COW AND CALF GRAZING PERFORMANCE ON COASTAL AND TIFTON 85 PASTURES WITH CREEP GRAZING AND STEER PERFORMANCE ON COASTAL, RUSSELL AND TIFTON 85 BERMUDAGRASS HAYS

by

VANESSA ANN CORRIHER

(Under the direction of Gary M. Hill)

ABSTRACT

Beef cow and calf performance was determined prior to weaning in 2-yr grazing experiment using replicated Coastal (C) or Tifton 85 (T85) bermudagrass (*Cynodon dactylon*) pastures without or with *Aeschynomene americana* L. creep grazing. The 91-d calf average daily gain (ADG) was 19% higher for calves grazing T85, and 9.4% higher for calves allowed to creep graze. Higher calf gains on T85, and on creep grazed aeschynomene, could significantly increase producer returns. Steer performance and in situ digestion of Coastal, Russell (R), and Tifton 85 bermudagrass hays were determined in a 40-d drylot experiment. Hays were fed with supplement, and steer ADG and hay dry matter intake was higher on C than R or T85 (0.90, 5.4 vs 0.58, 4.0 and 0.55, 4.1 kg). Hay samples incubated in ruminally cannulated steers over 72 h, had similar chemical composition and digestibility. Tifton 85 hay or pasture can improve performance of growing beef cattle.

INDEX WORDS: Creep grazing, Bermudagrass, Forage, Aeschynomene, Calf gain, Bermudagrass hay, In situ, Steer

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VANESSA ANN CORRIHER

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VANESSA ANN CORRIHER

Major Professor: Gary M. Hill

Committee: John G. Andrae
Mark A. Froetschel

Electronic Version Approved:

Maureen Grasso
Dean of the Graduate School
The University of Georgia
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DEDICATION

Dedicated to the memory of my grandfathers, Wert Carter, and Vance Corriher, both dedicated farmers and loving grandfathers. To my grandfather Carter for dragging me as a child across the carpet until I could not stop laughing. To my grandfather Corriher who grew watermelons just for me. They both shared their experiences as farmers with me and they taught me to enjoy life.

Dedicated to the memory of my grandmother, Beulah Carter, a dedicated teacher and a loving grandmother. The first woman I knew who was very knowledgeable of cattle. I can only hope that I am as stubborn, dedicated, and devoted as she was.

Dedicated to the memory of Dr. Ted L. James, a veterinarian from Salisbury, NC, for believing in me and for teaching me everything about veterinary medicine. I am blessed to have had the opportunity to work with him for nine years. I'll never forget the lessons about true love, devotion, life, faith and family that he taught me.

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I wish to acknowledge my family for supporting me and for always believing in me. Without them I would not be where I am today. They taught me the importance of an education and to always give life 110% of my effort.

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CHAPTER ONE

INTRODUCTION

Bermudagrass (*Cynodon dactylon*), a warm season perennial grass, is grown extensively throughout the Southeast for pasture and as harvested forage. It is widely adapted, has high yield potential, and has proven useful for thousands of forage producers. Numerous bermudagrass cultivars are grown in the United States but none are as widely utilized as Coastal bermudagrass. Coastal is the standard for comparison of new bermudagrass selections and hybrids in the United States because of proven adaptability, persistence, yield and quality.

In 1993, Dr. Glenn Burton released Tifton 85 bermudagrass, a hybrid resulting from a cross between Tifton 68 and a bermudagrass plant entry from South Africa. It is darker green in color, taller, has large stems and wider leaves than Coastal and Tifton 44. Tifton 85 is a higher quality and higher yielding forage compared with Coastal bermudagrass (Burton et al., 1993). Tifton 85 has higher dry matter and fiber digestibility than Coastal, resulting in higher gains and utilization by cattle (Hill et al., 1993; Mandebvu et al., 1999; Hill et al., 2001b). Additional research has indicated higher digestibility of Tifton 85 compared with Coastal hay at differing maturity dates (Hill et al, 2001b). Tifton 85 has lower concentrations of ether-linked ferulic acid than Coastal, with decreased ether bonding in lignin in Tifton 85, which results in higher ruminal microbial digestion of this forage (Mandebvu et al., 1999; Hill et al., 2001a, 2001b). Dry matter digestibility of Coastal is relatively low compared with several hybrid bermudagrass varieties (Ocumpaugh and Ruelke, 1979). Russell has higher yields, more vigor, and higher winter hardiness compared with Coastal. However, forage quality appears to be similar between Coastal and Russell bermudagrass. Russell's ability to hold up well under grazing gives it the potential to make an important contribution on farms in well-drained soils and areas of mild winters.

Bermudagrass pastures usually supply adequate nutrition for pregnant or lactating cows; however, they may not provide adequate nutrition for growing calves during late summer before weaning. Creep grazing provides high quality forage species to calves during the preweaning stage by allowing them selective access to small paddocks in larger pastures. If calves have access to a higher quality legume creep grazing area, preweaning late summer calf gains may be improved on bermudagrass pastures. Aeschynomene *(Aeschynomene americana)* is a high quality tropical legume with protein levels in the canopy reaching 21-24% (Hodges et al., 1982). Aeschynomene has potential to furnish high quality grazing during summer and autumn, a crucial time of the year when perennial grass quality does not meet the nutritional needs of calves.

Although Tifton 85 was released in 1993, large-scale experiments documenting replicated cow-calf grazing performance on this forage have not been reported. Likewise, little research has been reported comparing forage quality of 'Russell' with 'Tifton 85' bermudagrass. The objectives of this research project were to compare cow-calf performance on Tifton 85 versus Coastal pastures, and to determine performance of calves that creep grazed aeschynomene paddocks prior to weaning. In addition, Tifton 85, Russell and Coastal hay dry matter intake, growing beef steer gain performance, and in situ digestibility were determined.

CHAPTER TWO

LITERATURE REVIEW

Bermudagrass: Origin, Distribution, and Status as a Forage Crop

Bermudagrass (*Cynodon dactylon*), a warm season perennial grass, is grown extensively throughout the Southeast for use as pasture (Stephens and Marchant, 1959; Utley et al., 1976) and as harvested forage (McCormick et al., 1967; Utley et al., 1978b). It is widely adapted, has high yield potential, and has proven useful for most forage producers in the Southern US (Ball, 1996).

Bermudagrass was first introduced in the United States in 1751 by Henry Ellis in Savannah, Georgia. Common bermudagrass is the most widely adapted variety of bermudagrass. Common and seeded varieties of bermudagrass pose problems to producers because they encroach on other perennial grass stands, they compete for nutrients, and their continued re-seeding increases difficulty in controlling or removal of these grasses (Hill et al., 2001a). Hybrid bermudagrasses include the following varieties: Coastal, Tifton 44, Coastcross 1, Tifton 68, Tifton 78, Alicia, Grazer, Brazos, Russell, Tifton 85 and others. All hybrid bermudagrasses are sterile, therefore, they produce few viable seeds and reduce the risk of additional weed problems in pastures and hay fields. Since hybrid bermudagrasses have increased yields, better forage quality and greater cold tolerance; they are referred to as being improved (Ball, 2002). In the southern United States, hybrid bermudagrass cultivars supply forage for hay production and grazing by beef and dairy cattle, horses and other livestock species (goats, sheep, llamas, ratites, etc).

Important Cultivars of Bermudagrass

The USDA and the Georgia Coastal Plain Experiment Station released 'Coastal' bermudagrass in 1943 (Burton et al., 1943). Coastal has coarser stems, produces both rhizomes and stolons and grows taller than common bermudagrass. Coastal has improved vigor and higher yields, responds well to fertilizer and irrigation, and is drought tolerant. Coastal is grown on over 10 million acres in the Southern US as pasture (Stephens and Marchant, 1959) and hay (McCormick et al., 1967). 'Coastal' is considered the bermudagrass standard and has been the subject of many research studies throughout the southeast. In comparisons with Alicia bermudagrass, Coastal bermudagrass was similar in terms of annual forage plot yield, but higher in IVDMD (Eichhorn, 1996) and CP concentration (Brown et al., 1976; Evers, 1984; Gates et al., 1989). When compared with common bermudagrass, Coastal was similar in terms of IVDMD and CP concentration; however, it was more productive (Brown et al., 1976; Eichhorn et al., 1983; Gates et al., 1989). Dallisgrass was greater in IVDMD and CP than Coastal bermudagrass (Robinson, 1988) but less productive (Dobson and Beaty, 1977; Robinson, 1988). Dry matter digestibility of Coastal was relatively low (Ocumpaugh and Ruelke, 1979) compared with several released bermudagrass varieties.

Cecil Greer Grass Farms, a private farm, developed 'Alicia' bermudagrass in 1966 from forage originating in South Africa. It has improved vigor and establishes much more rapidly than Coastal. However, Alicia is not as winter hardy nor as disease resistant as Coastal, and its forage quality decreases more rapidly with increasing plant maturity. Overall forage quality of

Alicia is typically lower than Coastal, but forage yield is equal between the two. Eichhorn et al. (1983) reported higher Coastal yields than those of Alicia and common bermudagrasses in a 7-year study. In the same study, Alicia had the lowest IVDMD when compared with Coastcross-1, Coastal and common bermudagrass. Wyatt et al. (1997) reported CP concentration consistently less for Alicia than for common/dallisgrass (*Paspalum dilatatum*). Forage NDF concentrations were greater for Alicia than for common bermudagrass/dallisgrass. Daily weight loss of cows grazing Alicia was greater compared with cows grazing common/dallisgrass pastures. Cows on Alicia pastures lost more body condition than cows grazing common/dallisgrass (Wyatt et al., 1997). Calves suckling cows grazing common/dallisgrass pastures weighed 18% more at weaning and had 35% higher gains during the grazing season than calves suckling cows on Alicia pastures (Wyatt et al., 1997). Weaning condition scores were greater for calves grazing common/dallisgrass pastures than for calves on Alicia pastures (Wyatt et al., 1997). Cow and calf performance was consistently greater for common bermudagrass-dallisgrass than for Alicia bermudagrass pastures. Differences in forage quality were evident in terms of cow-calf performance possibly resulting from greater NDF concentrations for Alicia compared with common/dallisgrass (Wyatt et al., 1997).

Coastcross-1 bermudagrass (Coastal x Kenya 56 #14 bermudagrass hybrid), registered by the Coastal Plain Experiment Station (Burton, 1972), is widely used in Cuba, Mexico, Puerto Rico, Central America, Venezuela, and Brazil, but it is only used in a limited area in the United States because it has very little cold tolerance. Research has shown that performance of cattle fed Coastcross-1 bermudagrass is superior to Coastal bermudagrass (Lowrey et al., 1968; Utley et al., 1971). Chapman et al. (1972) reported Coastcross-1 bermudagrass to be superior to Coastal bermudagrass and Pensacola bahiagrass (*Paspalum notatum*) when grazed by yearling steers. In a later study, by Utley et al. (1974) ADG of steers grazing Coastal was higher than Pensacola bahiagrass and Coastcross-1 bermudagrass. However, steers grazing Coastcross-1 bermudagrass gained significantly faster than steers on the other two grass varieties (Utley et al., 1974).

In replicated clipping experiments conducted at Tifton, Coastcross-1 bermudagrass was consistently more digestible when measured by the nylon bag technique (Lowrey et al., 1968) and yielded as much forage per hectare as Coastal bermudagrass or Pensacola bahiagrass. The dry matter digestibilities of Pensacola bahiagrass and Coastcross-1 bermudagrass were greater than Coastal bermudagrass. The CP of the two bermudagrasses was more digestible compared with Pensacola bahiagrass (Utley et al., 1971). Apparent digestibilities for all fibrous constituents were greater for Pensacola bahiagrass than for Coastcross-1 bermudagrass and greater for Coastcross-1 than for Coastal. Steers fed pelleted Coastcross-1 gained faster than steers fed Pensacola bahiagrass and faster than steers fed Coastal bermudagrass (Utley et al., 1971).

'Russell' bermudagrass was found in the late 1970s in a field near Seale, Alabama, by a county agent in Russell County. 'Russell' is reported to be either a mutation of Callie bermudagrass or a natural hybrid between Callie and common bermudagrasses. The Alabama Agricultural Experiment Station and the Louisiana Agricultural Experiment Station jointly released Russell bermudagrass in 1994 (Ball et al., 1996). Compared with Coastal, Russell has higher yields, more vigor, and higher winter hardiness. However, forage quality appears to be similar between Coastal and Russell. Russell bermudagrass swards are quite dense thus allowing for high yields. However, forage height at normal cutting stage is typically lower than for other improved bermudagrass hybrids. It forms a thick sod, which has been noted to hold up well under grazing, enhancing value of this grass to prevent erosion (Ball et al., 1996). Russell bermudagrass utilization is expanding on farms in both warmer and cooler zones across the southeast. It establishes rapidly and appears to have more cold tolerance than some improved bermudagrasses, allowing establishment in upper Piedmont regions.

The USDA and the Georgia Agricultural Experiment Station released 'Tifton 44' in 1978 (Burton and Monson, 1978). It is a hybrid cross between Coastal and a winter hardy bermudagrass from Berlin, Germany. Tifton 44 was selected as the best of several thousand F1 hybrid bermudagrass screened for winter hardiness at the Georgia Mountain Station, Blairsville, GA. Tifton 44 is darker green, has finer stems that cure faster when cut for hay, has more rhizomes, and makes a denser sod. However, Tifton 44 has superior cold tolerance compared with Coastal bermudagrass and can be dependably grown as far north as Oklahoma, southern Illinois and western Kentucky (Burton and Monson, 1978). This results from the northern ancestry of the plant, and from the fact that Tifton 44 has more rhizomes than any other hybrid bermudagrass. Many horse producers in the United States prefer to use Tifton 44, but growing popularity of Tifton 85 across the region from the Carolinas to Texas may change this trend. Compared with Coastal bermudagrass, Tifton 44 is more digestible (Utley et al., 1978a,b) and appears to have a production advantage in areas of the Southeast where winter hardiness is more critical (Hoveland and McCormick, 1979).

Utley et al. (1978a,b) compared Coastal bermudagrass and Tifton 44 bermudagrass as pasture and as dehydrated pellets. Steers grazing Tifton 44 bermudagrass gained 19% faster than steers grazing Coastal bermudagrass. The observed 8% increase in live weight gain per hectare is consistent with reported increases in *in vitro* digestibility and dry matter yields for Tifton 44 and Coastal bermudagrass (Burton and Monson, 1978). Compared with Coastal, Tifton 44 tended to be lower in indigestible constituents, and have higher IVDMD (Hoveland and Alison, 1990). The digestibility of dry matter, crude fiber and nitrogen-free extract were greater for Tifton 44. Calculated total digestible nutrient (TDN) was lower for Coastal bermudagrass compared with Tifton 44 bermudagrass (Utley et al., 1978b). Digestibility values are consistent with previous research involving Coastal bermudagrass (Utley et al., 1971) and with *in vitro* values for both Coastal and Tifton 44 (Burton and Monson, 1978). Tifton 44 is an improved hybrid bermudagrass with better winter survival; higher forage digestibility than Coastal or Alicia, and forage yield generally equal to other bermudagrass varieties.

Callie, a bermudagrass selected at Mississippi State University, was a high quality and fast growing variety (Ruelke, 1976) which displayed a greater tendency to winter kill (Hoveland and McCormick, 1979). Utley et al. (1981) compared Coastal, Tifton 44 and Callie bermudagrass as grazing crops for growing beef calves and evaluated forage and animal production from these grasses. Average daily gains of steers grazing Callie bermudagrass were 13% greater than those grazing Tifton 44 bermudagrass and 16% greater than those grazing Coastal bermudagrass (Utley et al., 1981). The Callie bermudagrass pastures produced 35% more total gain/ha than Tifton 44 and 43% more total gain/ha than Coastal (Utley et al., 1981). Research in Florida obtained similar forage production values ranking Callie above Coastal and Tifton 44 in both DM yield and IVDOM (Ocumpaugh and Ruelke, 1979). Hoveland and McCormick (1979) evaluated Callie, Coastal and Tifton 44 bermudagrasses at several locations throughout Alabama and obtained variable results depending on the area of the state in which the grasses were grown. Animal performance reported for steers grazing Callie bermudagrass corresponds with observations reported by Carver et al. (1977). Callie was more sensitive to cool spring weather than Coastal and Tifton 44, therefore delaying early leaf production. However, once stolons were established and temperatures began to rise, spring growth was more rapid for Callie than for Coastal or Tifton 44. Total weight gains per hectare were greater on Callie compared with Coastal or Tifton 44 (Utley et al., 1981). In 2006, few producers grow Callie bermudagrass. Its decrease in popularity is related to winterkill, and development of more persistent and improved cultivars.

The USDA and the Georgia Agricultural Experiment Station released 'Tifton 68', a hybrid cross, in 1983 (Burton and Monson, 1984). It is a large plant, with an open canopy, large stems, and wide leaves and it is often pale green in color. Tifton 68 is not grown on farms in the United States because it has very few rhizomes and poor cold tolerance. Tifton 68 is one of the higher yielding bermudagrasses released by Dr. Burton, and it has extremely high quality. It is primarily maintained and used as a parent in crosses to increase yield and quality in new bermudagrass developed by USDA and others. Tifton 68 gets most of its quality from a stargrass (*Cynodon* spp.) that was one of the parents, and this is also the reason Tifton 68 has few rhizomes. Tifton 68 is widely grown in Brazil, Venezuela, Cuba and other tropical countries where it is not limited by frost.

Dr. G.W. Burton at the Coastal Plain Experiment Station in Tifton, GA developed Florikirk (F1 hybrid between 'Callie' and 'Tifton 44' bermudagrasses). It was evaluated in small plot and grazing studies in southern Florida beginning in 1979, and it was released by the Florida Agricultural Experiment Station in 1994 (Mislevy et al., 1995). Another hybrid from the same cross was evaluated and released as ‘Tifton 78’ because it appeared to have greater rust resistance and lower HCn concentration (Burton and Monson, 1988).

‘Tifton 78’ is a cross between Tifton 44 and Callie (Mississippi State University), which was released by the USDA and the Georgia Agricultural Experiment Station in 1984. Tifton 78 produces more stolons, spreads more rapidly and grows taller than Coastal. In 1988, Burton and Monson reported 25% higher yields and 7% higher IVDMD rates for Tifton 78 when compared with Coastal bermudagrass. In a grazing comparison of Coastal and Tifton 78 pastures, Tifton 78 produced large increases in steer ADG and a 24% increase in BW gain/ha compared with Coastal (Hill et al., 1990). Tifton 78 encountered some stand maintenance problems in Florida and Georgia and was eventually replaced by Tifton 85, which had greater persistence, yields and quality.

‘Florico’ stargrass was released to commercial growers cooperatively by the Florida Agricultural Experiment Station, Institute of Food and Agricultural Sciences University of Florida, Puerto Rico Agricultural Experiment Station; and USDA, ARS, TARS (Puerto Rico) (Mislevy et al., 1989). Florico stargrass is a dark green perennial grass with long vigorous stolons that are similar to Ona stargrass. It is well adapted to many south-Florida flatwoods soils; however, it will not tolerate long periods of flooding. The northern limit for Florico stargrass is a line between Brooksville and Orlando, Florida because of cold intolerance. Like hybrid bermudagrass varieties, Florico must be propagated by vegetative material and establishes rapidly. Dry matter yields and digestibility are generally higher for Florico compared with Ona stargrass. Florico is generally more persistent than Ona stargrass. It makes excellent growth in late fall and spring with adequate rainfall and fertilization therefore little forage is produced during drought stress periods of April and early May. Florico hay cures rapidly during favorable weather conditions. Florico requires more fertilization than bahiagrass, limpograss or digitgrass. After either a heavy frost or after 5 weeks of regrowth, forage quality declines rapidly relative to bermudagrasses.

Tifton 85 bermudagrass is a F1 hybrid cross between PI 290884 from South Africa and Tifton 68 (Burton et al., 1993). It was developed as high-yielding, high-quality forage for grazing cattle and hay production. Despite having higher NDF, Tifton 85 consistently has higher IVDMD and total tract digestibility compared with other bermudagrass cultivars. Tifton 85 is characteristically darker green in color, taller, has larger stems and wider leaves than Coastal and Tifton 44. It responds well to nitrogen fertilization and adequate rainfall makes it highly productive. Tifton 85 can be established from top-growth forage if soil moisture is adequate.

During its establishment year, Tifton 85 is more productive than Coastal or Tifton 44. It is rare to produce hay or graze Coastal, Alicia or Tifton 44 during the first year of establishment. However, it is common to obtain one to three hay harvests with Tifton 85. For maximum quality, Tifton 85 should be harvested at 3- to 4-wk intervals. Tifton 85 has greater forage mass and larger stems compared with Alicia and Coastal. It often requires an extra day of hay drying time (Hill and Gates, 2003). Tifton 85 has more stolons and fewer rhizomes compared to Coastal; therefore, the potential to maintain stand of Tifton 85 is optimized at lighter grazing pressure. Rouquette et al. (2002) reported ADG of steer and heifer calves were higher for low stocking rate pastures of Tifton 85 compared with medium and high stocking rates. The lower grazing pressure used on Tifton 85 pastures had a slight, positive cow ADG compared to cow weight loss on Coastal pastures (Rouquette et al., 2002). Tifton 85 is highly persistent and productive in the Deep South, but production diminishes northward. Experiments conducted since 1988 have indicated few stand maintenance, weed encroachment or disease problems with Tifton 85, even though forage quality, persistence and feeding value of this forage were questioned in early years after it was released. Researchers across the Southeastern United States have addressed most of these concerns during the last decade.

Grazing and Hay Comparisons with Bermudagrass

Yield trials were conducted that compared Tifton 85 with other bermudagrass cultivars (Tifton 68, Tifton 44 and Coastal). The first trial compared DM yield and IVDMD of Tifton 85 with other bermudagrass hybrids in small-plot trials (Hill et al., 1993). In trial two, Tifton 85, Tifton 78, Tifton 44 and Coastal were compared to determine steer performance and forage quality. In both trials, Tifton 85 had higher DM yield and IVDMD than other cultivars. Tifton 85 produced an average of 11% more DM than Coastal, and was generally higher in quality.

In a 3-yr study, Hill et al. (1993) reported similar animal average daily gains, but higher gain/ha for Tifton 85 than for Tifton 78 pastures. Tifton 78 and Tifton 85 pastures were grazed by esophageal cannulated steers in June, July and September of each year. Esophageal samples were chemically analyzed and IVDMD was determined for each pasture and sampling date. The IVDMD was higher for Tifton 85 than Coastal in September and July. In July, Tifton 85 had higher ADF than Tifton 78, but in September ADF was similar for all pastures, and NDF was higher for Tifton 85 than other pastures in July. Tifton 85 tended to have higher IVDMD than Coastal in July, and in September. High NDF concentrations in Tifton 85 relative to high IVDMD values suggest its fiber was more highly digestible than Coastal. Even during the late season (mid-September) IVDMD of Tifton 85 remained above 65%. Meanwhile, IVDMD for Coastal and Tifton 78 pastures were reduced.

In a grazing comparison using yearling steers to evaluate Tifton 78 and Tifton 85 pastures esophageal cannulated steers grazed pastures and whole masticate samples were analyzed to determine forage quality (Hill et al., 1993). The CP was similar for Tifton 85 and Tifton 78 pastures in May and July, however; CP was higher in September for Tifton 85 samples. Tifton 85 masticate had higher IVDMD and NDF in May than in July or September. Indicating that even though NDF was high, digestibility was unaffected. Higher IVDMD and CP in September masticate from Tifton 85 pastures was consistent with tester steer BW increase late in the grazing season. Even though tester ADG was practically identical for steers throughout the grazing season, and forage availability and quality were approximately equal between the two forages, steer-grazing days/hectare were 38% higher for Tifton 85 than for Tifton 78. This resulted in 46% higher BW gain for Tifton 85 compared with Tifton 78. Tifton 85 retained higher stocking rates and higher nutritive value under continuous grazing compared with Tifton 78. Tifton 85 proved to be productive into the autumn and yield higher BW gain than Tifton 78 (Hill et al., 1993). Previous studies have reported higher cattle stocking rates, higher gain per hectare and higher IVDMD for Tifton 85 than for Florikirk bermudagrass (Pedreira, 1995; Pedreira et al., 1999).

In a two-year grazing study, Hill et al. (1997a) determined forage quality and steer performance using replicated pastures of Coastal, Tifton 78 and Tifton 85 bermudagrass. Among the three bermudagrass treatments, steer daily gains were similar. However, steer gain/ha was higher for Tifton 85 than Coastal and Tifton 78, primarily because of higher yields of Tifton 85 bermudagrass. Tifton 85 had more grazing days per hectare compared with Coastal and Tifton 78.

Hill et al. (1998a) conducted a 2-yr grazing study in which Angus cows and calves were assigned to three bermudagrass pasture treatments: Coastal with volunteer ryegrass (CR), Tifton 85, or Tifton 85 pasture with an additional alfalfa creep grazing area for calves (T85-A). Calf final weights and 135-d ADG tended to be similar for the treatments. Cows were milked with a portable milking machine in late May and late August. Milk production was higher in May than in August, possibly a function of the lactation curve. A trend was indicated for cows on Tifton 85 and T85-A to have higher 12-hour milk production than those on CR in May. Milk fat tended to be higher for Tifton 85 and T85-A, although milk fat was similar for all treatments in May. Milk protein was higher for all treatments in August than in May, and was higher for Tifton 85 and T85-A at both dates. Even though milk yield was similar for treatments, one might expect higher calf gains due to increased milk fat and protein yield on Tifton 85 and T85-A treatments. However, calf gains were similar for all treatments. Allowing T85-A calves to graze the alfalfa creep area did not improve calf gains, indicating that milk and Tifton 85 forage were supplying optimal nutrition for the calves before weaning (Hill et al., 1998a). Fike et al. (1997a) reported lower milk production in Holstein dairy cows grazing Tifton 85 pastures compared with rhizome peanut. However, higher DM production allowed higher stocking rates on Tifton 85 pastures, resulting in greater total milk production for cows on Tifton 85 pastures. When cows were supplemented with grain mixtures, cows on Tifton 85 responded with higher milk production than cows on rhizome peanut (Fike et al., 1997a).

West et al. (1997) reported that when Tifton 85 hay was included in alfalfa hay or corn silage total mixed rations, lactating dairy cows had higher NDF and ADF digestibilities and higher DMI, average milk yield and 3.5% fat corrected milk were recorded. As the level of Tifton 85 hay or silage increased in the diet, apparent digestibilities of NDF and ADF levels increased. Hay or silage bermudagrass had little to no effect on milk yield and milk composition despite the reduced DMI and milk yield from increased NDF. West et al. (1997) concluded that Tifton 85 might be a suitable substitute for alfalfa hay in lactating dairy cow diets, because of the improved apparent digestibility of dietary NDF and ADF in Tifton 85.

Mandebvu et al. (1999a) conducted a study with Coastal and Tifton 85 bermudagrasses to study nutrient composition, DM yield, digestible DM, IVDMD, cell wall composition, in situ digestion, feed intake and digestion by growing beef steers. The NDF concentrations were higher for Tifton 85 hays compared with Coastal. Tifton 85 bermudagrass forage had higher digestible DM yield and higher IVDMD than Coastal. As age at harvest increased, DM and digestible DM yields of both bermudagrass forages increased, however IVDMD decreased. These results were consistent with those of Hill et al. (1993), who reported that Tifton 85 had higher DM yield and IVDMD than Coastal. In a later study (Mandebvu et al., 1998b) reported that Tifton 85 had higher IVDMD than Coastal even when compared at similar stages of maturity. In the original study, Tifton 85 had greater concentrations of OM, NDF, ADF, hemicellulose and cellulose when compared with Coastal. However, Tifton 85 had a lower concentration of ADL. Concentrations of ADF and ADL had been reported previously to be greater at 7-vs 6-week harvested bermudagrasses (Mandebvu et al., 1998a,b). The concentration of cell walls increased as bermudagrass aged from 2-7 weeks. The cell wall fraction of Tifton 85 is expected to be more digestible than Coastal because of the greater lignin concentration in Coastal and the higher amount of cellulose in Tifton 85 cell walls.

In the study by Mandebvu et al., (1999a) Tifton 85 had higher yields of DM and higher percentage of digestible NDF, and ADF, higher in vitro disappearances NDF, and ADF, and higher in situ DM and NDF digestion. Digestibilities of DM, NDF and ADF in vitro were lower after 7 vs 6 wks of growth. Steers fed Tifton 85 had improved digestion of DM, OM, NDF, ADF, hemicellulose and cellulose despite the lack of differences in DMI or OM intake between cultivars by steers. As harvest age for both cultivars increased, digestion of NDF, ADF, hemicellulose and cellulose decreased (Mandebvu et al., 1999a).

Tifton 85 and Coastal were produced in adjacent plots and harvested forages after 3-wk or 6-wk regrowth (Mandebvu et al., 1999b). All forages had relatively high CP, from 14 to 18% of DM. Tifton 85 had the highest NDF at 6-wk maturity even though NDF was high for both forages. Coastal bermudagrass had greater concentrations of acid insoluble lignin and of ether-linked ferulic acid. The following: IVDMD, in situ DM digestibility, the NDF digestion after 72 h and in vitro NDF digestion after 48 h, were all higher for Tifton 85 at either maturity compared with Coastal (Mandebvu et al., 1999b).

Reasons for Higher Forage Quality of Tifton 85

Tifton 85 has distinguished itself from other bermudagrass hybrids by its characteristic high IVDMD (Burton et al., 1993; Hill et al., 1993). Research has indicated a high NDF content, even at early maturity, and NDF has often increased with maturity of Tifton 85 hay (Hill et al., 1997b; Mandebvu et al., 1998; 1999a). Hill et al. (1993) observed increased IVDMD of Tifton 85 compared with Tifton 78 using esophageal cannulated steers grazing pasture, despite the high

NDF levels of Tifton 85 forage. In various experiments it has been reported that the digestibility of hays is reduced as bermudagrasses mature especially after 4- to 5-wks of growth (Hill et al., 1997b; Mandebvu et al., 1998; 1999a). Tifton 85 has consistently been observed to have high fiber content (NDF>75% on DM basis) accompanied by high digestibility estimates determined by in vitro and in situ methods (Hill et al., 2000). Despite higher NDF content, Tifton 85 consistently has higher digestibility.

Paterson et al. (1994) reported that cell wall contents is regarded as the most important factor affecting forage utilization and is negatively correlated with forage intake and digestibility. Intakes of forage dry matter (DM) and availability of energy depends on digestibility and concentration of cell wall. Plant cell walls can be divided into a potentially digestible fraction and an indigestible fraction that resists digestion (Smith et al., 1972). The size of the potentially digestible fraction is more important than rate of digestion in affecting digestibility and intake. It is also the component of the digestive process that is most highly related to chemical composition, specifically lignin content (Mertens and Ely, 1982). The digestibility of the NDF fraction is highly correlated to intake and thus is a useful guide for ration formulation (Mertens, 1992). Mandebvu et al. (1998) studied the effects of increasing maturity on *in vitro* digestion kinetics of T85, and compared the digestion of T85 with that of Coastal. T85 had a greater NDF and DM digestibility, and potentially digestible fraction of NDF than Coastal at similar stages of maturity even though the forages had similar concentrations of NDF, ADF, and lignin. Extraction of NDF from the hays increased the potentially digestible fraction of NDF. Delayed harvesting of T85 was shown to negate the improved quality attributes of this forage (Mandebvu et al., 1998a).

Mandebvu et al. (1999a) reported that T85 had lower concentrations of lignin and ether-linked ferulic acid and greater concentrations of NDF, ADF, hemicellulose and cellulose compared with Coastal. When T85 was fed, steers had higher digestion of DM, OM< NDF, ADF, hemicellulose, and cellulose compared with those fed Coastal (Mandebvu et al., 1999a). Coastal had higher ether-linked ferulic acid compared with T85 harvested at 3 or 6 weeks (Mandebvu et al., 1999a). Mandebvu et al. (1999a, b) was the first to report ester- and ether-linked ferulic acid concentrations in bermudagrass, although many different grasses and legumes have been analyzed for these components. Mandebvu et al., (1999a) and Hill et al., (2000) reported that the lower ether linked ferulic acid concentrations explain the higher digestibility of Tifton 85 when compared with Coastal. Lignin concentration is a key factor in forage digestibility because lignin content limits cell wall digestion (Van Soest, 1965). However, digestibility of bermudagrass has not been correlated with lignin content. Lignin content of the two grass hays was similar, but digestibility was different for Coastal and Tifton 85 (Mandebvu et al., 1999a). Jung and Allen (1995) reported that ferulic acid linkages between lignin and cell wall polysaccharides are possibly required before lignin effects digestibility. Arabinoxylan, a component of hemicellulose in cell walls of forages, forms bonds directly with ferulic acid by an ester linkage. As a result ferulic acid then bonds with lignin by ester or ether linkages. Ruminal bacteria and fungi have esterases that can break the ferulate ester linkages. However, cleavage of ether linkages has not been found in anaerobic microorganisms (Jung and Allen, 1995). According to Jung and Allen (1995), since the majority of p-coumaric acid is esterified to lignin, it probably does not directly affect polysaccharide digestion. Therefore, it is believed that the higher concentrations of ether-linked ferulic acid in Coastal are the primary cause of its decreased digestibility as compared with Tifton 85.

Ether-linked ferulic acid concentration could explain the lower digestibility of some bermudagrasses such as Alicia (Eichhorn et al., 1983), or higher digestibility of Coastcross-1 (Burton, 1972) and Tifton 68 (Burton and Monson, 1984). In hay studies, Hill and Gates (2003) indicated that lower ether ferulic acid in lignin of Tifton 85 were responsible for increased digestibility compared with Coastal and Alicia and ultimately improved animal performance.

A study by Hill et al. (2002a) was the first to compare Alicia and Tifton 85 hays harvested at two maturities, and documented ferulic acid concentrations in Alicia hay. Steers were fed Tifton 85 and Alicia bermudagrass hays harvested at 5- or 7-wk maturity to determine dry matter intake and digestibility. Ether ferulic acid was not affected by maturity and ether ferulic acid was higher for Alicia than Tifton 85 hays. Dry matter intake was higher for steers fed Alicia hays than steers fed Tifton 85 hays; maturity of hay had little influence on DMI (Hill et al., 2002a). Other hay intake and digestion studies have observed similar DMI and effects of maturity on DMI when comparing Tifton 85 and Coastal hays (Hill et al., 1997b; 2001b; Mandebvu et al., 1999a). Cultivar and maturity affected digestibility of Alicia and Tifton 85 hays, however; it did not affect either IVDMD or *in vitro* total tract digestion. IVDMD for Tifton 85 was higher for Alicia hays despite similar CP, ADF and NDF in both hays (Hill et al., 2002a). Digestibility of bermudagrass hay tends to decline with increasing maturity (Hill et al., 1997; 2001a,b). Total tract digestion of OM, CP, ADF, and NDF were all significantly higher for T85 hays and for 7 wk hay than for AL hays. ADF digestibility was 27.5% higher for T85 than AL hays, and NDF digestibility was 28% higher for T85 vs AL hays. This study is consistent with others that demonstrate higher Tifton 85 digestibility compared with Coastal hays, as shown with Coastal and Tifton 78 pasture esophageal steer extrusa (Hill et al., 1997b; Hill et al., 2001a,b; Mandebvu et al., 1999a), (Hill et al., 1993). Tifton 85 had lower ether linked ferulic acid concentrations than AL hays. Lower ether ferulic acid concentrations in bermudagrass lignin appear to be the controlling factor that affects digestibility (Mandebvu et al., 1999a, b), not the concentration of lignin. Higher concentrations of ether-linked ferulic acid in lignin of Coastal compared with Tifton 85 has been observed with hay and silage research (Mandebvu et al., 1999a,b). Lower ether-linked ferulic acid concentrations in lignin of T85 have been associated with increased fiber digestibility of this cultivar (Hill and Gates, 2003).

Hill et al. (2002b) conducted two experiments to determine intake and digestion of Coastal and Tifton 85 hays harvested at two maturity stages and the effects of supplemental energy on digestion of the hays. Prior to harvesting hay increasing maturity leads to a decline in digestibility of CP, ADF and NDF of forages (Hill et al., 1997b; 2001b; Mandebvu et al., 1999a). As coastal hay matured, ADF tended to increase, but only slight NDF increases occurred of Tifton 85 at 7 wk maturity (Hill et al., 2002b). Mandebvu et al., (1999b) reported slight increases in ADF for Coastal, and larger increases for Tifton 85 as maturity advanced from 4- to 6-wk. NDF was higher for Coastal and Tifton 85 hays harvested at 5 wk than hay harvested at 3 wk maturity, but 7-wk hay was somewhat lower in NDF than 3 wk maturity (Hill et al., 2002). Previously, NDF has been higher in Tifton 85 hays than in Coastal. Maturity of the hay had no impact on DMI for the Coastal and Tifton 85 hays that was similar (Hill et al., 2002b). Therefore, Tifton 85’s higher fiber content did not negatively impact DMI as might be expected based on other research with bermudagrasses. Tifton 85 hays had 10% higher OM digestibility than Coastal hays, and OM digestibility was lower for 7- vs 5-wk hays (Hill et al., 2002b). In previous studies by Hill and Mandebvu (Hill et al., 1997; Mandebvu et al., 1999a) growing steers fed Tifton 85 hays had higher OM digestibility and in both studies OM was depressed by increasing maturity. Even though Coastal and Tifton 85 had similar CP digestion, higher digestibility occurred for 5- vs 7-wk hays. Digestibility of ADF and NDF was higher for Tifton 85 than for coastal despite similarities in ADF for both forages and tendency for Tifton 85 to have higher NDF (Hill et al., 2002b). NDF was higher for Tifton 85 than for Coastal, but in vitro, in situ and total tract digestibility of forages were higher for Tifton 85 than for Coastal. Lower concentrations of ether-linked ferulic acid in Tifton 85 hays possibly contributed to higher fiber digestibility despite high NDF content (Hill et al., 2002b).

Crude protein, ADF and NDF digestibility were decreased as hay maturity at harvest increased from 5- to 7-wks. OM digestibility of a coastal hay diet was increased to the level of a Tifton 85 hay diet without added energy, by feeding corn as an energy source. However, by adding energy to the Tifton 85 hay diet the digestibility was not improved. Indicating that feeding high quality Tifton 85 hay could reduce energy supplementation costs for beef cattle (Hill et al., 2002b).

Grazing Performance of Weaned Calves on Tifton 85 Bermudagrass

Summer-weaned calves that are backgrounded on bermudagrass pastures tend to present some of the most challenging stocker performance goals. Previous research at Tifton, GA has shown Tifton 85 bermudagrass to increase ADG of growing cattle (Hill et al., 1993; 1997a) in which Tifton 85 was efficiently utilized by growing calves to provide increased ADG, compared with Coastal bermudagrass. Implementation of a supplement program can further increase performance to a level previously unattainable on warm season grass pastures (Woods et al., 2004). They indicated that providing the most efficient and economic supplement strategy, along with high quality forage, could improve both production and profits. In some practical situations, despite an increase in ADG from increasing supplement level, a decrease in efficiency may occur. Tifton 85 alone has the potential to increase ADG above that currently realized with current bermudagrass cultivars (Woods et al., 2004).

Grazing studies at Texas A&M University, Overton, TX, have shown improved gains in young growing cattle grazing Tifton 85 bermudagrass and fed increasing levels of a protein supplementation (2:1 SBM: Corn; Woods et al., 2004). Each increase in the amount of supplement fed showed an increase in ADG. Gain in body weight of stockers receiving the most supplements continued to increase at a faster rate than others. Protein supplementation enhanced stocker gains from Tifton 85 bermudagrass (Woods et al., 2004).

Rouquette et al. (2002) found that stockers grazing Tifton 85 gained 67% faster than stockers grazing Coastal bermudagrass, and stockers grazing Tifton 85 alone gained at similar rates to stockers receiving a supplement (1:1 corn: SBM) while grazing Coastal bermudagrass. The advantage in using T85 increased live weight gains and higher stocking rates per acre. Woods et al. (2004) determined the level of supplement needed to optimize performance and efficiency of supplement utilization for stockers grazing Tifton 85. Stockers receiving supplement in addition to Tifton 85 had higher gains than those just grazing Tifton 85. Stockers grazing Tifton 85 gained 1.69lb/d, while those receiving supplement in addition to Tifton 85 gained 2.02 lb/d over the duration of the trial (Woods et al., 2004). Rouquette et al. (2004a) found that stocker ADG from non-supplement Tifton 85 was about the same as ADG from

Coastal plus supplement. Regardless of bermudagrass variety, there was an advantage when using supplement. These studies reported that the added nutritive value of Tifton 85 has created potential opportunities for backgrounding cattle during the summer (Rouquette et al., 2004a).

Rouquette et al. (2004b) quantified animal performance on stockpiled Tifton 85 bermudagrass for fall-weaned calves. The 70-day backgrounding period resulted in ADG of a loss for Tifton 85, and an increase in ADG as supplement treatments increased. Body condition scores declined nearly a half BCS unit for stockers on non-supplemented Tifton 85, and either maintained or slightly improved BCS on all supplement treatments (Rouquette et al., 2004b). However, the overall 70-day extra gains due to supplement were improved due to lowered weight loss on Tifton 85. Backgrounding stockers on stockpiled Tifton 85 during the fall-early winter can enhance performance as long as animals can graze selectively. Extended grazing period or increased stocking rate would likely reduce ADG. Protein supplementation makes up for the declining forage nutritive value throughout the season. It can result in relatively expensive gains during this critical backgrounding period prior to winter pasture grazing.

For grazing cattle Tifton 85 provides higher stocking rates, higher gain per hectare, higher IVDMD, and increased milk production (Hill et al., 2001b). Tifton 85 has been more productive in beef cattle grazing trials than Tifton 78 (Hill et al., 1993) or Coastal and Tifton 78 (Hill et al., 1997a). Tifton 85 has been highly digestible in beef and dairy cattle digestion experiments (Hill et al., 1997b; West et al., 1997; Mandebvu et al., 1999a,b), even though NDF concentrations are often very high. Tifton 85 has the potential to produce high quality hay and pasture forage with its rapid growth rate and high IVDMD values compared to other bermudagrass hybrids.

Improved hybrid bermudagrasses have been primary forages for beef and dairy cattle for more than 50 yr in the southern United States. Primarily because they are persistent and productive over a wide range of soils, nitrogen applications, and grazing and climatic conditions. Most hybrids offer higher yields, greater persistence, and improved quality. Tifton 85 is very versatile, it can be used in total mixed rations for lactating dairy cows, in grazing systems for milking herds or for beef cattle herds, and for hay production. Tifton 85 has presented new nutritional challenges in assessing its forage quality using fiber analysis because its NDF might not be an important quality indicator. However, the digestion coefficients and ether ferulic acid concentrations of Tifton 85 may be more appropriate to indicate quality. Bermudagrasses will continue to be the primary perennial warm-season grass used in the southern United States and other countries. Tifton 85 bermudagrass is and will continue to be an important hay and grazing forage for beef and dairy cattle in the southern US and subtropical countries.

***Aeschynomene americana L.* Utilization by Cattle**

Aeschynomene *(American Jointvetch)*, a summer growing, annual legume, has potential value for either livestock or wildlife food plantings (Moore and Hilmon, 1969) on tropical, subtropical and warm temperate sites. The leaves and young stems are highly palatable to grazing animals (Sollenberger et al., 1987c). In south and central Florida, aeschynomene is the most widely adapted warm-season legume available for grazing. It performs well on the large expanses of poorly drained soils in Florida and has shown potential for use in overseeding perennial grass sods (Sollenberger and Quesenberry, 1985). Forage production ceases when air temperatures reach 10 C (50F) or lower, therefore it is better suited for tropical climates. Research has previously indicated aeschynomene may be grown as a summer annual successfully in north-central Florida (Hanna, 1973; Ruelke et al., 1975), and in southern Georgia. Aeschynomene grows well on sandy, moderately drained, level soils; however, it is tolerant of limited water logging or temporary flooding (Hodges et al., 1982). Depending on stocking rate and management, Aeschynomene can be used for up to 25 percent of the grazing area. For maximum production between grazing periods, 3 to 5 weeks should be allowed for regrowth (Hodges et al., 1982) therefore it is best suited for rotational or limit grazing.

Productivity will decrease if grazed before the plant is sufficient in size. Research suggests that summer grazing should begin when legume is 0.20-0.40m tall (Sollenberger et al., 1987a). Grazing aeschynomene when it was 0.60 to 0.80 m tall resulted in extensive trampling damage and stand loss (Sollenberger et al., 1987a). Early initiation of grazing results in highest CP and IVDOM in forage, more rapid aeschynomene regrowth with a higher leaf/stem ratio, and greater consumption of DOM per hectare by grazing animals (Sollenberger et al., 1987b). Early grazing can open up the canopy and allow for better light penetration (Gildersleeve, 1982). In limpograss pastures, Rusland et al. (1988) reported aeschynomene herbage high in CP and IVDOM from June to October. Sollenberger et al., (1987b) indicated that grazing management during establishment was critical if CP concentrations of herbage consumed were to be above levels where intake and animal performance are limited.

Minson (1980) suggested that the most economical way to overcome a protein deficiency in pastures was to include a legume. Protein levels in the canopy of aeschynomene, or the top 6 inches of the plant, reach 21-24%, which is higher than that typically found in common perennial forages (Hodges et al., 1982). Aeschynomene leaf CP of 250 g/kg DM and IVDOM of 750 g/kg OM have been reported (Gildersleeve, 1982). Brink et al. (1988) compared the nutritive value of warm season legumes and cool season legumes during the summer. Among the warm-season legumes the higher CP concentrations were measured in aeschynomene as compared with cowpea and phasey bean (Brink et al., 1988). Also, the CP concentrations of aeschynomene and cowpea were equivalent to, or greater, than that of red clover and Bigbee berseem clover. The CP concentrations observed for aeschynomene were generally similar to those reported by Sollenberger (1987b). Since Aeschynomene is available in late summer and fall it has the potential to furnish high quality grazing from August to November. This is a crucial period because perennial grasses usually are in a period of nutrient and production decline and are inadequate in meeting nutritional requirements of nursing cows or grazing calves. Aeschynomene can also be used to reduce the need for nitrogen fertilizer of animal numbers maintained at a constant stocking rate (Hodges, 1982). Kretschmer et al. (1973) reported legume-grass mixtures always had significantly higher concentrations of crude protein than the respective grass alone receiving N fertilization.

Established pastures of bahiagrass with aeschynomene, phasey bean (*Macroptilium lathroides*), or nitrogen fertilizer were evaluated over three years at Ona, Florida, USA for potential to provide sustainable pasture systems of increased productivity (Pitman et al., 1992). Aeschynomene pastures produced the highest ADG of yearling steers compared with phasey bean when established in bahiagrass pastures (Pitman et al., 1992). Despite highest steer ADG, carrying capacity was lowest on pastures with aeschynomene. High animal gains were a result of aeschynomene contributing forage of exceptionally high quality. Despite the lack of improvement in total herbage quality, selective grazing of aeschynomene allowed cattle to benefit from the enhanced quality in mid-to late summer (Pitman et al., 1992).

Aiken et al (1991b) reported a positive linear ADG response of yearling steers to legume herbage quantity available per head from bahiagrass pastures containing a mixture of aeschynomene and phasey bean. Aeschynomene and phasey bean herbage in these pastures were reported to have high IVDMD and CP (Aiken et al., 1991b). Aeschynomene and phasey bean are recognized as highly palatable in Florida (Hodges et al., 1982; Pitman et al., 1986) and, despite sparse stands, were apparently selected in preference to bahiagrass. Selective grazing of palatable, high-quality legumes could result in sufficient dietary CP to maximize intake of low quality grasses. These high quality legumes can contribute to animal performance on bahiagrass pastures, especially in areas of limited rainfall (Pitman et al., 1992). Except on especially moist sites or under more intensive management, producers can most effectively utilize phasey bean and aeschynomene to contribute high quality legume to bahiagrass pastures (Aiken et al., 1991b).

Kalmbacher et al. (1978) reported that suppressing bahiagrass sods with herbicides facilitated aeschynomene establishment. Excellent aeschynomene stands have also been obtained by grazing bahiagrass to stubble during legume establishment (Kalmbacher and Martin, 1983) and by lightly disking limpograss sod prior to seeding aeschynomene (Sollenberger and Quesenberry, 1985). Stand establishment involves considerable risk even on suppressed bahiagrass sods (Kalmbacher et al., 1988), because of erratic early-summer rainfall.

Sollenberger et al. (1987b) suggested that overseeding limpograss pastures with aeschynomene may improve animal performance during midsummer, a period when gains provided by perennial grasses are low. Sollenberger et al. (1987b) reported that CP concentration in cattle diets grazing aeschynomene-limpograss exceeded 70 g/kg DM. Rusland et al. (1988) reported higher ADG for steers grazing limpograss-aeschynomene pastures compared with N-fertilized limpograss pastures. Similarly, Pitman (1983) reported that cattle grazing bahiagrass overseeded with aeschynomene had higher gains compared with those grazing fertilized bahiagrass. Superior steer gains on pastures overseeded with aeschynomene indicate that this legume should be useful in systems inducing higher levels of animal performance during midsummer and early fall and providing an economic advantage to the producer (Rusland et al., 1988).

Brink et al. (1988) compared the nutritive value, relative palatability and yield of selected cool-season (Lucerne, berseem clover and red clover) and warm-season legumes (aeschynomene, cowpea, alyceclover, lespedeza, phasey bean and hyacinth bean) during the summer, when greatest contribution to forage quality and productivity could be expected. Alyceclover and aeschynomene generally had superior forage quality and productivity compared with the cool season legumes (Brink et al., 1988). NDF concentration for aeschynomene was similar to or less than that of cool and warm season legumes. Among the warm-season legumes, sheep had greater preference for aeschynomene and alyceclover. The DM yield of aeschynomene exceeded that all cool season legumes and was comparable with other warm season legumes. The IVDMD concentration of aeschynomene and alyceclover were similar to or greater than that of Lucerne and red clover. Selected warm-season legumes had equivalent or greater quality and productivity potential as the cool-season legumes (Brink et al., 1988).

Aiken et al. (1991b) evaluated the effects of stocking rate and grazing season on botanical composition, herbage availability, and herbage nutritive value. They reported stocking rate did not affect the diet composition for yearling steers in bahiagrass pastures sod-seeded with aeschynomene, phasey bean and carpon desmodium. Percentages of grass and aeschynomene plus phasey bean in the diet did not change significantly. Selectivity ratios indicated that aeschynomene and phasey bean were selectively grazed during summer grazing periods. Increased ADG corresponded with increased herbage quantity during summer grazing periods. Stocking rates may be optimized for gain or for economic returns without additional adjustments required to support nutritional requirements of grazing livestock from a mixture of aeschynomene, phasey bean, and carpon desmodium on peninsular Florida bahiagrass pastures (Aiken et al., 1991b).

In their study, Aiken et al., (1991b) reported that leaf/stem ratio decreased with time as a result of leaf removal by grazing and increases in size and density of stems during the grazing season. This was reflected in a decrease in stem IVDOM. As the grazing season progressed IVDOM decreased in the leaves. This reflects grazing of the upper canopy, resulting in a higher proportion of lower leaves. Despite the decrease in aeschynomene CP and IVDOM over the grazing season, they were still at levels that would support animal performance (Aiken et al., 1991b).

Aeschynomene has been evaluated extensively in Florida for its forage potential, for improving forage yield and animal performance as compared to grass systems receiving no nitrogen fertilization. Research has previously indicated aeschynomene may be grown as a summer annual successfully in north-central Florida (Hanna, 1973; Ruelke et al., 1975) as well as southern Georgia. Ocumpaugh (1979) indicated that aeschynomene was the best summer annual forage available for creep grazing of calves. Aeschynomene has the potential to furnish high quality grazing during a crucial period when perennial grass quality often does not meet the needs of grazing calves (Hodges et al., 1982).

Supplemental Grazing Effects on Calf Performance:

In the eastern US, the primary form of beef production is the cow-calf enterprises, with essentially all feed consumed as forages (Wilson and Watson, 1985; Hoveland 1986). A goal in forage systems is to optimize economic returns in terms of animal gain, reproductive efficiency, and cow longevity. Animal gain can be in the form of weaning weight of calves or pounds of gain by yearling steers, both of which are dependent on forage quality and availability during the grazing season. Forages influence calf gains indirectly through milk production of the dam and directly through consumption of forage by the calf. As the calf grows older, and its digestive system gradually changes from non-ruminant to ruminant, a larger part of intake will be forage (Neville, 1962; Burns et al., 1973; Boggs et al., 1980; Gill, 1987). Factors including forage availability and physiological needs of grazing beef cows and their calves can affect intake of forage. Milk consumption also affects forage consumption by calves during the preweaning interval (Joyce and Rattray, 1970; Lusby et al., 1976). Intake of pasture forages is influenced by season, involving changes both in forage composition and availability (Lesperance et al., 1960; Reid et al., 1962), and cow productivity in terms of calving cycle and milk consumed by the calf.

During the summer, low pasture productivity and slow calf gains tend to be problems that can decrease income for cattlemen. This is especially true throughout the southeastern US, where cool-season forages become dormant during mid-summer and periodic droughts can limit warm season forage production. Part of the reduction in calf gains results from the reduced production and less support for calf gain after the third month of lactation (Neville, 1962; Robinson et al., 1978). Several management tools have been developed to overcome this problem. These include creep feeding grain (Marlowe et al., 1965; Cundiff et al., 1966; Martin et al., 1981), creep grazing (Vicini et al., 1982; Bagley et al., 1987), early weaning of calves and providing them concentrate on pasture (Harvey et al., 1975), feeding in drylot (Williams et al., 1975) or some combination of these practices (Neville and McCormick, 1981). For spring-born calves some form of supplement can be used to increase weaning weights since cool-season forages decline in availability and quality during summer. A popular supplement for calves involves creep feeding with grain. Creep feeding is a means of providing supplemental nutrients to nursing calves, usually in the form of grain, protein supplements, or commercial calf feeds. Calves are usually allowed access through a gate large enough to allow calves to enter but small enough to restrict access by cows. To be economically feasible, creep feeding depends on the ratio between creep feed cost and feeder calf prices. Whether or not creep feeding is profitable depends on such factors as creep feed prices, production objectives, creep diet, pasture species, breed of cattle and time of year. Bransby and Griffey (1990) showed that creep feeding was profitable on endophyte-infected fescue in Alabama. In this study, on average, creep feeding shelled corn in Kentucky 31 fescue pastures increased calf ADG for all stocking rates. Advantage in ADG provided by creep feeding resulted in a 32-kg increase in weaning weight. Replacing grain or concentrate mixtures by creep grazing high quality forages has received increased attention because of lowered costs per unit calf gain. Creep grazing allows calves to pass through a fence opening to a smaller pasture of higher quality forage. Vicini et al. (1982) and Morrison et al. (1984) reported that supplemental creep forage improved performance of calves. Calves may take advantage of creep forages when forage availability of the main pasture is low (Blaser, 1987). Yearling steers can be grown on forages to reduce time in the feedlot to bring them to a desirable market weight (Dyer, 1947; Branaman and Harrison, 1949). Heifer calves allowed to creep graze were heavier compared with those not allowed to creep graze (Morrison et al., 1984). Calves may not fully take advantage of creep paddocks until fall, when cow milk production or forage quality declines (Tucker et al., 1989). Creep grazing improved the performance of calves on high-endophyte pastures to a level similar to that of calves on low-endophyte pastures and no creep (Tucker et al., 1989). Young calves have a greater need for high-quality forage to promote gain (Harvey et al., 1988), therefore, supporting the use of limited amount of pasture as creep grazing in larger pastures could have economic potential for producers.

Creep grazing is defined as the utilization of a high quality forage species that only the calves have access to during the preweaning stage (Matches and Burns, 1995). Creep grazing is accomplished by using a creep gate typically may have an opening 14 inches wide and 4 feet high, between pastures that would allow passage by calves, but not by cows. Creep grazing rye, clover, millet, and ryegrass increased 205-d and weaning weights in Coastal and common bermudagrass pastures (Bagley et al., 1987). Harvey et al. (1988) reported that calf production per hectare was increased by creep grazing Tifleaf millet and red clover. Creep grazing and early weaning increased calf production per hectare markedly as long as cows were stocked intensively. In some cases, calf gains may not be improved by creep grazing if the base pasture retains high quality and the stocking rate allows adequate available forage (Harvey et al., 1988; Hill et al., 1998a). Both Tifleaf millet and red clover can provide high-quality forage during the summer period when cool-season forages are under stress (Harvey et al., 1988).

Vicini et al. (1982) evaluated the effects of forage quality and creep grazing on digestibility and intake by cows and calves on pastures consisting of Kentucky bluegrass and white clover (native), of tall fescue plus bluegrass-white clover, and Kentucky 31 tall fescue. The IVDMD of pasture forages were superior for the native and creep areas of the fescue-creep pasture. However, digestible DM declined during the summer. Digestibility of the fescue and fescue-creep pasture forages increased over the summer. Forage intake by suckling calves were superior for fescue-creep compared with native and fescue treatments. When higher quality forages (bluegrass-white clover), including a creep pasture, were incorporated into the grazing system, increased forage consumption by the calves was obtained. Relative forage consumption by the cow is not a good indicator of relative forage consumption by the calf, especially when forage availability is limited. Average daily gain of calves with access to creep grazing had higher ADG and higher later summer body condition scores (BCS), but creep grazing the calves had no effect on cow performance (Vicini et al., 1982).

Creep grazing legumes should be beneficial to calf performance especially where tropical grasses such as bahiagrass make up the base forage. Rhizoma perennial peanut (*Arachis glabrata*; RPP) is a tropical forage legume with nutritive value similar to alfalfa (Prine et al., 1981, 1986; French and Prine, 1998). Most of the RPP material is used for commercial hay production and little space is used for pasture even though studies have consistently shown an increase in ADG for cattle grazing RPP (Williams et al., 1991; Bennett et al., 1995; Valencia et al., 2001). Although RPP is high in nutritive value, establishment is very slow often requiring two to three years to get a stand for grazing or hay production. Limiting the use of RPP stands to those cattle that would individually benefit from the improved nutritional value of the forage; such as calves and replacement heifers may be a more practical management system for beef cattle producers. Creep grazing may be one method of efficiently utilizing improved nutritional value and limited acreage of RPP. The benefits of creep-grazing legumes could be more consistent with tropical grasses, which have generally lower nutritive value. The benefit of creep grazing would be particularly high if the milking ability of the dam was relatively low, or if the lactation curve was in a declining phase (prior to weaning of spring born calves that are weaned in fall). In a study by Ocumpaugh (reported in French et al., 1987), calves with access to RPP had increased gains compared with those on bahiagrass alone. In the Ocumpaugh study, the cows nursing calves that were creep-grazed lost less during the grazing season than those cows with non-creep-grazed calves (French et al., 1987). Creep-grazing RPP may not only improve the preweaning performance of calves, while improving the reproductive performance of their dams by reducing weight loss and body condition during lactation.

Williams et al. (2004) determined the effect of creep grazing of RPP in bahiagrass pastures on the performance of cows and calves in a subtropical environment. As the season progressed, and maturity of the herbage increased, both bahiagrass CP and IVOMD declined. Calves with access to creep grazing gained more than control calves grazing bahiagrass pastures. This improvement in calf gain was similar to that previously reported for 'Tifleaf 1' pearl millet or hairy indigo creep grazing reported by Ocumpaugh and Dusi (1981). The benefits of creep grazing were greater later in the grazing season as quality of the bahiagrass base pasture and cow milk production declined (Williams et al., 2004).

Throughout much of the eastern United Stated, perennial grass pastures consist mainly of tall fescue, bluegrass, or orchardgrass combined with legumes such as white clover and red clover. Allen et al. (1992) determined the influence of grass-legume combinations on cow-calf performance, and forage productivity and longevity under various management systems. Calves from fescue-ladino systems tended to have slightly heavier weaning weights than calves from bluegrass-white clover systems. Calves creep grazing fescue-red clovers were lighter than calves creep grazing orchardgrass-red clover or orchardgrass-alfalfa forage in April, August, and September. Calves creep grazing orchardgrass-red clover had greater ADG and weaning weights than those creep grazing orchardgrass-alfalfa. Allowing calves access to high-quality, plentiful forage by creep grazing resulted in similar improvements in daily gains by calves regardless of the forage species used (Allen et al., 1992)

Bagley et al. (1997) measured the effects of different forage management systems (rotational grazing, stockpiling, and creep grazing) on cow-calf performance, forage production, and estimated economic returns. Pastures consisted of common bermudagrass and tall fescue and creep-grazing paddocks consisted of pearl millet (*Pennisetum typhoides*) and alfalfa (*Medicago sativa L., variety Vangaurd*). Cows in creep grazing systems did not produce as much milk as cows without creep grazing. Calves may compensate for the lower milk production of the cows with higher weight gains later during the year because of increased availability of both millet and alfalfa for creep grazing (Bagley et al., 1997). The possible lack of milk production would allow cows in creep grazing systems to allocate more of their nutrient intake to increasing bodyweight rather than to maintaining milk production. The ADG were highest for calves in rotational grazing and creep grazing compared to calves in stock piling. Calf weaning weights were not different, but tended to be higher for calves in rotational grazing and creep grazing than calves in stock piling. The higher levels of management and fertilizer in rotational grazing and creep grazing resulted in slightly improved weaning weights, but a higher cost per pound of gain by calves. Rotational grazing and creep grazing demand more inputs, and a producer should calculate all costs and labor requirements when deciding upon a forage-animal management system to utilize (Bagley et al., 1997).

Warm-season perennials account for the primary grazing crops in the mild, humid climate in the lower Gulf Coast region. The use of cool season annuals planted on prepared seedbeds or sod-seeded in perennial grass sods has lengthened the grazing season (Hoveland et al., 1977), increased forage production and provided high quality forage for ruminants (Bagley et al., 1984). Fontenot and Blazer (1965) reported that cattle allowed more opportunity to graze selectively chose to graze higher quality forage. Creep grazing would allow calves more selectivity in higher quality forages therefore increasing selectivity of cows.

Bagley et al., (1987) investigated the effects of creep grazing of beef calves and different proportions of cultivated land area on the productivity and economic efficiency of beef cow-calf production systems in the southeast. Common bermudagrass pastures were planted with ryegrass, crimson clover and white clover in cultivated areas. Cows in pastures without creep grazing had slightly longer calving intervals than cows in pastures with creep grazing (Bagley et al., 1987). The availability of creep grazing for calves could have reduced the stress of nursing calves on cows by offering another nutrient source, particularly during the fall calving period. Stricker et al. (1979) previously reported higher conception rates of cows with creep grazing calves compared with cows with non-creep grazing calves. During the late fall and winter, cows and calves in pastures without creep grazing had access to hay and supplement only (Bagley et al., 1987). This exerted heavy demands on the cows by nursing calves because milk provided their only source of nutrients compared with creep grazing calves (Bagley et al., 1987). Cows in pastures without creep grazing lost more weight compared with cows in pastures with creep grazing from December to April (Bagley et al., 1987). This indicated that cows in pastures without creep grazing were under greater nutritional stress.

Calves with creep grazing had heavier 205 d and weaning weights and higher feeder grades compared with calves without creep grazing (Bagley et al., 1987). The creep grazing of higher quality forages by calves has repeatedly shown impressive results (Blaser et al., 1977; Vicini et al., 1982). Calves were observed to actively utilize creep grazing areas; they tended to stay in the creep areas and away from cows only during grazing periods (Bagley et al., 1987).

Producers with poor quality forage should take advantage of creep grazing to improve calf performance. In pastures comprised of perennial grasses, forage quality generally declines rapidly during the summer because of increased lignification of the plants. This results in decreased digestibility and lower daily gains of cattle. Thomas et al. (1983) initiated a creep grazing system using Tifleaf 1 pearl millet to avoid a decrease in animal performance and to increase beef production. Calves with creep grazing available had higher ADG compared with those calves without creep grazing. This resulted in an additional 170 kg of beef per acre of Tifleaf 1 pasture (Thomas et al., 1983). In addition, large differences in body weight of the brood cows were observed depending upon whether calves were creep grazed. Control cows lost an average of 27 kg of BW in contrast to a gain of 12 kg by the cows nursing creeped calves (Thomas et al., 1983). Cows in good body condition at the time of calving breed back faster, thus contributing to a shorter breeding season and more uniform calves at time of weaning. Dual benefits result from the creep grazing of Tifleaf 1 by calves in a forage system in which fescue is the predominant species. Creep grazing increased growth rate and economic returns of the calves in addition to improving the body condition of cows as they entered calving season.

The most crucial period for profitability of beef cow/calf production is from calving to weaning. Lactation, calf growth and reproductive efficiency of the cow are all influenced by seasonal supply of nutrients from pastures. Seasonal supply of nutrients can be insufficient for optimal productivity of cows and calves. Increasing feed costs and calf value has encouraged producers to consider creep grazing to supplement calves prior to weaning. Creep grazing has potential to increase calf gain and improve cow condition especially during the summer when low forage availability restricts gains and pasture nutritive quality is low. Problems associated with excessive body condition, often resulting from creep feeding high-energy grains such as corn, are generally overcome by high-protein creep grazing systems for calves. Compared with creep feeding, creep grazing is relatively inexpensive since it only requires a small area of high quality forage. Summer perennial pastures usually supply adequate nutrition for pregnant or lactating cows; however, they often do not provide adequate nutrition for growing calves during late summer before weaning.

The Effects of Forages on Milk Production in Beef Cattle:

In beef, cow-calf production, calf weaning weights have important economic implications. Weaning weights are affected by the genetic potential of the calves for growth and the calves preweaning environment. Part of this preweaning environment is milk production of the dam, which may account for 40% of the variance in 205-d weight (Robison et al., 1978), and it is the most important postnatal maternal influence on preweaning growth in beef cattle (Willham, 1972). Research indicates that the nutritional environment of the cow and calf influences level and content of milk produced (Brown et al., 1993).

Milk production and milk fat of Angus and Brahman cows managed on common bermudagrass or endophyte-infected fescue were determined (Brown et al., 1993). The interaction of breed of dam and forage was significant for milk production. Both Angus and Brahman cows on common bermudagrass had higher average daily milk production than cows on tall fescue (Brown et al., 1993). Milk yields for Angus cows in their study were reasonably similar to previous estimates for British and British cross cows (Melton et al., 1967; Cundiff et al., 1974; Notter et al., 1978; Holloway et al., 1985; Sacco et al., 1987; McCarter et al., 1991). However, estimates for Angus cows were lower than those reported by Kress et al. (1990) for Hereford and Angus x Hereford cross cows. Reynolds et al. (1967) reported similar levels of milk production in Brahman and Angus cows, whereas Criss (1986) reported higher levels of milk production in Brahman than in Angus, when cows grazed endophyte-infected tall fescue for the first three months of lactation (Brown et al., 1993). Brahman cows had higher milk fat than Angus cows. Cows on common bermudagrass had higher percentage of milk fat compared with those on tall fescue despite the lower milk yield on tall fescue (Brown et al., 1993). Estimated milk fat for Angus cows was similar to values reported by McMorris and Wilton (1986) for Hereford cows, and by Criss (1986) for Angus cows.

Sire selection by milk EPD has successfully predicted the differences in milk yield of the daughters (Johnson et al., 2003; Diaz et al., 1992; Marston et al., 1992; Mallinckrodt et al., 1993). However, cows that produce more milk tend to have faster declines in yield after achieving peak milk production (Mallinckrodt et al., 1993; Minick et al., 2001). The influence parity and predicted difference in milk production on forage DMI in late gestation, early lactation, and late lactation indicated that cows in their third lactation produced about 30% more than during their first lactation (Johnson et al., 2003). In a different study, Clutter and Nielsen (1987) reported that milk production was 25% higher in mature cows (age = 4 to 5 yrs old) compared with primiparous cows. Primiparous cow milk production is adjusted to 60% of mature milk production (Johnson et al., 2003; Fox et al., 1988). Johnson et al. (2003) reported reduced milk production of primiparous cows as a result of relatively low forage quality and low energy intake.

Lactating cows consume more forage DM than gestating cows (Vanzant et al., 1991; Stanley et al., 1993; Marston and Lusby, 1995). As milk yield increases, forage DMI also increases (Wyatt et al., 1977; Wagner et al., 1986; Hatfield et al., 1989). When the relationship between potential milk production and forage intake during early and late lactation was evaluated (Hatfield et al., 1989), a quadratic increase in intake expressed per unit of BW was observed as milk production increased during lactation. Wagner et al. (1986) reported a positive relationship between forage DMI and milk production. Each kilogram increase in milk yield was associated with an increase in forage DMI during lactation. BW and milk yield can explain significant portions of the variation associated with DMI during lactation in beef cows (Hatfield et al., 1989).

Nutritional requirements of beef cows are known to peak during early lactation, and during lactation the maintenance requirements of cows are estimated to be about 20% higher than nonlactating cows (NRC, 1996). The increased forage intake, a result of increased milk production observed during early lactation, may be a response to increased maintenance energy requirements in addition to increased production requirements of the beef cow (Johnson et al., 2003). Body condition score may be influenced by stage of production; it was greatest during late gestation and tended to decrease as lactation progressed (Johnson et al., 2003). Forage consumption was greater during early and late lactation compared with late gestation and as cows progressed from early to late lactation, DMI decreased. Vanzant et al. (1991) reported a 20% increase in forage OM intake of primiparous cows compared with late gestation. During early lactation, cows consume 13 to 50% more feed than during late gestation (Ovenell et al., 1991; Stanley et al., 1993; Marston and Lusby, 1995). Forage intake was sensitive to genetic potential for milk production during lactation in Brangus cows even when low-quality forage was the primary feed source (Johnson et al., 2003).

High DMI is critical for supplying required nutrients to support high milk yield. Indigestible DM in the diet can be a major constraint to the DMI of ruminants (Conrad, 1966), and DMI is positively correlated with digestibility of the diet (Waldo et al., 1981). Bermudagrass is well adapted to wide regions of the southern US, but bermudagrass has high NDF content and a slower rate of NDF digestion compared with legumes such as alfalfa. Lactating dairy cows were offered diets containing increasing quantities of T85 hay or silage and increasing dietary NDF to determine effects of method of bermudagrass storage and dietary fiber content on intake, milk yield, and nutrient digestion (West et al., 1998). Holstein cows offered diets with increasing proportions of NDF from Tifton 85 resulted in similar DMI and milk yields for lactating dairy cows. The digestibility of NDF of the diets improved as the percentage of bermudagrass increased, reflecting the high digestibility of NDF from bermudagrass. High quality Tifton 85 bermudagrass hay or silage can be used in dairy diets with similar effectiveness, and Tifton 85 can be used as a source of digestible fiber for lactating cows to supplement high-energy diets.

Fike (1999) tested effects of two pastures forage species, rhizoma peanut or Tifton 85 bermudagrass, two supplementation rates (SUP; 0.33 or 0.5 kg/kg of milk), and two stocking rates on performance of mid-lactation Holstein cows. Improved grasses in combination with large amounts of supplemental feeds are most likely suited for pasture-based dairy systems throughout the Southeast. Interest in the use of pasture-based forage systems for dairy production has increased. Milk production was higher per cow with RP, but milk production per ha was higher for bermudagrass pastures. Poppi and McClennan (1995) reported that the benefit of legumes in pasture might be due primarily to their effect on intake rather than an improvement in forage nutritive value. Cows grazing RP had greater forage and total organic matter intakes (OMI) (Fike, 1999). The greater OMI of RP compared with bermudagrass suggests that the legume could be useful in improving DMI if used with an appropriate grass. Tifton 85, despite large concentrations of fiber and moderate digestibility, proved to be desirable forage for milk production (Fike, 1999). The high carrying capacity and improved response to supplement of cows grazing T85 are useful attributes for forages in grazing systems (Fike, 1999).

Fontaneli (1999) compared milk production and composition from pasture-based systems for lactating dairy cows with those of a conventional confinement housing system. One pasture system was based on a rye-ryegrass-crimson and red clovers mixture during the winter and pearl millet during the summer. The second pasture system was based on a rye-ryegrass mixture during the winter and bermudagrass during the summer. Feeding costs per unit of milk produced for the two pasture systems and a conventional confinement housing system were also compared. Cows in confinement produced more milk than those on pasture systems; there were no differences in available forages. There were no differences in concentration of milk fat, protein, and urea nitrogen; however, somatic cell count was higher for the confined system than pasture systems. Grazing cows lost more BW than confined cows, especially cows grazing pearl millet that only maintained BW during most of the summer, while cows on other treatments gained BW. Economic analyses suggested the pasture system based on rye-ryegrass mixture during winter and bermudagrass during summer had the lowest feed cost per unit of milk produced and that pasture systems based on perennial forages may have application (Fontaneli, 1999).

Numerous efforts have been made to assess milk production of beef cows with suckling calves (Lampkin and Lampkin, 1960; Neville, 1962; Christian et al., 1965; Gleddie and Berg, 1968; Lamond et al., 1969; Deutscher and Whiteman, 1971; Totusek et al., 1973). The primary methods include machine milking after oxytocin injection, and weighing the calf before and after nursing. Estimates of milk yield of grazing cows have been made at intervals varying from daily to twice during the entire lactation period and time of separation of the calf from the cow has varied. Milk yield estimates can vary depending on the method used. In addition, milk yield estimates differ based on the genetic potential of the cow to produce milk, age and breed of the cow, capacity of the calf to consume milk (which is influenced by breed, size, age, and sex of the calf), pasture forage availability and quality, nutritional status, environment, and stage of lactation (NRC, 1996). The most commonly adapted procedure has been the weigh-suckle-weigh procedure, but several groups of researchers have used machine or hand milking. With machine milking, researchers have reported both yield and milk composition. Some of the factors influencing milk composition include collection procedure, breed and age of cow, stage of lactation, and nutritional status (NRC, 1996). Either method requires a lot of labor, and time to complete. The weigh-suckle-weigh procedure appears to have the most potential problems, and machine milking after oxytocin injection might become the preferred method. In most instances, since beef cows are only milked on one day, estimates have a low probability of actually predicting milk yield.

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CHAPTER THREE

GRAZING PERFORMANCE OF COWS AND CALVES ON COASTAL OR TIFTON 85 PASTURES WITH AESCHYNOMENE CREEP GRAZING[1]

1 Corriher, V.A., G.M. Hill, J.G. Andrae, M.A. Froetschel, and B.G. Mullinix, Jr. To be submitted to *Journal of Animal Science*.

ABSTRACT:

Cow and calf performance was determined during a 2-yr 2 X 2 factorial grazing experiment using Coastal (C) or Tifton 85 (T85) replicated bermudagrass pastures (4 pastures each; 4.86 ha each yr) without or with aeschynomene creep grazing paddocks (n=4; 0.202 ha; planted in May each year, 13.44 kg/ha). On June 10, 2004, and June 8, 2005, 96 tester winter-calving beef cows and their calves were grouped by cow breed [9 Angus (AN), 3 Polled Hereford (PH)/group], initial cow BW (592.9 +/- 70.1 kg, 2-yr mean), age of dam, calf breed (AN, PH or AN X PH), calf sex, initial calf age (117 +/- 20.1 d, 2-yr mean), initial calf BW (161.3 +/- 30.4 kg), and randomly assigned to pastures. Additional cow-calf pairs and open cows were added as forage increased during the season. Forage mass was similar for treatments, estimated from bi-weekly ground-level samples averaged for the 91-d grazing period. Main effect interactions did not occur for variables ($P > 0.10$; 2-yr means), year only affected initial and final BW of calves and cows. Least squares means were adjusted for significant covariate effects of birth weight, breed, sex, initial BW, initial age, and cow age for calves; and, breed, age, calf initial BW, and calf initial age for cows. Calf BW at weaning was adjusted to 205 days of age, for calf sex and cow age adjustments of Beef Improvement Federation, and for appropriate covariate effects. Pasture X creep grazing interactions ($P > 0.10$) did not affect performance. The 91-d tester calf ADG was 19% higher for calves grazing T85 than C (0.94 vs 0.79 kg, $P < 0.01$), and 9.4% higher for calves allowed access to aeschynomene creep grazing compared to those without creep grazing (0.90 vs. 0.82 kg, $P < 0.03$). Calf 205-d adjusted weaning weights were 12.6 kg higher for calves grazing T85 than C (252.9 vs 240.3 kg, $P < 0.01$), and 6.6 kg higher for calves with access to creep grazing (249.9 vs 243.3 kg, $P < 0.05$).

Cow 91-d total gain and stocking rates were higher for T85 than C. Forage mass was similar for all pastures, and analyses of esophageal samples indicated that forage CP and IVDMD were more than adequate to support observed gains. These results complement previous research, and indicated increased forage quality and greater performance of cattle grazed Tifton 85 forages. An improvement of calf gains on Tifton 85 pastures, and to a lesser extent those on creep grazed aeschynomene paddocks, were substantiate enough to significantly influence producer returns from their cow-calf operations.

Key words: Forage, creep grazing, bermudagrass, calf gain, aeschynomene

INTRODUCTION:

Bermudagrass (*Cynodon dactylon*), a warm season perennial grass, grown extensively throughout the Southeast for pasture and harvested forage. Tifton 85 bermudagrass is a higher quality and yielding forage compared with Coastal bermudagrass (Burton et al., 1993). Tifton 85 has higher dry matter and fiber digestibility than Coastal, resulting in greater gains and nutrient utilization by cattle (Hill et al., 1993; Mandebvu et al., 1999; Hill et al., 2001a). Additional research has indicated higher digestibility of Tifton 85 hay compared with Coastal hay across maturity dates (Hill et al, 2001). Tifton 85 has lower concentrations of ether-linked ferulic acid than Coastal, with decreased ether bonding in lignin in Tifton 85, which results in higher ruminal microbial digestion of this forage (Mandebvu et al., 1999; Hill et al., 2001a, 2001b).

Aeschynomene *(American Jointvetch)* is a high quality tropical legume with canopy protein concentration reaching 21-24% (Hodges et al., 1982). Aeschynomene has potential to furnish high quality creep grazing during a crucial period when perennial grass quality does not meet the needs of calves. Bermudagrass pasture usually supplies adequate nutrition for pregnant or lactating cows; however, it often is inadequate for growing calves especially during late summer prior to weaning. Creep grazing allows for selective utilization of a high quality forage species by calves to support performance during the preweaning stage. Providing a higher quality legume in creep grazing areas, may improve preweaning late summer calf gains of cattle on bermudagrass pastures. Although Tifton 85 was released in 1993, experiments documenting large-scale replicated cow-calf grazing performance on this forage have not been reported. Our objectives were to compare cow-calf performance on Tifton 85 versus Coastal pastures, and determine performance of calves that creep grazed aeschynomene paddocks prior to weaning.

MATERIALS AND METHODS:

Small-plot Yield and Forage Quality Experiment:

Replicated small plots (5-m X 7-m plot area; 3 replicates per treatment) of Tifton 85 and Coastal bermudagrass (*Cynodon dactylon*, L.) were established in Tifton sandy loam soils in 2001, at the Coastal Plain Experiment Station, Tifton, GA. Plots were used in other yield studies prior to July 2004, when they were mowed and prepared for a yield trial. On August 26, 2004, plots were mowed to stubble heights of approximately 5 cm, to initiate a new yield and quality trial. Four harvests were made at intervals of approximately 2 wk beginning September 10, 2004. Fertilizer was applied at 224 kg/ha on August 26, 2004 as a 24-6-12 ratio of N: P_2O_5: K_2O. Four quadrants (.1 m^2) were clipped to ground level in each plot, and clipped samples were oven-dried at 60° C for 72h. Pooled estimates were converted to a moisture-free basis using pooled DM values. Plot DM yields were determined, and IVDMD of the 6- and 8-wk samples were determined using the DAISY incubator procedure (Ankom, 2005).

Grazing Experiment:

Summer grazing cow and calf performance was determined in a 2-yr replicated 2 X 2 factorial experiment using Coastal (C) or Tifton 85 (T85) bermudagrass pastures (4 pastures each; 4.86 ha each yr) without (NCG) or with aeschynomene (*Aeschynomene americana* L.) creep grazing (CG) paddocks (0.202 ha creep grazing area in each CG pasture; planted in May of each year at 13.44kg/ha). Coastal and Tifton 85 pastures were established prior to initiation of this grazing experiment. Bermudagrass pastures were fertilized with a blended fertilizer (24-6-12, N–P_2O_5–K_2O, at 336, 280, and 224 kg/ha, respectively, in March, early June and late July each year). In the variable stocking rate study that began on June 10, 2004 and June 8, 2005, 96 winter-calving tester beef cows and their calves were grouped by cow breed [9 Angus (AN), 3 Polled Hereford (PH)/group], initial cow body weight (592.9 ± 70.1 kg, 2 yr mean) age of dam, calf-breed (AN, PH or AN X PH), calf sex, initial calf age (117 ± 20.1 days, 2- yr mean), and initial calf weight (161.3 ± 30.4 kg, 2-yr mean) before groups were randomly assigned to pastures. Cows and calves were grazed in a put-and-take (Mott and Lucas, 1952) grazing management system. Cows similar to the tester cows in weight, age, background, and breeding were designated as "grazer" cows, and were used to adjust forage mass in pastures. Additional grazer cows included dry pregnant cows and replacement heifers (18 mo. of age) and these grazers were adjusted to a cow-calf equivalent using animal units (AU; Ball et al., 2002). Total pasture forage mass was targeted at approximately 2,800 kg of DM/ha because we wished to provide enough forage to allow detection of differences in nutritive value of the forages unlimited by forage mass. At 14-d intervals beginning in June, forage mass was estimated using a double sampling procedure. Four quadrants (.1 m^2) were clipped to ground level in each pasture, and clipped samples were oven-dried. Pooled estimates were converted to a moisture-free basis using pooled DM values. Stocking rates were adjusted by addition or removal of grazer cows to achieve the targeted 2,800 kg of DM/ha in each pasture. Cows and calves were weighed at 28-d intervals, and initial and final BW were means of consecutive daily full weights. A commercial mineral (NaCl [maximum] 16.8%; Ca [maximum] 19.20%; P [minimum] 8.0%; Mg [minimum] 1.00%; Cu [minimum] 0.15%; Zn [minimum] 0.27%; Se [minimum] 0.003%; Beef 8™, W.B. Fleming Co., Tifton, GA) was provided free choice along with water in each pasture. All cattle were managed under procedures approved by the University of Georgia Animal Care and Use Committee Guidelines.

Pasture Quality:

Mature steers previously surgically fitted with esophageal cannulas grazed each of the eight treatment pastures in June, August and September in each year. In 2004, two esophageal cannulated steers were used for each sampling date; in 2005, two steers were used in June, and four steers were used in August and September. Cannulated steers grazed Coastal bermudagrass pastures before and after each forage mass sampling. Cannulated steers were confined in drylot with a 24h to 36h feed restriction before each sampling period (Fisher et al., 1989). This procedure was used because Fisher et al. (1989) reported no difference in forage particle size distribution or forage quality when samples were collected from esophageal cannulated steers either fasted with no adaptation to forage to be samples, or not fasted and adapted to the forage. In our study, cannulas were removed as steers sampled each pasture, and forage masticate was collected in small mesh hand fishnets. Steers were allowed to graze unrestricted in each pasture until .5 to 1.0 L of masticated forage was collected. Extrusa samples (forage and saliva) were quick-frozen in liquid N at the pasture site. Samples were stored (-15 degrees C) and the entire sample was subsequently lyophilized. The dried masticate samples were ground through a 1-mm screen in a Wiley mill (Arthur H. Thomas, Philadelphia, PA) in preparation for chemical analyses and IVDMD determination.

Freeze-dried masticate samples were analyzed for acid insoluble ash and CP (micro-Kjeldahl; total N X 6.25) using AOAC (1991) procedures. The NDF and ADF were determined using methods of Van Soest et al., (1991). The Daisy incubator system (Ankom, 2005) was used to determine IVDMD of forage samples from the freeze-dried masticate from pastures in the grazing experiment.

Milk Production and Quality:

Forty Angus cows with calves were selected by cow BW, breed, AOD, calf age, sex, and breed (5 cows/pasture treatment). Cows were milked once in yr 1 (August 10, 2004) and twice in yr 2 (June 28, 2005 and August 9, 2005) with the first measurement at day 62 of the experimental period. For yr 1 cows were milked 177 days post-partum and 137 and 177 days post partum for yr 2. Calves were separated from dams for 5h then allowed to nurse for 30 min. approximately 12h prior to milking. Before milking each cow was administered IM injection of 2mL acepromazine and 1mL of oxytocin. The acepromazine was given 10 minutes prior to milking for sedation. Each cow was milked with a portable milking machine. The milk was then weighed, stirred and two 30mL samples were collected. One sample was frozen and retained, and one sample at each milking date was sent to Southeast Milk, Inc. Belleview, Florida for analysis (somatic cell count, fat, protein).

Statistical Analyses:

The small-plot yield experiment was analyzed as a randomized complete block in which DM yield was the average of four clippings at different dates during the growing season, and IVDMD of the forages was the mean of the 4-wk and 6-wk clipping dates used in 2004. Mixed Model Procedures of SAS (2003), with least squares means adjusted for appropriate covariate effects was used. Cow and calf data were analyzed as a randomized complete block with 2 replications. The four treatments were arranged as a 2 X 2 factorial with sub-sampling using Mixed Model Procedures of SAS (2003), with least squares means adjusted for appropriate covariate effects. Covariate adjustments included calf sex, birth weight, age, breed, initial weight, cow age, and cow breed. Statistical analyses of the esophageal steer grazing data and laboratory analyses of masticated forage were conducted using the GLM procedure of SAS (2003). Masticate data were presented as main effect means for forages and creep grazing. There were no significant effects of year or year interactions for chemical data. A forage X creep grazing interaction occurred for IVDMD of forage masticate. Chemical analysis of forage masticate was unaffected by treatments. Sampling dates for forage masticate were separated at .01, .05 and .10 significant levels. Milk weights were analyzed with age of dam as a covariate.

RESULTS AND DISCUSSION:

Small-plot Yield and Forage Quality Experiment:

Small-plot experiments were established to determine yield and nutritive value of Coastal (C) and Tifton 85 (T85) bermudagrass to be compared with earlier results (Hill et al. 1993; Mandebvu et al., 1999a), and to provide information on ungrazed forage production in replicated plots of C and T85 that could support the larger cow-calf continuous grazing study being conducted with these two cultivars. In the experiment, DM yield at 8-week harvest was higher ($P < 0.01$) for T85 than for C (Table 1).

Forage samples from the plants were chemically analyzed, and CP at 2-week harvest was higher ($P < 0.01$) for Coastal than for Tifton 85. Yield of DM increased as harvest interval increased ($P < 0.01$), but percent CP decreased with maturity ($P < 0.01$) for both C and T85 over time. There was a forage X sampling date interaction ($P < 0.05$) for NDF increased more for T85 than C after the 4-wk harvest. The IVDMD was higher ($P < 0.05$) for T85 than C samples at both the 4-wk and 6-wk maturity, and both T85 and C had lower IVDMD at 6-wk compared with 4-wk maturity. The T85 IVDMD was only slightly depressed at 6-wk compared with 4-wk samples, but C plots had 9.5% lower IVDMD at 6-wk compared with 4-wk samples. Even more dramatic was the 17% higher ($P < 0.05$) IVDMD of T85 compared with C at 6-wk maturity. Despite high NDF concentrations Tifton 85 had relatively higher IVDMD values suggesting that its fiber is more highly digestible as shown in previous research (Hill et al.1993; Mandebvu et al.1999). Hill et al. 1993 reported higher IVDMD for T85 than C in two 3-yr small-plot yield and quality experiments. Mandebvu et al. (1999) found higher IVDMD and higher 72 h and 96 h in situ DM digestion in T85 than in C samples from plots harvested from 2 wk to 7 wk, and they reported lower IVDMD for July than September samples. Although silicon from sand attached to samples may be a problem in our environment, Mandebvu et al. (1999) reported 90.5% to 93% organic matter in plot samples, and Hill et al. (1993) reported only 1.3% to 2.4% acid insoluble ash in esophageal samples from C and T85 pastures over a 3-yr period. The small-plot data verifies earlier quality and yield characteristics of C and T85, and supports grazing cow-calf performance data on pastures of these forages.

Cow and Calf Grazing Experiment:

In the 2-yr cow-calf grazing study, available forage mass in each pasture was targeted at 2,800 kg of DM/ha. This forage mass resulted in average forage heights of approximately 4 cm to 5 cm forage height in previous research (Hill et al., 1993), which allows more than adequate forage for gain and maintenance, but prevents forage shortages if rainfall distribution and amounts become unfavorable. Monthly precipitations on the current study are shown in Figure 1. Data for May was included because of possible carryover effects on forage growth when the grazing experiment was initiated in early June of each year. Rainfall in May was similar for both years of the study, and near 80-yr average levels. Rainfall in June was higher than average in both years, with more than twice the average rainfall occurring in June 2004, and about 50% higher rainfall than average in June 2005. During July and August, rainfall was low in 2004, but near average in 2005. The experiment ended in early September of each year, and forage production and cattle performance was likely influenced more by rainfall in August than September. Rainfall apparently did not limit forage production, because DM remained above the forage mass target level of 2800 kg/ha throughout the study (Figure 2), despite heavily increased stocking rates.

Cow BW were different ($P < 0.01$) between years, with higher initial and final BW recorded for both cows and calves in 2005 than in 2004 (Table 2). This was the only instance of year affecting cow or calf performance. Year did not interact with treatments ($P > 0.20$), main effect interactions did not occur ($P > 0.10$) for cow and calf variables, and least squares means were adjusted for significant covariate effects as indicated in Table 3. Calf adjusted weaning weights and 205-day weaning weights including Beef Improvement Federation adjustments for sex and age of dam were higher ($P < 0.01$) for T85 than C, and these weights were higher ($P < 0.05$) for CG compared with NCG. The 91-d tester calf ADG was 19% higher ($P < 0.01$) for calves grazing T85 than C, and 9.4 % higher ($P < 0.03$) for calves on CG with access to aeschynomene than calves on NCG. Calf gain/ha was higher ($P < 0.03$) for calves grazing T85 than C, and even though calf gain/ha tended to be higher for calves on CG, 2-yr means were not significantly different. Cow performance was higher on T85 than C; with higher cow 91-d ADG ($P < 0.04$), cow gain/ha ($P < 0.01$), and stocking rate/ha ($P < 0.08$). Wyatt et al. (1997) reported an increase in BW of cows grazing common bermudagrass-dallisgrass when compared with cows grazing Alicia bermudagrass. In the same study, calves suckling cows grazing common bermudagrass-dallisgrass pastures weighed 18% more at weaning than calves on Alicia bermudagrass pastures. Cow and calf performance were consistently greater for common bermudagrass-dallisgrass than for Alicia bermudagrass pastures (Wyatt et al., 1997). Earlier research has also shown improved cow and calf gains on forages such as endophyte-free tall fescue and orchardgrass (Peters et al. 1992; Seath et al., 1956; Gay et al., 1988). Strahan et al. (1987) reported higher BW of cows that consumed endophyte free compared with endophyte infected tall fescue. Keltner et al. (1988) reported that ADG was greater and weaning weight was heavier for calves that grazed endophyte-free tall fescue than for calves that grazed 80% endophyte-infected tall fescue pastures.

Cow ADG ($P < 0.03$) and cow gain/ha ($P < 0.01$) were higher for CG than NCG, but cow stocking rate were similar for NCG than CG. The 2-yr mean forage mass was similar for all treatment pastures ($P > 0.70$; 6939 vs 6628 kg/ha, C vs T85; 6664 vs 6896 kg/ha, NCG vs CG), well above the normally recommended average of 2500-3000 kg/ha. For each pasture, average cow and calf weights of testers and grazers were adjusted to animal units (Ball et al., 2002), and AU were unaffected by treatments. In this experiment cows and calves were assigned to pastures in early June of each year, following the spring breeding season. Earlier research has documented higher quality of C bermudagrass, and other cultivars in spring (Hill et al., 1985; Utley et al., 1978), which often gives calves a good start before summer grazing. In the present study, cow and calf production were challenged by pasture quality and environmental conditions.

Although grazing research on C has been reported on all classes of beef cattle over the years, cow-calf performance on T85 pastures in the US has not been studied. The design of our experiment puts pressure on the forages to support calf gains in the last 90 d before weaning, a time when calf nutrient requirements are increasing, forage DMI is increasing, but cow milk production is declining. Summer temperatures, rainfall amounts, and rainfall distribution often affect summer grazing performance of calves. Inclusion of a high quality legume as a creep grazed forage was predicted to supply additional nutrients for the calves as they approached weaning time in late summer.

However, increased cow and calf performance on T85 pastures was observed and consistent with previously reported increased stocker steer performance on T85 pastures compared with Tifton 78 and C pastures (Hill et al., 1993; 1997a, b; 2001a). Creep-grazing aeschynomene resulted in additional calf gains on both C and T85 pastures, which is consistent with previous research (Ocumpaugh and Dusi, 1981) in which aeschynomene provided the highest calf gains of several legumes and grasses compared as creep grazing forages in perennial grass pastures. Since T85 forage has higher quality than C, an interaction was anticipated from creep grazing the aeschynomene, with a greater response for C pastures. However, calves creep grazing both C and T85 treatments showed similar gain increases, resulting in no pasture X creep grazing interaction ($P > 0.10$). Tifton, GA, is near the northern limit for aeschynomene production, and we observed slow forage growth from establishment in May until mid-July each year, possibly as a result of normally low rainfall during establishment (Figure 1). However, calves consistently responded to creep grazing with increased gains during late summer before weaning. The substantial increase in preweaning ADG of calves on T85 in our study is consistent with recently reported performance of weaned calves grazing T85 pastures in Texas (Rouquette et al., 2004). Results of this experiment suggest that higher gains from calves grazing T85 during summer and this forage could be used to improve production efficiency of Southern cow-calf operations.

Esophageal cannulated steers grazed bermudagrass pastures on three occasions during each grazing season, and whole masticate samples were analyzed to determine quality of available forage (Table 4). Chemical analyses of masticate samples from pastures in both years (Table 4) revealed no year interactions; however, forage X creep grazing interactions ($P < 0.05$) occurred for IVDMD. The IVDMD was lower for C in the CG treatment than C in the NCG treatment. There was no difference in IVDMD for T85 pastures in CG or NCG. The CP concentrations were above requirements for cows and calves on all pastures (NRC, 1996). Masticate CP concentrations were lower for August masticates samples compared with June and July samples ($P < 0.05$). Chemical analyses of masticate samples from pastures in 2004 and 2005 (Table 4) indicated no significant effects of year or year interactions ($P > 0.10$) for chemical data, but forage X creep grazing interactions ($P < 0.05$) occurred for IVDMD. The CP concentrations and fiber in masticate samples were unaffected by treatments. Sampling date effects were detected for fiber, CP and ADL ($P < 0.01$; $P < 0.05$; $P < 0.10$, respectively) for forage masticates. Higher inherent NDF in Tifton 85 masticate (Hill et al., 1993) and T85 hay samples (Mandebvu et al., 1999, Hill et al., 2001b) has been reported. In the present study, increased NDF on C with creep grazing apparently occurred from increased grazing of aeschynomene on the C CG treatment resulting in higher forage mass, and higher fiber. Forage X creep grazing interactions ($P < 0.05$) occurred for IVDMD, with very similar values for CG and

NCG pastures on T85, but IVDMD was higher for NCG than CG on C pastures. Additionally, IVDMD was higher for T85 than for C pastures, which corresponds to higher esophageal forage masticate IVDMD in May and September in a previous steer grazing study (Hill et al., 1993). Sampling date affected forage quality, with higher ($P < 0.01$) IVDMD in June than in August or September. The higher forage mass of all pastures (Figure 2) throughout the study suggested that forage selectivity by cows and calves was high, but it may also indicate more maturity of pasture forages, resulting in lower forage quality as indicated in the esophageal masticate samples.

A forage X creep grazing interaction ($P<0.06$) was observed for milk weights with highest 12 h milk weights observed on C NCG, and lowest on C CG ($P<0.05$) in Figure 3. Previous research has indicated higher 12-hour milk production for cows grazing T85 than those on C with volunteer ryegrass (Hill et al., 1998a). Reduced milk production of cows in creep grazing systems would allow them to allocate more of their nutrient intake to increasing body weight rather than to maintaining milk production. Bagley et al. (1997) reported cows in creep grazing systems did not produce as much milk as cows in non-creep grazing systems. Calves may compensate for the lower milk production of the cows with higher weight gains later during the year because of the increased nutrient availability of creep grazing forage. Milk protein was higher ($P<0.01$) for cows grazing T85 than C, but it was also higher ($P<0.05$) for cows on NCG than CG treatments (Figure 4). Hill et al. (1998a) reported higher milk fat and higher milk protein for cows grazing T85 pastures with versus without alfalfa creep grazing. Lower milk protein for cows on CG is possibly a result of calves consuming creep grazing forage for their protein needs. Trend for higher milk fat and higher protein ($P<0.01$) on T85 pastures contributed to higher gains in calves on T85 pastures in this study.

IMPLICATIONS:

Tifton 85 bermudagrass continues to prove to be the premier bermudagrass for the southern United States, and for other tropical and subtropical regions of the world. Tifton 85 has produced substantially higher dry matter yields, higher digestibility and higher average daily gains than Coastal bermudagrass. Cow and calf performance were improved and cow-stocking rates were higher for Tifton 85 pastures. Under continuous grazing, Tifton 85 pastures had higher nutritive value than Coastal pastures. Calves with access to aeschynomene creep grazing paddocks had higher ADG and weaning weights. Results suggest higher gains from calves grazing Tifton 85 bermudagrass and/or creep grazing aeschynomene during the summer could improve production efficiency in Southern cow-calf operations.

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Table 1: Comparison of Tifton 85 with Coastal bermudagrass in small-plot experiments

Item	Forage							
	Coastal				Tifton 85			
	2 wk	4 wk	6 wk	8 wk	2 wk	4 wk	6 wk	8 wk
DM, kg/ha	752.64	1775.2	2760.8	4777.9	985.6	1909.6	3917.8	6114.1
CP,%	24.82^{aA}	19.64^{B}	14.61^{B}	15.54^{B}	18.02^{bA}	18.07^{a}	11.64^{B}	12.24^{B}
ADF,%	28.63	27.96	29.14	30.0	31.45	29.61	32.93	33.29
NDF,%	71.55^{cC}	67.47^{cC}	72.66^{cC}	70.28^{Cd}	69.16^{cD}	67.03^{cD}	75.99^{Cc}	77.08^{Cc}
IVDMD,%		61.43^{fE}	55.55^{fF}			68.57^{eE}	65.24^{eF}	

a,b=grasses Coastal vs Tifton 85 $P<0.05$
A,B=cutting dates
C,D=cutting date interaction
c,d=grass interactions
E,F= SE=0.78 LSD=3.05
e,f=SE=0..46 LSD=1.80
(IVDMD change on coastal was greater than on Tifton 85; simple effects for interaction)

Table 2: Year effect on initial body weights of cows and calves in grazing experiment

Item	**Year**	
	2004	2005
Cow BW, kg	580.45[b]	607.78[a]
Calf BW, kg	155.27[b]	167.83[a]

[ab]Means on the same row with uncommon superscript letters differ ($P < 0.01$).

Table 3. Two-year average cow and calf performance on Coastal or Tifton 85 bermudagrass pastures with or without aeschynomene creep grazing [a].

Item	**Pasture**		**Creep Grazing**			**Probability, *P*<**	
	C	T85	Without	With	SE	Pasture	Creep
Tester cow-calf pairs/yr	48	48	48	48			
Calf age, days[b]	119	119	118	120	0.97	0.70	0.22
Initial calf wt, kg[c]	158.9	159.4	160.3	157.9	3.17	0.80	0.29
Weaned calf wt, kg[d]	233.4	246.6	236.5	243.5	1.88	0.01	0.03
205-d BIF, adj. wt.,kg[e]	240.3	252.9	243.3	249.9	2.18	0.01	0.05
Calf 91-d ADG, kg	0.79	0.94	0.82	0.90	0.02	0.01	0.03
Calf gain/ha, kg	202.6	261.9	224.2	240.3	12.00	0.03	0.40
Cow 91-d ADG, kg	0.04	0.14	0.03	0.15	0.04	0.04	0.03
Cow gain/ha, kg	14.5	57.1	16.8	54.8	6.8	0.01	0.01
Cow stocking rate hd/ha	3.73	4.39	4.27	3.58	0.08	0.01	0.30
Animal units/ha	1.55	1.57	1.53	1.59	0.13	0.80	0.50

[a] Coastal (C), Tifton 85 (T85); Least squares adjusted means; Pasture X Creep Grazing ($P >$ 0.10) for all variables.
[b]Covariate adjustments: calf sex, birth weight, age, breed, initial weight, cow age.
[c]Covariate adjustments: calf sex, birth weight, age, cow age, cow breed.
[d]Covariate adjustments: calf sex, birth weight, age, initial weight, cow age.
[e]Covariate adjustments: calf sex, birth weight, age, cow age.

Table 4: Two-year forage quality of pastures determined using forage masticate of esophageal steers in June, August and September.[ab]

Item	Forage C	Forage T85	Creep Grazing NCG	Creep Grazing CG	SE	Sampling month Jun	Sampling month Aug	Sampling month Sep	SE
	----	----	----	----	%	----	----	----	
Chemical Composition									
DM	92.4	92.2	92.2	92.4	0.24	92.9[d]	91.2[e]	92.8[d]	0.31
Ash	9.2	9.5	9.6	9.2	0.31	9.2[d]	9.7[d]	9.3[d]	0.28
CP	16.5	16.9	17.0	16.4	0.39	17.4[m]	17.3[m]	15.4[n]	0.48
ADF	46.3	46.9	46.3	46.9	0.62	44.0[f]	49.1[d]	46.8[e]	0.55
NDF	70.1	71.9	70.9	71.0	0.88	69.7[d]	71.8[d]	71.4[d]	0.87
ADL	25.5	25.1	25.2	25.4	1.19	29.7[x]	22.5[y]	23.9[xy]	1.23
IVDMD[c]	54.7	59.5	58.2	56.0	2.12	63.3[d]	55.4[e]	52.7[e]	1.25

a Abbreviations: C=Coastal bermudagrass; T85=Tifton 85 bermudagrass; NCG=pastures without creep grazing available; CG=pastures with creep grazing available.

[def]Means for pasture forage masticate at different sampling dates differ at ($P < 0.01$).

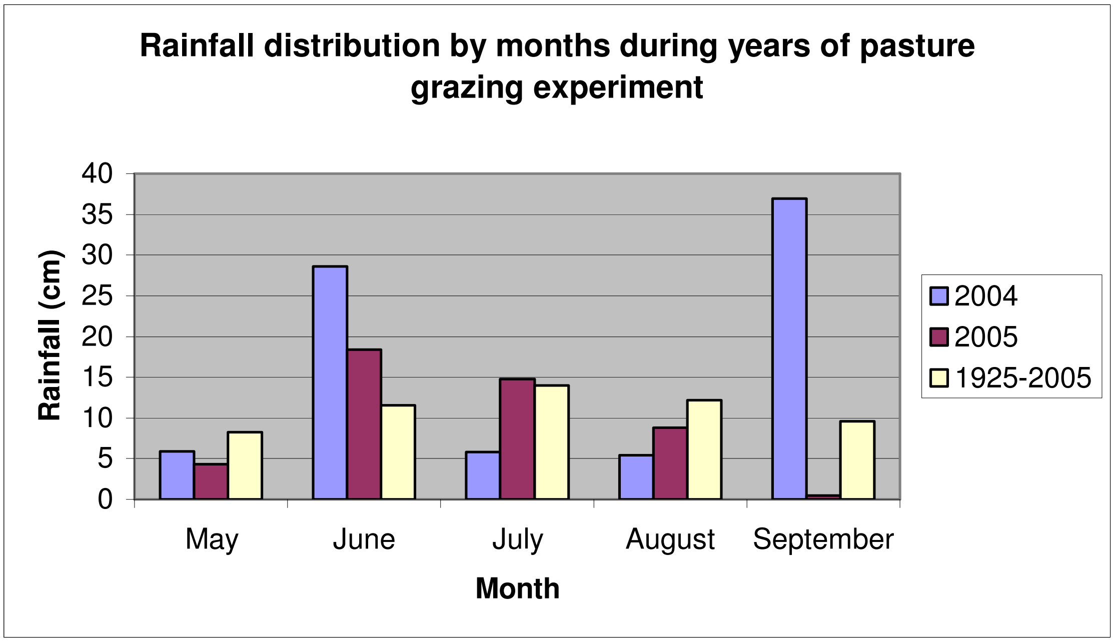
[mn]Means for a pasture forage masticate at different sampling dates differ at ($P < 0.05$).

[xy]Means for a pasture forage masticate at different sampling dates differ at ($P < 0.10$).

[b] Data presented as main effect means for forages and creep grazing, there were no significant effects of year or year interactions for chemical data.

[c]A Forage X creep grazing interaction ($P < 0.05$) occurred for IVDMD, (C-NCG = 57.4%; C-CG=52.1%; T85-NCG=59.1%; T85-CG=60.0%).

Figure 1: Rainfall distribution by months during years of pasture grazing experiment



[a]Rainfall recorded at University of Georgia Coastal Plain Experiment Station, Tifton.
[b]Mean annual rainfall for months of May through September from 2004 to 2005.
[c]Mean annual rainfall for months of May through September from 1925 to 2005.

Figure 2: Two-year mean forage mass in Tifton 85 (T85) and Coastal (C) pastures with month during grazing seasons relative to forage mass target of 2,800 kg of DM/ha for each pasture.

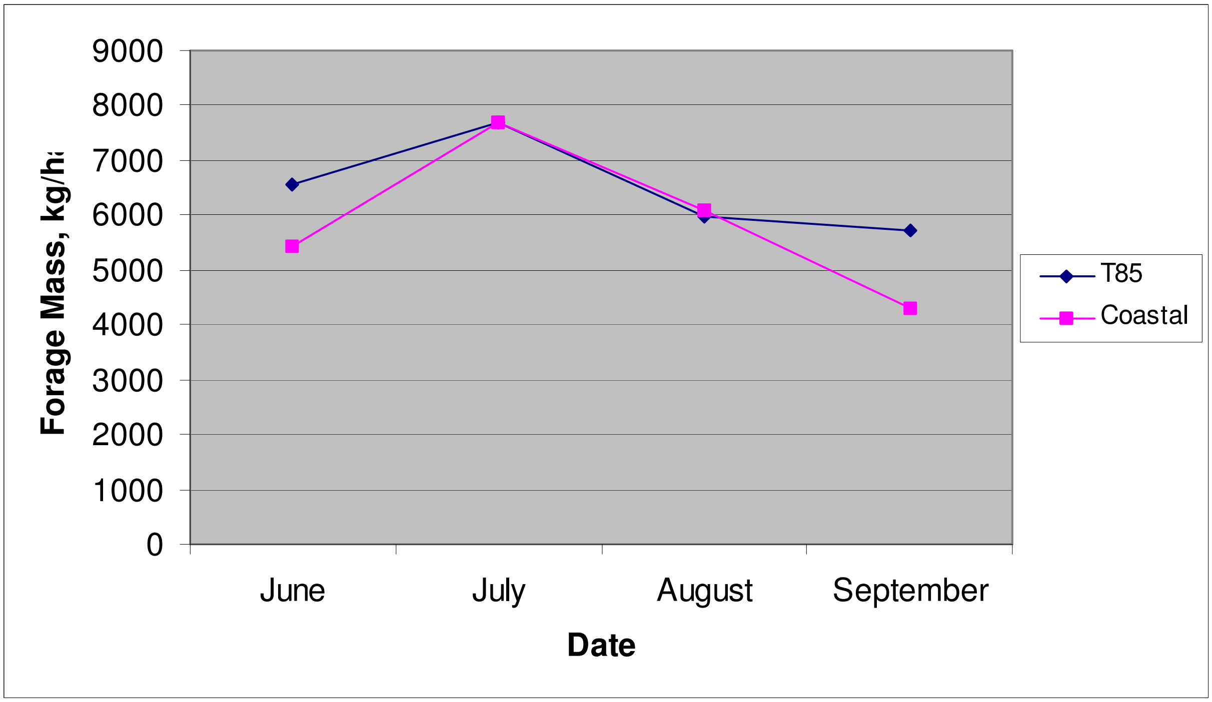


Figure 3: Mean estimates of milk yield in 2004 determined by machine milking in Coastal (C) and Tifton 85 (T85) pastures with (CG) or without (NCG) aeschynomene creep grazing.

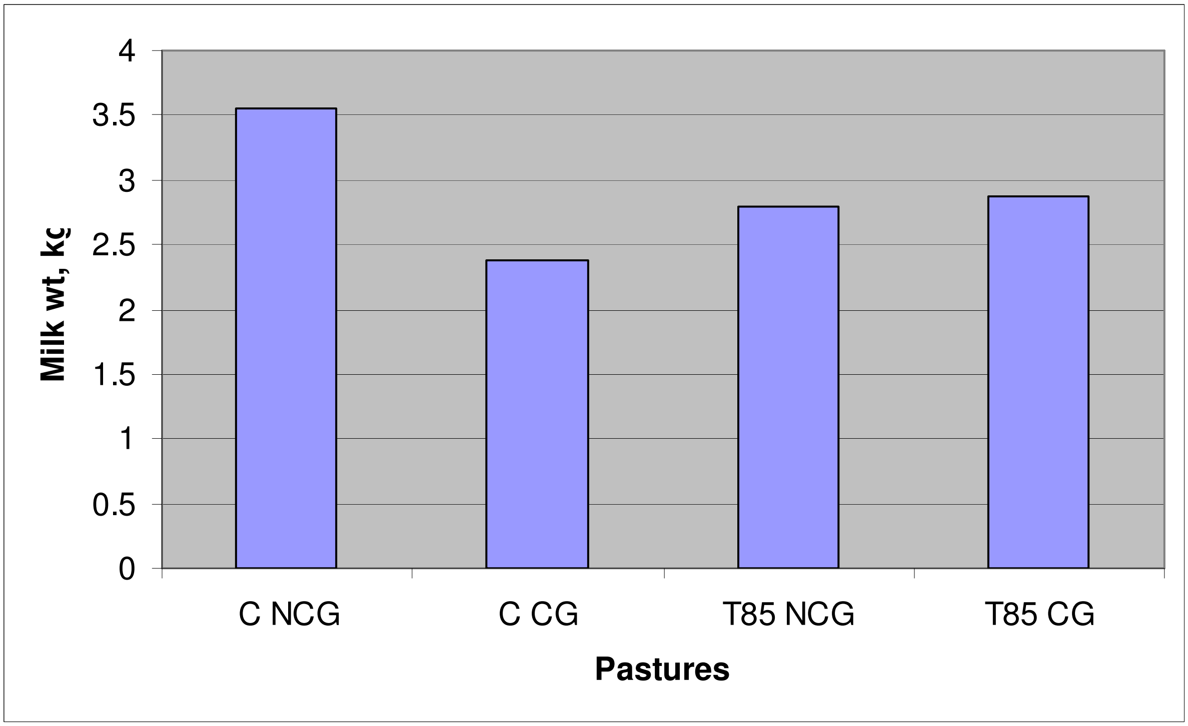


Figure 4: Average fat and protein of milk collected by machine milking in 2004 (C=Coastal; T85-Tifton 85; NCG=without creep grazing; CG=with creep grazing).

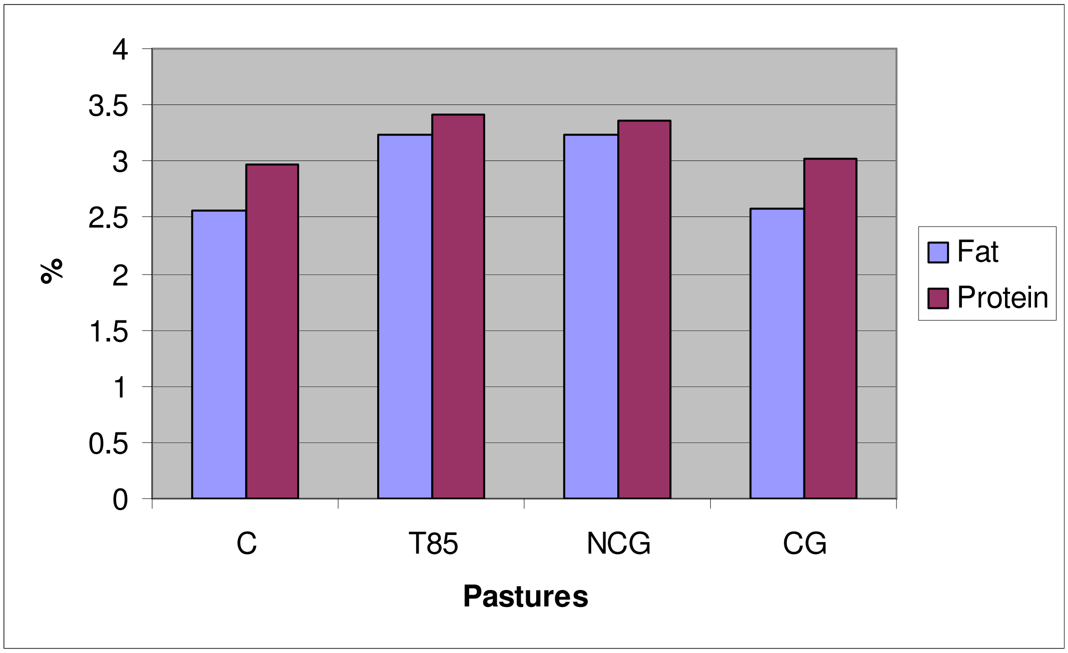
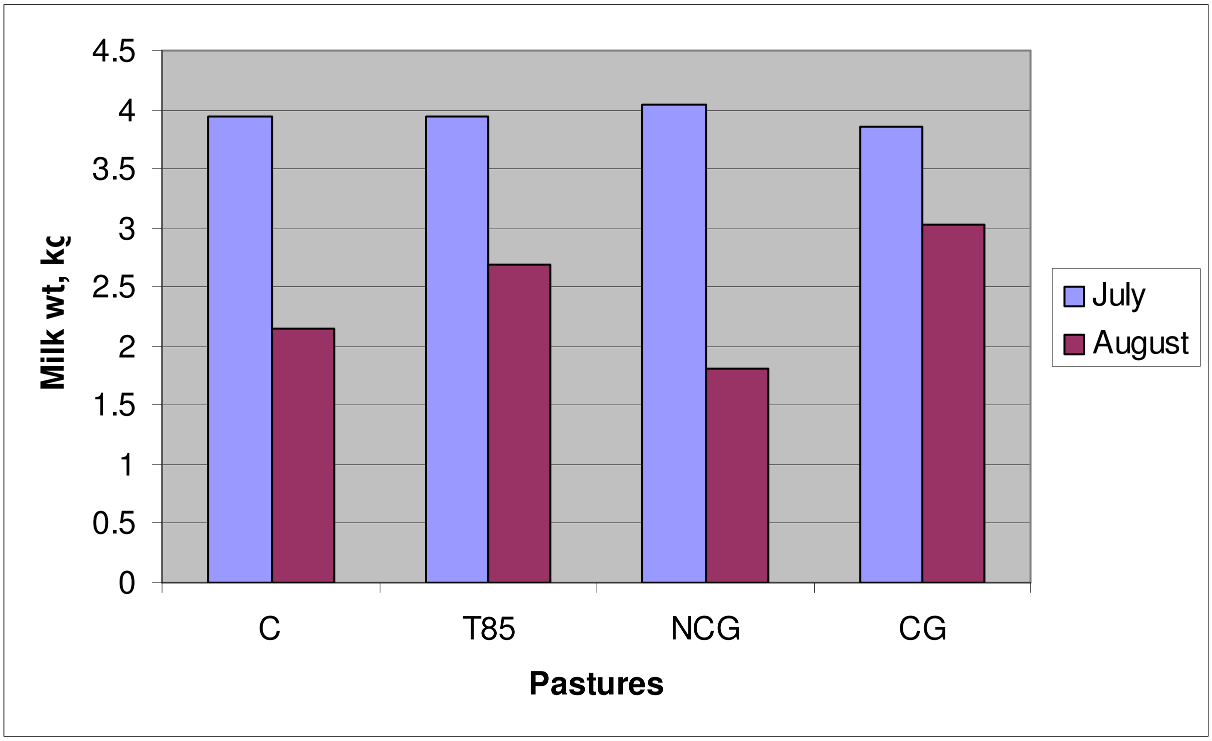


Figure 5: Mean estimates of milk yield in July and August, 2005 determined by machine milking in Coastal and Tifton 85 pastures with or without aeschynomene creep grazing.



CHAPTER FOUR

COASTAL, RUSSELL AND TIFTON 85 BERMUDAGRASS HAY CONSUMPTION BY GROWING BEEF STEERS AND IN SITU DIGESTION[1]

1 Corriher, V.A., G.M. Hill, and B.G. Mullinix, Jr. Submitted to Journal of Animal Science, 2006.

ABSTRACT:

Steer performance and in situ digestion of Coastal (C), Russell (R), and Tifton 85 (T85) bermudagrass hays were determined in two experiments. Hays were produced on the same farm and harvested the same day, containing DM, CP, ADF and NDF (%), respectively: C=91.6, 11.4, 33.8, 71.5; R=91.7, 12.2, 36.4, 75.3; T85=92.0, 10.0, 40.6, 76.8. Exp1. Hays were fed free-choice for 40 d with a supplement (2.49 kg DM/steer daily; 85% corn, 10% SBM, 6% dried molasses, and 1.5% minerals; 89% DM, 14% CP) to beef steers (n=30; age=11mo, 232 +/- 24.7 kg initial BW). Steers were randomly assigned to six pens in a completely random design. Steer ADG and hay DMI (C= 0.90 kg, 5.43 kg; R= 0.58 kg, 4.04 kg; T85= 0.55 kg, 4.11kg) were affected by hay cultivar, with higher ADG ($P < 0.01$) and a trend for higher ($P < 0.16$) DMI on C than R or T85.

Exp 2. Two ruminally cannulated Polled Hereford (PH) steers were fed Tifton 85 hay ad libitum for 11 d. Starting on d 8, C, R, and T85 ground hay samples were, placed in nylon in situ bags, and ruminally incubated for 0, 6, 12, 24, 36, 48, and 72 h. The average in situ digestion for the times sampled were similar ($P > 0.10$) for digestion of DM (DMD), ADF (DADF), and NDF (DNDF), but digestion of CP (DCP) was higher (P < 0.02) for C than T85. Incubation time affected all variables ($P < 0.01$), and after data was centered (28.28 h), digestion rate/h increased linearly for DDM (0.12%/h). For DCP digestion, hay and time interacted ($P < 0.01$), and rate of digestion increased linearly for C (+0.100%/h), R (+0.098%/h) and T85 (+0.137%/h). Steers had higher DMI and gains on C than R or T85 hays, but chemical composition and overall average digestion of the hays were similar. Results differ from studies in which cattle gains and digestibility were consistently higher for T85 than C hays and pasture forages.
Keywords: bermudagrass hay, in situ, steer

INTRODUCTION:

Bermudagrass, a warm season perennial grass, is grown extensively throughout the Southeast for use as pasture and as harvested forage. Tifton 85 bermudagrass is a higher quality and higher yielding forage compared with Coastal bermudagrass (Burton et al., 1993). Tifton 85 bermudagrass has higher dry matter and fiber digestibility than Coastal, resulting in higher gains and utilization by cattle (Hill et al., 1993; Mandebvu et al., 1999; Hill et al., 2001a). Additional research has indicated higher digestibility of Tifton 85 hay compared with Coastal hay at differing maturity dates (Hill et al, 2001). Tifton 85 has lower concentrations of ether-linked ferulic acid than Coastal, with decreased ether bonding in lignin in Tifton 85, which results in higher ruminal microbial digestion of this forage (Mandebvu et al., 1999; Hill et al., 2001a, 2001b). Dry matter digestibility of Coastal is relatively low compared with several bermudagrass varieties (Ocumpaugh and Ruelke, 1979). Russell bermudagrass has higher yields, more vigor, and higher winter hardiness compared with Coastal (Ball et al., 1996). Forage quality appears to be similar between Coastal and Russell. But little research has been reported comparing Russell with Tifton 85. Harvesting bermudagrass hays at 4 to 6 week maturity is recommended. Increasing maturity of hays leads to a decline in digestibility of OM, CP, ADF and NDF (Hill et al., 1997b, 2001b; Mandebvu et al 1998a; 1999a). Our objectives were to determine hay dry matter intake and steer gain performance when growing beef steers in a dry lot were fed Coastal, Russell and Tifton 85 hays and to determine in situ digestibility of hays.

MATERIALS AND METHODS:

The hays utilized in the study were produced on a private farm near Verner, GA. Pastures were all fertilized on the same dates throughout the season (74 kg/ha Ammonium Nitrate). Hay was cut and baled on the same dates at 5 week maturity.

Hay study:

Growing British crossbred beef steers (n=30; age=11 mo; BW=232 +/- 24.7 kg) were selected for the experiment approximately 8 weeks after weaning. Predominantly Angus and Polled Hereford sired steers from British based cows were selected for this study. Steers were randomly assigned to six pens in a completely random design. Hays were fed free choice for 40 d with a supplement (2.49 kg DM/steer daily; 85% corn, 10% SBM, 6% dried molasses, and 1.5% minerals; 89% DM, 14% CP) to beef steers. Hay weigh backs were taken daily to determine DMI. Steers were weighed at 28-d intervals, and initial and final BW were means of consecutive daily full weights. Steers were provided water in each pen.

In situ study:

Samples were obtained from Tifton 85, Coastal, and Russell bermudagrass hay bales using a hay core drill. All forages were ground with a 1-mm Wiley mill screen (Arthur H. Thomas, Philadelphia, PA). Ten grams of each hay sample was placed in separate in situ Nitrogen free polyester bags (10cm X 20cm; 15 micron pore size; ANKOM Company, Fairport, NY) that were heat-sealed. Two ruminally cannulated Polled Hereford (PH) steers were fed ad libitum a diet of Tifton 85 hay for 11 d. Following an 8-d diet adaptation period, duplicate samples, of each forage, were placed in the rumen of each steer and incubated for 0, 6, 12, 24, 36, 48, and 72 h. All sample bags were placed in a large mesh nylon bag. After removal from the rumen, bags (including the 0-h bag) were quickly rinsed in tap water to remove large particles of debris. Bags were then dried in a forced-air oven at 55□C for 48 h prior to chemical analysis. The In Vitro True Digestibility using the DAISY Incubator (Ankom, 2004) procedures were used to determine IVDMD. Samples were analyzed for crude protein (micro-Kjeldahl; total N X 6.25) using AOAC (1991) procedures. The NDF and ADF were determined using methods of Van Soest et al. (1991).

Statistical analyses:

Statistical analyses of the steer in situ experiment and laboratory analyses of incubated forages were conducted using the Mixed Model Procedure of SAS (2003). Least squares means were used to separate treatment effects. The model included steer, treatment, hour and interactions. Hour was centered for statistical analysis.

RESULTS AND DISCUSSION:

Steer ADG and hay DMI (Table 1) were affected by hay cultivar, with higher ADG ($P < 0.01$) and a trend for higher ($P < 0.16$) DMI on C than R or T85. The average in situ digestion for the times sampled were similar for digestion of DM (DMD), ADF (DADF), and NDF (DNDF), but digestion of CP (DCP) was higher ($P < 0.02$) for C than T85. Tifton 85 has had higher DM yields, higher digestibility of NDF and ADF, higher in vitro digestible NDF and ADF and higher in situ DM and NDF digestion when compared with C bermudagrass (Mandebvu et al., 1999a). Tifton 85 hays have consistently had higher in vitro and in vivo digestibility than C or Tifton 78 hays, even when NDF of the T85 hay was above 70% (Hill et al., 2001a). Incubation time affected all variables ($P <$

0.01), and after data was centered (28.28 h), digestion rate/h increased linearly for DDM (0.12%/h). For DCP digestion, hay and time interacted ($P < 0.01$), and rate of digestion increased linearly for C (+0.100%/h), R (+0.098%/h) and T85 (+0.137%/h). Steers had higher DMI and gains on C than R or T85 hays, but chemical composition and overall average digestion of the hays were similar. Results of this study differ from several reports in which cattle gains and digestibility were consistently higher for T85 than C hays and pasture forages.

IMPLICATIONS:

Tifton 85 has previously proven to be the premier bermudagrass for portions of the southern United States, and for other tropical regions of the world. Steers had higher dry matter intake and gains on Coastal than Russell or Tifton 85 hays, but chemical composition and overall average digestion of the hays were generally similar. Results differ from other studies in which cattle gains and digestibility have been consistently higher for Tifton 85 than for Coastal bermudagrass.

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Table 1: Performance of British steers fed diets based on Tifton 85, Coastal or Russell bermudagrass hay in a feedlot.

Item	C	R	T85	SE	P<
Final BW, kg	268.3	254.3	255.3	1.74	0.05
ADG, kg	0.90	0.58	0.55	0.04	0.01
Hay DMI, kg	5.43	4.04	4.11	0.08	0.16
Total DMI, kg	7.92	6.53	6.60	0.10	0.20

Table 2: Apparent in situ digestibility of Tifton 85, Coastal or Russell bermudagrass hay determined using rumen fistulated steers.

Item	C	R	T85	SE	P<
DDM, %	42.7	37.3	38.2	2.02	0.17
DCP, %	16.5	16.2	15.8	0.19	0.02
DADF, %	39.7	40.3	41.4	0.60	0.18
DNDF, %	83.0	83.1	83.2	0.67	0.90

CHAPTER FIVE

CONCLUSIONS

Bermudagrass has been the most popular warm-season perennial grass for pastures and hay throughout the South in the United States. It is widely adapted, has high yield potential, and has proven useful for most forage producers. Since hybrid bermudagrasses have increased yields, better forage quality and greater cold tolerance; they are referred to as being improved. Improved hybrid bermudagrasses have been primary forages for beef and dairy cattle for more than 50 years in the southern United States. Primarily because they are persistent and productive over a wide range of soils, nitrogen applications, and grazing and climatic conditions. Most hybrids offer higher yields, greater persistence, and improved quality.

Tifton 85 is very versatile, it can be used in total mixed rations for lactating dairy cows, in grazing systems for milking herds or for beef cattle herds, and for hay production. Tifton 85 has presented new nutritional challenges because its NDF might not be an important quality indicator. However, the digestion coefficients and ether ferulic acid concentrations of Tifton 85 may be more appropriate to indicate quality. Bermudagrasses will continue to be the primary perennial warm season grass used in the southern United States and other countries.

Tifton 85 bermudagrass has the potential for becoming the premier bermudagrass for portions of the southern United States, and for other tropical and temperate regions of the world. Tifton 85 has produced substantially higher dry matter yields than Coastal, the dominant hybrid bermudagrass. Cow and calf performance were improved and cow-stocking rates were higher for Tifton 85 pastures. Under continuous grazing, Tifton 85 pastures had higher nutritive value and were stocked at considerably higher levels than Coastal pastures. Calves with access to aeschynomene creep grazing paddocks had higher average daily gain and weaning weights. Higher gains from calves grazing Tifton 85 bermudagrass during the summer could improve production efficiency in Southern cow-calf operations.