Suplementação de vacas de corte em pastagens diferidas

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Introduction

The great majority of beef cattle production in the world is conducted in subtropical and tropical regions. In the United States, the majority of cow-calf operations are located in the Southeast and Southern Plain regions. These regions have mild winters and are more suitable for forage production, require less supplemental feed, and have lower production costs compared to other regions in world (McBride and Matthews, 2011).

Cow-calf operations in tropical and subtropical regions rely heavily on warm-season grass pastures with limited supplemental feed used during the winter period. Although pastures are the main source of nutrients for cow-calf production, limited forage production and nutritive value during the winter months may limit livestock production. Therefore, an efficient grazing management program, which includes conserved forage and supplementation, is crucial to improve the profitability of cow-calf operations in Florida.

Stockpiling forage for the winter months has some advantages compared to hay or haylage, including less equipment, labor, fuel, and consequently at lower cost. Poore et al. (2000) concluded that stockpiled tall fescue grass (*Festuca arundinacea*) with moderate N fertilization levels (50 and 100 kg/ha) was more economical than hay to provide forage for cows during the winter. According to Lalman et al. (2000), stockpiled bermudagrass (*Cynodon dactylon*) can be used to reduce cost of animal production and is more economical than making or purchasing hay (Lalman et al., 2000). However, nutritional strategies are needed during fall and winter to maintain animal production on stockpiled pastures (Stateler et al., 1995). Supplemental strategies can decrease weight loss in cows and optimize stocker gains during the winter (Rush and Totusek, 1976).

Supplemental feed, such as hay, haylage, and concentrated feed may represent approximately 60% of the total production cost of cow-calf operations (Quanbeck and Johnson, 2009). Supplementation strategies, such as different sources of supplement, need to be investigated to improve efficiency and decrease cost of supplemental feed.

The objective of this article is to provide information about supplementation strategies of cow-calf pairs grazing stockpiled warm-season pastures during winter in tropical and subtropical regions.

Stockpiled pastures

Warm-season grasses have superior production in tropical and subtropical regions of the world, however, are generally low in nutritive value and may not meet animal requirements (Moore, 1992). Brown and Simmons (1979) reported that warm-season grasses produce more forage than cool-season grasses in tropical and subtropical climates, as a result of better water use and light conversion efficiency. However, warm-season grasses tend to have lesser nutritive value [crude protein (CP) and digestibility] than cool-season grasses, due in part to the parenchyma bundle sheath cells and a higher proportion of cell-wall material (Akin and Burdick, 1975). Although cell-walls are potentially digestible, chemical barriers and anatomical structures decrease microbial attachment, degradation rate, and fermentation. The leaves of warm-season grass have lower degradability in the rumen compared to leaves of cool-season grasses (Van

Soest, 1982) due to greater proportions of vascular tissues, bundle sheath, and sclerenchyma (Coleman et al., 2004).

Conserved or stockpiled forage are alternatives to supply forage for ruminants during the periods of forage shortage, usually late autumn and winter (Ruelke and Quesenberry, 1983). According to Mays and Washko, (1960), stockpiling is a practice that allows forage to grow for a certain period of time for further utilization. Stockpiled forage can be used to maintain pregnancy and body condition score (BCS) in beef cows during the winter at low cost (Hitz and Russel, 1998). A desirable characteristic of suitable forages for stockpiling is the slower decline in nutritive value with advancing maturity during the growing season.

There are many management practices that affect production and nutritive value of stockpiled pastures. Forage species, fertilization, and maturity are the main factors affecting quantity and quality of stockpiled warm-season grass pastures.

Evers et al. (2004) stockpiled six seeded and two hybrid bermudagrass cultivars, two bahiagrass (*Paspalum notatum*) cultivars, and a kikuyugrass (*Pennisetum clandestinum*) for approximately 120 d in Texas and sampled the pastures during the winter. Crude protein decreased with time, but the rate of decline was related to initial CP concentrations and forage maturity at first frost. Bahiagrass cultivars and kikuyugrass generally had higher CP concentrations than bermudagrass cultivars. Crude protein concentrations were always above the minimum requirements for mature, nonlactating, pregnant beef cows (7–8%). Acid detergent fiber increased with time for all entries, with the largest monthly increase usually occurring after December. The ADF concentration in bahiagrass cultivars was always higher than in bermudagrass cultivars and kikuyugrass.

In a study conducted in south Florida, Brown et al. (2005) tested the nutritive value and intake of four forage species, bahiagrass, bermudagrass, limpograss (*Hemarthria altissima*), and stargrass (*Cynodon nlemfuensis*) stockpiled for 10 weeks. It was observed that limpograss and bahiagrass had greater digestibility (60% and 58%) than the other grasses (~ 45%); however, there was similar OM intake among stargrass, bermudagrass, and bahiagrass. Limpograss had lesser intake than stargrass and bermudagrass.

Ruelke and Quesenberry (1983) evaluated yield and nutritive value of stockpiled limpograss pastures. Pastures were staged and fertilized with 75 kg N/ha in August and harvested thru February in a two week interval. Herbage mass reached ~8000 kg/ha on late September and was similar from late September to December (~10,000 kg/ha). Crude protein was at maximum level in the middle of September (11%) and decreased to levels below 50% in December. After the first frost, the CP concentrations of limpograss decreased to 4%.

In general, the main benefit of increasing n fertilization levels to stockpiled pastures is to increase herbage accumulation; however, increase in nutritive value is observed in some occasions. Davis et al. (1987) imposed eight levels of fertilization (0 to 400 kg N/ha) on limpograss staged in early October; monthly samples were taken from December to April and analyzed for nutritive value. There was no effect on NDF and ADF between fertilization rates; however, CP and IVDMD increased when nitrogen fertilization was greater than 68 kg/ha. In addition, there was an increase in yield from

550 to 4,350 kg/ha with N fertilization levels from 0 to 135 kg N/ha. Kretschmer et al. (1996) evaluated different autumn application dates (early and late autumn) and N levels (0, 50 and 150 kg/ha) on stockpiled limpograss and reported no difference in dry matter yield, IVDOM and TDN between all combinations of dates and N fertilization levels. However CP was greater when late fertilization was used.

Longer stockpiling periods favor forage quantity but it may decrease forage nutritive value. Since the main objective of stockpiling is to generate sufficient forage quantity with known limited nutritive value, longer stockpiling periods may be desirable to reach the main goal. Wallau et al. (2015) tested the effects of length of stockpiling on limpograss herbage accumulation and nutritive value. Increasing the length of stockpiling from 8 to 16 weeks increased herbage mass from 5300 to 7400 kg/ha. However, there was a slight decrease in CP and digestibility from 8 to 16 weeks.

The variation in herbage mass and nutritive value of stockpiled pastures during grazing period may affect supplementation strategies and animal performance. Vendramini et al. (2015) stratified the forage canopy in three, 25-cm vertical increments (0-25, 25-50, and 50-75 cm from soil level) and evaluated herbage mass, canopy morphology, and nutritive value during the winter in Florida. Pastures were grazed with a stocking rate of 3 animal units (450 kg BW)/ha. Herbage mass was 4200, 3300, and 1000; 2500, 3200, and 0; and 3400, 300, and 0 kg/ha for the 0-25, 25-50, and 50-75 cm layers, respectively, in January, February, and March, respectively. Crude protein concentrations were 5.8, 5.8, and 9.3; 6.7 and 6.3; and 6.3 %; and IVDOM concentrations were 38, 47, and 56; 36 and 43; and 36% for the different layers in January, February, and March, respectively. The summary of the herbage mass and nutritive value responses are presented in Figure 1. The authors concluded that to meet the nutritional requirements of beef cattle grazing stockpiled pastures, it is necessary to adjust the supplementation quantity and quality due to the variation in herbage mass and vertical distribution of nutritive value in the canopy.

Supplementation of cow-calf pairs on stockpiled pastures

Protein is usually the first nutrient addressed in supplementation programs in stockpiled pastures for beef cows. Crude protein is required in lesser quantity than energy and may increase forage intake, indirectly increasing energy intake. Levels and sources of protein supplementation should be carefully determined to achieve efficient and cost effective gains.

According to Moore et al. (1999), ruminants consuming forage with IVDOM:CP ratio greater than 7 may respond positively to protein supplementation. Moore et al. (1991) summarized the nutritive value of forages commonly used in Florida and reported that the majority of the samples have CP concentrations between 5 to 7% and total digestible nutrients (TDN) from 48 to 51%. According to the NRC (1996), these values do not meet the requirement of a lactating beef cow (11% and 62% TDN).

In ruminant nutrition, CP can be fractionated in three different fractions, rumen-degradable protein which is converted into microbial protein, rumen-undegradable protein that is degraded in the gastrointestinal tract and lastly undegradable protein which is excreted in feces (NRC, 1996).

Rumen-degradable protein is used to improve microbial protein production in the rumen. Microbial protein is a high quality protein that is highly digestible in the small intestine. The usual aminoacids profile expressed as a percent of total CP in the ruminal microbial protein are: histidine (2.2%), isoleucine (7.3%), leucine (9.4%), phenylalanine (6.8%), threonine (6.4%), tryptophan (6.8%), valine (7.2%), methionine (2.6%) and lysine (11.3%), the last two aminoacids are known as the first limit aminoacids in ruminant diet (Van Soest, 1994). According to NRC (1996) feedstuffs have lower values of essential aminoacids than microbial protein and aminoacids from microbial protein have greater use efficiency due to balance, consistence, and extensive degradation (Owens and Zinn, 1988).

Animals grazing low nutritive value forage are usually deficient in rumen-degradable protein, which is the first limiting factor for forage digestibility in the rumen (Köster et al., 1996) due to limited microbial activity. Rumen-degradable protein increases forage intake and digestibility, improving microbial synthesis, and improving performance on animals grazing low-quality forage (Guthrie and Wagner, 1988; McCollum and Horn, 1990; Mathis et al., 1999).There is a positive relationship between rumen-degradable protein and rumen ammonia (McCollum and Galyean, 1985) to levels above the minimum required 5 mg dL^{-1} (Satter and Slyter, 1974). Köster et al., (1996) reported that supplementation of 4 g of rumen-degradable protein kg^{-1} $BW^{.75}$ increased the total tract digestibility of NDF, digestibility of organic matter, which leaded to an increase in forage intake on cows consuming tallgrass-prairie forage. Mathis et al. (1999) evaluated the performance of beef cows grazing low quality tall-prairies (5.3% CP, 49% RDP) forage consuming increasing soybean meal levels from 0.08 to 0.48 % body weight (BW) daily. Soybean meal supplementation with 0.30% BW/d improved performance of cows grazing low-quality pastures.

Urea is often used to decrease the cost of protein supplementation and can substitute up to 33% of the degradable protein intake in high protein supplement without affecting cow-calf performance (Köster et al., 2002); however, it is not recommended to exceed 1% of the total dry matter intake in the concentrate, or 20 % of the total dietary CP (Kertz, 2010). Köster et al. (2002) tested different levels of urea in the supplement on forage intake, digestion, and animal performance of cows consuming tallgrass prairie (experiment 1, 2 and 4) or forage sorghum (*Sorghum bicolor,* experiment 3). Levels of urea were 0, 20, 40, and 60 % of rumen-degradable protein or 0, 15, 30 and 45 % (experiment 3) of the supplemental rumen-degradable protein. In experiment 1, there was no difference in total OM and forage intake, and OM and NDF digestibility of tallgrass prairie hay (CP = 2.4%). However, there was a linear increase in rumen ammonia as urea concentration increased. In experiment 2, there was no effect of urea concentrations on performance of cows and calves and body condition score of the cows grazing dormant tallgrass prairie pastures. In experiment 3, cows were fed with forage sorghum hay in the feedlot for two months and moved to tallgrass prairie pastures. There was no difference on cumulative body weight change and body condition score of the cows and no difference in calf performance; however, there were linear decreases in body weight change as urea concentration increased. In experiment 4, cows grazing dormant tallgrass prairie decreased body weight and body condition score during calving and breeding season in all treatments but not during weaning season. In addition, calf performance was not affected on any of the experiments. Currier et al. (2004) tested the effect of NPN source on performance of cows consuming low nutritive value hard fescue (*Festuca trachyphylla*) straw (CP = 43 g/d) on drylot.

The NPN sources were urea and biuret to provide 90% of rumen-degradable protein requirement. Cows receiving protein supplementation had greater body weight change than control treatment during the pre-calving season (33 vs. 10 kg). Additionally, cows lost less weight during post-calving season (-14 vs. -40 kg).

Aguiar et al. (2015) evaluated the effects of different sources of RDP on forage characteristics, animal performance, and ruminal and blood parameters of beef cows grazing stockpiled pastures. Treatments were two different sources of RDP, urea or cottonseed meal (CSM). Feather meal and corn (*Zea mays*) meal were added to the urea treatments to balance RUP and energy. The treatments were mixed in sugarcane (*Saccharum officinarum*) molasses (1.8 kg/animal/d), which resulted in 3 kg DM/animal/d of supplement. There were no differences in herbage mass (mean = 3,200 kg/ha), herbage allowance (mean = 1.9 kg DM/kg LW), CP (mean = 5.2%), and in vitro digestible organic matter (mean = 47%) concentrations. Cows ADG (mean = 0.23 kg/d), BCS (mean = 4.6), milk yield (mean = 7.0 kg/d), blood urea nitrogen (mean = 16.1 mg/dL), and calf ADG (mean = 0.71 kg/d) were similar among treatments. In addition, there was no difference forage intake (mean = 2.1 % BW) and total DM intake (mean = 2.5% BW) between treatments. Ruminal NH_3-N (mean = 12.9 mg/dL), pH (mean = 6.5), and propionic (mean = 25 mol/100 mol), acetic (mean = 69.2 mol/100 mol), and butyric acids (mean = 4.5 mol/100 mol), and branched chain VFA (mean = 1.3 mol/100 mol) concentrations in the rumen were similar as well. The authors concluded that urea can be as effective as CSM as the main source of RDP in the molasses based supplement to mature lactating beef cows grazing stockpiled limpograss pastures.

Rumen-undegradable protein is defined as the fraction of the protein that is not digested in the rumen by microorganisms but escapes rumen digestion and is digested in the gastrointestinal tract (GIT), starting in the abomasum and finishing in the large intestine. Warm-season grasses have generally decreased CP concentrations and a greater portion of the total CP may be digestible in the rumen. Vendramini et al. (2008) observed that 70% CP of total CP of 'Tifton 85' (*Cynodon* spp.) disappeared in the rumen. However, growing animals may not meet the metabolizable protein requirements from warm-season grasses only and rumen-undegradable protein supplementation may be needed (Klopfenstein et al., 1996). Supplementing animals with rumen-undegradable protein has the objective to increase aminoacids flow to gastrointestinal tract, especially small intestine (Legleiter et al., 2005).

Lima et al. (1999) supplemented beef heifers grazing limpograss pastures with rumen-degradable protein and rumen-undegradable protein plus rumen-degradable protein and also two N fertilization levels (50 vs. 150 kg N/ha). The authors reported an increase on animal performance 0.06, 0.41 and 0.56 kg/d for control, rumen-degradable protein, and rumen-degradable protein plus rumen-undegradable protein, respectively, when pastures were fertilized with 50 kg N/ha. However the response was lesser when pastures were fertilized with 150 kg N/ha, 0.36, 0.39 and 0.47 for control, rumen-degradable protein, and rumen-degradable protein plus rumen-undegradable protein, respectively. The forage CP increase from 5.6 to 7.3% as fertilization increased from 50 to 150 kg N/ ha. Low levels of forage CP plus rumen-degradable protein and rumen-undegradable protein supplement increased animal performance; however when forage CP was higher there was no response of supplementation, suggesting that animal protein requirement was met by rumen-undegradable protein supplementation or by increasing N fertilization.

Bohnert et al. (2002) reported no difference in cows body weight change, pre-calving (14 d of calving)- and post- calving (within 24 h of calving), body condition score change, calf birth date between animals supplemented with rumen-degradable protein and rumen-undegradable protein supplement, daily, 2x, 6x/wk. Farmer et al. (2004) tested the effect of infrequent and levels of protein supplementation on cow performance grazing tallgrass and reported similar performance for cows. The authors reported an improvement on OM and NDF digestibility for animals fed daily compared to 3x wk^{-1}; however, no difference in forage, supplement and digestible OM intake were detected. Additionally no differences on cows and calf ADG and cows body condition score were detected. Schauer et al. (2005) fed grazing cows either daily or 1x wk^{-1} with cottonseed meal (4.3% CP) and reported no difference in ADG and no effect on grazing behavior between supplementation frequency, and both supplemented treatments had greater positive response to supplementation when compared to nonsupplemented animals.

In an energy supplementation review, Caton and Dhuyvetter (1997) reported that the decrease in forage intake is correlated with substitution of forage by the energy supplement, however, when energy supplement is offered at low levels, forage dry matter intake and digestibility may be improved. According to Poppi and McLennan (1995), energy supplements for grazing animals are fiber, sugar and starch. The most common energy supplement in South of Florida is sugarcane (*Saccharum officinarum*

L.) molasses due to low cost, availability of the product, and convenience of less frequent feeding

Vendramini et al. (2009) tested three levels of soybean hulls (0, 1.6, or 3.2 kg DM/cow daily) additional to a base supplement of 1.6 kg of liquid molasses and 0.8 kg of cottonseed meal to first calf-heifers. Pastures with cows receiving no supplemental soybean hulls had a greater decline in herbage mass (1,490 to 960 kg DM/ha) than pastures with cows receiving soybean hulls (1,640 to 1,250 kg DM/ha). Cow ADG (-0.12 to 0.22 kg/d), BCS change (-0.65 to 0), milk production (4.2 to 6.6 kg/d), and calf ADG (0.60 to 0.88 kg/d) increased linearly as the rate of soybean hull supplementation increased. While forage DMI decreased (1.95 to 1.58 % BW) as level of soybean hull supplementation increased, total DMI increased linearly. The substitutive effects of greater quantities of energy supplements to cows grazing warm-season grasses have been well reported in the literature. Although substitution effect is perceived as an undesirable outcome, it may be positive in situations of shortage of forage or desire to increase stocking rates and gain per hectare.

Sources of fibrous highly-digestible energy, such as soybean hulls or wheat middlings, have shown the most consistent response, presumably because of the good synchrony with NH_3 released (Poppi and McLennan, 1995). Johnson et al. (2001) supplemented mature cows on bermudagrass pastures with soyhulls or corn at 0.17% BW. There was no difference in dry matter intake (DMI) or ADG between the treatments. These results suggest that low levels of corn supplementation did not affect forage intake and animal performance. Supplementing forage with a starch source, especially at levels > 25% of the total DM tends to reduce fermentation of the basal forage [Goetsch et al. (1991), cited by Coleman et al. (2004)]. According to Fieser and Vanzant (2004), when fed at similar levels of OM, soybean hull supplementation provided an average of 6% greater DOM intake than corn supplementation. It is expected that different sources of energy supplement would affect fiber digestibility differently; however, in practical situations of limited cow-calf supplementation in extensive grazing systems, supplementation quantity will be the main factor affecting forage digestibility and intake.

Summary and Conclusions

Stockpilling is the main forage conservation management used by cow-calf producers in tropical and subtropical regions in the world. Variations in forage quantity and quality are the main determinants of animal performance on stockpiled forage systems. Management practices must be used to optimize the production and use of stockpiled pastures.

Supplementation is a crucial management practice used to improve performance of cow-calf pairs grazing stockpiled pastures, primarily due to decreased stockpiled forage quality and/or quantity. Levels and sources of supplementation must be carefully formulated to optimize cow-calf production efficiency; however, the decision must be based on economic return and practical feasibility, rather than solely animal performance parameters.

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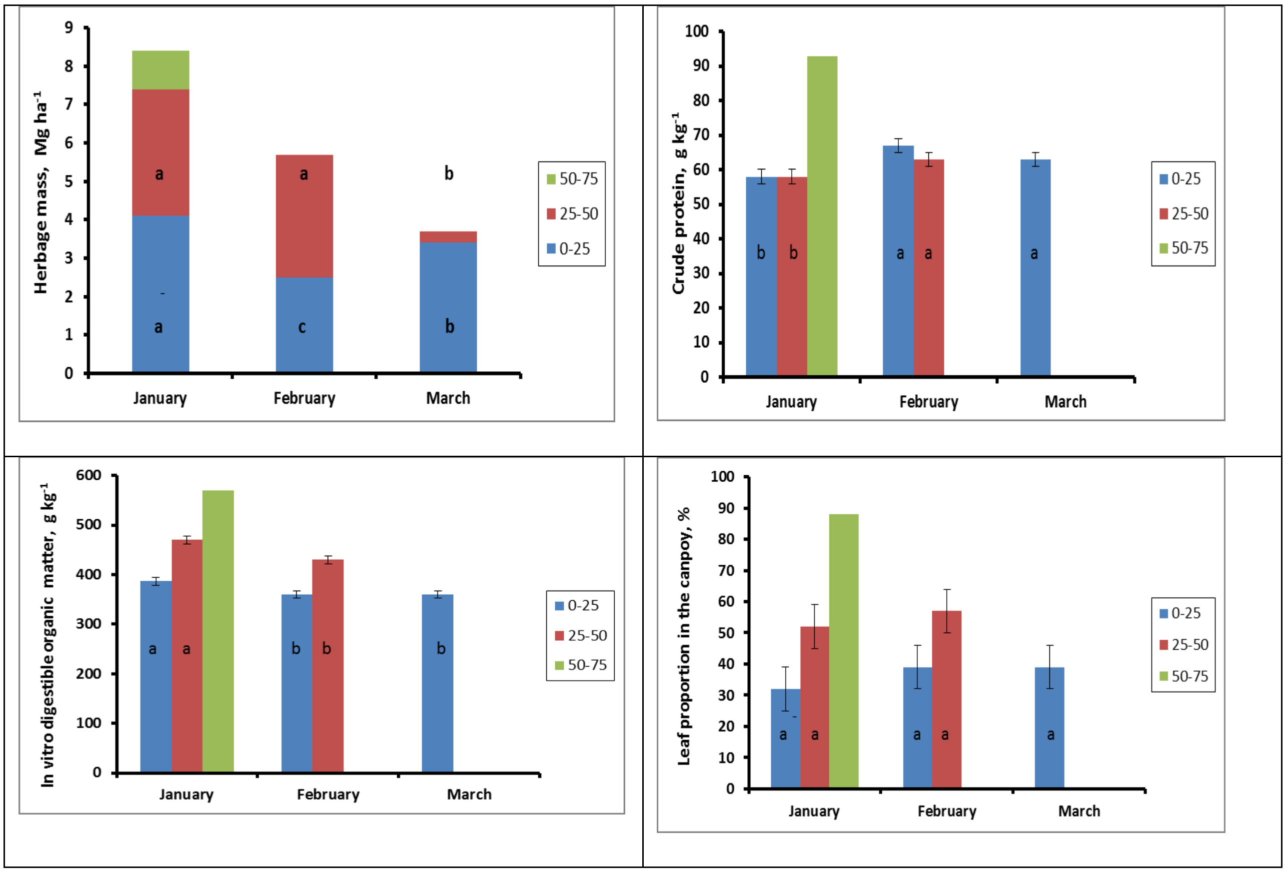

Figure 1. Herbage mass, leaf proportion and nutritive value of limpograss pastures grazed by beef cows at different heights during the winter months in Florida