



2012

**Proceedings of the 66th
Southern Pasture and Forage
Crop Improvement Conference**



**San Juan, Puerto Rico
June 6 – 9 2012**

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Using Tropical and Subtropical Legumes to Improve Animal Productivity and Health

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Introduction

Warm-season forages are the primary component of livestock diets in tropical and subtropical climatic regions. Grass monocultures are most commonly used in both introduced and native livestock systems in such regions because they are more persistent and easier to manage than legumes. However, grass-legume inter-seeded pastures require less fertilizer, extend the grazing season and increase nutrient supply and therefore, decrease feed costs for livestock production (Leep et al., 2002; Muir, 2002). The benefits of incorporating cool-season legumes particularly clovers (*Trifolium*) and alfalfa (*Medicago sativa* L.) in temperate animal production systems are well known. However, the use of legumes in tropical livestock operations has been limited despite their great potential except for a few success stories such as the use of leucaena (*Leucaena leucocephala* [Lam.] de Wit) in tropical Australia. The limited use of warm-season legumes in livestock systems is partly due to the limited availability of tropical/subtropical legume germplasm, especially perennial species (Muir et al., 2011). The two warm-season legumes that have received most attention in Florida are rhizoma perennial peanut (*Arachis glabrata* Benth.) and common aeschynomene (*Aeschynomene Americana* L.). However, establishment of rhizoma peanut takes two to three years, while aeschynomene is susceptible to drought-induced failures. This paper discusses recent studies in Florida aimed at improving the productivity and health of livestock with legumes that are adapted to tropical subtropical environments. Perennial warm-season legumes were not used due to factors such as limited germplasm availability, low herbage mass and persistence, pest susceptibility and invasive potential. Rather, the studies focused mainly on evaluation of seeded annual legumes including soybean (*Glycine max* [L.] Merr., cv. Pioneer 97B52), cowpea (*Vigna unguiculata* [L.] Walp. cv. Iron clay), pigeonpea (*Cajanus cajan* [L.] Millsp., cv. Georgia 2), and annual peanut (*Arachis hypogaea* L., cv. Florida MDR 98) as compared to perennial peanut (cv. Florigraze). Although they

require annual reseeding, these legumes are easy to establish, potentially high yielding and high in nutritive value.

Use in grazing systems

Due to the low nutritive value of warm-season grasses, incorporation of warm-season legumes in warm-season grass pastures grazed by growing or lactating ruminants can potentially increase animal performance. However, the lack of persistence of the legume component of such pastures has often prevented realization of the promised benefits. Rusland et al. (1988) observed that steers grazing limpoglass [*Hemarthria altissima* (Poir.) Stapf and C.E. Hubbard]-aeschynomene pastures had greater average daily gain (ADG; 0.70 vs. 0.39 kg d⁻¹) and gain per ha (377 vs. 263 kg) than steers grazing limpoglass pastures fertilized with approximately 150 kg of N/ha. Despite the impressive animal performance potential of aeschynomene overseeded on grass pastures, lack of persistence of aeschynomene is frequently observed in most grazing systems where it is used (Vendramini et al., 2011). Early studies in Hawaii and recent studies in Australia indicate that pigeon pea may have some potential as a grazed forage, but a recent study noted the scarcity of commercial cultivars and showed that the two early-maturing experimental cultivars tested only supported high ADG (1 kg/d) for about 20 d (Rao and Northup, 2011). Myer et al., (2010) reported that annual peanut did not regrow after defoliation by early weaned calves and the forage quality declined over time resulting in gains of only about 143 kg/ha. Kiesling and Swartz (1997) showed that lambs grazing cowpea pasture had greater ADG than those grazing sudangrass (*Sorghum bicolor* (L.) Moench ssp. *drummondii* (Nees ex Steud.) de Wet & Harlan cv. Piper) and similar ADG to those fed concentrate supplemented a hay ration in dry lot.

However, studies examining the performance of cattle on cowpea pastures have been less promising. Vendramini et al. (2011) compared the performance of cow-calf pairs grazing on bahiagrass (*Paspalum notatum* Flueggé) alone or on pastures consisting of 50% of bahiagrass and 50% of cowpea or 90 % of bahiagrass and 10% of a creep-grazed cowpea pasture in South Florida. The cowpea pasture had greater nutritive value than the bahiagrass but had less herbage mass and did not persist. Consequently, ADG was unaffected by cowpea inclusion. A North Florida study also showed that creep-grazed cowpea did not increase the ADG of calves on

bahiagrass pastures (Foster, 2008). In contrast, Holzknicht et al. (2000) demonstrated that steers grazing cowpea (cv. Meringa) grew faster than those grazed on pangola grass (*Digitaria eriantha* Steud. cv. Stendel). However, a greater stocking rate and continuous stocking was used for the pangola grass, whereas a lower stocking rate and rotational stocking was used for the cowpea to maintain sufficient growing points for regrowth of the latter. These studies emphasize the low persistence of cowpeas under close continuous stocking. Likewise, soybean forage does not persist under close continuous stocking (Ball et al., 2007). In contrast, rhizoma peanut often results in superior levels of animal performance when incorporated into warm-season grass pastures (Hernández Garay et al., 2004). This is because unlike most tropical legumes, rhizoma peanut is productive and persistent over a relatively wide range of grazing management practices (Ortega et al., 1992). Nevertheless, the low adaptability to poorly drained soils and the high cost and slow rate of establishment continue to limit the use of rhizoma peanut for grazing beef cattle production systems (Williams et al., 2004).

Forage productivity and nutritive value

Due to the low persistence of most grazed warm-season legumes, growing them as monocultures and using them as a protein bank is an attractive alternative. A recent study in North Florida evaluated the herbage mass and nutritive value of soybean, cowpea, and pigeon peas grown in field plots during three years (Foster et al., 2009a). When harvested at the recommended maturity stage for forage, which was pod setting for pigeon peas, the R6 stage for soybean, and pod yellowing for cowpea, maximum forage production values were 8.5, 8.5, and 6 Mg DM/ha, respectively (Foster et al., 2009a). By comparison, annual peanut can produce up to 4.5 Mg DM/ha at beginning peg (Foster et al., 2012). The crude protein (CP), neutral detergent fiber (NDF), and in vitro digestibility (IVDMD) values of pigeon pea, soybean and cowpea forage were 121, 176, and 188 g kg⁻¹, 695, 423, and 447 g kg⁻¹, and 351, 729, and 689 g kg⁻¹, respectively. Therefore, soybean and cowpea had the greatest potential to provide forage with the greatest nutritive value for livestock but soybean provided greater N yield than cowpea. The low nutritive value of pigeon pea limited its promise for forage despite its' high yields.

Hay and silage potential

Storing warm-season legumes as hay or haylage is a potential alternative to grazing and avoids the management challenges of legume protein banks. In addition, these storage methods can be used to guarantee forage availability during the winter and allow transportation of the forage to the animal. However, storing forages is more expensive, requires specialized equipment, and often reduces nutritive value compared to grazing them. In particular, the potential for considerable leaf loss during haymaking, the attendant losses in CP coupled with the slow rate of drying even with conditioners limits the attractiveness of making hay with such legumes.

Storing warm-season legumes as haylage or silage instead of hay is preferable due to the reduced leaf and CP loss and the reduced drying requirement. However, the low water-soluble carbohydrate concentration and high buffering capacity of legumes makes ensiling these forages a challenge. Wilting to 35 to 45% is critical to concentrate the sugars and improve the fermentation. Foster et al. (2011), determined the nutritive value and ensiling characteristics of bahiagrass, perennial peanut, annual peanut, cowpea, and pigeonpea when harvested at the recommended maturity stage for forage, wilted to 45% and ensiled in round bales. Despite the wilting, pH values were generally high (> 4.60 to 5.43) as were butyric acid concentrations (> 0.4). Yeast and mold counts were generally low (≤ 3.5 log colony forming units/g), consequently, aerobic stability was high (> 84 h). Mean CP concentration and vitro digestibility of cowpea, annual and perennial peanut haylage (16.7 and 73.3%) were greater than those of bahiagrass haylage (8.8 and 58.6%), showing their potential for supplementing the latter. Nevertheless, the high pH and butyric acid concentrations of all the silages highlight the need for more research on using homolactic inoculants or additives to improve their fermentation.

Supplementation of warm-season grass diets with legumes potentially increases digestibility and intake particularly when the quality of the basal diet is low. An experiment that investigated how supplementing bahiagrass hay with cowpea, perennial peanut, annual peanut, soybean, or pigeonpea hays offered at 50% of the diet DM or soybean meal offered (at 4.25% of the diet DM; to match the average CP of the legumes) indicated that all supplements increased N intake, digestibility and retention but responses were greatest with the peanuts and least with pigeonpea (Table 1). Intake was increased by all legumes except pigeon pea but digestibility and microbial N synthesis were only increased by annual or perennial peanut supplementation (Foster et al.,

2009b). When these forages were stored as haylages and the experiment was repeated, similar DMI, N intake, retention and digestibility responses were obtained for all legumes except pigeon pea, which decreased the responses. However, DM digestibility was only increased by soybean meal supplementation (Foster et al., 2009b; c). The superior performance of the supplemental soybean meal in this study reflects the greater quantity fed because it was fed to match the average CP level of the legumes in both studies. That digestibility was improved by legumes in the hay study but not the haylage study, is likely due to relative difference in passage rates of the legumes and the grass in the studies. Nevertheless, both studies demonstrated that legume supplementation can be used to increase the N retention and hence growth potential of livestock.

Anthelmintic potential

Several studies have conclusively demonstrated that sericea lespedeza (*Lespedeza cuneata* [Dum. Cours.] G. Don) can be effectively used to reduce the parasite burden of small ruminants (Terrill et al., 2009). These effects are typically attributed to the tannins in lespedeza, but this forage is not recommended for Florida (Newman et al., 2010). Because improved nutrition can also increase the resilience of small ruminants to parasites, an experiment compared the antiparasitic effects of supplementing bahiagrass hay (8.0% CP) with hays made from chopped perennial peanut (13% CP), cowpea (10.7% CP), soybean (13.5% CP) and lespedeza (13% CP), when offered at 50% of the diet DM. Goats fed lespedeza had lower gastrointestinal fecal egg counts compared to those fed bahiagrass alone and similar trends were evident for goats fed PP and SB. All legume supplements also increased packed cell volume. This experiment showed that the soybean and perennial peanut increased resilience to gastrointestinal nematodes, though lespedeza was the most effective treatment for increasing resistance to the worms. A subsequent study, which compared supplementation of a less mature bahiagrass hay (11.9% CP) with lespedeza (14% CP) or perennial peanut (13.8% CP) hay fed at 50% of diet dry matter or 10 g of *Carica papaya* daily (29.8% CP), or with seeds of *Carica papaya* or *Mucuna pruriens* (27.5% CP; 10% of diet DM), showed that *Carica papaya* and lespedeza reduced counts of *Hemonchus contortus* adult worms in the abomasum but the other supplements did not. These studies confirm the efficacy of using lespedeza to reduce gastrointestinal parasitism in goats and suggest that warm-season legumes with moderate to high CP concentrations can increase the resilience to parasites when the quality of the basal forage is low.

Summary

This paper reviewed Florida studies aimed at examining the potential to use annual seeded warm-season legumes to improve animal productivity and health. Though high in nutritive value and yield, the annual legumes did not persist under continuous stocking, suggesting they should be grown as a protein bank or a forage crop rather than grazed. When stored as hay or haylage, soybean, cowpea, and annual peanuts had more potential to replace perennial peanut and enhance animal productivity than pigeon pea. Soybean and perennial peanut also showed promise for increasing the resilience of small ruminants to gastrointestinal parasites by reducing anemia but lespedeza was the most effective treatment for reducing fecal egg counts. Research efforts should be directed at developing strategies to reduce nutrient losses during the storage of these forages, examining the potential of the stored forages to increase gain and milk production in cattle, developing herbicides and pesticides that can be labeled for these forages, and developing cultivars that are more persistent under grazing. Expense analyses of hay and haylage production of several annual seeded legumes and perennial peanut verified that the cost of sprigging the perennial peanut is twice that of planting annual seeded legumes. However, over a 20-year expected production period, the net present value of the perennial peanut is one-third greater (Foster, 2008) than those of the annual seeded legumes. In the long term, perennial crops are a better option for producers, and therefore, research should focus on developing a greater variety of perennial, persistent warm-season legume germplasm for improving animal productivity (Muir et al., 2011).

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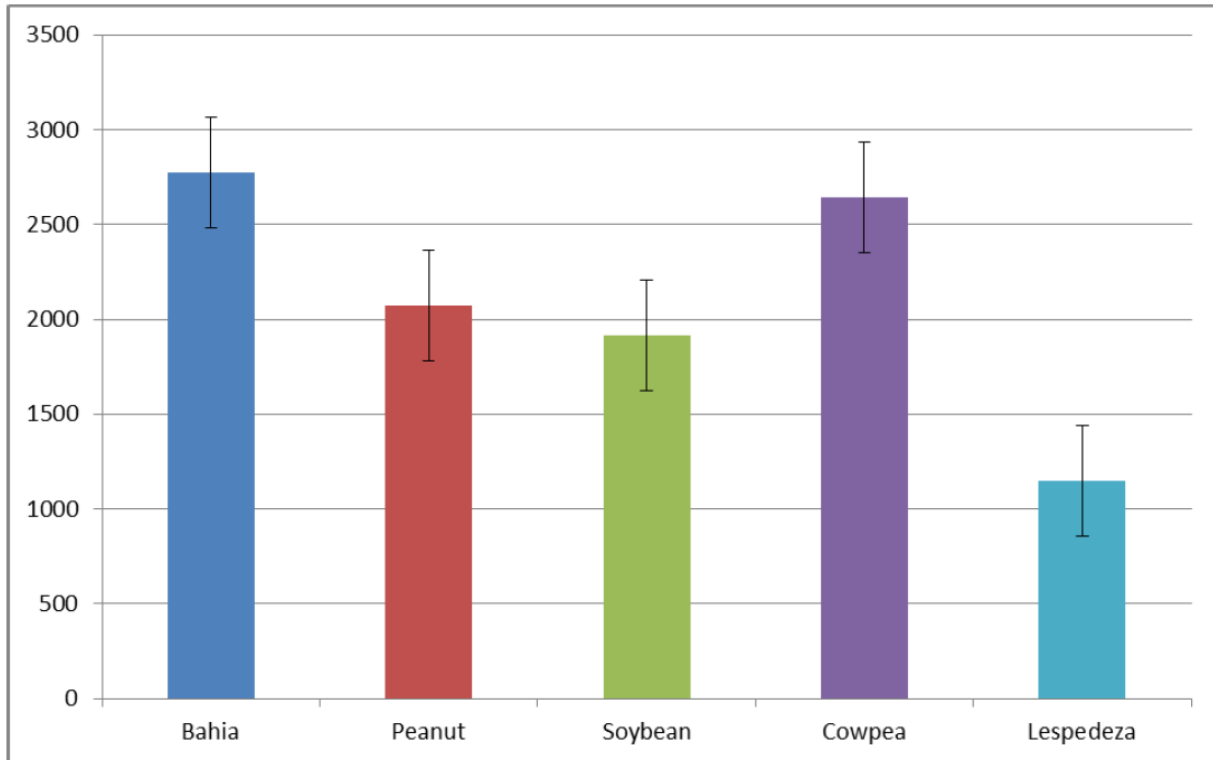
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Table 1. Intake, apparent digestibility (DM basis) and N utilization of lambs fed bahiagrass hay supplemented with warm-season legume hays or soybean meal (SBM) Foster et al. (2009b)

Item	Bahiagrass	Soybean meal	Annual peanut	Perennial peanut	Cowpea	Pigeonpea	Soybean	SEM
Total intake, g/d								
DM	665ef	726de	975b	1105a	803cd	612f	864c	29.2
OM	629ef	685de	911b	1034a	752cd	579f	811c	27.6
NDF	500e	522de	594b	654a	558cd	468e	583c	19.4
Nitrogen	8.8e	12.1d	17.7b	21.3a	12.9d	11.8d	15.6c	0.54
Digestibility, %								
DM	58.5cd	60.3c	64.3b	67.8a	58.8cd	56.3d	60.7c	0.9
OM	60.6c	61.4c	65.4b	68.7a	59.7cd	57.5d	61.7c	1.0
NDF	60.8abc	60.8abc	57.9cd	62.2a	56.6d	58.7bcd	58.9bcd	1.0
N	46.5e	56.8cd	62.4b	66.8a	54.0d	55.6cd	58.1c	1.1
N retention, g/d								
N retention, g/d	2.0d	4.2c	7.0b	10.5a	4.6c	4.1c	5.1c	0.54
Microbial N synthesis g N/d	6.4bc	5.5c	8.7a	9.5a	5.4c	6.2c	8.4ab	0.91

Within a row means without a common superscript letter differ ($P < 0.05$).

Figure 1. Effect of supplementing bahiagrass hay with hays of perennial peanut, soybean, cowpea, or lespedeza on gastrointestinal parasite fecal egg counts (eggs/g) in goats



Dung Beetle (Coleoptera: Scarabaeidae) Abundance and Diversity in Alpaca Pastures of Virginia

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Dung baited pitfall traps were used to conduct a survey of dung beetles in alpaca pastures located at Virginia State University in Petersburg, VA from May to September in 2010 and 2011.

Beetles were collected weekly and identified to species. Of the 3,136 beetles collected, 11 species were represented: *Onthophagus taurus* Schreber, *O. pennsylvanicus* Harold, *O. hecate hecate* Panzer, *Copris minutus* Drury, *Phanaeus vindex* MacLeay, *Dichotomius carolinus* Linnaeus, *Sphaeridium scarabaeoides* Linnaeus, *Aphodius erraticus* Linnaeus, *A. fimetarius* Linnaeus, *A. (Nialaphodius) nigrita* Fabricius, and *A. (Labarrus) lividus* Olivier. The most common species found in both years was *O. taurus*, which accounted for 43% and 59% of the populations in 2010 and 2011, respectively. Paracoprid tunneler beetles dominated the collection in both years. Both native and exotic species were abundant, indicating that the presence of exotic dung beetle species in this study was not detrimental to native populations. The species abundance and diversity fluctuated throughout the summer, likely related to weather patterns.

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Timing of Exposure to Toxic Tall Fescue Negatively Affects Reproductive Success in Two- and Three-Year Old Beef Cows

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Tall fescue [E+, *Schedonorus phoenix* (Scop.) Holub] is the predominate, cool-season forage used in beef cattle production in the southern U.S., but grazing this forage is known to negatively impact growth and may impair reproductive performance. Two- and 3-yr old (young) beef cattle respond differently to synchronization protocols and have higher energy requirements compared with mature cows under normal management conditions. Interestingly, limited data indicate that young cattle reproductive performance is negatively impacted to a greater extent than mature cattle when grazing E+. Effects of E+ on pregnancy rate have been documented, but specific timing of exposure and negative events remain unclear. Objectives of these studies were to determine if grazing E+ negatively impacts reproduction pre- or post-insemination. Data was collected from a local beef cattle producer's operation in Oconee County, South Carolina. Fourteen days prior to the initiation of synchronization protocol, Brangus x Angus cows, stratified by breed and age, were allocated to graze E+ (n = 50) or novel endophyte-infected fescue (NE+; n = 31) throughout the breeding season (60 d). Data indicated a reduction in timed artificial insemination (TAI) pregnancy rates due to E+ exposure. In addition, young cattle tended ($P = 0.07$) to have reduced TAI pregnancy rates compared with ≥ 4 -yr old cattle. In a follow-up study, young Angus and Angus-crossbred cattle (n = 114) were blocked by breed, body condition score (BCS) and age and allotted to treatment groups grazing E+ (> 70% wild-type infected) or other nontoxic forages (O; common bermudagrass and annual ryegrass) for 90 d prior to TAI. Immediately following TAI, approximately 50% of cows from each original grazing treatment were switched to the alternate grazing treatment for the remainder of the trial (130 d), consistent with a 2x2 factorial arrangement. Cattle grazing E+ pre-TAI had lowered ($P < 0.05$) d 30, 60 and 130 pregnancy rates when compared with grazing O. Grazing E+ post-AI lowered d 60 and 130 pregnancy rates compared to O treatment ($P < 0.05$). Therefore, grazing 2- and 3-yr old beef cattle on E+ prior to the breeding season decreases TAI and natural service pregnancy rates.

Keywords: fescue, beef cow, reproduction

Effects of Finishing Heifers on Endophyte-Free Tall Fescue, with and without Grain Supplementation, or Alfalfa on Carcass Characteristics and Fatty Acid Composition

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With increasing consumer demand for forage-finished beef, the objective of this study was to evaluate carcass characteristics and fatty acid composition of cattle finished on 3 different pasture-based systems at 2 time endpoints. Angus heifers (n = 40) were grazed on endophyte-free tall fescue (TF), TF with grain supplementation (TF+G), or alfalfa (AL) until slaughter at 161 or 189 d. Approximately 105 d into grazing treatment, TF+G heifers received corn grain *ad libitum*, following an adaptation period, for a total of 56 or 84 d prior to slaughter. Carcasses were graded 24 h postmortem and a longissimus muscle steak was taken from the posterior end of the rib for proximate composition. Hot carcass weight, fat thickness, kidney pelvic heart fat, marbling score, and quality grade were higher ($P < 0.05$) in AL than TF and TF+G. Total lipid content was greatest ($P < 0.05$) in AL compared with TF and TF+G. Saturated fatty acid concentration was greater ($P < 0.05$) in TF and AL than TF+G. Monounsaturated fatty acid concentration was highest ($P < 0.05$) in TF+G and lowest ($P < 0.05$) in TF. The amount of time on grain increased ($P < 0.05$) linoleic acid (C18:2 n-6) in TF+G. Total omega-6 polyunsaturated fatty acid (PUFA) concentration was greatest ($P < 0.05$) in TF+G at 189 d and lowest ($P < 0.05$) in TF at 189 d. Omega-3 PUFA concentration was greatest ($P < 0.05$) in AL and lowest ($P < 0.05$) in TF+G. Subsequently, the ratio of omega-6 to omega-3 PUFA was greater ($P < 0.05$) in TF+G at 189 d than TF+G at 161 d, which were both greater ($P < 0.05$) than TF and AL. Length of grain supplementation decreased ($P < 0.05$) *trans*-vaccenic acid (C18:1 *trans*-11) in TF+G. Concentration of *cis*-9, *trans*-11 isomer of conjugated linoleic acid (CLA *cis*-9, *trans*-11) was greatest ($P < 0.05$) in TF at 189 d and TF+G at 161 d compared with all other finishing system and endpoint combinations. Overall, finishing heifers on alfalfa increased carcass weight, backfat, and marbling. Corn supplementation increased linoleic acid and omega-6 to omega-3 PUFA ratio.

Keywords: beef, forages, carcass, fatty acid

Voluntary Intake and Digestibility of Bluestem Hay (*Dichanthium annulatum*) Treated With and an Enzyme and Liquid Urea

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An experiment assessed the effect of applying the fibrolytic enzyme containing cellulose (Cellulose Dyadic PLUS: DC), liquid urea (UL, 16% N) and control (untreated hay) on chemical composition, voluntary intake (VI) and digestibility of different chemical fractions of old world bluestem hay (DHA; *Dichanthium annulatum*). Enzyme and LU were applied by spraying 24-h prior to feeding. Nine mature crossbred rams [31.4 kg mean body weight (BW)] were used in a 3x3 Latin Square design (7-d adaptation and 5-d data collection period). Daily hay offerings were at 3.5-4% of BW on a dry matter (DM) basis. Treatments did not increase contents of DM, but crude protein (CP) was higher for LU relative to the enzyme and untreated hay. Neutral detergent fiber (NDF) and hemicellulose concentrations were similar, but acid detergent fiber (ADF) was higher through enzymatic treatments relative LU and control. Intake of DM of hay treated with LU (1026 g DM/d) exceeded ($p=0.06$) either the enzyme (937 g DM/d) or control (985 g DM/d). The VI of CP was higher for hay treated with UL than for DHA untreated or treated with enzyme, but NDF and ADF were not different. Rams fed DHA treated did not differ in % DM intake. Dry matter, NDF and ADF digestibility did not differ ($P>0.05$) were not affected by treatments, but CP digestibility was higher ($p=0.06$) for LU treated hay relative to enzyme. In summary, LU treated hays had positive effects on chemical fraction of the mature tropical bluestem hays, but cellulase did not have an effect on hay. Treating low quality grass with LU is the better option to increase intake and CP by ruminants in Puerto Rico.

Keywords: nutritional quality, tropical grass hay, additive

Strategies to Control Weed Competition in Strip-Planted Rhizoma Peanut in Existing Bahiagrass Pastures

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Rhizoma peanut (*Arachis glabrata* Benth.; RP) spreads laterally in grass swards and has demonstrated long-term persistence under grazing, making it an ideal candidate for sustainable forage-livestock systems in the southeastern USA. Thus far, RP has been used primarily for hay production systems where high costs of establishment and management for weeds and water may be affordable. Research is critical to develop novel approaches for overcoming the barriers to successful growth of legumes in association with grasses in warm climates and to identify low-cost, long-term solutions to the problem of N limitation in low-input systems. Research was conducted for two years in Gainesville, FL to evaluate planting of RP in clean-tilled strips in established, low-input bahiagrass (*Paspalum notatum* Flügge) pastures. The objectives were to determine: 1) the effect of chemical and cultural management practices to control competition for nutrients and light from weeds growing in the strips planted to RP and 2) the effect of N application on RP establishment and the interaction with management practices. The use of imazapic and imazapic + 2,4-D in strips planted to RP greatly reduced weed competition and allowed greater RP cover and frequency (20 and 19% cover, 50 and 53% frequency, for imazapic and imazapic + 2,4-D, respectively) compared to an untreated control (3 and 24%), frequent mowing (2 and 14%), application of clethodim (6 and 30%) or pendimethalin (3 and 24%) herbicides. Incident light reaching the RP canopy followed the same trend as RP canopy cover and frequency (91% for imazapic and imazapic +2,4-D compared to 71, 81, 66, and 76% for untreated control, frequent mowing, pendimethalin and clethodin, respectively). Application of 50 kg N ha⁻¹ following herbicide treatment resulted in greater RP cover and frequency in treatments where weeds were controlled successfully. Data show that strip planting RP in bahiagrass is a viable option, but weed management to control competition for nutrients and light is critical to RP establishment success.

Forage-fed Beef Production for Appalachia

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Consumer markets for natural, forage-finished beef products are expanding in the U.S. As a result of this demand, some livestock producers are electing to finish animals on forages and market beef products directly to consumers. One of the greatest challenges facing livestock producers is the consistent supply of high quality forages for finishing. Forage nutritive and fatty acid content are variable among species, variety, harvest time, and growing season. These differences in forage fatty acid content influence meat and milk fatty acids produced in grazing animals. The Pasture-Based Beef Systems for Appalachia project has been evaluating forage and beef cattle production systems for 10 years in order to determine the best practices for finishing cattle on forages in this region. Over 500 steers have been finished on forages (n = 408) or concentrates (n = 144) in this project to assess changes in carcass and meat quality with finishing system. Results from our research show that forage-finishing reduces fat content of the carcass and muscle compared to grain-fed beef. Forage-finishing also increases the concentrations of all n-3 fatty acids, cis-9 trans-11 conjugated linoleic acid, fat-soluble vitamins and b-vitamins. Tenderness of the beef products finished on forages is similar to grain-fed when finished to a similar age endpoint. Animal age at harvest impacts tenderness and therefore we recommend harvesting at 18.5 mo. of age or less for acceptable tenderness levels. Finishing on different forage species (alfalfa, pearl millet or mixed pastures) for 30 to 48 d prior to finishing did not alter carcass or meat quality. Forage-finished beef can be produced in the Appalachian region of the U.S. with enhanced nutrient composition and similar eating quality compared to traditional grain-fed beef.

**Problem Based Cooperative Extension/Research Collaboration – The Case of Smutgrass
Control Using Mob Grazing**

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This summary presents the case of successful extension/research collaboration between University of Florida (UF) Extension Agents, UF Agronomy, NRCS and two large influential ranch owners/managers. The collaboration was problem based on controlling the noxious weed smutgrass (*Sporobolus indicus*) using mob grazing in combination with field practices as alternatives to the use of chemical herbicides. Smutgrass is a noxious weed in Florida pastures. As infestations increase, forage suitable for grazing decreases. In 2008, a large group of landowners with significant infestations requested attention to this problem. Natural Resources Conservation Service (NRCS) teamed up with several Central Florida Livestock Agents and Forage Specialist at UF to develop a plan to examine and address the issue. Four phases have been identified as key in the success of the research/extension collaboration. First, an exploratory phase consisted of multi-team discussions of problem scope, literature review, and experimental approach. Second, an implementation phase included selection of cooperators and study site, discussion of experimental design, feasibility of study completion and tasks assignments. Third, an experimental phase, included field preparation, preliminary observations during one year, and an additional two years of data collection. Fourth, the information dissemination phase included different venues where results have been presented. The results have been demonstrated at a field day, and four different seminars at Florida Cattlemen's Convention, Central Florida Prescribed Fire Council, Florida Grazing Lands Coalition and Spring Rancher's Forum.

Effects of Using Different Stocking Rates of Goats under Pine Plantation on Understory Vegetative Cover, Biomass, and Soil Physical Properties

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The pine growers in the southeastern United States are seeking short-term incomes while awaiting income from timber sales. Meat goats have potential to provide short-term income. The objectives of this study were to evaluate the sustainable stocking density of meat goats under pine plantation and their impacts on soil physical characteristics as well as on understory cover density. A randomized complete block designed study was established at the Federation of Southern Cooperatives in Epes, Alabama with Kiko cross-bred goats using different stocking densities per acre. We had low, medium and high stocking densities of 4, 8 and 12 goats, respectively. Prior to the start of the study, plant species composition, biomass, soil compaction, soil bulk density and soil nutrient status were determined. Goats were introduced to the experimental plots for a 10- week period with adequate vegetation for grazing, mineral blocks to supplement nutrients as well as constant and adequate fresh drinking water. The experiments were replicated three times concurrently. Animals were regularly weighed to monitor growth. The results showed that there were no significant differences ($P > 0.05$) among treatments on initial plant cover (cover density). After the grazing, the plant cover density values were similar between control and low stocking rates ($P > 0.05$) but they were different ($P < 0.05$) from both medium and high stocking rates. The medium and high stocking rates were similar ($P > 0.05$) in plant cover density. The understory plant biomass was similar ($P > 0.05$) when measured before the grazing initiated but the post-grazing values were decreasing linearly ($P < 0.05$) as the stoking rates increased. The diversity of understory plant species and species evenness were similar ($P > 0.05$) among treatments on both before and after measurements. Even though there were no significant differences among stocking rate treatments for soil compaction, there were difference amongst the treatment means during before and after study data.

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Effects of Commercial Agricultural Bio-stimulants on Yield and Quality of Forage Bermudagrass in Central Mississippi

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An experiment was designed to study the effects of commercial agricultural bio-stimulants on yields and quality of forage bermudagrass in central Mississippi. The experiment was conducted at the Forage Unit in the Henry H. Leveck Animal Research Farm (33°25'18.23" N, 88°47'31.88" W), Starkville, MS. Established plots of Sumrall 007 hybrid bermudagrass were used for this study. Soil samples were taken prior to fertilizer application and at the end of the growing season. Phosphorus and potassium application were adjusted based on soil test recommendations. The experimental design was a randomized complete design replicated twice. Research plots were 6 ft x 9 ft. Treatments consisted of an untreated control, urea-ammonium nitrate solution (32%) (UAN), urea (46-0-0) (U), Enhance (AgSource, LLC) (AGS), Hydrhume (Helena Chemical Company) (HH), Sumagrow (AuroraAgra, LLC) (SG) and combinations of AGS, HH and SG with U and UAN. Treatments were first applied on June 8, 2011, before the first harvest and following each of four harvest dates with nitrogen applied at a rate of 50 lb N/ac at each application. Plots were harvested at 4 to 5 week intervals throughout the growing season depending on weather conditions. Yields were significantly ($\alpha=0.01$) affected by treatment and harvest date. There was also an observed treatment*date interaction for yield. All U treatments produced significantly ($\alpha=0.05$) higher yields than bio-stimulant treatments alone, while AGS and HH treatments produced significantly higher yields than controls. U and UAN treatments had significantly ($\alpha=0.05$) higher NDVI values than bio-stimulant treatments. All treatments had significantly higher total removal of phosphorus than controls, while SG did not differ from controls in total removal of potassium, calcium and magnesium.

Evaluation of Chicory to Control Gastrointestinal Nematode Infection and Finish Lambs

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Gastrointestinal nematode infections are a major source of production loss for small ruminant producers in the Southeastern U. S. Studies in New Zealand and the United Kingdom have shown that chicory [*Cichorium intybus* L.] can reduce fecal egg counts and increase performance in grazing lambs when compared to grass species. The purpose of this study was to evaluate the efficacy of chicory versus bermudagrass [*Cynodon dactylon* (L.) Pers.] pastures on fecal egg excretion, FAMACHA score and animal performance when controlling for crude protein differences in forages. Southdown lambs (n=27; 72.9 ± 3.9 lb initial BW) stratified by weight, sex and FAMACHA© score were assigned to graze either chicory (CH) or bermudagrass with alfalfa pellet supplementation (BG+S). Lambs grazed for 56 d from June 24, 2010 to August 19, 2010. BG+S lambs were supplemented to increase crude protein content to the level of the chicory pasture. Lambs were weighed and FAMACHA© scored every 14 d. Fecal samples were taken on d 0, 28 and 56 for modified McMaster fecal egg counts. Ultrasound measure of subcutaneous fat thickness (FT) over the 12th and 13th rib was taken on d 56. Lambs grazing CH had lower ($P < 0.01$) FAMACHA© scores by d 56 than lambs grazing BG+S (2.6 ± 0.19 and 3.5 ± 0.18 respectively) and fewer ($P < 0.01$) CH lambs than BG+S lambs required anthelmintic treatment (2/10 and 8/10 respectively). CH lambs also exhibited lower ($P < 0.01$) FEC than BG+S lambs by d 56. Average daily gain and subcutaneous fat thickness did not differ between treatments ($P < 0.01$). At the end of 56 d, weights were 97.2 ± 9.4 and 87.1 ± 9.1 lb ($P < 0.01$) for CH and BG respectively. Lambs grazing CH exhibited reduced GIN infection levels and reduced need for anthelmintics compared to those grazing BG even when provided diets similar in protein.

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Predicting Forage Mass for Cereal Forages with a Rising Plate Meter

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In much of the Southern Great Plains, wheat and rye are important winter forages for beef stocker operations. Accurate measurements of forage mass are needed to manage stocking rates. Rising plate meters have been used on forage crops to rapidly estimate forage mass. The objective of this study was to develop equations to estimate forage mass for grazed wheat and rye pasture with a rising plate meter. We collected 20 datasets with paired measurements of plate height and clipped mass between 15 November, 2011 and 20 April, 2012 (388 paired observations). A linear mixed model with a random intercept for dataset was developed. We investigated the effect of forage (rye or wheat), tillage (no-till or conventional), and days since 1 September (typical seeding date in this region) on the relationship between forage mass and plate height. Only days since 1 September had a significant effect on this relationship. The final model was:

$$Y = (-478 + 62.82d - 0.2307d^2) + (674.9 - 1.0620d)(H - 4.91), \quad (1)$$

Where Y is forage mass (lb DM/acre), d is days since 1 September, and H is plate height (in). Residuals were heteroscedastic and we modeled them as a power function on the fitted value. Table 1 illustrates the effect of d on the regression intercept, slope, predicted forage mass, and residual sd for a 5-in plate height measurement on the given date. The standard deviation of the random intercept for dataset was 406 lb/ac. The standard error of an estimate from the population level model includes the random effect and the residual error. In practice, a pasture forage mass is estimated from the mean of many samples. With 30 and 60 height measurements ($\bar{x} = 5$, $sd = 1$) and a population level model, users can predict forage mass with $sd = 437$ and 429 lb/ac, respectively. With the dataset specific model, the sd is reduced to 129 and 92 lb/ac, respectively, with only a small change in the absolute estimate (-31 lb/ac). If relatively low precision of forage mass estimates is acceptable, the plate meter is a very efficient method. Greater precision of estimates requires a dataset-specific model, which requires additional calibration effort.

Table 1. Variation in parameters over time with estimated forage dry matter value given a rising plate height of 5 in.

Date	d	Intercept	Slope	Y(H = 5 in)	Residual sd
15 November	76	2963	594.1	3017	714
15 January	134	3796	532.6	3845	788
15 April	230	1764	430.6	1803	582

**Beef Cattle Production on Grass-legume Mixes: Economic Implications of Establishment
Methods and Grazing Systems Performance**

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The objective of the first study was to examine the effects of different strategies for ‘Dixie’ crimson and ‘Regal Graze’ white clover establishment when over-seeded into an existing bermudagrass pasture. The experimental design was a randomized complete block with whole plots representing cattle grazing before and after planting to test for effects of hoof action on clover emergence. Within each whole plot, eight treatments were randomly imposed as a subplot factors; these included planting by no-till drill or by broadcast at high and low seeding rates for both species. Overall, no-till planting resulted in higher seedling rates than broadcasting, although the latter appeared to be a low-cost alternative for establishing white clover. Maximum counts observed for crimson clover and white clover were 20 seedlings / sq foot for both crimson and white clover, using no-till planting with a high seeding rate. Grazing by cattle (hoof action) had no effect on clover establishment success. The number of seedlings decreased during winter, especially when established with the no-till drill procedure. The objective of the second study was to compare forage production and beef cattle gains from bermudagrass/annual ryegrass pastures fertilized with N or overseeded with either crimson or white clovers. Gelbvieh × Angus crossbred heifers (n = 120; 581.3 ± 100.57 lb initial BW) were assigned to 1 of 8, 5-acre pastures in the spring of each of the three-year study. All pastures were overseeded with ‘Marshall’ annual ryegrass, and were not seeded with any clover (N) or overseeded with ‘Dixie’ crimson (C), ‘Osceola’ ladino (L), or a combination of crimson and ladino clover (CL). Heifers were turned out between January to March and grazed pastures until end of August. Total BW gain was not significant ($P = 0.99$) among treatments. Also, ADG was not significant ($P = 0.99$). It appeared that while N fixed by legumes may contribute to the overall nutrient balance in a pasture ecosystem, positive effects may take several years before they result in significant higher animal gains and financial returns.

Feeding the Pasture vs. Feeding the Steer: Interaction of Fertilizer and Supplement inputs to a Wheat Grazing System

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Producers may consider using several types of inputs in grazing systems, including both agronomic and animal management inputs. This study sought to determine how these two types of inputs may interact in a typical stocker cattle grazing program. Treatments were arranged in a 2x2 factorial with 2 levels of fertilizer and 2 levels of soybean hull supplementation. Twelve 2-ac paddocks were established to wheat (*Triticum aestivum*, var. ‘Endurance’) in the fall of 2011. In a completely random design, paddocks received combinations of 50 or 150 lb per acre of actual nitrogen fertilizer, and soybean hull supplementation at 0 or 0.75% of steer body weight (BW) per day (fed in three feedings per week). Paddocks were stocked with 2 tester steers (initial BW 403 ± 21 lb) for 175 d. Tester steers were shrunk in drylot for 16 h and then weighed on calibrated scales. Forage mass in each paddock was measured twice per month with a calibrated electronic plate meter, and stocking rate adjusted with grazer steers to maintain a forage allowance of 2.5 lb of forage DM per lb of steer BW. Dependent variables were subjected to analysis of variance with paddock as the experimental unit. Fertilizer and supplementation inputs both increased the number of grazing days, but neither affected ADG (**Table 1**). Consequently, both inputs improved total gain per acre. There was no interaction between the inputs, indicating that a producer should evaluate the economic value of each input independently. Further, the input effects were additive, indicating that they should be used in combination if they are each economically justified.

Table 1. Effects of additional nitrogen fertilizer and soybean hull supplementation on performance of steers grazing wheat.

Item	Nitrogen		Soybean Hulls		SE	P-value		
	50 lb	150 lb	0.0 % BW	0.75% BW		N	SBH	N*SBH
ADG, lb/d	2.37	2.46	2.32	2.51	0.076	0.40	0.12	0.22
Grazing Days / acre	282	320	285	317	6.3	<0.01	<0.01	0.67
Total Gain, lb/acre	670	789	663	796	33.5	0.03	0.02	0.60
Forage allowance*	2.56	2.63	2.63	2.57	0.07	0.48	0.60	0.37

*lb of forage dry matter per lb of steer body weight, held constant by design

Response of Summer-dormant and Summer-active Type Tall Fescue with and without Fungal Endophyte Infection to Plant Parasitic Nematode Exposure

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Summer-active (continental) tall fescue (*Schedonorus arundinaceus*) is well adapted to the southeast and Midwest where annual precipitation is in excess of 35 inches. Continental types possess drought avoidance mechanisms but will re-grow with summer rains which reduce their persistence in continental climates such as the southern plains. Mediterranean basin origin summer-dormant tall fescue (Mediterranean) avoids extended moisture and heat stress periods by invoking dormancy in response to increasing day length and temperature. Mediterranean tall fescues may expand the tall fescue adaptation zone due to their summer dormancy. Persistence of continental types is enhanced by presence of an ergot alkaloid producing endophyte *Neotyphodium coenophialum* (wild) conferring resistance to insects, drought, and grazing. Ergot alkaloids cause fescue toxicosis in livestock. Non-ergot alkaloid producing strains of *N. coenophialum* (novel) endophytes have been identified and placed into tall fescue selections. Some novel strains in continental tall fescue confer resistance to plant parasitic nematodes while others do not. Resistance to nematodes by novel endophytes in Mediterranean tall fescues is uncertain. This study sought to compare effects of four nematode types on wild endophyte-infected continental tall fescue and novel endophytes in continental or Mediterranean tall fescue. This greenhouse study was conducted with two continental varieties; Kentucky 31 (wild); and Texoma MaxQ II (novel) and the Mediterranean variety Flecha AR542 (novel). Endophyte-free plants of each variety were controls. Plants were established from seed, endophyte presence verified then transplanted to 7.5 inch pots. Pots were inoculated with two levels of stunt (*Tylenchorhynchus* spp.) low 90, high 270; ring (*Criconemella* spp.) low 250, high 800; spiral (*Helicotylenchus* spp.) low 75, high 225; and lesion (*Pratylenchus* spp.) low 20, high 55 nematodes. Study length was seven months then nematode populations were determined. Lesion populations were near zero in all plants. Texoma MaxQ II populations were similar to wild for stunt and spiral but higher for ring. Ring populations were higher for Flecha AR542 than other variety by endophyte combinations. Flecha AR542 stunt populations were higher than either endophyte-infected continental line. Results indicate that AR542 increases host suitability of Flecha summer-dormant tall fescue to nematodes.

Impact of Adding Four Rates of A BMR-6 Forage Sorghum to late Corn Plantings on Yield and Nutritive Value of Silage

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Corn silage is grown on more than 190,000 acres in Virginia and North Carolina and is the primary component of dairy rations throughout the mid-Atlantic region. Although the yield potential of corn grown for silage is high, it is also sensitive to environmental stress. Dry conditions during any stage of corn growth can significantly reduce corn silage yields. In contrast to corn, forage sorghum possesses a much higher level of drought tolerance and water use efficiency. Planting mixtures of corn and forage sorghum may reduce the risk of low yields during years with below average rainfall and above average temperatures. The objective of this study was to evaluate the impact of planting corn alone or in mixtures with four rates of forage sorghum (2 to 8 lb/A) on the yield and nutritive value of late planted corn silage. Plots were established at Virginia Tech's Southern Piedmont Research Station located outside of Blackstone, VA in late May 2010 and 2011, approximately a month after the optimal planting date. Adding as little as 4 lb/A of forage sorghum to late planted corn doubled (4.9 to 11.5 ton/A) and tripled (5.4 to 14.3 ton/A) the adjusted silage yield in 2010 and 2011, respectively. These data indicate that forage sorghum grown either in mixtures with corn or alone could help to mitigate the effects of drought and high temperatures in silage production systems in the mid-Atlantic region of the United States.

Using Yield and Digestibility Data to Select Summer Annual Varieties

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Trials conducted at Virginia Tech's Southern Piedmont Agricultural Research and Extension Center in 2009, 2010, and 2011, evaluated the yield and digestibility of summer annual grass varieties including conventional and BMR forage sorghums species and pearl millet. Plots were established in early June and harvested when the average height was 30 inches. Total yield was ranged from 4911 to 8289 lb DM/acre in 2009 and 3670 to 5297 lb DM/acre in 2010. Average over harvests, in vitro true digestibility also varied, ranging from 59 to 76% and 66 to 76% for the 2009 and 2010 growing seasons, respectively. What was most interesting is that the highest yielding variety in the trial was also one of the most digestible. This indicates that high yield and digestibility may not be mutually exclusively traits. To better understand how to use yield and digestibility data when selecting or recommending a summer annual grass species-variety, the difference from average for the yield and digestibility was graphed and the graph was divided into four quadrants. The upper right hand quadrant includes varieties that have above average yield and digestibility. These species-variety combinations would be the most desirable to include in a forage production system. In contrast, the bottom left hand quadrant contains species-variety combinations with below average yield and digestibility. These varieties would likely be the last choice for including in forage production programs.

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Relative Forage Quality Index

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Forage quality indices estimate voluntary intake of available energy when forage is fed alone. Relative Feed Value (RFV), used widely in the U.S., is voluntary intake (% BW) of digestible dry matter (DDM) divided by a factor (1.29) so that RFV of full bloom alfalfa = 100. Accuracy of predicted RFV values is dependent on the equations used to predict voluntary forage intake (VFI) and DDM from NDF and ADF analyses, respectively. The intake equation used in RFV assumes that NDF intake is a constant 1.2% BW. For grasses, however, NDF intake is not constant and NDF is not correlated closely with DMI. Also, differences between observed and predicted DDM values are often large. Therefore, new approaches for predicting VFI and available energy of forages must be considered, but it is not possible to separate RFV from the equations used to predict it.

Relative Forage Quality (RFQ) is an alternative to RFV in order to facilitate improvements in the accuracy of predicting forage quality. The available energy component of RFQ is TDN, rather than DDM. A summative equation is recommended (e.g., NRC. 2001. Nutrient Requirements of Dairy Cattle or NRC. 1996. Nutrient Requirements of Beef Cattle). Thus $RFQ = (VFI, \% BW) * (TDN, \% DM / 100) / 1.23$. The divisor, 1.23, was developed and evaluated using two independent animal data sets. In both sets, observed RFV and RFQ were correlated ($r = .99$), and the means and ranges of RFV and RFQ were similar. Predicted RFQ and RFV values for individual samples may vary greatly, however, because RFQ will use more accurate prediction equations for VFI and TDN. Potential uses of RFQ include hay inventorying, hay marketing, and benchmarking quality progress.

Advantages of RFQ are: multiplying RFQ by 1.23 gives an estimate of TDN intake (% BW); TDN may be converted to NE; VFI can be calculated by dividing TDN intake by TDN; and both VFI and TDN can be used as inputs for nutritional models.

Total digestible nutrients for warm and cool season grasses are calculated as:

$TDN_{grass} = (NFC*.98) + (CP*.87) + (FA*.97*2.25) + (NDFn*NDFDp/100) - 10$ (Moore and Undersander, 2002)

Where terms are as defined previously and

$$\text{NDFDp} = 22.7 + .664 * \text{NDFD}$$

$$\text{Maximum protein} = 16\%$$

Dry matter intake for warm and cool season grasses are calculated as:

$$\text{DMI}_{\text{Grass}} = -2.318 + 0.442 * \text{CP} - 0.0100 * \text{CP}^2 - 0.0638 * \text{TDN} + 0.000922 * \text{TDN}^2 + 0.180 * \text{ADF} - 0.00196 * \text{ADF}^2 - 0.00529 * \text{CP} * \text{ADF} \text{ (Moore and Kunkle, 1999).}$$

Where DMI is expressed as % of BW, and CP, ADF, and TDN are expressed as % of DM

Note also that the maximum CP to be entered is 16%.

$$\text{RFQ} = (\text{DMI}_{\text{grass, \% of BW}}) * (\text{TDN}_{\text{grass, \% of DM}}) / 1.23$$

Tropical forages to enhance sustainable intensification of mixed systems in Central America and the Caribbean

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Population growth has caused unsustainable intensification of land use in Central America and the Caribbean. Severe land degradation, as a consequence of inadequate management practices like slash & burn, and edaphic and climatic stresses jeopardize agricultural productivity, income generation and food security. However, mixed systems integrating crops and livestock offer a good potential for eco-efficient agriculture by reducing risks and providing new opportunities. Improved multipurpose forages well adapted to edaphic and climatic constraints constitute an essential interface between crop and livestock components. For almost two decades CIAT and partners have worked on the integration of tropical forages in smallholder mixed crop-livestock systems in Central America. Two major challenges (chronic dry season feed shortage and declining soil fertility) have been addressed using participatory germplasm selection and development approaches. Impacts of drought adapted grasses (mainly *Brachiaria*) include increased availability of good quality feed and enhanced milk production, in particular during the dry season. Some herbaceous and shrub legumes have emerged as promising options to improve animal feeding and also enhance soil quality. For instance, mixed cropping of herbaceous legumes (e.g., *Canavalia brasiliensis*) addresses the critical issue of dry season feeding while improving soil quality: Symbiotic N₂ fixation by the legume improves soil fertility (replacing up to 60% of required fertilizer) and increases subsequent maize yields, whereas milk production increases by 20-30% when cows graze the legume-enriched maize residues. CIAT and partners have also engaged on research on forages for monogastrics, in addition to their utilization for ruminants. New options particularly focused at small scale (female) farmers include replacing up to 30% of cereals by fresh material or silage of forage legumes for feeding of pigs, increasing productivity and product quality while reducing costs. While important progress has been made, there is still a lack of knowledge on how to manage agronomical aspects in these improved production systems at specific locations to enhance adoption. More emphasis must be put on the generation of extension information to enable farmers to benefit from the full potential of the new forage options, particularly to confront the challenges of climate change.

Keywords: Mixed systems, Tropical multipurpose forages, Adoption, Central America and the Caribbean

Forage Nutritive Value of Seeded Bermudagrasses in Central Florida

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Hybrid bermudagrasses are outstanding warm-season perennials; however, vegetative propagation is not suitable for many small landowners. Seeded types offer ease of establishment and the alternative for sites with high soil pH where bahiagrass may not adapt well. The objectives of this study were to evaluate the nutritive value of seeded bermudagrasses and to use the on-going research/evaluation for forage demonstration in multiple field days. Three replicates of eight commercial seeded varieties (Cheyenne, Common, Mohawk, Riata, Stampede, Sungrazer, Texas Tough, and Wrangler) plus hybrid bermudagrass controls (Coastal and Tifton-85) were planted in a randomized block design during July 2008. Plots were successfully established and fertilized with 60 lb N/harvest; weed control practices followed IFAS recommendations, and three growing seasons of data were collected. Plots were harvested every 28 days and samples were analyzed for nutritive value [CP, TDN, lignin, plus minerals (P, Ca, K, Mg)]. Crude protein had a year effect ($P < 0.01$). In 2009 CP ranged from 12 to 15%, in 2010 from 16 to 18%, and in 2011 from 15 to 19%. In two of the three years CP for most seeded types was similar or higher than control Coastal, and did not fluctuate much between seeded varieties. Total digestible nutrients are presented for 2009 only; values for seeded types ranged from 49.7 to 52.3% and were comparable to Coastal but significantly lower than Tifton-85 (58.7%). Phosphorus concentration ranged from 0.22 to 0.25% and there were no differences among varieties or years. The results show that nutritive value of seeded bermudagrasses is adequate for livestock production with high CP and TDN comparable to Coastal but less than Tifton-85.

Evaluation of 12 Conventional Alfalfa Varieties for Use in Mississippi

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Mississippi has well over a million acres dedicated primarily for pasture or hay production. Rising nitrogen (N) prices are negatively affecting the economic efficiency of predominately grass pastures that requires high N input to produce good quality forage. Legumes such as alfalfa have the ability to produce high quality forage with no N input. Alfalfa is common in the mid-western United States but is not often utilized in Mississippi due to its susceptibility to fungus and insect predation characteristic in the humid southeast. The study included 12 conventional alfalfa varieties ranging from dormancy 4 to dormancy 10. The study was planted on October 20, 2011 at a seeding rate of 20 lb/ac. Plots were harvested on April 18, May 25, June 29, August 5, September 8 and October 31, 2011. Samples were analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and TDN concentrations using the Foss 6500-C near-infrared reflectance spectroscopy (NIRS) instrument. Data was analyzed by using the Generalized Linear Mixed Models (GLIMMIX) of SAS and mean separation was done using the least significant difference (LSD) at $\alpha = 0.05$ or 0.10 when appropriate. Varieties: Bulldog 805, Magna 601, Hybrid Force 2420 and PGI 1007 BA produced the greatest cumulative yields in 2011 with total yields over 10,000 lbs/ac. The April harvest produced the greatest yields with subsequent harvest gradually declining in yield until October. Generally, NDF and ADF were highest in April and May but TDN was lowest. Crude protein ranged from 24 to 27% among harvest dates. Total yearly yields and quality observed in this study were comparable to the minimal yields observed in other regions of the country will alfalfa is a staple forage product, suggesting that alfalfa may be a viable grazing or hay crop in Mississippi when managed correctly.

Bermudagrass Stem Maggot Identified in Florida

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The Bermudagrass Stem Maggot (*Atherigona reversura*) is a new, exotic invasive fly that was first discovered damaging bermudagrass pastures and hay fields in Georgia. The identification of the fly was the first record of this species in North America and it has the potential to become a serious pest of bermudagrass forage and turf in Florida. This pest was detected in Florida in 2011 when it was identified to genus (*Atherigona* spp.) by entomologists at the Florida Division of Plant Industries from specimens collected in Gadsden, Madison, Alachua and Bradford counties. Verification of adult flies to species is currently in progress. Symptoms of the bermudagrass stem maggot include the death of top leaves to the node or growing point. These leaves can easily be pulled out of the leaf whorl and feeding by the stem maggot can often be seen with the naked eye. A recent study at the University of Georgia and USDA-ARS Coastal Plain Station have indicated that while all bermudagrass varieties tested so far have been susceptible to the maggot, thinner stem bermudagrass varieties, such as common and Alicia bermudagrass, are more prone to insect feeding. Control for this pest includes timely hay harvest or the use of pyrethroid applications when warranted. Using livestock to graze affected fields could potentially reduce maggot populations. The potential permanent presence of this insect pest to bermudagrass should encourage early scouting of fields for evidence of the fly or maggot. Because this is a new pest to the United States, we have no threshold tolerance levels established or legally labeled insecticides that would provide longer-term protection from insect feeding. The University of Georgia and The University of Florida specialists are currently testing strategies to provide long-term protection from bermudagrass stem maggot fly infestations.

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