UF UNIVERSITY of FLORIDA
Institute of Food and Agricultural Sciences

Range Cattle Research and Education Center

Field Day
&
Dedication of new Buildings

April 16, 2009
Ona, Florida

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Supporting Extension Education Documents

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10:00	**Ribbon Cutting Ceremony** *- Jim Handley, Executive Vice President* *Florida Cattlemen's Association* *- Dr. John Arthington, RCREC Director* *- Dr. Larry Arrington, UF-IFAS Senior Vice President*
10:30	**Forage Nutritive Value: What is the value of purchased hay?** *Dr. Joe Vendramini, Forage Agronomist*
11:00	**Combating Hard to Control Weeds** *Dr. Brent Sellers, Extension Weed Specialist*
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FORAGE NUTRITIVE VALUE:
WHAT IS THE VALUE OF PURCHASED HAY?

Joao Vendramini, Forage Agronomist

Forage testing provides useful information about the nutritive value of forage. This information can be used to adjust the amount and composition of nutritional supplements offered to livestock consuming forage. The correct adjustments can reduce costs of forage production and optimize the amount of nutrients imported to the property.

Where to Send Forage Samples and What Testing Results Will Be Provided

The UF/IFAS Forage Extension Laboratory is located at the Range Cattle Research and Education Center in Ona, Florida. The laboratory provides forage testing for Florida's livestock and forage producers. Results of the tests include crude protein (CP) and total digestible nutrients (TDN).

Mail samples to Forage Extension Laboratory, UF/IFAS, Range Cattle REC, 3401 Experiment Station, Ona, FL 33865.

Beyond understanding the nutrient quality of your forage, it is also valuable to understand how your forage samples compare with other such samples submitted to the laboratory. On an annual basis, the Forage Extension Laboratory publishes the average forage nutritive values by forage species (Table 1).

Nutritive-Value Parameters and Definitions

The nutritive-value parameters reported by the Forage Extension Laboratory are as follows:

1) Dry matter (DM): DM refers to the portion of the forage after water is excluded. All nutritive-value parameters are reported on a "dry matter basis," thus results of samples with different DM concentrations can be compared. Dry matter concentration is important for conserved forage -- such as hay, haylage, and silage -- because this measure indicates how the conservation process may impact forage nutritive value. Dry matter concentration for hay should be approximately 85–92%, haylage 40-60%, and silage 30-40%.

2) Crude protein (CP): CP is the nitrogen and amino acids in feeds. An estimate of forage total crude protein is obtained by multiplying total nitrogen concentration by a constant of 6.25. Adequate CP concentrations in the forage are dependent on forage species and animal requirements. For more information, see EDIS Publication AN190, *Basic Nutrient Requirements of Beef Cows* (http://edis.ifas.ufl.edu/an190).

3) Total digestible nutrients (TDN): TDN represents the energy concentration in the forage, the sum of digestible fiber, starch, sugars, protein, and fat in the forage.

Energy is the nutrient required by cattle in the greatest amount and usually accounts for the largest proportion of feed costs.

4) Neutral detergent fiber (NDF): NDF represents plant cell wall components (hemicelluloses, cellulose, lignin), which are more or less degradable, depending on stage of maturity and degree of lignification of the forage. In general, as NDF increases, voluntary forge intake is reduced.

5) Acid detergent fiber (ADF): The ADF component of forage is determined when either the NDF residue or an intact forage sample is processed in a detergent solution primarily containing sulfuric acid. The remaining fiber residue, mostly cellulose and lignin, is called ADF. In general, as ADF increases, forage digestibility is reduced.

How to Collect a Sample

Properly collecting and identifying a sample is very important. A sampling device or tool is needed for collecting hay samples. Several commercial types are available. These tools usually consist of a tube -- with a cutting edge on one end and a shank on the other -- that is fastened in the chuck of an electric drill or hand brace. The sampler is driven into the end of a rectangular bale or the rounded side of the round bale. Collect a single core sample from each of 12 bales for a particular lot of hay. To ensure the sample is representative, combine the 12 cores into one sample. The outer layer of weathered round bales should be pulled away before sampling. Each hay cutting, type of hay, etc. should be sampled and analyzed separately. Each hay cutting or lot should be identified and stored separately.

Silage samples can be collected from the face of a bunker silo as it is being fed and from the unloader of an upright silo. Bagged silage can be sampled by cutting small slits along the side of the bag and penetrating the hay sampler to collect the material. Producers must reseal the slit with waterproof tape after collection.

Collect silage from five or six places along the bag, mix well, and extract a single sample to send to the laboratory. Immediately place the sample in a plastic bag and seal it. If the sample is not mailed right away, place the sample in a refrigerator or freezer.

Pasture samples can be collected and analyzed by plucking the forage with your fingers at the height the animals are grazing it. However, keep in mind that, when adequate pasture forage is available, cattle may select forage with a better nutritive value than the forage sampled by hand plucking. One practical example of selection can be found in limpograss pastures with good forage availability. In this example, cattle will typically select leaves that have greater nutritive value than hand-plucked samples collected with leaves and stems. In this case, forage testing results may suggest that cattle would respond to protein supplementation. However, in fact, the animals are already consuming adequate amounts of protein from forage selection and may not respond to supplementation.

Scissors or some other cutting device also can be used. If possible, these samples should be dried before sending to the laboratory. If drying is not possible, mail the sample immediately after it is harvested. Your results are only as good as your sample!

Additional Information and Testing Procedures

Nutritive value results (Table 1) are reported by forage species. Forage species not included in this publication were not received by the laboratory in sufficient numbers to be included in this annual report. Crude protein and TDN were analyzed in all samples. Dry matter (DM), NDF, and ADF were analyzed in selected samples submitted by dairy producers participating in the Southeast Dairy, Inc., Check-Off Program.

The UF/IFAS Forage Extension Laboratory sample processing and analyses are as follows:

- Forage samples are dried at 55°C in a forced-air oven for DM determination.
- Total digestible nutrients (TDN) are estimated using the "in vitro" dry matter digestibility (IVDDM) procedure described by Goering and Van Soest (1970). USDA-ARS Agric. Handb. 379. U.S. Gov. Print. Office, Washington, DC). modified for the Ankom Daisy II In Vitro Digester (Ankom Technol. Corp., Fairport, NY).
- Crude protein was calculated by multiplying nitrogen concentration by 6.25.
- Nitrogen is determined by combustion using the Flash EA 1112 Series (Thermo Electron Corporation, Waltham, MA).
- Neutral detergent Fiber (NDF) and acid detergent fiber (ADF) are analyzed using an Ankom 2000 Fiber Analyzer (Ankom Technology Corp., Fairport, NY).

Many laboratories provide forage testing results based on NIRS procedure. The NIRS procedure is often valid, depending upon the set of forage samples originally used to establish the procedure's equations. In general, wet chemistry procedures are more accurate.

If you do not know how to interpret the results, contact your County Agricultural Extension Office, or the UF-IFAS Forage Extension Laboratory at jv@ufl.edu.

The authors sincerely thank the Dairy Check-Off Program for sponsoring forage testing for the Southeast Diary Inc. producer samples.

References

Ankom Technology Corporation. 1998. Method for determining Acid Detergent Fibre, Neutral Detergent Fibre and Crude Fibre, using the Ankom Fibre Analyser. Ankom Technology Corporation, 14 Turk Hill Park, Fairport New York 14450, USA

Goering, H.K., and P.J. Van Soest. 1970. Forage fiber analysis (apparatus, reagents, procedures, and some applications). USDA Agric. Handb. 379. U.S. Gov. Print. Office, Washington, DC.

Hersom, Matt. 2007. Basic Nutrient Requirements of Beef Cows. (http://edis.ifas.ufl.edu/an190) Animal Science Department, University of Florida, Gainesville, FL

Table 1. Dry matter (DM), crude protein (CP), total digestible nutrients (TDN), acid detergent fiber (ADF), and neutral detergent fiber (NDF) of forage samples submitted to the Forage Extension Laboratory at the RCREC – Ona, FL (Oct., 2006 to July, 2008)

Forage Species1	Number of	DM	CP	TDN	ADF	NDF
		---------- % ----------				
Bahiagrass[a]						
Hay	36	85 ± 4	7.5 ± 2.4	49 ± 5	--	--
Pasture	8	24 ± 2	9.2 ± 0.8	53 ± 3	--	--
Bermudagrass						
Hay	82	89 ± 2	10.3 ± 3.5	53 ± 7	44 ± 5	79 ± 3
Silage/Haylage	18	31 ± 5	8.8 ± 1.8	50 ± 3	45 ± 1	77 ± 1
Stargrass						
Hay	18	84 ± 2	9.9 ± 2.7	53 ± 5	59 ± 2	73 ± 3
Pasture	26	36 ± 3	13.1 ± 3.6	58 ± 7	50 ± 20	68 ± 15
Silage/Haylage	56	34 ± 8	10.1 ± 2.5	57 ± 7	52 ± 13	69 ± 16
Limpograss						
Hay	48	83 ± 3	4.2±1.2	54 ± 6	38 ± 5	78 ± 8
Pasture	13	35 ± 3	7.5±1.3	57 ± 3	--	--
Silage/Haylage	28	40 ± 4	6.1±0.9	49 ± 6	40 ± 4	70 ± 6
Corn						
Silage/Haylage	18	28 ± 2	8.4±0.8	75 ± 5	28±1	48 ± 9

[a]ADF and NDF analysis performed only on samples submitted by dairy producers.

COMBATING HARD TO CONTROL WEEDS

Brent Sellers, Extension Weed Specialist

Herbicide Update

There are a couple new herbicides that are available for pasture weed control. Outrider received a federal label for sedge control in established bahiagrass and bermudagrass pastures. The application rate of 1.33 oz/A provides excellent control of sedge species. Although there are no injury concerns to limpograss or stargrass, Outrider is not currently labeled for use on these forages. We are hoping to get this resolved in the next couple of years. We are also investigating this for sedge control at forage establishment; we are working with Monsanto on this issue.

Another herbicide that will soon be marketed by Dow AgroSciences is called Chaparral. It is a premix of metsulfuron (Cimarron/Escort/Ally) and aminopyralid (Milestone). The use rate for Chaparral will be 2 to 3.3 oz/A. This product should not be applied to bahiagrass pastures. It will provide good blackberry control, as well as control of several broadleaf weeds.

Smutgrass

Unfortunately, we really do not have anything new coming along for smutgrass control in pastures, but we are continuously trying to figure out ways to "manage smutgrass" in pastures after Velpar has been applied. Our most current research has determined that Velpar should be applied at 2 qt/A (1 lb hexazinone/A) during the rainy season. It is extremely important that rainfall occurs within one week after application to ensure that the herbicide is washed into the soil for root uptake. There is very little foliar activity on smutgrass from Velpar; therefore root uptake is essential for effective smutgrass control. Additionally, we have found that a surfactant is not necessary when spraying Velpar. Velpar is already expensive and the additional cost of a surfactant is not needed.

Blackberry

Dr. Jay Ferrell and I have been working hard on solving blackberry control problems over the past several years. Our research has shown that fall applications of herbicides tend to be more consistent than spring applications. This is likely due to two reasons: 1) blackberry plants are sending energy to the root system during the fall, causing the herbicide to be transported to the roots, resulting in more effective control, and 2) rainfall is more consistent in the fall and blackberry plants tend to be less stressed by limited rainfall as in the spring. The herbicides that are the most effective on blackberry include Remedy at 2 pt/A, Pasturegard at 4 pt/A, and Cimarron Plus at 0.38 oz/A. Our research has shown that Cimarron Plus is the most consistent herbicide, but its use is limited to pastures other than bahiagrass. This really limits the amount of Cimarron Plus that can be used in Florida. Lastly, where a lot of us consider blackberry a

problem, it did not show up overnight. Similarly, it is not going to be controlled overnight.

Cogongrass

Many of us already know what cogongrass is and the vast devastation it can cause to pastures as well as other important ecosystems within Florida. However, for those who do not know cogongrass, this article will provide some basic information on the history of cogongrass in the U.S., its basic biological characteristics and identification. Cogongrass is found on every continent and is considered a weedy pest in 73 countries. In the U.S., cogongrass is found primarily in the southeast. It was accidentally introduced into Alabama in the early 1900s, and purposely introduced as a potential forage and soil stabilizer in Florida (and other states) in the 1930s and early 1940s. However, it was realized that cogongrass could be a weedy pest soon after investigations began. Since its introduction, it has spread to nearly every county in Florida. In some cases it has completely taken over pastures so that it is the only species present in the pasture. This is a common thread where cogongrass invades; invasion quickly causes displacement of desirable species and requires intensive management strategies.
There are many reasons why cogongrass is such a prolific invader. It is a warm-season, perennial grass species with an extensive rhizome root system. In fact, at least 60% of the total plant biomass is often found below the soil surface. In addition to the rhizome root system, cogongrass is adaptable to poor soil conditions and fire, it is drought tolerant, and it has prolific wind-dispersed seed production. Additionally, it can grow in both full sunlight and highly shaded areas; although it is less tolerant to shade. Cogongrass spread occurs through the creeping rhizome system as well as seed production. The rhizomes can penetrate to a depth of 4 feet, but most of the root system is within the top six inches of the soil surface. The rhizomes are responsible for long-term survival and short-distance spread of cogongrass. Long-distance spread is accomplished through seed production; seeds can travel by wind, animals and equipment. The rhizome system, as stated earlier, is responsible for long-term survival of cogongrass. Established stands are capable of producing over 3 tons of root biomass per acre. It is a specialized rhizome that is capable of conserving water. Notice that during the dry season, the top growth dies back. This is essentially a survival mechanism to keep the rhizome system alive. Additionally, another key to invasion is that the root system is thought to produce allelopathic chemicals, reducing the competitive ability of other plants.

Identification

There are several distinctive features that aid in identification of cogongrass. First, cogongrass infestations usually occur in circular patches. The grass blades tend to be yellow to green in color. Individual leaf blades are flat and serrated, with an off-center prominent white midrib. The leaves reach 2 to 6 feet in height. The seed head is fluffy, white, and plume-like and flowering typically occurs in spring or after disturbance of the sward (mowing, etc.). Seed heads range from 2 to 8 inches in length and can contain up to 3,000 seeds. Each seed contains silky-white hairs, which are thought to aid in wind

dispersal. When dug, the rhizomes are white, segmented (have nodes), and are highly branched. The ends of the rhizome are sharp pointed and often are able to pierce the roots of other plants as well as animals walking or grazing within infested areas. Awareness of the biology of a particular plant helps us to understand how long of a fight we are up against if we want to control it. Cogongrass may be one of our toughest weed management challenges in Florida. If you did not already know, now you should understand that one application of an herbicide or one management tactic will not likely control this plant.

Control

Control of cogongrass has been studied for many years by researchers all over the world. During this time nearly all available herbicides have been tested on cogongrass, but few effective products have been found. For example, all of the commonly used pasture herbicides such as Cimarron, 2,4-D, Remedy, Velpar, and Weedmaster have no activity on cogongrass. Only, glyphosate (Roundup, etc.) and imazapyr (Arsenal, Stalker, etc.) herbicide have been found to be effective, but long-term control is rarely achieved.

Imazapyr is an extremely effective herbicide that controls a variety of weeds, from herbaceous to woody species. One or two applications of imazapyr (0.75 lb/acre) will often effectively control cogongrass for 18 to 24 months. However, there are several disadvantages to using this herbicide. First, imazapyr will severely injure or kill forage grasses such as bermudagrass and bahiagrass. It also has a long soil half-life and will remain in the soil for several months after application. This often leads to "bare ground" for up to 6 months in the application area due to the non-selective nature of this herbicide. Imazapyr also has the potential to move down slopes during periods of rainfall, killing or injuring other species in the runoff area (oaks and other hardwood trees are especially sensitive). Secondly, imazapyr can only be used as a "spot-treatment" with no more than 10% of the pasture area treated per year.

Small infestations. Early detection of cogongrass in any setting is extremely important. This is because a young infestation will be much easier to treat and eradicate than long-established infestations. In this case, we would define a small patch as one that is 20 to 30 feet, or less, in diameter. Even for a small patch, monitoring will be required after the initial application to ensure that any re-sprouting is quickly treated. See Table 1 for specific timelines and suggested herbicide rates.

Large infestations. Large infestations are those that are 30 feet, or larger, in diameter. These types of infestations can typically be considered as established and will likely have a large, intact root system. This will require more herbicide treatments to completely eradicate cogongrass. See Table 2 for specific timelines and suggested herbicide rates.

Integrated management. Herbicide inputs alone are rarely successful in eradicating perennial species like cogongrass. In these cases, we need to utilize all of the

tools we have to remove an unwanted species to reestablish a desirable species. This type of strategy would be best employed in an area where cogongrass has long been established and is the predominant species present. See Table 3 for specific timelines and suggested herbicide rates. In general, the area infested with cogongrass should be burned in August to September. Then treat the burned area one to four months after burning with a mixture of imazapyr and glyphosate. Take soil samples prior to spring tillage the next growing season to ensure that the soil pH is adequate for your desirable forage species. Till the treated area the following spring to a depth of at least 6 inches and prepare a seedbed. Consult with your local county extension agent to consider your options for forage cultivars and fertility recommendations. Getting a good start on the desirable forage will help limit reinfestations of cogongrass in your pasture. Continue to monitor this area in six months intervals until the 4th year. Spot treat with glyphosate when necessary to remove any new cogongrass growth.

Based upon these recommendations, it's easy to see that eradicating cogongrass is not an easy task. Be sure to follow sanitary practices when moving equipment from cogongrass infested areas by cleaning off mowers and tillage equipment before moving into cogongrass-free pastures. It is spreading enough on its own without our help. If you have further questions concerning cogongrass control, please consult your local county extension agent.

Table 1. Herbicide suggestions for small infestations of cogongrass in grazing areas. This includes both improved and native rangeland. These concentrations are good for mixing in small (3-30 gallon) sprayers. Please read the entire label of the suggested products prior to treating existing cogongrass stands.

	Timing	Herbicide Rate	Application Notes
1st year	Fall (August-November)	1% Arsenal/Stalker + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
		3% Glyphosate	No grazing or haying restrictions. Read the herbicide label for mixing instructions
		0.5% Arsenal/Stalker + 2% Glyphosate + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
2nd year	Spring (monitor regrowth)	2-3% Glyphosate	See above.
	Fall (monitor regrowth)	2-3% Glyphosate	See above.
3rd year - until eradicated	Spring - Fall (monitor regrowth)	Spot treat at the above rates for the 2nd year.	

Table 2. Herbicide suggestions for large cogongrass infestations in grazing areas, including both improved and native rangeland. These suggestions are intended for large (>100 gallon) sprayers. Please read the entire label of the suggested products prior to treating existing cogongrass stands.

	Timing	Herbicide Rate	Application Notes
1st year	Fall (August-November)	48 oz/acre Arsenal/Stalker + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
		3 to 4 qt/acre Glyphosate	Do not graze for 8 weeks. Read the herbicide label for mixing instructions
		24 oz/acre Arsenal/Stalker + 2 qt/acre Glyphosate + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
2nd year	Spring (monitor regrowth)	2-3% Glyphosate	No grazing or haying restrictions.
	Fall (monitor regrowth)	2-3% Glyphosate	No grazing or haying restrictions.
3rd year - until eradicated	Spring - Fall (monitor regrowth)	Spot treat at the above rates for the 2nd year.	See above.

Table 3. Control of cogongrass using an integrated approach. Adjust your timelines based upon your location within Florida. For example, burning will have be performed earlier in north Florida than in south Florida due to the first onset of a potential killing frost. Please read all herbicide labels prior to treating cogongrass for restrictions and mixing instructions.

	Timing	Herbicide Rate	Application Notes
1st year	Summer - Fall (August-November)	1. Burn	Cogongrass fires burn extremely hot. Be sure to have firebreaks in place before attempting to burn cogongrass.
		2. Apply herbicide: 24 oz/acre Arsenal/Stalker + 2 qt/acre Glyphosate + 0.25% non-ionic surfactant	Treat only 10% of the area to be grazed. No grazing restrictions, but do not cut for hay for 7 days. Read the herbicide label for mixing instructions.
		3. Take soil samples	Have the soil pH tested at a reputable laboratory. Amend the soil as needed to grow a desirable forage.
2nd year	Spring	1. Tillage	Prepare a seedbed for desirable forage species. Repeated tillage will help to dessicate any remaining cogongrass rhizomes.
		2. Plant desirable forage	Please consult your local extension agent for up to date recommendations on forage cultivars and fertility recommendations.
3rd year	Spring (monitor regrowth)	2-3% Glyphosate	No grazing or haying restrictions.
	Fall (monitor regrowth)	2-3% Glyphosate	No grazing or haying restrictions.
4th year - until eradicated	Spring - Fall (monitor regrowth)	Spot treat at the above rates for the 3rd year.	See above.

CHANGES IN BAHIAGRASS FERTILIZATION RECOMMENDATIONS

Maria L. Silveira, Soil and Water Scientist

Fertility management for bahiagrass pastures is an evolving process. Since 1990, fertilizer recommendations for bahiagrass have been changed in order to address scientific, economic, and technological considerations of pasture fertilization. These changes included optimum soil pH levels, phosphorus fertilization and division of the State into north and south regions.

Over the last decade, phosphorus fertilization and soil testing calibrations for phosphorus fertilizer recommendations have become important topics of pasture fertilization. That is because phosphorus not only represents an expensive input but also may impact the environment when mismanaged. Research in Florida has shown that bahiagrass may produce satisfactorily without phosphorus fertilization. That is likely due to the apparent ability of bahiagrass to access phosphorus from deep soil depths. However, continuous grazing and/or haying production in absence of phosphorus fertilization may lead to phosphorus deficiency, which in turn may reduce forage production. There have been several reports in Florida indicating yield decline in bahiagrass pastures that received no phosphorus fertilization for several years. Under these circumstances, it appears that soil phosphorus "reserves" had been completely depleted and the overall pasture sustainability could be at danger because of soil nutrient deficiency. However, the key for most producers was to distinguish situations where phosphorus is needed to improve bahiagrass production.

Although most Florida sands exhibit very low phosphorus concentrations in the top surface soil, adequate concentrations are often found in deep soil depths. Soil test alone has been shown to poorly predict bahiagrass phosphorus requirements. This is mainly because soil test typically examines the top 6 inches of the soil profile, which may not reflect the total soil phosphorus available pool present at deeper soil depths. The challenge for agronomists and soil scientists was to develop additional tools to better predict phosphorus requirements in established bahiagrass pastures. In this context, plant analysis in combination with soil test has proven to be a useful diagnostic tool to manage soil fertility. Although using the concept of plant nutrient analysis has been long used in many agricultural systems, incorporating this concept into existing forage nutrient management programs in Florida require special attention. Research is still need to fine-tune the correlation between tissue and soil test phosphorus and bahiagrass response to fertilization. It is possible that recommendations may still be subjected to modification as research data from different regions of the State become available.

The following represents a brief summary of the main changes in the IFAS fertilization recommendations for bahiagrass pastures.

1. Optimum soil pH

Root development and nutrient availability are affected by soil pH. Thus, it is essential that soil pH is addressed before considering nitrogen and/or phosphorus fertilizer application. Optimum soil pH for bahiagrass is 5.5. Soil test is now recommended for both north and south regions of the State. Soil samples should be periodically taken and analyzed to determine soil pH. Excessively high pH is as undesirable as low pH. Thus, it is important that soil is tested at least once every three years to determine pH and lime requirements. The frequency of soil sampling will depend on several factors including soil type, nitrogen application rate, nitrogen fertilizer source, and forage utilization (grazing versus haying). It is also important to allow enough time for the lime material to react with the soil particles and bring the pH to the desirable ranges. Because of the low solubility of the majority of the liming materials, these should be applied from 3 to 6 months prior to fertilizer application.

2. Soil test

Despite the limitations described previously, soil test continues to be an important nutrient management tool. Again, it is important the soil sample truly represents the area of interest. Thus, proper sampling is a crucial step. Soil samples should be submitted to a reputable laboratory for analysis. Caution should be exercised when submitting soil samples to "out of State" laboratories. Because IFAS recommendations are based on an analysis procedure known as "Mehlich-1" or "double-acid", it is important that the laboratory where the soil samples will be analyzed uses the same method. If the producer decides to use the UF/IFAS Extension Soil Testing Lab, note that new analysis codes were created for bahiagrass pastures. In case the producer is interested in phosphorus recommendations, both soil and forage tissue samples must be submitted to the UF/IFAS Extension Soil Testing Lab at the same time. If only soil samples are sent to the lab, the soil test report will provide the soil phosphorus levels in the soil but will not include phosphorus recommendations. Alternatively, if the producer is only interested in testing the soil for pH, Ca, Mg and K levels, soil samples alone can be sent to the lab.

3. Tissue test

In order to better predict bahiagrass phosphorus requirements, we recommend that soil and tissue samples are submitted to the lab at the same time. Similarly to soil sampling, collection and handling of tissue samples are crucial steps. The part of the plant to be sampled, maturity stage and time of sampling are also important factors that can affect plant nutrient composition. Forage grasses and hay fields should be sampled prior to seed head emergence or at the optimum stage for forage utilization. As the plant matures, nutrient concentrations decline, so it is critical that plants are sampled at the proper stage of maturity. The four uppermost leaf blades should be sampled. Do not sample seeds since they are not useful for assessing nutrient status of forage crops and may introduce large errors in the report interpretation. If deficiency symptoms are suspected, plants showing these symptoms should be sampled and analyzed separately from "normal" or healthy appearing plants. It is very important that issue samples are

immediately sent to the lab after collection. That minimizes changes in the nutrient concentrations in the plant tissue.

Phosphorus recommendations for established grazing bahiagrass in the laboratory report will be based on both soil and tissue test results and the nitrogen fertilizer option chosen by the producer. Nitrogen options should be chosen based upon economic considerations of each individual production system. The tree fertilization options are presented below:

- Low-Nitrogen Option. Apply 50 to 60 lb N/A in the early spring. Apply 25 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. For Medium and High soil P levels, neither P application nor tissue analysis is recommended since there will be no added benefit of P fertilization on bahiagrass yields.

- Medium-Nitrogen Option. Apply 100 lb N/A in the early spring. Apply 25 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. For Medium and High soil P levels, neither P application nor tissue analysis is recommended since there will be no added benefit of P fertilization on bahiagrass yields. Apply 50 lb K_2O/A if your soil tests Very Low or Low in K and none if it tests Medium or High.

- High-Nitrogen Option. Apply 160 lb N/A in two applications of 80 lb N/A in early spring and early summer. Apply 40 lb P_2O_5/A if your soil tests Very Low or Low in P and tissue P concentration is below 0.15%. Do not apply P if tissue P concentration is at or above 0.15%, even if the soil tests Very Low or Low in P. For Medium and High soil P levels, neither P application nor tissue analysis is recommended since there will be no added benefit of P fertilization on bahiagrass yields. Apply 80 lb K_2O/A if your soil tests Very Low or Low in K and 40 lb K_2O/A if it tests Medium. No K should be applied if your soil tests High or Very 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.

SL259

UF UNIVERSITY of FLORIDA
IFAS Extension

Dealing With High Fertilizer Costs in Forage Production Systems[1]

M.L. Silveira, J.M. Vendramini, P.J. Hogue and J.F. Selph[2]

Introduction

Fertilizer costs have increased tremendously over the last few decades. For instance, nitrogen (N) fertilizer prices have doubled in the last two years. Unfortunately, this trend is expected to continue in the future in response to high energy demand and decreased reserves of fossil fuels. Commercial fertilizers are the most costly input in warm-season grass forage production. Thus, it is important that fertilizers are used efficiently, so the investment return can be optimized. This document addresses some important issues relative to fertilizer efficiency as well as alternatives for reducing fertilizer use and reducing production costs for forage production.

Soil Testing

Adequate soil fertility is one key to successful forage and livestock production in Florida. Most soils in Florida are deficient to some degree in more than a single essential plant nutrient. Unless all required nutrients are supplied in adequate amounts, the benefits of a single nutrient application are not fully maximized.

Soil testing is still the best management tool to monitor soil fertility levels. Routine soil tests can help identify nutrient deficiencies and inadequate soil pH. Similarly, soil test results can also indicate which nutrients are present at adequate levels in the soil so fertilizer can be omitted. In addition to the money saved by limiting application to required fertilizers, losses and associated environmental problems can also be minimized. Based on soil test results, cost-effective fertilization programs can be developed to meet forage nutrient requirements and minimize production costs.

Although soil testing is a vital component of soil fertility programs for forage crops, the results and interpretation of a soil test are only applicable if the soil samples have been properly collected. Soil samples submitted to the laboratory should accurately represent the area of interest. A minimum of 15 to 20 subsamples (0 to 6 inches in depth) should be collected from each field. Areas that are managed or cropped differently should be sampled separately. Similarly, areas that show clear problem signs (i.e., poor forage production, disease) should also be

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All chemicals should be used in accordance with directions on the manufacturer's label.

sampled and analyzed separately. After collecting a minimum of 15-20 subsamples, soil should be mixed in a clean plastic bucket. A hand full (~1 pint) of soil should be sent to a reputable laboratory for analysis. Soil testing should be repeated at least every 3 years.

Soil pH

Often overlooked, maintenance of adequate soil pH is an extremely important step in soil fertility programs for forage crops. Soil pH is one of the most important soil properties because it controls nutrient availability to plants, root development and fertilizer efficiency. Optimum soil pH promotes better root growth, which, in turn, results in more efficient fertilizer and water utilization by the plants. For instance, N fertilization efficiency in forage systems can increase 2.5 times by increasing soil pH from 4.5 to 5.5. Similarly, P and K fertilization efficiency is also increased when soil pH is adequate.

Florida soils often exhibit low pH and are considered "acidic". Lime is frequently used to raise soil pH. By raising the soil pH, macronutrient (i.e. N, P, and K) availability is typically increased. However, at high soil pH (> 6.5) micronutrients become less available. Therefore, it is important that adequate amounts of lime material are applied to the soil to bring the pH to a desirable range.

Forage crops require different soil fertility conditions and target pH varies according to the forage species. In general, warm-season grasses are more tolerant of soil acidity than legumes. Liming frequency as well as application rates will depend on the soil's characteristics and management practices. Nitrogen fertilization and decomposition of organic materials contribute to soil acidity. It is important to closely monitor pH and soil fertility status by testing the soil regularly. Routine soil testing provides the soil pH levels as well as the recommended lime application rates.

Choosing the most adequate fertilizer source

Several fertilizer sources are commercially available to supply N, P, K, and micronutrients to forage crops. In this section, we will focus on commercial N sources, but the same considerations should be applied to other essential nutrients.

Ammonium nitrate, ammonium sulfate, and urea are the major N sources used on pastures in Florida. Organic sources such as biosolids and animal manure also represent important sources of N that can be used in pastures. When choosing the right fertilizer source, it is important to consider important factors, such as price, fertilizer effectiveness, method and rate of application.

Cost of fertilizer should be calculated in terms of dollars per pound of nutrient. Below is an example how this can be easily calculated. Please note the fertilizer prices used here are just an example, so please check with your local fertilizer dealer the current fertilizer cost.

- Ammonium nitrate (34% N) costs $350/Ton. 2000 lb ammonium nitrate contains 680 lb N (2000 X 0.34 = 680). Thus, the price per lb of N is $0.51 (350/680= 0.51)

- Ammonium sulfate (21% N) costs $300/Ton2000 lb ammonium sulfate contains 420 lb N (2000 X 0.21 = 420). Thus, the price per lb of N is $0.71 (300/420= 0.71)

In addition to fertilizer costs, it is also important to consider the acidity potential of each N fertilizer source. Regardless of the source, N fertilization typically reduces soil pH. However, some N sources can cause a reduction in soil pH more rapidly than others. Thus, when choosing a N source, it is also important to account for additional costs associated with lime application. For instance, ammonium nitrate requires 0.61 lb of lime per lb of fertilizer, while ammonium sulfate and urea require 1.10 and 0.81 lb of lb of lime per lb of fertilizer to maintain soil pH.

Commercial fertilizer mix often provides multiple nutrients, which can be most economical in some situations. However, the N:P:K ratio of the fertilizer formula should coincide with the soil test recommendations to avoid unnecessary nutrient application. For instance, if a soil test indicates that P levels are adequate, producers should select fertilizer mixes that contain no P (i.e. 20-0-20).

Organic fertilizer sources such as animal manure and biosolids can satisfactorily provide N and other nutrients to forage grasses. When properly applied, these organic sources can be beneficial to agriculture with no negative impact on the environment. Another advantage of organic sources is that, because of the alkaline nature of some of these materials (i.e., lime-stabilized biosolids), they can increase soil pH and reduce costs associated with liming.

One important aspect to consider when using organic amendments is that the N present in these sources is not readily available to plants and total N is often a poor indicator of N availability. For instance, while only 40% of the total N in some biosolids materials may become available in the first year, up to 80 to 90% of the total N present in chicken manure may be available during the same period. As the organic compounds mineralize, N and other essential nutrients become available to the plants. Factors such as source, time and rate of application and environmental conditions can impact the effectiveness of organic materials in providing N to pastures. From an environmental prospective, because improper application of organic amendments may lead to excessive soil P concentrations and increase soil pH above the desirable range, it is important to monitor soil fertility after manure and/or biosolids application.

Timing and rate of fertilizer application

Fertilizer should be applied when the forage is actively growing. For most warm-season grasses commonly used in Florida, such as bahiagrass, growing season does not start until night temperatures reach 60^{o}F, which typically occurs in early spring. For establishment of new plantings, fertilizer should not be applied until plants have emerged. Nitrogen and K should be split-applied into two applications: after emergence and 30 to 50 days later. For hayfields, N and K should be applied after each cutting.

Unlike P and K recommendations, N application rates are not based on soil test results, but rather they are calculated based on expected yields. From an economic perspective, it is important to consider realistic yield expectations when calculating the amount of N that a pasture will receive. Improved grasses such as bermudagrass and stargrass usually require higher fertilizer application rates than bahiagrass pastures. Beside the forage species, another important aspect that should be considered is how much grass is needed. Do not fertilize pastures if forage production will not be consumed by grazing animals and/or harvested for hay. For instance, N fertilization will likely increase forage production and nutritive value but these benefits may not be economical if not converted into animal product. Thus, adequate stocking rate is another important variable to consider when choosing N rates.

Utilization of forage N-fixing forage legumes

Nitrogen-fixing legumes have the ability to convert atmospheric N into compounds that plants can use. Symbiotic fixation of N is achieved by the association of bacteria and the roots of legumes species. Normally the association between legume and bacteria species is very specific, so the efficiency of the symbiosis is largely dependent on the presence of the bacteria. Legumes are only able to fix N from the air if specific strains of bacteria are present in nodules on their roots. The seed must be inoculated before planting to ensure that the best strain of bacteria is present for each legume species. In addition, soil fertility (i.e. pH and cations) and environmental conditions also affect the efficiency of N fixation. The primary driving force in calculation of N fixation is legume yield. High yielding legumes fix more N.

Cool-season legumes grow the most in the spring when temperature and rainfall are favorable. Cool-season legumes are more widely used in North Florida because they more adapted to well drained soils and mild temperatures. Some clovers such as arrowleaf, ball, rose, and white clover produce a high percentage of hard seed which allows them to reseed if managed properly. Cool-season legumes are high in nutritive value and when grazed by beef cattle provide excellent animal performance. Annual clovers can contribute with about 75-100 lbs N/acre for the subsequent grass crop.

The most common warm-season legumes species adapted to Florida's conditions are perennial peanut (North-Central regions of the state), and aeschynomene (South region). Perennial peanut has primarily been used for hay production, while aeschynomene, an annual warm-season legume, is commonly used in beef cattle grazing systems.

The majority of the legume-N is transferred to the soil by unused plant material and/or animal excreta. Grazing animals can return more than 80% of the consumed nutrients to the soil through the feces and urine. If the legume crop is harvested and removed from the pasture as hay, haylage, or silage, the contribution of legume-N to the subsequent crop is reduced.

Grazing management

Because a large proportion of nutrients are returned to the soil via animal excreta, grazing management can have significant impacts on soil fertility status. Significant amounts of N, P, Ca, Mg, and micronutrients can be recycled to the soil via animal feces and urine. However, because grazing animals tend to excrete near to water, shade and feeding area, homogeneous distribution of excreted minerals is typically a major challenge. The heterogeneous distribution of nutrients is not only undesirable in terms of forage management, but it may also result in high concentration of nutrients in small areas.

Grazing management can have a major role in maximizing the benefits of nutrient recycling in grazing pastures and, consequently, reducing the dependence on commercial fertilizer. Stocking rate and grazing method (rotational versus continuous) are important factors that may affect nutrient redistribution. Typically rotational grazing leads to a more homogeneous distribution of excreta. Research in Florida has shown that short grazing periods can increase the uniformity of excreta return as well as the efficiency of nutrient recycling compared to continuous grazing. Similarly, increasing the stocking rate may increase nutrient concentration and redistribution across the pasture but it may also lead to excessive nutrient accumulation in the soil. Environmental factors such as daily temperature and animal type may also affect animal grazing behavior and, consequently, nutrient redistribution in pastures.

SS AGR 303

UF UNIVERSITY of FLORIDA
IFAS Extension

Mulato (*Brachiaria sp.*)[1]

J. Vendramini, U. Inyang, B. Sellers, L.E. Sollenberger and M. Silveira[2]

Introduction

Brachiariagrasses, including Mulato, are tropical warm-season forages native to Africa (Kenya, Ethiopia, Uganda, Tanzania, Zimbabwe, Rwanda, and Burundi). Brachiariagrasses were first introduced in tropical Australia in the early 1960s and subsequently in tropical South America in early 1970s (Parsons, 1972; Sendulsky, 1978).

Brachiariagrasses are the most widely grown forages in tropical South America, occupying over 80 million hectares (Boddey *et al.*, 2004). They are extensively used as pasture grasses, but *Brachiaria* species are not commonly used for harvested forage. Exceptions include creeping signalgrass (*Brachiaria humidicola*) and a few other species that are used for hay (Boonman, 1993; Stur *et al.*, 1996). The growing interest in brachiariagrasses has prompted an urgent need to develop new cultivars with outstanding agronomic characteristics, greater range of adaptation, greater biomass production and nutritional quality, and resistance to *Rhizoctonia* (a disease-causing fungus) and spittle bug species.

A hybridization program was initiated at the International Center for Tropical Agriculture (CIAT, Colombia), and conducted in collaboration with the Brazilian Agricultural Research Agency (EMBRAPA, Brazil). This effort resulted in the release of an apomictic hybrid, Mulato (CIAT, 2000). Mulato is the first hybrid in the *Brachiaria* genus and results from crossing ruzigrass (*Brachiaria ruziziensis* clone 44-6) and palisadegrass (*Brachiaria brizantha* CIAT 6297) (CIAT, 2001). A series of agronomic tests in Mexico, Colombia, and Central America has proved Mulato to be high in vigor and with good production potential (Miles, 1999).

Morphology

Mulato is a semi-erect perennial apomictic (produces seed asexually) grass that can grow up to 9 ft tall. It is established by seed, although it could be propagated vegetatively stem segments if necessary. It produces vigorous cylindrical stems, some with a semi-prostrate habit, capable of rooting at the nodes when they soil. Mulato has lanceolate and highly pubescent leaves of 40-60 cm in length and 2.5-3.5 cm width (Guiot and Melendez, 2003).

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Region of Adaptation and Growing Season in Florida

Mulato is adapted to many soil types ranging from sands to clays; however, it does not tolerate poorly drained soils. Even short periods of standing water may reduce stands considerably. The tropical origin of Mulato limits its productivity and persistence in latitudes above 28^{o} (North of Interstate 4). In South Florida, Mulato grows well from spring (May) to fall (late October). Mulato is very sensitive to cold weather and above-ground forage browns quickly after a frost.

Establishment

Summer is the best time to establish Mulato in Florida because of the greater probability of adequate temperature and moisture conditions. Spring planting may be used; however, there is greater risk of dry conditions and stand failure. Commercial seed has good vigor and when placed in a moist, firm seedbed, it germinates in 5 to 10 days. Seeds can be broadcast at 10 lbs/A and covered with 1/2 inch of soil. A cultipacker-type seeder or drill can be used for more precise seed placement. Using a rolling device after seeding is recommended to assure adequate seed-soil contact and better soil moisture retention.

Fertilization

Before establishing any crop, soil testing is strongly recommended. Although UF-IFAS does not have a specific recommendation for Mulato fertilization, the stargrass recommendation can be used. Target soil pH should be between 5.5 to 6.0. For new plantings, apply 30 lb/A N, all of the P_2O_5, and half of the K_2O recommended on your soil test report after germination. Apply additional N fertilization and remaining K_2O according to the target production. For established stands, apply 50 lbs/A N and recommended P_2O_5 and K_2O in the spring. Greater N rates may be applied if greater forage production is desired. It is not recommended to apply more than 100 lb/A N in one single application because of increased chances of N lost by leaching and/or volatilization.

Weed Control

As with any forage species, proper fertility and grazing management are very important for weed control. Weed management in Mulato, since it is a bunch-type grass, may be more challenging than for bahiagrass and bermudagrass. This makes fertility and grazing management very important with regards to weed control.

Herbicides may be applied to Mulato after at least two true tillers have formed after planting seed. These herbicides include 2,4-D, WeedMaster (2,4-D + dicamba), Forefront, Milestone, Pasturegard, Remedy, and Cleanwave. These herbicides may be applied at labeled application rates specific to the weed species present in the pasture. However, there may be some damage from triclopyr-containing herbicides (Pasturegard, Remedy) when environmental conditions are hot and humid and when Mulato is rapidly growing. Herbicides like Cimarron Plus, Cimarron X-tra, and Impose have not been investigated for their tolerance on Mulato.

Utilization

Mulato has been primarily used for grazing beef cattle in South Florida. The vigorous and prostrate-type growth during the summer makes rotational grazing recommended for Mulato pastures. Rotational grazing facilitates the adjustment of optimum stocking rate and control of grazing stubble height. The target stubble height for grazing Mulato should be 6-10 inches. With respect to nutritive value, generally Mulato has CP of 11-16% and TDN of 55-60%. Research was conducted at the Range cattle Research and Education Center to evaluate the performance of yearling heifers grazing Mulato and bahiagrass from June to September 2007 at different stocking rates, 1.6, 3.2, and 4.8 heifers/A (Table 1). Mulato pastures received 140 lbs nitrogen/A split in three applications. Results showed that the highest stocking rate pastures (4.8 heifer/A) were overgrazed, with a decrease in Mulato stand, and greater area occupied by common bermudagrass, bahiagrass, and broadleaf weeds. Stocking rates of 1.6 and 3.2 heifers/A resulted in similar average daily gain, however, 3.2 heifers/A resulted in the greatest animal gain per acre. In addition, heifers grazing Mulato at

Table 1. Performance of heifers grazing Mulato and bahiagrass pastures at three stocking rates

Stocking rate	Average Daily Gain		Gain per acre (112d)	
	Mulato	Bahia	Mulato	Bahia
	lb/d		lbs	
1.6 heifers/A	1.34Aa	0.81Ba	608Ab	407Ac
3.2 heifers/A	1.32Aa	0.99Ba	1196Aa	916Ba
4.8 heifers/A	0.48Ab	0.48Ab	656Ab	674Ab
Average	1.04A	0.76B	820A	665B

Forage species means followed by the same upper case letter are not difference from each other (P > 0.05).
Stocking rate means followed by the same lower case letter are not different (P > 0.05).

3.2 heifers/A had greater average daily gain and gain per acre than heifers grazing bahiagrass at the same stocking rates.

Although Mulato has not been used typically as conserved forage by producers, the vigorous growth and superior nutritive value to bahiagrass make it a very attractive option for hay and haylage. Mulato hay samples from producers analyzed by the Forage Extension Laboratory in Ona tested on average 14% CP and 55% TDN

Summary

Advantages of Mulato

1 Vigorous growth and superior nutritive value to bahiagrass

2) Established by seed

3) Rapid establishment

4) Can be utilized for pasture, hay, or haylage

Disadvantages of Mulato

1) Does not tolerate poorly drained soils

2) Forage browns following frost and plant survival is significantly reduced by extended periods of temperatures below 32^{o}F

3) Shorter growing season than limpograss, bahiagrass, or bermudagrass

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SL252

UF UNIVERSITY of FLORIDA
IFAS Extension

Tissue Analysis as a Nutrient Management Tool for Bahiagrass Pastures[1]

M.L. Silveira, J.M. Vendramini, L.E. Sollenberger, C.L. Mackowiak, Y.C. Newman[2]

Principles of Tissue Analysis

While some plant nutrient deficiencies can be easily identified based on visible symptoms, others may not produce any specific foliar symptoms other than reduced yield. In this case, plant analysis can be useful for diagnosing nutrients that are limiting optimum crop production. Although the concept of using plant analysis for nutrient diagnostics is not new, there is growing interest in using nutrient concentration in plant tissue as a tool to manage soil fertility in bahiagrass pastures in Florida. This is due in part to the inability of soil tests to accurately predict forage nutrient requirements. While soil tests typically examine nutrient levels in the upper 6 inches of the soil profile, plant analysis can integrate the nutrient pools present at the various soil depths. Because of extensive plant root systems, plant analysis is believed to better assess the overall nutrient status of forage crops and also reveal imbalances among nutrients that may affect crop production.

Plant analysis involves the determination of nutrient concentrations in a sample from a particular part or portion of a crop, at a specific time or stage of development. Since various factors can influence crop tissue concentrations, tissue tests should be used with some restraint and in conjunction with a routine soil testing program. Nutrient concentrations in the plant are not static and may vary within parts of the plant, time of the year, and among forage varieties and species. The factors that affect plant nutrient concentrations include (1) physiological maturity of the stand, (2) sampling procedure and parts of the plant that are sampled, (3) sample preparation and handling, and (4) environmental conditions, such as soil moisture and temperature. Thus, it is essential that samples are properly collected and handled prior to analysis. The interpretation of a plant analysis report requires a through understanding of the factors that may influence the test results. Therefore, great care should be taken when considering forage fertilization programs based on tissue analysis.

The basic principle involved in plant analysis interpretation is that yield will be limited at a critical nutrient concentration for each specific crop. The basic relationship between nutrient concentration and yield is shown in Fig. 1. The critical level, defined as

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the nutrient concentration range in the plant sample below which crop yield is significantly reduced, varies among forage crops. For most forage crops, however, there is a "critical range" associated with yield reduction rather than a single value. Realistically, a number of factors may affect nutrient concentration and crop yield, which makes it impossible to define a specific optimum nutrient concentration in the plant.

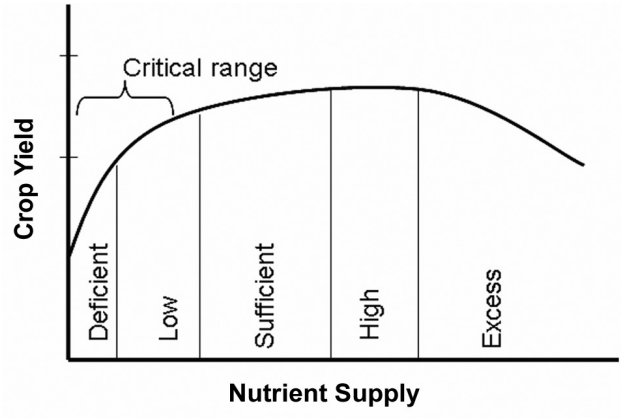

Figure 1. Relationship between nutrient supply and crop yield.

The "critical range" refers to the nutrient level below which significant yield reduction is expected. Although "significant" yield reduction is open to interpretation, typically 10% is used for many crops. On the other hand, if a nutrient is either at the sufficient or high range, minimal or no yield response is expected due to fertilization.

Tissue Sampling and Handling

Sample collection and preparation are important steps for ensuring accurate tissue analysis results. Similarly to soil testing, tissue samples must be representative of the field. The number of plants to sample in a specific area will depend on the general conditions of plant vigor, soil heterogeneity, and forage management. A truly representative sample should be taken by sampling a large number of plants so that the sample represents the field. Collect at least 1 ounce (30 g) of fresh material (Fig. 2). Sampling is not recommended when plants are injured by insects and diseases. To avoid contamination, plants should not be sampled soon after spraying pesticides or herbicides. Care should be taken to minimize soil contamination on the sampled plant material. In addition, plants should not be sampled under temperature or moisture stress. Preferably samples should be collected during a time of the day when climatic conditions are mild, generally early to mid-morning or early evening.

Figure 2. Approximately 1 ounce (30 g or a handful) or more of leaf sample representing the field should be collected and placed in a paper bag.

The plant part, maturity stage and time of sampling are also important factors that can affect plant nutrient composition. Forage grasses and hay fields should be sampled prior to seed head emergence or at the optimum stage for forage utilization (Jones et al., 1971). As the plant matures, nutrient concentrations decline, so it is critical that plants are sampled at the proper stage of maturity. Care should be taken to select the plant part that accurately reflects the nutrient status of the plant**. The four uppermost leaf blades should be sampled** (Fig. 3). Do not sample seeds since they are not useful for assessing nutrient status of forage crops and may introduce large errors in the report interpretation. If deficiency symptoms are suspected, plants showing these symptoms should be sampled and analyzed separately from "normal" or healthy appearing plants.

After sampling, tissue should be placed in properly labeled paper bags and sent immediately to a reputable laboratory for analysis. Avoid plastic bags because they can hold heat and moisture. The same precautions used for collecting the plant material should be used to handle the samples. Because fresh plant material may start decomposing shortly after collection, it is important that plant material be sent

Figure 3. Gathering young bahiagrass leaf blades using scissors.

to the laboratory as quickly as possible. Prior to transporting the samples to the laboratory, plant material should be stored in a refrigerator at 41^{o}F (or 5^{o}C).

Tissue Analysis Interpretation

Critical concentrations of N, P, and K in bahiagrass forage are shown in Table 1. Tissue analysis has been recently incorporated into the revised IFAS fertilizer recommendations as a management tool to guide proper P fertilization in established bahiagrass pastures. According to the revised IFAS recommendations, tissue analysis should be performed when soil tests very low or low in P. Assuming the soil pH is within the optimal range for bahiagrass (around 5.5) and the tissue P concentration is below the critical concentration of 0.15%, P fertilization is expected to improve bahiagrass production. Recommended P application rates vary from 25 lb P_2O_5/A for the low- and medium-N input options (50 and 100 lb N/A, respectively), up to 40 lb P_2O_5/A for the high-N option (160 lb N/A).

Table 1. Critical concentrations of N, P, and K in bahiagrass tissue.

Element	Critical concentration (%)
N	< 1.5
P	<0.15
K	<1.2

Future Directions

Similar to soil testing, plant analysis is an evolving process and our understanding needs to be updated as research results become available. Current data on critical nutrient concentration in bahiagrass should be considered preliminary and subject to modification as more science-based information becomes available. The balance among the various essential nutrients as well as the effects of bahiagrass varieties, soil characteristics, and management practices need to be fully explored in order to establish critical nutrient criteria for bahiagrass pastures in Florida. Nevertheless, from both agronomic and environmental perspectives, plant tissue analysis has potential to be a useful diagnostic tool for developing nutrient management programs that predict when crops need additional nutrients while avoiding negative impacts on the environment.

SS-AGR-08

UF UNIVERSITY of FLORIDA
IFAS Extension

Weed Management in Pastures and Rangeland - 2009[1]

B.A. Sellers and J.A. Ferrell[2]

Effective weed control begins with good pasture or rangeland management. Weeds are seldom a serious problem in a well managed, vigorously growing grass. Good management begins with proper choice of the forage species and variety, adequate fertility and soil pH, proper grazing management, and control of pests, such as insects, diseases, and nematodes. If the grass dies or is not growing well, there is usually some weed that will tolerate the condition which caused the grass not to grow, and that weed will become established. Once a weed is established, mechanical or chemical methods are usually employed to control the weeds (Table 1). However, unless the basic management problem is corrected, the grass will not regrow in the area, and weeds will continue to infest the area.

Mechanical Control

Mowing is one of the most often used methods of weed control in pastures. Mowing improves the appearance of a pasture and if properly timed will prevent weeds from producing seed.

However, the effectiveness of mowing in terms of controlling weeds depends on several factors. The major consideration is the type of weed present. Mowing is generally more effective on broadleaf weeds than on grasses and more effective on annual weeds than on perennial weeds. Knowledge of the weed and its life cycle will generally indicate how effective mowing will be. Carefully consider the amount of energy required and anticipated the likely effectiveness before mowing; other methods of weed control may be more energy efficient. Another factor to consider prior to mowing is whether the plant can regenerate vegetatively. Mowing can spread weeds that can form new plants from the cut vegetative plant parts. Prickly pear is one example of a weed that can propagate vegetatively.

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Sanitation

In addition to controlling weeds in a pasture, efforts should be taken to prevent weeds from reinfesting the pasture. Knowledge of how weeds are dispersed is important.

Weeds may be dispersed by wind, carried by water, distributed in planting seed, in feed or hay, carried by animals including man, or moved by machinery. Animals grazing in a weed-infested pasture and then allowed to move directly to a clean pasture may move weed seed both internally and externally.

One of the most common problems is failure to control weeds in ditch banks, fence rows, and farm roads. Weeds growing in these areas produce seed and/or vegetative growth that reinfests the pastures. For more on this topic, see EDIS Publication SS-AGR-110, *Weed Management for Grazed Fence Rows and Non-Cropped Areas* (http://edis.ifas.ufl.edu/wg210) and EDIS Publication SS-AGR-111, *Weed Management for Fence Rows and Non-Cropped Areas* (http://edis.ifas.ufl.edu/wg068).

Fence rows are also a common area where poisonous plants are often left uncontrolled. Plants such as crotalaria, black nightshade, and lantana are commonly found poisonous plants in Florida.

Animals won't usually choose to graze most poisonous plants. However, if grass is limited in pastures due to poor growing conditions or overstocking, animals may try to eat poisonous plants. Some poisonous plants may become more palatable following herbicide application and then be more readily grazed. Therefore, if poisonous plants are present in fence rows, and pastures are in short supply, care should be taken and cattle watched closely.

When treating fence rows, it is often advisable to apply a foliar-applied herbicide to kill the existing vegetation along with a soil -pplied residual herbicide to prevent weeds from regrowing in the fence row.

Chemical Control

The herbicide and application rates are extremely important in chemical weed control. Rates too low will not give adequate weed control, and rates too high may injure the forage and result in only partial control of perennial weeds.

Time of application is also important with herbicides. Preemergence applications are made before the weeds germinate and emerge; therefore, knowledge of the life cycle of the weed becomes important. For example, a herbicide applied in October for crabgrass (a summer annual that germinates in early spring) would be wasted.

One of the most important factors in choosing a herbicide is proper weed identification. After identifying the weed, use tables 2 and 3 to choose the herbicide recommended for the particular weed.

Postemergence Applications

Postemergence applications are made after the weeds have emerged. Most effective applications are made when the weeds have recently germinated and are small. For perennial weeds (regrowing from storage organs) it is often advisable to allow them to grow for a short period of time before spraying. This allows a sufficient leaf surface for coverage and insures that the perennial is manufacturing food (through photosynthesis) and translocating it along with the herbicide back to the roots (which is the part of the plant you must kill).

Herbicides may be applied broadcast over the entire pasture or may be applied as spot treatments to localized infestations of weeds. The lower cost and energy saved by spot treatment makes this a desirable method in many situations.

The attached table lists the currently recommended herbicides in pastures and rangelands in Florida. In all cases it is extremely important to carefully read the label of the herbicide before purchase to determine whether that herbicide will be effective in your situation.

The herbicides listed for use in pastures and rangelands are generally safe to use and offer minimal hazard to animals when used according to

label directions. Table 4 lists the grazing and haying restrictions for the recommended herbicides.

Precautions when Using Phenoxy or Benzoic Acid Herbicides

1. For information about growth-regulating herbicides not covered below, see IFAS Publication SS-AGR-12, *Florida's Organo-auxin Herbicide Rule* (http://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 with household ammonia as follows:

   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 clean in fresh water.

   d. Repeat step b.

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

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

Table 1. Weed control in pastures and rangeland.

Trade Name and Rate of Commercial Product Per Acre	Common Name and Rate in Pounds of Active Ingredient Per Acre	Remarks
DURING ESTABLISHMENT		
Preemergence 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 and certain grasses may be noted for 2 to 3 weeks if proper environmental conditions exist.
Diuron 4L - (Agriliance) 1.5 to 4.5 pt/A or Diuron 80 - (Drexel) 1 to 3 lb/A	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.
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 and certain grasses may be noted for 2 to 3 weeks if proper environmental conditions exist. **Do not apply to limpograss (*Hemarthria*).**
Postemergence 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 to 6" tall. Do not apply to limpograss (*Hemarthria* sp.).** 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/A	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 1 inch at time of application. Best results are seen if applications are made 7 - 10 days after planting. **Do not apply to limpograss (*Hemarthria*).**
Banvel, Clarity, Vanquish 1.5 - 2 pt/A	dicamba	Primarily used for establishment of Floralta limpograss (*Hemarthria*). Annual sedges and some grasses will be suppressed if less than 1 inch at time of appliation. Best results are seed if applications are made 7 - 10 days after planting.
ESTABLISHED STANDS		
Dormant Pastures		
Gramoxone Inteon 1 - 2 pt	paraquat	For **dormant** bermudagrass or bahiagrass. Apply in 20 to 30 gallons of water in late winter or early spring (probably in January or February) before grass begins spring green-up. Add 1 pt. surfactant (non-ionic) 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 broadspectrum control.
Roundup Weathermax 11 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 to 4 week delay in green-up. No restrictions exist between application and grazing or haying.

Table 1, continued. Weed control in pastures and rangeland.

Trade Name and Rate of Commercial Product Per Acre	Common Name and Rate in Pounds of Active Ingredient Per Acre	Remarks
Non-Dormant Pastures		
Aim 1 - 2 oz	carfentrazone	Aim provides control of small broadleaf (<2") weeds. In most cases Aim should not be applied alone, but tank-mixed with other pasture weed control products. Combining Aim with other herbicides often increases overall weed control and speed of kill. A 2-4% v/v liquid nitrogen fertilizer, 2-4 lb/acre spray-grade ammonium sulfate or an AMS replacement/water conditioning product should be added to water prior to the addition of Aim. Use caution when applying AMS to newly established grasses as crop injury could occur. When tank-mixing Aim with other herbicides, it is important that Aim is added to the nitrogen-water solution before other herbicides. A non-ionic surfactant at 0.25% v/v must be added. Do not apply >5.9 fl oz/acre/year and do not make more than 3 applications of Aim per year.
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" 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.
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* sp. has generally exhibited more tolerance to dicamba than 2,4-D.
Cimarron Plus 0.125 to 1.25 oz/A or Cimarron Xtra 0.5 to 2.0 oz/A	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 non-ionic surfactant at 1-2 pts/100 gal of solution. Avoid application during spring green-up. Varieties and species of pasture grasses differ in their tolerance to herbicides.
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 to 20 acres. For specific information on rate selection, consult the product label.
Cleanwave 14 - 26.6 oz/A	fluroxypyr + aminopyralid	Excellent tank mix partner for 2,4-D, Forefront, and Remedy. Tank mix 14 oz with one of these products for dogfennel < 36"; 20 oz for dogfennel between 36 and 60"; 26.6 oz for dogfennel > 60". If tank-mixing with Milestone add 20 oz Cleanwave to dogfennel < 60" and 26.6 oz to dogfennel > 60". Cleanwave is safe on limpograss.
Forefront 2 - 2.6 pt	aminopyralid + 2,4-D	Excellent control of TSA, horsenettle, and other members of the nightshade family. Also control pigweeds and other broadleaf weeds including less than 20" dogfennel. Do not apply greater than 2.6 pt/A/yr. Do not apply to desirable forage legumes or severe injury and stand loss will occur. Do not apply to limpograss. Forefront will pass through animals and remain in the waste. Do not mulch sensitive crops with manure if animals have been grazing on Forefront-treated pastures. Avoid applications of this product to limpograss pastures during hot and humid conditions.

Table 1, continued. Weed control in pastures and rangeland.

Trade Name and Rate of Commercial Product Per Acre	Common Name and Rate in Pounds of Active Ingredient Per Acre	Remarks
Impose or Panoramic 4 to 12 fl. oz/A	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 to 4 weeks of bermudagrass stunting after application, followed by quick recovery and rapid growth. This will reduce harvest yields of that cutting by 30 to 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/A. For suppression of bahiagrass, use 12 oz/A.
Journey (10.6 - 16 fl. oz)	imazapic + glyphosate	Similar to Impose and Panoramic.
Milestone (3 - 7 oz)	aminopryalid	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/A/yr. Do not apply to desirable forage legumes or loss of stand will occur. The use of a non-ionic 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	**Established bahiagrass and bermudagrass only.** Provides excellent control of annual and perennial sedges. Provides some suppression of vaseygrass.
PastureGard[1] (2 - 4 pt)	triclopyr + fluroxypyr	Provides excellent control of dogfennel, blackberry, teaweed, and other broadleaf weeds. Less effective on tropical soda apple than Remedy alone. Forage legumes will be severely injured or lost if present at time of application. Applications of 2 pt/A may result in less than desirable weed control. Do not apply more than 8 pts/A per season. Surfactant should be added to spray mixture at 0.25% v/v.
Remedy Ultra 2 pt	triclopyr	Provides excellent control of herbacious 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 >85F may cause moderate to severe bermudagrass injury for 2 to 3 weeks.
Roundup Weathermax 8 - 11 fl. oz/A	glyphosate	For control of annual grasses in bermudagrass and stargrass. Apply immediately after hay removal, but prior to regrowth. Applications made after regrowth has occurred will cause stunting. Application rates as low as 6 oz/A are often effective for crabgrass and other small annual grass weeds. Do not apply more than 2 qt/A/year. If Roundup Weathermax is applied to a dormant pasture, it can not be sprayed again that season.
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/A/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.

Table 1, continued. Weed control in pastures and rangeland.

Trade Name and Rate of Commercial Product Per Acre	Common Name and Rate in Pounds of Active Ingredient Per Acre	Remarks
Hard-To-Kill Perennial Grasses		
glyphosate (1 to 4 oz per 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 to 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.
Smutgrass		
Velpar L (2.75 - 4.5 pt) **or** Velpar DF (0.9 - 1.5 lb)	hexazinone	Apply Velpar 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. Some temporary yellowing of the bermuda or bahiagrass will be noted, but plants will soon outgrow this effect. Apply Velpar by ground equipment only, and only **one** application is allowed per year. **KEEP SPRAYS WELL AWAY (AT LEAST 100 FT) FROM THE BASE OF DESIRABLE TREES, ESPECIALLY OAKS.** Check label instructions for further precautions and safe use suggestions. Control at either time of year will be enhanced with a nonionic surfactant at 0.25% v/v.
Pensacola Bahiagrass		
Cimarron Plus 0.5 oz/A or Cimarron Xtra 1.0 oz/A	metsulfuron + chlorsulfuron	Apply to bermudagrass hay fields early in the season, after bahiagrass green-up but prior to seed head 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.
Tropical Soda Apple		
Forefront (2 - 2.6 pt)	aminopyralid + 2,4-D	Excellent control of tropical soda apple. Provides preemergence control TSA seedlings for approximately 6 months after application. The 2 pt/a rate is highly effective on emerged TSA plants, but the 2.6 pt/a rate will provide the greatest length of residual control. Do not apply more than 2.6 pt/a/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 7 days.
Milestone (5 - 7 oz)	aminopryalid	Excellent control of tropical soda apple. Provides preemergence control of TSA seedlings for approximately 6 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/A/yr. Do not apply to desirable forage legumes or loss of stand will occur. Volatility is low. The use of a non-ionic surfactant at 0.25% v/v is recommended.
Remedy Ultra [1] (1.0 qt)	triclopyr	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. Thirty to forty gal/A application 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.

Table 1, continued. Weed control in pastures and rangeland.

Trade Name and Rate of Commercial Product Per Acre	Common Name and Rate in Pounds of Active Ingredient Per Acre	Remarks
	Prickly Pear Cactus	
Remedy Ultra [1] (20%) **+** diesel fuel or basal oil (80%)	triclopyr (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.
Cleanwave 50 oz	fluroxypyr + aminopyralid	Apply Cleanwave at 50 oz/A as a broadcast treatment in water. The use of a surfactant is required. For spot treatment, use a 2% Cleanwave solution. Control is very slow and it often takes more than 1 year to see satisfactory results.
	Blackberry	
Cimarron Plus 0.75 oz/A or Cimarron Xtra 2.0 oz/A	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 1 yr prior to application or control will be reduced. **DO NOT** apply to bahiagrass pastures.
PastureGard[1] 4 pt	triclopyr + fluroxypyr	Control similar to Remedy.
Remedy Ultra [1] 2 pt	triclopyr	For best control of blackberry, apply 2 pt when blooming and do not mow within 1 yr prior to application. Remedy does not control dewberry. The addition of a nonionic surfactant at 0.25% v/v will increase control. 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 to 3 pt	dicamba + 2,4-D	Apply when plants reach a height of 12-18". Weedmaster is most effective approximately 1 month after dogfennel transition from winter dormancy. Refer to previous comments for dicamba and 2,4-D above.
PastureGard[1] (3 pt)	triclopyr + fluroxypyr	For control of larger dogfennel that has reached 40 inches or more in height.
Forefront (2 pt)	aminopyralid + 2,4-D	Apply when plants are less than 30" tall. If plants are larger than 30", tank mix Forefront with 3 pt/A 2,4-D, 1 pt/A Pasturegard, or see comments for Cleanwave herbicide.
Cleanwave (14 - 26.6 fl oz)	fluroxypyr + aminopyralid	Excellent tank mix partner for 2,4-D, Forefront, and Remedy. Tank mix 14 oz with one of these products for dogfennel < 36"; 20 oz for dogfennel between 36 and 60"; 26.6 oz for dogfennel > 60". If tank-mixing with Milestone add 20 oz Cleanwave to dogfennel < 60" and 26.6 oz to dogfennel > 60". Cleanwave is safe on limpograss.
	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 of specific use information
	Thistles	
2,4-D (2 qt)	2,4-D (2 lb)	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.

Table 1, continued. Weed control in pastures and rangeland.

Trade Name and Rate of Commercial Product Per Acre	Common Name and Rate in Pounds of Active Ingredient Per Acre	Remarks
Milestone (3 - 5 fl. oz)	aminopyralid	Excellent control of thistles at any stage of growth.
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 >50F. Applications are most effective if applied 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/A rate is sufficient. For larger rosettes, 1.5 to 2 qt/A will be required.

[1] For state rules pertaining to application of organo-auxin herbicides in Florida, see EDIS Publication SS-AGR-12, *Florida Organo-Auxin Herbicide Rule* (http://edis.ifas.ufl.edu/WG051) .

Herbicide recommendations in this report are contingent upon their registration by the U.S. 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[1].

Weed Name	2,4-D	Cimarron Plus or Xtra	Banvel or others	Cleanwave	Diuron	Forefront	Impose/ Panoramic
bitter sneezeweed	E	E	E	-	G	E	-
blackberry	P	G-E	F-G	F-G	P	P-F	P
bracken fern	P	-	G	-	P	-	-
bullrush	G	-	G	P	P	P	-
chickweed	F	E	E	-	P	F	-
crotalaria, showy	G	-	G	G	-	G	-
cudweed	F	G	E	-	-	E	-
curly dock	F	E	E	-	P	E	-
dodder	P	-	P	-	P	-	-
dogfennel	F-G	F	F-G	G	P	G	-
evening primrose	E	G	E	-	G	E	-
Florida pusley	P	-	P-F	P	E	G-E	-
gallberry	G	-	E	-	P	-	-
goatweed	G	G	F-G	P-F	-	-	P
goldenrod	F	P	G		P	G	-
honeysuckle	-	-	E	-	P	-	-
horsenettle	P	P-F	G	F	P	E	-
horseweed	F	F	E	-	P	E	-
kudzu	P-F	P-F	G	P	P	G	P
maypop	P	P	P	-	-	-	-
stinging nettle - fireweed	P	-	-	G-E	-	E	P
palmetto	P	P	F	G	P	P	P
persimmon	P	-	F-G	-	P	P	P
pigweed	F	E	E	P	F	E	G
plantains	E	E	E	-		-	-
pokeberry	G	-	E	P	P	P	-
prickly pear	P	P	F	G	P	P	P
ragweed	E	G	E	G	G	E	F
red sorrel	P	E	E	-	F	-	-
shepherdspurse	E	-	E	-	G	-	-
sicklepod	G	G	E	G	F	G	F-G
thistles	E	F	G	G	F	E	-
tropical soda apple	P	P	F-G	F	P	E	P
Virginia pepperweed	G	-	E	G	G	-	-
wax myrtle	P	-	P-F	-	P	P	-
wild garlic	G-E	G	E	-	P	-	-
wild radish	G	G-E	E	-	P	G	-

Table 2, continued. Estimated effectiveness of herbicides on common broadleaf weeds in pastures and hayfields[1].

Weed Name	Journey or others	Milestone	Outrider	PastureGard	Remedy	Velpar	WeedMaster others
bitter sneezeweed	-	E	-	E	E	-	E
blackberry	-	P	P	G-E	G-E	F	P-F
bracken fern	-	-	-	F	G	F	-
bullrush	-	P	-	P	G	-	-
chickweed	-	-	-	F	E	E	E
crotalaria, showy	-	-	-	E	E	-	G
cudweed	-	E	-	G	E	-	G
curly dock	-	E	-	F	E	P	E
dodder	-	-	-	P	P	-	P-F
dogfennel	-	P-F	P	E	G-E	G	G
evening primrose	-	E	-	G	E	E	E
Florida pusley	P	-	-	G	-	-	F
gallberry	-	-	-	E	E	P	G
goatweed	F	-	-	F	F	-	G
goldenrod	-	G	-	G	G	-	G-E
honeysuckle	-	-	-	P	P	-	E
horsenettle	P	E	-	F	F-G	-	F
horseweed	P	E	-	G	G	-	E
kudzu	P	G	P	F	F	-	F
maypop	P	-	P	G	F	-	P-F
stinging nettle - fireweed	-	E	P	E	E	-	F
palmetto	P	P	P	G	F	P	P-F
persimmon	P	P	P	F-G	F-G	F	P-F
pigweed	E	E	-	F	E	G	E
plantains	-	P	-	-	-	-	E
pokeberry	-	F	-	P	P	-	E
prickly pear	P	P	P	F	G[2]	P	P-F
ragweed	F-G	E	-	E	E	F	E
red sorrel	-	-	-	F	E	-	G
shepherdspurse	-	-	-	G	E	E	E
sicklepod	E	-	-	G-E	E	-	E
thistles	-	E	-	G-E	E	E	E
tropical soda apple	P	E	P	G	G-E	F-G	F-G
Virginai pepperweed	-	-	-	G	P	E	E
wax myrtle	P	P	-	F-G	G	P	P-F
wild garlic	-	P	-	P	-	-	E
wild radish	E	P	-	G-E	E	E	E

[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 3. Estimated effectiveness of herbicides on commong grass and sedges in pastures and hayfields.

Herbicide	bahia-grass	bermuda-grass	broom-sedge	crab-grass	dallis-grass	guinea-grass	johnson-grass	rye-grass	sandbur	smut-grass	vasey-grass	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
Cimarron Plus or Xtra	G	P	P	P	P		-	P	P	P	P	P
Cleanwave	P	P	P	P	P	P	P	P	P	P	P	P
Diuron	P	P	P	F-G	P	P	P	P	G	P	P	P
Forefront	P	P	P	P	P	P	P	P	P	P	P	P
Impose/ Panoramic	P-F	P	P	E	F	-	G	F	G-F	P	P-G	G-E
Journey or others	P-F	P	P	G	F	-	G	F	G-E	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
PastureGard	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
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.15594

Table 4. Days between herbicide application to forage or pasture for feeding, grazing or animal slaughter.

Herbicide	Non-lactating Cattle			Lactating Dairy Cattle		Horses
	Grazing	Hay Cutting	Slaughter	Grazing	Hay Cutting	
Aim	0	0	0	0	0	0
Banvel						
Up to 1 pt	0	0	30	7	37	0
Up to 1 qt	0	0	30	21	51	0
Up to 2 qt	0	0	30	40	70	0
Cimarron Plus and **Cimarron Xtra**	0	0	0	0	0	0
Cleanwave	0	7	0	0	7	0
2,4-D	0	30	3	7	30	0
Forefront	0	7	0	0	7	0
Impose or Panoramic	0	7	0	0	7	0
Journey	0	7	0	0	7	0
Milestone	0	0	0	0	0	0
Outrider	0	14	0	0	14	0
PastureGard	0	14	3	1 season	1 season	0
Remedy Ultra	0	14	3	1 season	14	0
Roundup WeatherMax						
Dormant application	0	0	0	0	0	0
Between cuttings	0	0	0	0	0	0
Pasture renovation	56	56	56	56	56	56
Telar	0	0	0	0	0	0
Velpar	60	60	0	60	60	60
2,-D + dicamba (Weedmaster, others)	0	37	30	7	37	0