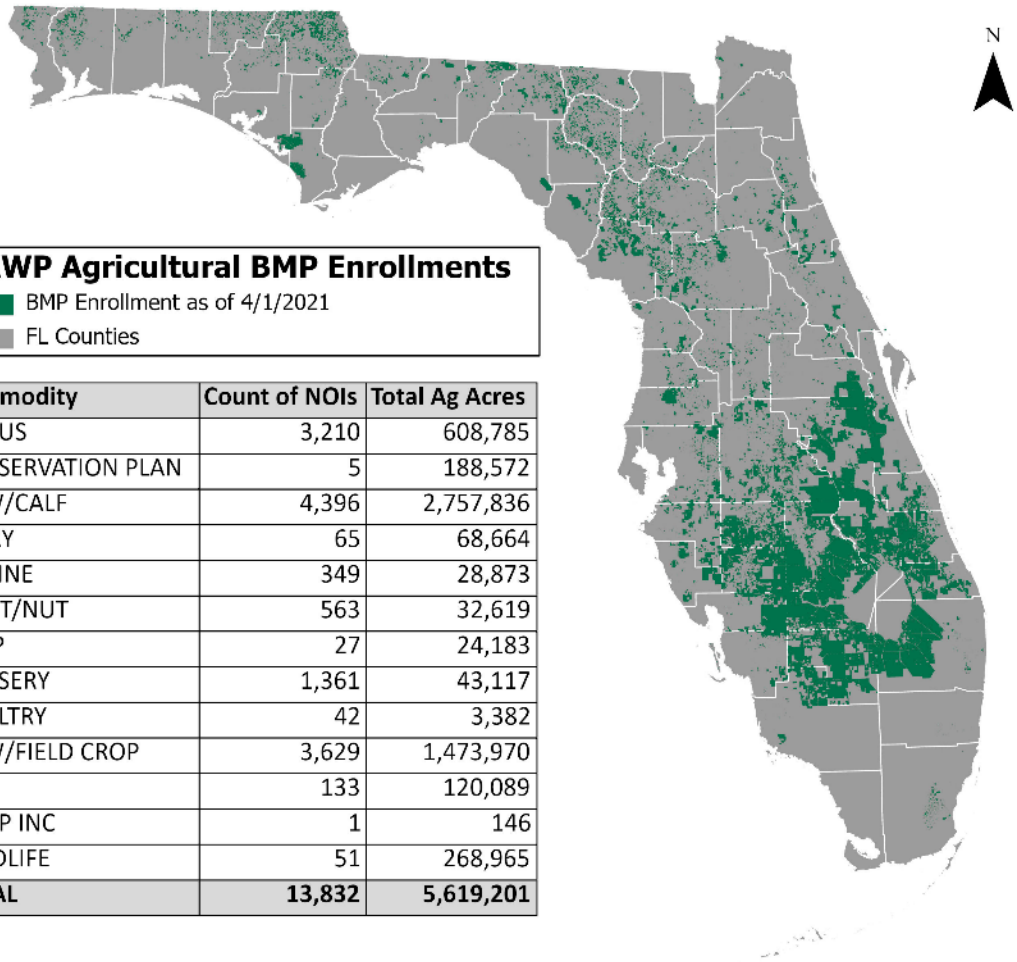
DEP

Office of Agricultural Water Policy

- **Field Staff**: Enrollment in BMP program for producers, technical assistance with implementation; coordination of cost-share projects
- **Water Policy Planning**: Interaction with DEP on Basin Management Action Plans (BMAPs), agriculture's role in water supply planning
- **Program Development**: Best Management Plans (BMPs) adoption, implementation verification, research support
- Currently 38 Field Staff and 18 contract technicians in locations around the state

Statewide BMP Enrollment

- 10 active BMP manuals
- 13,000+ enrollments
- ~5.6 million acres enrolled



Commodity	Count of NOIs	Total Ag Acres
CITRUS	3,210	608,785
CONSERVATION PLAN	5	188,572
COW/CALF	4,396	2,757,836
DAIRY	65	68,664
EQUINE	349	28,873
FRUIT/NUT	563	32,619
LOPP	27	24,183
NURSERY	1,361	43,117
POULTRY	42	3,382
ROW/FIELD CROP	3,629	1,473,970
SOD	133	120,089
TEMP INC	1	146
WILDLIFE	51	268,965
TOTAL	**13,832**	**5,619,201**

TMDL

- In 1973, FCWA (Federal Clean Water Act) required states to identify impaired waters and establish Total Maximum Daily Load (TMDL's) for pollutants entering these waters.
- TMDL's establish the maximum amount of pollutants that can be discharged to a swimming, fishing or a potable water source and still meet the state water standard.
  - Implementing BMPs benefits both the farmer and the environment and demonstrates agriculture's commitment to water resource protection.

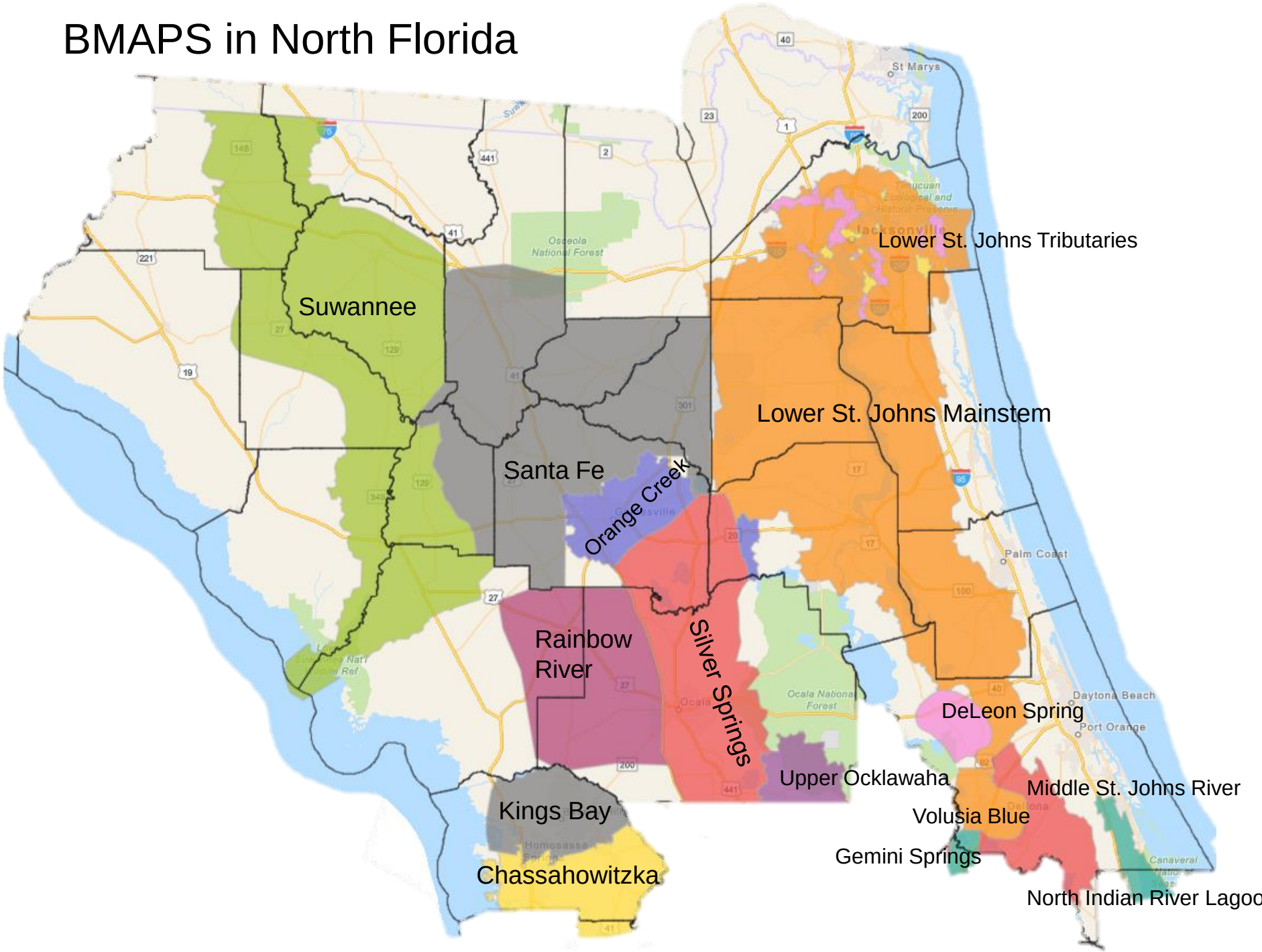
Florida Watershed Restoration Act (1998)

- **Authorizes FDACS to develop BMPs for agricultural nonpoint sources** to help meet Total Maximum Daily Loads (TMDLs) and otherwise protect water quality.
- Implementation of FDACS BMPs, according to rule*, **provides a "presumption of compliance"** with state water quality standards for the pollutants addressed by the BMPs (e.g., nitrogen, phosphorus, etc.).
- *FDACS rules require **submittal of Notice of Intent** (includes checklist of practices), **implementation of applicable practices**, and **record keeping.**
- **Production practices are exempt from public records request.**

Basin Management Action Plan

- Strategy by which Florida Department of Environmental Protection (DEP) and stakeholders within the TMDL area intend to achieve the water quality goal within 20 years.
- BMAPs are enforceable by DEP.
- BMAPs are reviewed annually and updated every 5 yrs.

BMAPS in North Florida



What is Water Quality

- It is a measure of the condition of water relative to the requirements of one or more biotic species and or to any human need or purpose.

- Point source vs non-point source pollution

Basin Management Action Plan Regulatory Framework

- The Legislature provided for agricultural operations to implement BMPs as the preferred means to help meet TMDLs and otherwise protect water quality.
- Agricultural operations within BMAP areas, and within the Northern Everglades, have two options:
  - ✓ **Enroll in and implement FDACS BMPs**

    Or

  - ✓ **Follow a DEP- or WMD-prescribed water quality monitoring plan at the producer's own expense (complicated and costly)**

Failure to do either could bring enforcement action by DEP

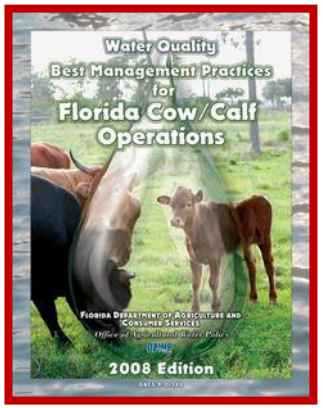
Florida's Water Issues…

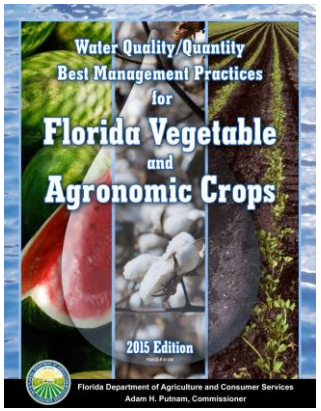
- Studies conducted by the Environmental Protection Agency (EPA) indicate that the nation's greatest nonpoint source contributors are both urban and agricultural sources.
- Agricultural concerns…
- Nutrient Management
  - Nitrogen
  - Phosphorous
- Irrigation Management

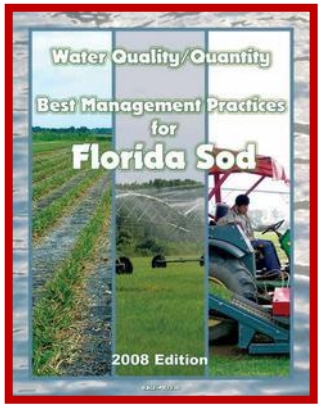
Best Management Practices

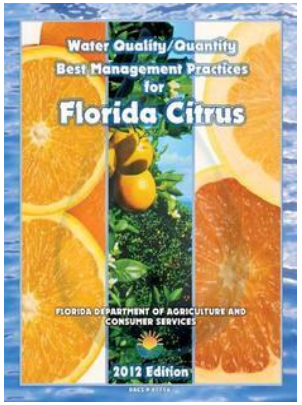
- Management strategies, tools and practices that improve water quality, conserve water, and protect water resources
- Best available science and technology
- Technical and economic feasibility
- Confirmed through implementation verification site visits
- Balance production and water resource protection
- Need to be enrolled to be eligible for cost-share

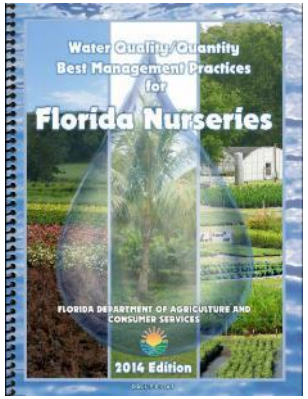
Adopted BMP Manuals

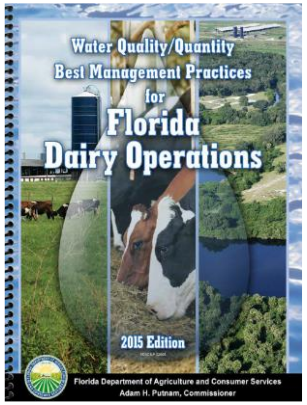


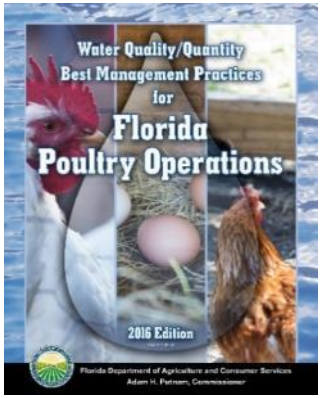


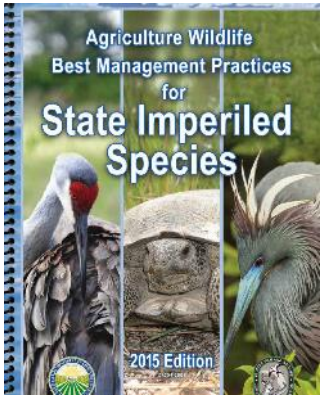








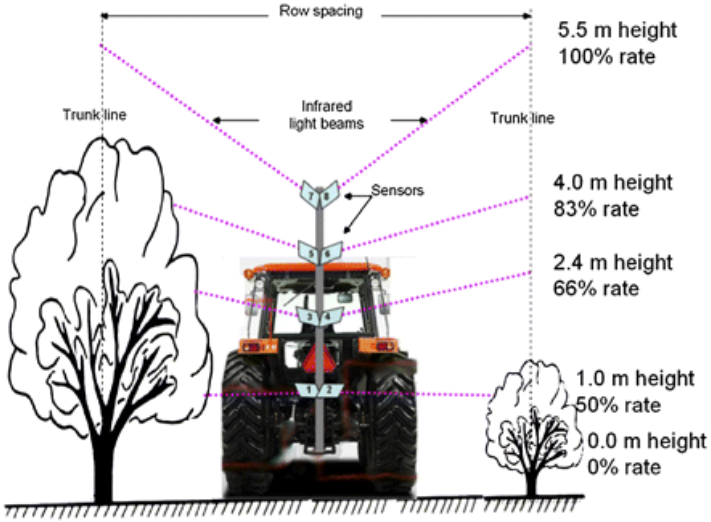


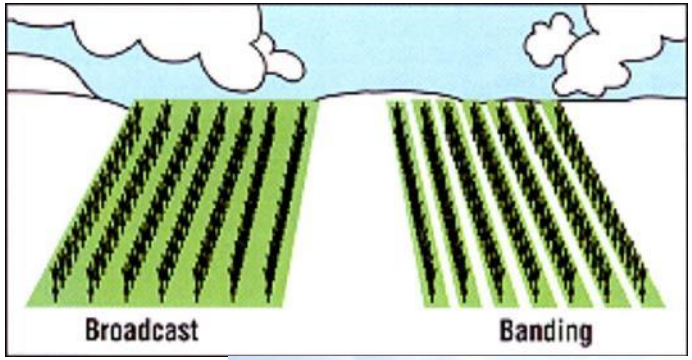


** Hemp and Diversified Operation Manuals Under Development

Nutrient Management BMPs

- Precision Fertilization – Allows precise placement of nutrients to roots and leaf tissue
- Variable Rate Technology – Multiple technologies such as soil sampling on a grid or precision application equipment – reduces fertilizer inputs as much as 35%





Water Resource Protection BMPs

- Cross fencing and solar water pumps– Rotational grazing maintains plant vigor, prevents soil erosion and maintains soil moisture

We are here to HELP

- FDACS has the lead in working with agricultural producers to develop Best Management Practices (BMP's)
- When implementing BMPs you have a presumption of compliance with the state water quality standards.
- **Production practices are exempt from public records request.**

SB 712

New Statutory Language in SB 712, s. 403.067(c)7(d)3, F.S.

At least every 2 years, the Department of Agriculture and Consumer Services shall perform onsite inspections of each agricultural producer that enrolls in a best management practice to ensure that such practice is being properly implemented. Such verification must include a collection and review of the best management practice documentation from the previous 2 years required by rules adopted pursuant to subparagraph (c)2., including, but not limited to, nitrogen and phosphorus fertilizer application records, which must be collected and retained pursuant to subparagraphs (c)3., 4., and 6. The Department of Agriculture and Consumer Services shall initially prioritize the inspection of agricultural producers located in the basin management action plans for Lake Okeechobee, the Indian River Lagoon, the Caloosahatchee River and Estuary, and Silver Springs.

SB 712 language and requirements

- IV Site Visit required for all enrolled producers every two years
- Review current BMP checklist to make sure applicable BMPs are being implemented
- Records are required to be retained by OAWP. (N and P fertilizer application records quantifying the amount of nutrients applied on each enrollment).
- Rolling two years from the date of the IV visit.

** Nutrient information obtained will be provided to the Department of Environmental Protection for utilization within BMAP assessment process

BMP Checklist

BMP #	BMP Group (See body of manual for full description)	In Use/CP#	Planned	Will not implement (check reason below)			
		Check below/ Enter FOTG #	Enter month/ year	NA	TNF	ENF	Other
1.0 Nutrient Management							
1.1. Level I - Fertilizer Management 							
1.	Use Mehlich-1 soil test results or equivalent to determine P application rate						
2.	Determine supplemental fertilizer needs using appendix 5 worksheet						
3.	Use IFAS publication SL-129 to determine fertilization rates						
4.	Time fertilizer applications for maximum nutrient uptake						
5.	Prevent spreading fertilizer material within 50′ of streams, sinkholes, or wetlands						

Recordkeeping Requirements

Existing Requirements for Nutrient Management

- Quantify all nutrient sources
  - Guaranteed analysis for commercial fertilizer
  - Book values, other lab analysis, supplier data for other sources
- Plan nutrient applications to match plant requirements
  - UF/IFAS recommendations are the default; some manuals have special nutrient management measures to justify exceedances
  - Soil and tissue testing
- Keep records of sources (w/content), application rates, location, and timing

Current Recordkeeping Requirements

In the <u>Narrative</u> of the manual

✓ **10.** Keep records of all nutrient applications that contain N or P.

In the <u>Checklist</u> of the manual

10. Keep records of all nutrient applications that contain N or P.

APPENDIX 7: EXAMPLE RECORD-KEEPING FORMS

Keeping records aids in operating and maintaining BMPs. To reiterate, BMPs that have a pencil icon require records to be kept for a minimum of five years.

You may maintain your records as hard copies or in an electronic format, depending on your preference. Below is an example of a set of record-keeping forms. You may use these tables, develop your own, or choose commercially available record-keeping software suited to your operation.

Soil Sample Records (Retain all Lab Results)

Sample Date	Field Location	# of Samples	Name of Lab	Records Location

Tissue Sample Records (Retain all Lab Results)

Sample Date	Field Location	# of Samples	Name of Lab	Records Location

Fertilization Records (Retain all Receipts)

Field Name					Production Acreage		Year	
Brand	Application method	Grade $N\text{-}P_2O_5\text{-}K_2O$	% CRN	% CRP_2O_5	Amount of fertilizer applied (lbs/total production acreage)	Amount of fertilizer applied (lbs/acre)	Total N applied (lbs/acre)	Total P_2O_5 applied (lbs/acre)

Rainfall (inches)

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.

Well Records

Location	Year Constructed	Constructed By	Last Modified	Modified By	Records Location

NICOLE "NIKKI" FRIED
COMMISSIONER

Florida Department of Agriculture and Consumer Services
Office of Agriculture Water Policy

NUTRIENT APPLICATION RECORD FORM

Rule 5M-1.008, F.A.C

FDACS-OAWP
407 S. Calhoun Street, MS-E1
Tallahassee, FL 32399

NOI Number:

Producer Provided Electronic Excel Spreadsheet (●) Yes ( ) No

☐ No Fertilizers Applied

I certify that the information on this form is accurate and based on those records required under the applicable BMP Manual.

Print name

Date

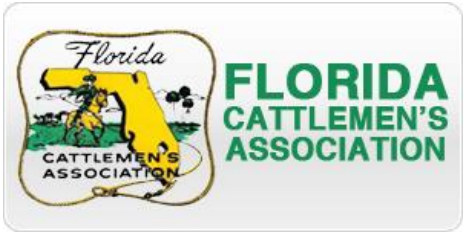
Signature of authorized contact for this NOI

Application Month	Application Year	BMP Manual	Commodity Grown	Other Commodity Description	Nutrient Source	Other Nutrient Source Description	Pounds of nitrogen applied	Pounds of phosphorus (P_2O_5) applied	Crop Acres Fertilized

FDACS-04005 06/20

Working Together

National Association of Conservation Districts



Thank You!

http://www.fdacs.gov/Divisions-Offices/Agricultural-Water-Policy

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