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Texas Program

South Texas Natives and Texas Native Seeds Projects

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Introduction

South Texas Natives (STN) and *Texas Native Seeds* (TNS) are collaborative projects with an overall objective to increase the availability of native seeds for use in restoration and reclamation activities in south, central, and west Texas. STN began in 2001 at the request of private landowners in response to concerns about the use of introduced plants in restoration and reclamation activities in South Texas. TNS began in 2010 at the request of private landowners and the Texas Department of Transportation (TxDOT) to meet native seed supply needs in central and west Texas. Both STN and TNS are headquartered at the Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville. Collaborators include the USDA NRCS Plant Materials Centers in Kingsville and Knox City; Texas AgriLife Research Stations in Beeville, Stephenville, and Uvalde; Tarleton State University; Sul Ross State University; TxDOT; and numerous private landowners. Our primary goal is to collect, evaluate, increase, and commercialize regionally adapted native plant germplasm selections that can be successfully used in restoration and reclamation activities in south, central, and west Texas.

Need for STN and TNS

Land management goals in Texas have changed dramatically in the last 2 decades. These changes are influenced in part by research results indicating lower wildlife habitat value of introduced grass monocultures than native habitats, as well as by changing land use and resulting real estate values for range and pasture land. Throughout much of Texas, primary land management goals are shifting from primarily livestock based toward efforts aimed at benefiting recreational opportunities associated with wildlife and natural ecosystems and enhancing economic value associated with fee and lease hunting of game species. Severe drought conditions of the past few years have accelerated this change in primary land use and management. In many areas of the state over the past 3 years, range and pasture conditions have necessitated a significant reduction in livestock numbers, or in some cases, complete livestock deferral. While drought conditions have clearly altered livestock production across the state, they have had less impact on hunting lease values or rural land prices, clear indications of the present drivers of land value.

As a result in the shift in land management goals, and since native plant dominated landscapes are near-universally accepted as being the superior habitat for native wildlife, the intentional planting of introduced forage grasses is no longer practiced by many private landowners. Unintended negative consequences such as uncontrollable spread and development of persistent botanical monocultures of some introduced forages, particularly Old World bluestem grasses (*Bothriochloa* and *Dichanthium* spp.), have resulted in some landowners developing strong avoidance of the use of introduced plant species. Research indicates that concerns over use of these plants, particularly in terms of potential negative implications to wildlife habitat value in general and biodiversity, are well warranted.

Furthermore, this change amongst private landowners has gradually influenced policy of government agencies away from the use of introduced plants, and toward the use of native plants in their management activities. A clear example is the changes TxDOT has made regarding seeding specifications for reclamation projects along highway right of ways in south Texas. Instead of using seed mixes for erosion control comprised primarily of introduced grasses (as was common and quite effective from an erosion control standpoint throughout the state for most of the last century), today the agency specifies 100% native seed mixes for use in most of the region. Even in regions where native seeds are not readily available, TxDOT completely avoids use of problematic introduced species such as Old World bluestem grasses, and has for over a decade.

Today, in most of Texas, land disturbance activities requiring reseeding, and particularly those associated with energy exploration and transportation infrastructure development, are occurring at an accelerated pace and scope. In regions outside of south Texas, adequate stocks of adapted native seeds are not commercially available, despite the apparent demand. In addition, available seeds are cost-prohibitive for use by many consumers, or on large projects. In other circumstances, available native seeds are of inherently low quality (e.g. sources harvested from untested parentage or wild stands), are of unknown origin, or lack traits necessary for successful use in restoration and reclamation settings. As a result, success of native seeding efforts has historically been poor. Thus, the intent of STN and TNS is to collect, select, and increase regionally adapted (ecotypic) native seed sources for certified commercial seed production and large scale availability to consumers at reasonable costs.

Methods

The initial phase of our seed source development program is to obtain a broad collection of populations of each native species of interest in order to ascertain the variability and adaptability of the species, and identify populations with needed traits for commercial production and restoration use. We try to obtain 2 seed collections from wild populations of each plant from each county of our region(s) of interest. In support of this goal, we have obtained almost 3,000 native plant seed collections from across Texas since 2001. Following collection, we establish evaluation plantings at a minimum of 2 locations within the area of intended use of the plant. Each collection is evaluated for 2-5 years for natural adaptations that influence successful use in restoration and reclamation settings, and for natural adaptations that would make successful commercial seed production possible.

After evaluating the germplasm collection, we select populations for release to commercial seed growers and increase the seed of promising collections in isolation to maintain the genetic integrity of each selected native population. Depending on market needs for a species, and evaluated potential of the material, we make multi-origin/population/species blends, or single collection releases of various native plants. Our goal is not to create novel material by breeding or intentional genetic manipulation; instead we seek to identify and increases populations that have the natural adaptations for successful use in restoration and reclamation plantings. The final product delivered to consumers is in most cases not different than the original wild population that the seed was collected from, other than it may have higher seed quality as a result of being produced under intense agronomic conditions, or that it may be a blend of several populations of the plant that possess adaptations that should benefit successful use in restoration and reclamation plantings.

Following increase, we distribute seed to commercial producers and provide technical assistance to insure successful production of the release. Throughout the development process we conduct numerous field trials to evaluate selections in common restoration and reclamation settings. These plantings are also used to develop planting methodology for each seed source and demonstrate successful uses to potential consumers.

Results

To date, the collaborative STN Project has released or helped commercialize 21 Texas Selected Native Plant Germplasm seed sources. Currently, these seed sources represent the only Texas Department of Agriculture-certified native seeds available to Texas consumers. Eighteen of these selections have been sold commercially by cooperating seed companies. We have negotiated production licenses to stimulate grower investment into production of 7 of these releases.
In 2012, the amount of certified commercial seed of releases developed by STN sold to consumers was sufficient for 25,000 acres of restoration and reclamation seedings in the south Texas region. By the end of 2013, commercial production capacity of STN releases should provide seed for over 50,000 acres of native seedings in the region. Retail price for these seeds

is currently the median of the range/reclamation seed market in Texas, with cost typically ranging from $75-100 per acre. Both STN and TNS are currently evaluating a number of additional native species for future release and commercialization. We have plans to make 9 additional native seed source releases for the south Texas region over the next 5 years, and hope to make as many as 20 native seed germplasm releases for both central and west Texas over the next decade.

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USDA NRCS East Texas Plant Materials Center, Seeking Conservation Solutions Through the use of Native Plants

Alan Shadow

East Texas Plant Material Center

Who We Are and What We Do

The East Texas Plant Materials Center (ETPMC) is one of 27 centers operated by the Natural Resources Conservation Service (NRCS), United States Department of Agriculture. The ETPMC services 42 million acres and covers portions of Texas, Louisiana, Arkansas, and Oklahoma. The center was established in 1982 and is a joint venture between Soil and Water Conservation Districts in east Texas and northwestern Louisiana, NRCS, Stephen F. Austin State University (SFASU), and US Forest Service. The ETPMC encompasses 75 acres of research and production fields, and is located in the Stephen F. Austin Experimental Forest, south of Nacogdoches, Texas.

The mission of the NRCS Plant Materials Program is to develop and transfer effective plant technology for the conservation of natural resources. In working with a broad range of plant species, including grasses, forbs, trees, and shrubs, the program seeks to address priority needs of NRCS field offices and land managers in both public and private sectors. Emphasis is focused on using native plants to solve conservation problems and to protect and restore ecosystems. Center personnel develop research projects and technical reports for use in developing technical guides for agency personnel and landowners on the use of plant materials in various conservation practices. The ETPMC's area of emphasis includes, but is not limited to:

- Enhancement of water quality through the protection of riparian and wetland areas
- Restoration of degraded pasture, range, and timber lands
- Restoration of surface-mined sites
- Wildlife habitat improvement
- Restoration of saline sites associated with the oil and gas industry
- Improvement of air quality as related to poultry and other livestock industries

Current Work

- Development of rust resistant Indiangrass (*Sorghastrum nutans*) release
- Native Warm Season Grass Release Evaluation
- Adaptation of commercial wildflower mixes for pollinator habitat
- Enhancement of longleaf pine planting
- Evaluation of cover crops and their effects on soil health
- Seed increases of selected material
    - *Liatris pycnostachya, Tridens strictus, Helianthus mollis, Schizachyrium scoparium*

- Germination and propagation of endangered species
  - *Hibiscus dasycalyx, Leavenworthia texana, and Physaria pallida*
- Cooperative studies with ARS and local universities
  - Perennial, warm season grass evaluation for biofuels (ARS)
  - Cold tolerance and adaptation of potential releases from the Kika de la Garza PMC in Kingsville, Texas
  - Simulated silvopasture shading effects on native and introduced forage grasses (SFASU)
  - Identification and quantification of species in seed bank of coastal wetlands (SFASU)
  - I dentification of fungal pathogens affecting Indiangrass (*Sorghastum nutans*) (SFASU)
  - Response of native and introduced cool season grasses to endophytes (Rice University)
  - Response of native shrubs and trees used in shelter belts around poultry production facilities (SFASU)

New Plant Releases for 2012-2013

'Nacogdoches' eastern gamagrass (*Tripsacum dactyloides*) was released as a cultivar in 2012. It will replace 'Medina' and 'Jackson' eastern gamagrass within the ETPMC service area. 'Nacogdoches' showed superior seed production when compared to 'Jackson' and 'Medina', with no loss in forage production or quality. Studies also showed it to be more disease resistant.

Cajun Sunrise Germplasm ashy sunflower (*Helianthus mollis*) was released cooperatively with the Golden Meadow Plant Materials Center and the Louisiana Native Plant Initiative. It has specific use for pollinator and wildlife habitat improvement and increased diversity in conservation plantings.

Current Collection Requests

The ETPMC is currently requesting collections of the following species. Please see the web link for details: http://www.tx.nrcs.usda.gov/technical/pmc/plant_collection_11.html

Andropogon gerardii	*Desmodium* sp.	*Ratibida columnifera*
Polygonum pensylvanicum	*Helianthus angustifolia*	*Echinochloa walteri*

Website and Publications

The ETPMC produced 17 new technical documents and newsletters during FY 2012. These documents include updated release brochures for all ETPMC plant releases, Technical Notes, Plant Guides, and Plant Fact Sheets. For a complete list of publications past and present, please see:
http://plant-materials.nrcs.usda.gov/etpmc/publications.html

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Forage Ecology/Physiology

Integrated Crop/Forage/Livestock Systems for the Texas High Plains

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Water supplies for agriculture are becoming increasingly tight because of recurring droughts and competing demands from urban and industrial users. The depletion of the Ogallala Aquifer on the Texas Southern High Plains presents a model for dealing with declines in irrigation supply while sustaining profitable agricultural communities. This semi-arid region in West Texas (470 mm or 18.5 in. of annual precipitation) was a short-grass prairie ecosystem before the widespread introduction of high-input irrigated crop production, of which cotton (Gossypium hirsutum L.) has been a major component. Once thought inexhaustible, aggressive water conservation measures are needed to extend the groundwater supply. We hypothesized that integrating forage crops and cattle grazing systems into local cropping systems would reduce whole-farm consumption of water, chemicals, and fossil energy, while enhancing soil quality and maintaining profitability.

An interdisciplinary team calling itself the Texas Coalition for Sustainable Integrated Systems (TeCSIS, www.orgs.ttu.edu/forageresearch) was formed at Texas Tech University, Lubbock, to test that hypothesis and to extend information to producers on how to improve efficiency of water use. We compared integrated crop/forage/livestock systems to a cotton monoculture system typical of the area between 1998 and 2008 (Allen et al., 2012). Two, large-scale, sub-surface drip irrigated systems (13 ha total area), with 3 replications in a randomized block design, compared water use, productivity, and economics of 1) a cotton monoculture, and 2) an integrated 3-paddock system that included cotton in a 2-paddock rotation with grazed wheat (Triticum aestivum L.) and rye (Secale cereale L.) and a third paddock of perennial 'WW-B. Dahl' old world bluestem [OWB; Bothriochloa bladhii (Retz) S.T. Blake]) for grazing and seed production. Angus crossbred beef steers (Bos taurus L.; initial body weight = 229 kg; SD = 33 kg) grazed from January to mid-July.

Over 10 yr, the integrated system used 25% less irrigation water, 36% less N fertilizer, and fewer chemical inputs as compared to the cotton monoculture. Irrigation plus precipitation replaced 68 and 73% of reference evapotranspiration (ET0) between May and September for the monoculture cotton and integrated cotton system, respectively. Cotton lint yields did not differ between systems (1,369 kg ha-1). The grasses in the integrated system required only about half the irrigation required by cotton. Irrigation water applied to cotton, OWB, rye, and wheat was 422, 230, 201, and 135 mm, respectively (crop effect, $P < 0.001$; SE = 5). In January, steers began sequentially grazing OWB and rye followed by wheat, returning to spring growth of OWB by mid-May. Dahl OWB provided almost three times more days for cattle grazing than rye, but cattle grazed rye about twice as many days as wheat, measured either as days paddocks were occupied or as steer grazing-days yr-1. About 44% of the total days on OWB were during the winter dormant period, with the remaining 56% during the active growing period during May, June, and July. Sequencing dormant OWB, rye, wheat, and spring OWB growth provided continuous grazing opportunities with an average of 185 d from January to termination of grazing in July with daily gains of 0.79 kg. Total gain system-ha-1 averaged over 10 yr was 259 kg (Allen et al., 2012).

Additional benefits of grazing the small grains and perennial grasses in the forage/livestock system were seen in reduced soil erosion (Collins, 2003), increased diversity and numbers of soil microbial communities and increased soil organic carbon (C) (Acosta-Martinez et al., 2010), and greater potential for soil C sequestration (Fultz et al., 2011). At the end of 10 yr, total soil C was higher in both the rotation and pasture of the integrated crop-livestock system (average across grazing treatments: 17.3 g kg-1 soil) compared with continuous cotton (11.4 g C kg-1 soil; Acosta-Martinez et al., 2010). The integrated system's perennial OWB was more energy efficient at producing grazing days (32 MJ animal-1 d-1) than the annuals wheat and rye (80 and 48 MJ animal-1 d-1, respectively). Energy required by steers depended greatly on management of cows that produced these steers. As the aquifer is depleted and water is pumped from greater depths, the integrated system's lower water use will save increasing amounts of energy relative to cotton monoculture (Zilverberg et al. 2012). Economic analysis of the two systems indicated that profitability over the 10-yr period was not different; however, during the first 4 yr, the integrated system was about twice as profitable. Conversely, over the last 6 yr of the project, the cotton monoculture became more profitable due primarily to use of higher yielding cotton cultivars. Results indicate that where water availability is adequate, the cotton monoculture system has higher profitability than the integrated system. Over the 10-yr study, integrating crops, forages, and cattle reduced irrigation, chemical inputs, and soil erosion. Soil organic matter, soil C , and overall soil health were increased, and fossil fuel energy inputs were lower than the cotton monoculture system. Economically, the integrated system was a viable alternative where irrigation was limited and-or pumping regulations exist. Relative profitability likely will increase as water becomes more limited (Johnson et al., 2013). Results supported the hypothesis that integrating forages and livestock can conserve overall use of water and other inputs.

To extend the research results, the Texas Alliance for Water Conservation (TAWC) was formed as a demonstration and education component of TeCSIS, and was guided by a board of producers and a management team of university and government scientists. This program has promoted technologies that conserve irrigation water for crop production and provided various online web tools including 1) Irrigation scheduling tool for tracking crop water use; 2) Contiguous acre calculator for calculating irrigation water availability; and 3) Resource allocation analyser for assigning crops to specific fields based on irrigation capacity while optimizing economic inputs. These producer tools may be found at www.tawcsolutions.org with additional information on TAWC at www.depts.ttu.edu/tawc. Through TAWC, information flows both to the producers and to the researchers involved. The information gained can be more thoroughly studied resulting in a better understanding of producer decisions and needs while the scientists can more readily recognize the researchable needs of the producers. Thus, TeCSIS-TAWC forms a unique entity of research, demonstration, and education and brings together a unique partnership of individuals from multiple universities, private companies, commodity groups, government agencies (state and federal) and producers with the purpose of finding ways to conserve water and other natural resources and together find solutions to the challenges and issues faced by agriculture today.

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Forage Utilization

Baled Silage – Uses for Beef and Dairy

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Round bale silage, also known as baleage is becoming widely adopted on many small to medium dairies in the eastern United States. In recent years, high grain and fertilizer costs have also spurred interest among beef producers. The bale silage conservation system originated in Europe over three decades ago, but wide spread use did not take place until stretch wrap plastic film and high-speed wrapping machines were introduced about 25 years ago. These two components are essential for excluding oxygen from the bales and are key components of any successful bale silage system. As with any silage system, optimum fermentation and high forage nutritive value are achieved with baled silage by harvesting immature forage containing high levels of fermentable carbohydrates.

Bale silage has many potential advantages over storing forage as hay, particularly in high rainfall areas of the world where successful hay production is difficult. For example, in Louisiana it is usually possible to make four or more cuttings of hybrid bermuda grass, but often rainfall damage occurs on at least one cutting and occasionally an entire cutting is lost to unpredicted high rainfall events. Optimum moisture concentration in hay is 15% or less while optimum moisture content in bale silage is generally from 40-60% moisture. Therefore, wilting times for baled silage typically range from 4-48 hours depending on forage species, stage of maturity, yield, drying conditions and type of mower-conditioner employed. Reducing wilting time reduces the number of days required to harvest the forage crop, which in turn allows for timelier harvesting of forage over the growing season and improved forage quality. Finally, storage losses for bale silages are typically similar to that observed for barn-stored hay (< 5% shrink) while dry matter losses of 25-35% for outdoor-stored hay are often reported. Compared to traditional grass silage, the baled silage system requires less capital investment in equipment and less labor. Plus, it allows the producer to harvest small acreages at optimum stages of maturity and is better suited for marketing forage off farm.

Although baleage has many advantages, there are several areas of concern with this forage conservation system. Because of the long particle length, poor availability of soluble sugars and relatively low density of baled silage; it typically undergoes a more restricted fermentation than conventional precision-chopped grass silage. As a consequence, baled silage often has a pH higher than 5.0 which under certain conditions may allow proliferation of undesirable bacteria such as clostridia and listeria. Poor oxygen exclusion from baled silage may also encourage proliferation of molds and yeasts which not only undermines forage quality but has the potential to produce mycotoxins. To minimize the undesirable effects of these microorganisms, most research suggests baling at lower moisture levels for low sugar crops such as bahia grass, bermuda grass and alfalfa and wrapping with at least six layers of plastic to minimize oxygen entry into the bale. In fact, recent research indicates that some bale silages may be safely fed to equine when forage moisture levels range between 17 and 37% provided extra plastic is applied at baling time. Best fermentations with bale silage appears to occur with high sugar crops such as annual ryegrass or forage sorghum that have either been conditioned prior to baling or chopped with balers equipped with fixed knives. Compared to hay, bale silage has a short shelf life and at high ambient temperatures should be fed to large groups of animals that can consume the forage in 1-3 days. However, when ambient temperatures are low, research suggests bale silage may be exposed to air for as long as four weeks without undergoing significant secondary fermentation. Although there are forage species differences, almost any forage may be conserved successfully as bale silage. From a nutrition potential standpoint, annual forages usually are the most suitable candidates for bale silages. These might include cool season forages such as annual ryegrass, oats and wheat and warms-season grasses such as crabgrass, millet, forage sorghum and sudangrass. Brown mid rib summer annuals may be particularly well suited to the bale silage system as they are usually high in sugars and harvest normally takes place at the vegetative stage before the threat of significant lodging. Perennial forages such as bahia grass, bermuda grass and alfalfa have been successfully stored as baleage, but their low sugar content often leads to high pH silages that are more prone to molding and secondary fermentations. Although more research is needed, most low sugar crops may benefit from baling at moisture levels less than 50% thereby relying on low moisture and anaerobic conditions to inhibit undesirable bacteria and mold growth rather than silage acids.

Enhanced animal production potential of bale silages is predicated primarily on the potential to harvest forage at a more immature, nutritious state than possible with hay systems. Perhaps the highest potential reward among forages in the southeastern U.S. may be realized with annual ryegrass. Research suggests that ryegrass bale silage may be reliably harvested 2-4 weeks earlier than hay in south LA. This resulted in higher protein and energy forage and improved milk yield for cows fed ryegrass baleage than those fed hay. However, neither ryegrass hay nor bale silage performed as well as same-day precision-harvested ryegrass silage which emphasizes the point that for intact baleage crops particle length will usually limit intake and performance compared to finely chopped silages. Outdoor-stored hay in the southern U.S. typically undergoes tremendous losses in dry matter and nutritive value; therefore in the absence of adequate barn space, animal performance may be enhanced by using the bale silage system. Results from a forage conservation study in Louisiana indicated that forage quality and milk yield tended to improve when dairy cows were fed same day harvested bahia grass baleage compared to hay stored outside. However, no differences were noted in animal performance between cows fed barn-stored hay and baleage. Although animal growth was not documented, Kentucky research showed improved intake with alfalfa baleage compared to hay due to reduced leaf loss and lower respiration losses.

Bale silage equipment and management techniques continue to advance each year. Many U.S. equipment dealers are now manufacturing balers and wrappers for use in bale silage production. Yet, many of the new equipment innovations and management strategies continue to come from European countries such as England, Ireland and Germany. New management strategies are emerging such as with maize bale silage that is being custom produced in Germany to improve efficiency of corn silage use on small livestock farms. In southern Louisiana and Mississippi the use of BMR summer annuals in baled silage systems is garnering considerable attention among producers. More research needs to be conducted with the BMR summer annuals to document proper stage of harvest, moisture levels, and feeding strategies to maximize intake and performance in beef and dairy animals. No doubt, equipment designed to reduce particle length pre and post-ensiling will have a positive effect on future animal performance. Also, continued research is required to improve bale silage fermentation and characterize changes in protein and energy fractions during ensiling. Only then, can proper diets be formulated that consistently generate high animal performance from baled silages.

In summary, the bale silage system has evolved remarkably since the days when overly moist bales were placed in loose fitting plastic bags or covered with tarps. Today, with the purchase of a wrapper and the use of high quality stretch film, most beef and dairy producers have the potential to store forages of very high quality that will improve animal performance and reduce dependence on high-priced concentrates.

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Forage Breeding

Reducing Seed Dormancy: the First Step in Domesticating Native Forage Grasses

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Eight native warm-season grasses (NWSG) and one native cool-season grass species are currently undergoing phenotypic recurrent selection for precocious germination. These species include: upland and lowland switchgrass (*Panicum virgatum* L.), big bluestem (*Andropogon gerardii* Vitman), indiangrass [*Sorghastrum nutans* (L.) Nash], little bluestem [*Schizachyrium scoparium* (Michx.) Nash], beaked panicum (*Panicum anceps* L.), purpletop [*Tridens flavus* (L.) Hitchc.] eastern gamagrass (*Tripsacum dactyloides* L.); the single cool season is southeastern wildrye (*Elymus glabriflorus* (Vasey ex L.H. Dewey) Scribn. Cr.R. Ball). Within the warm-season grasses there are two categories. The first category includes the tall stature grasses such as lowland switchgrass, big bluestem, and indiangrass. The second category includes short stature grasses such as, upland switchgrass, little bluestem, peaked panicum, purpletop and eastern gamagrass.

When Europeans came to North America they brought grazing animals and hay with seed of familiar Old World grasses. Prior to arriving in North America, that germplasm had already undergone 400-500 years of significant selection pressure to tolerate close continuous grazing and rapid germination during Europe's Enclosure Period.

Research by USDA-NRCS has shifted from promotion of exotic species toward exploitation of North American native species. Several species have shown promise for use as forage and hay crops, wildlife habitat and in land reclamation projects. Another (and perhaps larger) interest in NWSG has come from the bio-fuels market, because cellulose will have to be harvested from non-crop lands, making NWSG the prime candidate for a feedstock. Research indicates switchgrass has promise as fuel stock for cellulosic ethanol production (McLaughlin, 1993; Sanderson, 1996; Lemus and Parrish, 2009). Almost all native prairie grasses are cross pollinated by wind (Hanson and Carnahan, 1956) and are generally self-incompatible (Talbert, 1983; Taliaferro and Hopkins, 1996; Norman et al., 1997; Martínez-Reyna and Vogel, 2002). With cross pollinated progeny, a substantial degree of genetic variance exists in both native and cultivated populations. As such, these native grass populations have large innate genetic variability that allows continued selection and improvement.

Native warm-season perennial grasses are notoriously slow to establish, making the seedlings poor competitors with weeds, especially annual weedy grasses (Robocker et al., 1953; USDA, 1996). An important obstacle for the cultivation of these grasses is seed dormancy. Large percentages of seed often fail to germinate or emerge when planted (Robocker et al., 1953; Barnett and Vanderlip, 1969). Labeling laws allow seed labels for native grasses (non-domestic crops) to list total germination (immediate germination + dormant viable seed + hard seed) to be reported as percent germination, which falsely portrays what can be expected in a field germination situation. Seed dormancy is present in all perennial native grass species and can provide a selective advantage under varying, unpredictable environmental conditions, but it is a strong disadvantage in a situation where quick establishment and cover are desirable.

A majority of breeding efforts have focused on switchgrass. In his chapter on switchgrass, Casler (2012) notes 35 well known germplasm releases. Twenty-two have been released with minimal or no selection; 13 have been part of significant selection programs, predominantly for increased biomass and digestibility. Eight of these 13 have been released since 2006. Breeding efforts to enhance establishment included; one variety selected for reduced seed dormancy, and one for large seed size/mass. A survey of cultivar releases of native grasses indicates the prime selection criterion to be vegetative/forage yield. Little information is available on the improvements of indiangrass and big bluestem by the USDA-ARS, Plant Material Centers and Agricultural Experiment Stations (Anonymous 2005; USDA-NRCS 1993; 2004; 2006).

A comment by Doak et al. (2002) prompted our breeding efforts. He reported the exceedingly slow establishment of native grasses forced him to use tall fescue [*Schedonorus arundinaceus* (Shreb.) Dunort., nom.cons.] as the control species in his experiments on roadside revegetation.

Most of the best known varieties of NWSG have been released for 30-40 years (some longer). Most are simple selections from extremely limited germplasm resources. Given the obligate outcrossing nature of these species, it isn’t difficult to understand why progress for desirable characteristics hasn’t been made. It should also be noted, most of the “released cultivars” are often only one or two generations out of the wild, thereby limiting any selection for reduced seed dormancy. The polyploidy nature of these grasses hinders rapid progress toward improving this very quantitative trait, and promiscuous outcrossing makes marker assisted breeding prohibitively expensive; though the cost is steadily decreasing.

The objective of this project is to use phenotypic recurrent selection to reduce seed dormancy in the aforementioned native grass species. Reducing the seed dormancy period will allow these grasses to respond quickly to planting, thus enhancing their role in forage production, conservation, habitat establishment, and as a source of biomass for alternative fuels while reducing cost of establishment.

This work has been progressing intermittently since 2002 as part of a biomass/biofuel improvement project funded by a congressional earmark. Initially, only tall stature grasses were part of this breeding program (lowland switchgrass, big bluestem and indiangrass) (Jones, 2004). In 2005, short stature native grasses were added (upland switchgrass, little bluestem, purpletop, and beaked panicum; Holmberg, 2007). Southeastern wildrye (a cool season native perennial) was added in 2009/10 (Rushing, 2012). In 2011, Morrison began work with diploid populations of eastern gamagrass; initially screening commercial germplasm, then obtaining diverse diploid germplasm from Dr. Denise Costich (while at USDA-ARS at Ithaca, NY).

The greatest focus has been placed on a mixed population of tetraploid lowland switchgrass (deemed the greatest potential as a native biomass crop). In seven cycles of selection we have achieved a mean germination of ~90% in 14 days (30/20°C). The unselected population has a mean precocious germination of ~0.02% in 28 days under the same germination conditions.

The success of researchers with other grasses (and our own work, described below) strongly indicates the plausibility of using traditional breeding techniques to shift allelic frequencies responsible for seed dormancy even among polyploid species. This is a pragmatic approach to the improvement of these grasses. Sometimes the simplest approach is the best. Simple recurrent selection of seed that germinate in the shortest period of time is the most cost effective method of obtaining our goals.

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Selecting Native Grasses for Improved Survival under a Changing Global Climate

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In “The Changing Climate of South Texas 1900-2100”, Jim Norwine describes the likely climate scenario for south Texas in the year 2100. “South Texas will warm on average through the century. Because it will be hotter, even if annual rainfall remains roughly constant or increases a bit, the region will become drier due to increased evapotranspiration rates. Our infamous variability will probably increase as the climate mutates into one of more prolonged droughts and more extreme rainfall events/periods. Imagine Corpus Christi moved to Laredo by the year 2100”.

The rate of global warming and other associated climate changes such as increased evapotanspiration rates and drier moisture balances, which are anticipated over the next century, are expected to have significant impacts on south Texas vegetative communities.
To be prepared for these changing conditions, the USDA-NRCS E. “Kika” de la Garza Plant Materials Center (PMC) in Kingsville, Texas, has been evaluating methods for improving heat and drought tolerance in native grasses.

Switchgrass (*Panicum virgatum*) is a tall, perennial, native grass that produces abundant forage and has promising potential as a biofuel plant. However, one short coming of switchgrass is its panicoid seedling morphology. This morphology can result in the subcoleoptile internode elongating to elevate the coleoptile to the soil surface. This surface elongation can hinder or eliminate the development of its long-term adventitious root system. This trait has been implicated as a major limitation to successful switchgrass establishment under drought conditions. However, Tischler & Voight (1993) developed a selection method to overcome this problem.

The PMC began to evaluate and develop a more drought tolerant switchgrass in 2005. It began by establishing a 100 plant evaluation block from a composite collection from the King Ranch that had 6 day or earlier germination. We then used the Tischler & Voight protocol to establish a 150 plant low crown evaluation plot set-up as 6 blocks of 25 randomized plants from 8 maternal lines of the King Ranch Composite, 4 South Texas Accessions and *Alamo* LC-3. From this, we culled plants leaving 70 low crown plants representing 8 lines of the King Ranch composite collection.

Seed harvested from these 70 plants in 2010 and 2011 was compared to *Alamo* switchgrass for low crown development. *Alamo* only had 11% low crown seedlings whereas the PMC harvest of 2010 had 70% and the 2011 harvest had 72%. A seed germination test was conducted comparing *Alamo* to the PMC 2010 seed harvest. This test revealed that *Alamo* had a 7% germination rate within 4 days while the PMC 2010 harvest had a 26% rate.

Peter Setimela established in 1999 a rapid screening technique for heat tolerance in sorghum. We have adapted this protocol for evaluating heat tolerance in big sacaton (*Sporobolus wrightii*). We also have developed a screening technique for evaluating drought tolerance. This screening technique resulted in the mortality of 73% of the big sacaton plants leaving 27% of the plants for establishing a promising "drought hardy" seed increase block.

These measures appear to improve native grass seedlings for drought and heat tolerance. Although we have significantly more testing to confirm these improvements, we believe these measures will help us cope with the rapidly changing climate scenario expected for South Texas.

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Poster Session

A Growing Need for Small Farm Livestock Education

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Marion County was ranked number one in equine and small ruminant and eleventh in the state of Florida for beef cattle production by the 2007 Agriculture Census. Small Farms in Marion County and Florida represent over 90 percent of agricultural operations. Providing up-to-date, research based educational opportunities for small farmers in pasture management is a priority in this county due to economic and environmental reasons. A three part pasture management school series was designed covering topics such as basic plant physiology, forage varieties for Central Florida, weed control and grazing strategies. Four classes and a field trip were conducted as part of this course. A total of 28 people attended the Small Farms Pasture Management School. Their animal species of interest were small ruminants (12%), poultry (8%), bovine (35%), equine (35%) and swine (12%). Forty five percent of the audience farmed 1 to 10 acres, 20 percent farmed 11 to 20 acres and 21 to 50 acres while 15 percent had 50 acres or more. Survey response rate was eighty-nine percent (n=25). One hundred percent (n=22) would consider implementing pasture management practice changes discussed during the meetings. Examples of practice change include: grazing management (n=8), winter forage production (n=6) and weed management (n=8). The survey results indicated a significant need for more educational programs targeting small farmers and ranchers in the State of Florida. Further educational needs identified were: manure management (n=7), farm and pasture mathematics such as calculating fertilization rates (n=6), animal nutrition (n=3) and weed control (n=3). The survey also indicated that the Small Farms Pasture Management School had an average value of $917.85 to the attendees. Based on this producer feedback, CFLAG will extend the Small Farms Pasture Management School to include some of the educational needs identified in the survey.

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Protein Affinity of Protein Precipitating Phenolics in Leaves Changes with Repeated Defoliation of *Desmodium paniculatum*

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Protein precipitating phenolics (PPP), such as condensed tannins, bind to plant proteins, and are hypothesized to be a plant defense against herbivory. PPP are thought to have anti-nutritional effects on ruminants including decreased protein availability to rumen microbes. This experiment determined how PPP protein affinity in leaf material of a warm-season perennial herbaceous legume was affected by simulated herbivory. *Desmodium paniculatum* (panicled tick-clover; PTC) was reared in a greenhouse and subjected to one of four treatments: previously undefoliated plants and three successive defoliations of the upper 50, 75, and 100% of herbage regrowth**.** Defoliation took place at 145 (August 1, 2012), 181 (September 6, 2012), and 222 (October 17, 2012) days after seeding, approximately equivalent to vegetative, early reproductive and seed set stages. Protein affinity remained stable or increased in all treatments from the first to second defoliation. However, all treatment groups experienced a decrease ($P \leq 0.05$) in protein affinity between the second and third defoliation. Results suggest that repeatedly defoliated PTC plants may lack the resources to produce well defended leaves through PPP accumulation and instead opt to maximize photosynthetic tissue production. Animals consuming repeatedly defoliated PTC forage may not experience as many anti-nutritional effects associated with PPP. Expanded research is needed to determine if other legumes which accumulate PPP utilize the same adaptation strategies to intense, repeated herbivory.

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Survey of Pasture Management, Feeding Management and Milk Production on Pasture Based Dairy Farms in Florida and Georgia

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Pasture species and management, feed intake, and milk production on pasture based dairy farms in the southeastern USA appear to vary widely but are not well described. The objective of this study was to document pasture management, feeding management, and milk production on pasture based dairy farms in Florida and Georgia. A survey was developed that consisted of 62 questions and covered 7 areas, which included farm business structure, young stock, herd management, pasture and crop management, feeding management, manure and nutrient management, and environmental sustainability. This survey was conducted on 23 dairy farms that were responsible for approximately 29,000 cows and 17,000 heifers. Data was collected by personal interview from fall of 2012 to winter of 2013. The survey focused on the year 2011-2012. All farms grew warm-season perennials grasses. Warm-season annual grasses were grown on 14 farms. Cool-season annual grasses were established on 18 farms. For pest control, 13 farms (57%) used pesticides to treat fall army worm (*Spodoptera frugiperda*). For weed control, 16 farms (70%) used herbicides and 11 farms also used a machine to cut weeds. For lactating cows and dry cows, in winter, the average dry matter intake from stored feed was 37 ± 14 lbs/cow/day and 19 ± 11 lbs/cow/day, respectively. The average dry matter intake from grasses was 6 ± 5 lbs/cow/day and 14 ± 8 lbs/cow/day, respectively. In summer, the average dry matter intake from stored feed was 28 ± 16 lbs/cow/day and 15 ± 11 lbs/cow/day; and the dry matter intake from grasses was 14 ± 9 lbs/cow/day and 17 ± 6 lbs/cow/day, respectively. The average milk production was 59 ± 15 lbs/cow/day during the winter and 43 ± 16 lbs/cow/day during the summer. The average somatic cell count was 246,292 ± 69,614 cells/ml during the winter and 365,292 ± 78,587 cells/ml during the summer. Survey results will help direct subsequent research and extension programs to help promote sustainable agriculture practices and meet farmers' needs from university extension.

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Evaluation of a Non-Flowering, Perennial Sorghum spp. Hybrid

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Perennial *Sorghum* spp. hybrids (PSSHs) such as Columbusgrass (*Sorghum almum* Parodi; *S. bicolor* [L.] Moench x *S. halepense* [L.] Pers.) and the reciprocal hybridization (*S. halepense* x *S. bicolor*; e.g. Cv 'Krish') are high-biomass feedstocks currently utilized as forage but with potential as dual-use forage/biofuel crops. Acceptance of such hybrids is limited, however, by both their short-term persistence and tendency to produce significant quantities of seed which can become weed banks in subsequent crops. Natural PSSHs occur throughout annual sorghum production zones but have not been well characterized. Non-flowering PSSHs would not be a weed invasiveness risk via seed or natural hybridization with annual *S. bicolor*. The significantly reduced rhizome production in PSSHs in comparison to *S. halepense* also minimizes vegetative invasiveness risk. The objective of this study was to evaluate biomass potential of a novel, high-biomass, non-flowering PSSH (SOAL09TX15) at multiple locations spanning forage sorghum production zones across Texas. Replicated, small-plot yield trials were initiated at Beeville, College Station, and Commerce in 2011 following a two-harvest per year, 'Haygrazer' type forage sorghum cropping system. SOAL09TX15 yields averaged 8 and 10 dry tons per acre across all locations in 2011 and 2012, respectively, and were not statistically different from the check (SX-17). Crop eradication trials were initiated in the 2012 growing season, in which clipping (7, 14, 28 day frequency) was ineffective but glyphosate application (14 & 28 day frequency) successfully prevented SOAL09TX15 from overwintering. Because SOAL09TX15 is non-flowering, and therefore vegetatively propagated, rhizome propagule harvest, longevity, and planting experiments are currently ongoing. The utility of such non-flowering PSSHs as dual-use forage/biofuel feedstocks, and their value towards developing environmentally-benign, perennial sorghum feedstocks, will be discussed.

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Prediction of Nutritive Value of Bermudagrass Hays Using Internal Marker and the Current Arkansas TDN Equation

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This study was conducted to determine the relationship among in vivo DM digestibility (IVDMD), DMD predicted by the concentration of acid detergent insoluble ash (ADIA) as internal marker, and total digestible nutrients (TDN) values obtained by using the Arkansas TDN expression. Eight ruminally cannulated cows (594 ± 35.5 kg) were allocated randomly to 4 bermudagrass hay diets categorized by their low (L), medium low (ML), medium high (MH), and high (H) crude protein (CP) concentration (7.9, 11.1, 13.1, and 16.4% of DM, respectively). Diets were offered in 3 periods with 2 diet replicates per period (n = 24). Cows were individually fed their respective hay at 2% of BW in equal feedings at 0800 and 1600 h for a 10-d adaptation period followed by a 5-d total collection (TC). Apparent DMD was determined based on hay offered, ort, and feces. Estimates of DMD using ADIA marker (M) concentrations were obtained with the formula $[100 \times (1 - M_{feed}/M_{feces})]$. Estimates of TDN were obtained with the formula $(111.8 + 0.95 \times CP - 0.70 \times NDF - 0.36 \times ADF)$ currently used in Arkansas. Data for apparent DMD and estimated DMD were analyzed as a replicated 4 x 4 Latin-Square design with one period missing using PROC GLM of SAS. Effects of cow, diet, and period were included in the model. The DMD estimates using ADIA were not different ($P \geq 0.28$) from those derived with TC values. Furthermore, the correlation coefficient between actual DMD values and estimated values revealed a high correlation coefficient ($r = 0.72$, $P < 0.001$). There was a positive and significant relationship between DMD derived from TC and calculated TDN ($r = 0.58$, $P = 0.003$). The current bermudagrass TDN equation for Arkansas accurately predicted the energy content of L diet (50.1 vs. 51.1 % DM), but overestimated the energy content of ML, MH, and H diets. Bermudagrass DMD can be predicted using ADIA and there is a need to update the current bermudagrass TDN equation to account for high quality hay.

Keys words: Bermudagrass, nutritive quality, internal marker, cattle

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Efficacy of Seed Coatings, Chemical and Hormonal Treatments to Hasten Germination and Improve Overall Establishment of Native Warm-Season Grasses in Mississippi

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Research has shown that seed of several species of native warm-season grass require long periods of cold moist stratification to break primary dormancy and improve seed germination. Recent studies have also demonstrated that the use of hydrogen peroxide (H_2O_2) can substitute for the long process of stratification in many native grass species. In an effort to increase the rate and vigor of germination of native warm-season grass seed, a series of laboratory germination studies were conducted to evaluate the efficacy of chemical, hormonal and coating treatments to increase seed germination at varying temperature and light regimes representative of the Southern United States. These studies utilized six combinations of temperature and photoperiod in a full factorial design to test the impact of hydrogen peroxide, gibberellic acid (GA), starch-based hydration polymer (Zeba) [Absorbent Technologies, Inc.; Beaverton, OR], and starch-based hydration polymer in combination with proprietary abiotic mineral blend (GC) [DeltAg, Greenville, MS] on germination rate of four switchgrass [*Panicum virgatum* (L.)], three indiangrass [*Sorghastrum nutans* (L.) Nash] and two little bluestem [*Schizachyrium scoparium* (Michx.) Nash] cultivars. Chemical and hormonal treatments were applied at five rates, while seed coatings were applied at a 1:1 (w/w) ratio by a custom coating company [Summit Seed Coatings; Caldwell, ID]. Statistical data showed inconsistency within species (between cultivars). There was a significant decrease in germination associated with seed coatings among all cultivars. Treatment with peroxide had a negative effect on germination of many indiangrass and little bluestem cultivars. Gibberellic acid treatments increased germination of some indiangrass cultivars over untreated controls, but only at very high levels. There was an increased response to chemical treatments at lower temperatures (60° F) and a decreasing response to GA at temperature regimes higher than 86° F. Most cultivars of all three species appeared to peak in mean germination (control) at 68/86° F, under long-day photoperiod. This result was expected, and, as such, there were no significant responses to any treatment at that temperature-photoperiod combination. This result suggests an overall lack of efficacy of all treatments to significantly improve germination at ideal conditions.

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No-Till Establishment of two Wildrye Species into Existing Warm Season Pasture

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Mississippi livestock managers are often faced with provisional herbage declines during winter months when the growth of warm seasons grasses have ceased. Many producers often rely on exotic species and annual grasses to alleviate this feed deficit and extend the grazing season. To lessen the added expense and risks involved with exotic species, native cool season forages may complement warm season growth curves for year-round production. In 2012, researchers found that the native cool season perennial, southeastern wildrye [*Elymus glabriflorus* (Vasey) Scribn. & C.R. Ball], had production potential comparable to other wildrye species and cool season exotic grasses. Objectives of this study were to determine if wildrye could successfully establish and persist if planted into existing warm-season grass pasture. A randomized complete block design with a factorial arrangement of treatments was used. Treatments included combinations of two planting rates (7.5 and 15 lb/A PLS) and two species (*E. glabriflorus* and *E. virginicus*) that were drilled into dormant pasture on two planting dates (October and February). Four replications of wildrye were planted into three various warm season pastures using a nine-row Almaco®, no-till seed drill (Almaco®, Nevada, IA). Warm-season pastures included bermudagrass (*Cynodon dactylon*), indiangrass (*Sorghastrum nutans*), and a mixed native warm season grass pasture (*Andropogon gerardii*, *Schizachyrium scoparium, Panicum virgatum,* and *Sorghastrum nutans*), all previously established at least three years prior to this experiment. Cool-season weeds were controlled by two pints of Cornerstone® per acre in all February plots prior to planting. Emergence data in the bermudagrass pasture indicated that Virginia wildrye, planted in October at the 15 pound PLS per acre rate had the highest number of seedlings, but was not significantly different than the October planting of Southeastern wildrye at 15 pound PLS and Virginia wildrye at 7.5 lb PLS per acre. Stand emergence failed in the mixed NWSG and indiangrass pastures suggesting low seed/soil contact. Preliminary results indicate an October planting of wildrye in dormant bermudagrass increases emergence and establishment before the flush of cool-season weed competition.

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Evaluation of Wildrye (*Elymus* spp.) as a Potential Forage and Conservation Planting for Northeast Mississippi

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In northeast Mississippi, there is a need for a native, cool-season grass component for restoring and reclaiming grasslands and providing quality forage for livestock. Identifying one or more species that could fill this role would allow land managers to create a completely native grazing system by combining these species with native warm-season grasses. A field trial was established in Starkville, MS in the fall of 2010 to evaluate 18 entries of cool-season, perennial grasses: eight *Elymus* species including a Mississippi ecotype of southeastern wildrye [*Elymus glabriflorus* (Vasey ex L.H. Dewey) Scribn. & C.R. Ball], orchardgrass (*Dactylis glomerata* L.), tall fescue [*Schedonorus arundinaceus* (Schreb.) Dumort., nom. cons.], timothy (*Phleum pratense* L.), and wheatgrass [*Thinopyrum intermedium* (Host) Barkworth & D.R. Dewey] cultivars. A total of seven harvests (four in 2011 and three in 2012) were taken throughout the duration of the trial. Data collection included plant height, ground coverage ratings, dry matter (DM) yield and nutritive value consisting of neutral detergent fiber (NDF), acid detergent fiber (ADF) and crude protein (CP). The non-native entries, specifically the orchardgrass and tall fescue entries, outperformed the native entries in height, yield, and ground cover ratings. Kentucky-31 and Jesup MaxQ tall fescue were the only entries with significant amounts of DM produced for the 2011 growing season (6.6 and 7.0 ton A^{-1}, respectively). The 2012 DM totals were substantially less for all entries, with Potomoc orchardgrass and Kentucky-31 tall fescue having generated the greatest amounts of biomass (5.7 and 5.3 ton A^{-1}, respectively). Nutritive value analysis, however, indicated statistical similarities between *Elymus* species and domesticated, non-native cultivars. High innate nutritional values of certain native entries (southeastern, 'Icy Blue' Canada and Virginia wildrye) met dietary requirements for livestock. This was due, in most part, to delayed maturity stage of the plants when harvests took place. Results from this experiment indicate the need for improving agronomic characteristics in native germplasm before they can be adapted in intensively managed grazing systems.

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Performance and Grazing Behavior of Steers Grazing Three Bermudagrass Varieties

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Varieties of the same forage have different canopy characteristics and nutritive value that may affect the grazing animal. The objective was to evaluate the performance and grazing behavior of beef steers grazing ‘Jiggs’, ‘Alicia’, and ‘Tifton 85’ bermudagrass [*Cynodon dactylon* (L.) Pers.]. In 4 consecutive years, 36 spring-weaned steers (BW= 554 ± 16 lb) were rotationally stocked in two pasture-replicates (6 steers per experimental unit) of each bermudagrass variety at 1.1 steers/acre. Fertilizer rate was 100 units of N as urea on d 0 and 56 (average across years) of the grazing season. Grazing season lasted an average of 117 d. In years 1 to 3, 2 steers per group were fitted with a pedometer (IceRobotics, UK) and data transformed using an algorithm (Aharoni et al., 2009). Herbage mass was estimated and nutritive value samples were taken on d 0 and every 28 d thereafter. Bermudgrass variety affected ($P < 0.01$) ADG. Steers grazing ‘Jiggs’ and ‘Tifton 85’ gained more (1.21 and 1.07 lb/d, respectively) than those grazing ‘Alicia’ (0.58 lb/d). There was a quadratic effect ($P = 0.04$) of sampling day on forage mass which was greatest on d 56 (3,938 lb/acre). There were a year and sampling day effect on CP and a year effect on ADF and NDF ($P < 0.05$). Crude protein and ADF were smaller and NDF greater in year 1 (8.9, 34.4, and 66.7%, respectively) compared to other years. Crude protein was greater on d 28 (14.1%) compared to the rest of the sampling dates except on d 0 (11.9%) of the grazing period. There was a quadratic effect ($P = 0.03$) on CP concentration with d 56 being the lowest (6.6%). Lignin concentration was greater ($P = 0.02$) in ‘Alicia’ (7.1%) compared to ‘Tifton 85’ (4.5%) and ‘Jiggs’ (5.1%). Steers grazing ‘Alicia’ spent more time ($P < 0.05$) walking and standing than steers grazing the other varieties. Grazing time was shorter and biting rate greater ($P < 0.05$) in steers grazing ‘Alicia’. In this study, ‘Alicia’ bermudagrass negatively impacted performance and grazing behavior of beef steers, relative to other varieties.

Keywords: bermudagrass, grazing, steers

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Pasture Management Schools for the New and Traditional Livestock Producers in Central Florida

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Ponce de Leon introduced cattle to Florida in 1521, thus beginning the cattle business in the Americas. Florida had ample land, water, warm temperature, and an abundance of native grass. Almost 500 years later, urbanization has dictated increased land use efficiency. An influx of "new farmers" has emerged from cities, many of whom have limited knowledge of forage production or Best Management Practices. Small Farms in Central Florida represent >90% of agricultural operations; the remaining 10% of the farming operation represent > 90% of the livestock numbers and land. The rapidly increasing population's demand for water has elevated water quality as the number one issue in Florida. Providing current research based information to such an educationally diverse and experienced clientele is challenging. A three part pasture management school series was designed and delivered covering basic plant physiology, forage varieties, planting techniques, fertilization, soil testing, weed control, and grazing strategies. Classes were presented in various counties by agents and state specialist. A total of 103 attendees represented over 400,000 acres of pasture attended in a two year period but most farmed part-time on less than 40 acres. Surveys revealed that 100% of the attendees implemented management changes as a result of this program. Soil testing and fertilizer application according to UF/IFAS recommendation was highest on their list of changes, followed by rotational grazing, weed control, stocking rate adjustments, and planting legumes. As a result of these initial schools, bimonthly Pasture Management Class and Farmer to Farmer Discussion Group have evolved. Additional Pasture Management Schools have been presented focusing on small limited resource farmers.

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Long-term Environmental Effects on Tall Fescue Endophyte Types in Mississippi

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In the past several years, new varieties of tall fescue (*Schedonorus arundinaceus* Schreb) have been developed to replace the commonly used and considered most reliable Kentucky 31 endophyte infected (EI). These varieties have been produced to mitigate the endophyte toxicosis that is associated with Kentucky 31 and have either no endophyte (EF) or a non-toxic endophyte (NE) types. However, there is debate about the relative performance of EF and NE varieties in more extreme climates. Typically, tall fescue is limited to northern Mississippi and is not readily utilized in the south due to hot, humid summers. Regardless of this perceived range, variety trials have been evaluated in several locations in south Mississippi over a 10-year time period. To observe the effect of endophyte type on tall fescue yield, data from Mississippi State University forage variety trials were analyzed along with yearly degree growing degree days (GDD) and rainfall accumulation from each location. Yield data was analyzed using Proc GLM (SAS Institute, Cary, NC) and means were separated using LSD (α=0.05). Correlations were analyzed using the Proc Corr (SAS Institute, Cary, NC). All tall fescue types in north Mississippi had positive correlations between yield and date and yield and rainfall. However, in south Mississippi yields of EF (R = -0.48346, P < 0.0006) and EI (R = -0.44623, P < 0.0001) tall fescue were negatively correlated with GDD while NE types had no significant correlation (R = -0.26507). Adversely, EF and NE had positive yield correlations with GDD in north Mississippi with the exception of EI. This suggests that GDD is more vital to growth in north Mississippi where warm days are the limiting factor, but no real advantage was observed with endophyte type. Average yields in north and south Mississippi for NE types were greater when compared to EF or EI types. This was likely due to the quantity of NE entries present only in recent years which consistently produced higher yields among all tall fescue types. Data analysis showed that historical yields in Mississippi led to inconclusive performance advantage of endophyte types.

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Induced Chromosome Doubling of *Sorghum bicolor* x Sorghum *propinquum* Hybrids

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Sorghum bicolor (L.) Moench (2n=2x=20) and *S. propinquum* (Kunth) Hitchc. (2n=2x=20) have a significantly higher degree of interfertility than *S. bicolor* and *S. halepense* (L.) Pers. (2n=4x=40), which occurs rarely and results in largely sterile triploids (2n=3x=30). Interspecific hybridization between *S. bicolor* and *S. propinquum* therefore provides an efficient opportunity for both developing perennial sorghum feedstocks and investigating the genetics of rhizomatousness. Chromosome doubling of *S. bicolor* x *S. propinquum* hybrids would further provide novel, tetraploid (2n=4x=40) germplasm resources lacking interfertility with diploid *S. bicolor* due to chromosome imbalance mechanisms and reduced or removed risk of unintentional cross-pollination onto commercial annual sorghum. Because *S. propinquum* produces fewer and less invasive rhizomes than *S. halepense,* novel, chromosome-doubled *S. bicolor* x *S. propinquum* populations would provide opportunities for selection of sufficient degrees of perenniality combined with minimized risk of invasiveness. Such derived germplasm resources would have value towards breeding perennial forage, biofuel, and grain sorghums with increased suitability for renewable fuel standard mandates and sustainable cropping systems. The objectives of this project were to: 1) produce novel *S. bicolor* x *S. propinquum* hybrids, and 2) evaluate colchicine-induced chromosome doubling treatments of F_1 *S. bicolor* x *S. propinquum* hybrids. *Sorghum bicolor* x *S. propinquum* F_1 hybrids were successfully produced and subsequently treated with colchicine. Seven hybrids with chromosome-doubled tissue sectors have been identified using flow cytometry. These sectors are currently being propagated, subcloned, and evaluated to produce completely tetraploid genotypes.

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