PASTURE MANAGEMENT AND FORAGE UTILIZATION

Performance of Cows and Their Calves Creep-Grazed on Rhizoma Perennial Peanut

M. J. Williams,* C. C. Chase, Jr., and A. C. Hammond

ABSTRACT

Where tropical grasses such as bahiagrass (Paspalum notatum Flügge) make up the base forage, creep-grazing legumes should be beneficial to calf performance. Treatments of creep with rhizoma perennial peanut (Arachis glabrata Benth.) and no creep were set-stocked (n = 24, 20, and 32 cow/calf pairs per treatment/rePLICATE combination in 1997, 1998, and 1999, respectively) for an 84-d grazing period (June–September). Base pasture forage dry matter (DM) availability was similar all 3 yr (avg. 2.81, 2.63, and 3.13 Mg ha⁻¹ for 1997, 1998, and 1999, respectively) and for both treatments (2.84 and 2.87 Mg ha⁻¹ for creep and no creep, respectively). DM availability in the creep areas averaged approximately 3.0 Mg ha⁻¹ and was composed of about 60% grass and 30% rhizoma perennial peanut (RPP). Nutritive value of RPP was usually 60 mg kg⁻¹ higher for crude protein (CP) and 200 mg kg⁻¹ higher for in vitro organic matter disappearance (IVOMD) compared with the associated grass (97.7 mg kg⁻¹ CP and 415.8 mg kg⁻¹ IVOMD). Utilization of creep area varied with year and breed of calf (Angus < 10% vs. Romosinuano > 50%). As a consequence, performance of Angus calves was not affected, but average daily gain (ADG) for Romosinuano calves with access to creep area was higher (0.14 kg d⁻¹) than that for calves with no creep. Also, body condition score (BCS) that was higher in August and September for creeped-Romosinuano calves. Creep grazing the calves had no effect on cow performance (weight, ADG, or BCS).

RHIZOMA PERENNIAL PEANUT is a tropical forage legume with nutritive value similar to alfalfa (Medicago sativa L.) (Prine et al., 1981, 1986; French and Prine, 1998). Adapted throughout much of the Gulf Coast region of the USA (French et al., 1994; Venuto et al., 2000), it is now estimated that about 8000 ha of RPP has been planted, with most of production occurring in Florida and Georgia (Quesenberry, 1999). Most of the RPP material is used for commercial hay production, with little used for pasture even though studies have consistently shown between 0.7 to 1.0 kg ADG for cattle grazing RPP (Williams et al., 1991; Bennett et al., 1995; Valencia et al., 2001). This is in part due to dependence on vegetative propagation methods (Williams et al., 1997; Williams and Chambliss, 1999) that make the establishment of RPP relatively expensive with seeded forages. Limiting the use of RPP stands to classes of animals that would most 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 than planting enough area for the whole cow herd.

Creep grazing, 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), may be one method of efficiently utilizing limited acreage of RPP. Creep grazing in temperate areas has produced mixed results, but with tropical grasses, which have generally lower nutritive value than temperate grasses, the benefits of creep-grazing legumes should be more consistent. The benefit of creep grazing would be particularly high if the milking ability of the dam breed was relatively low. In a preliminary study by Ocumpaugh (reported in French et al., 1987), calves with access to RPP gained an extra 0.14 kg d⁻¹ compared with those on bahiagrass alone. Additionally, in the Ocumpaugh study, the cows nursing calves that were creep-grazed lost 20 kg less during the grazing season than those cows with non-creep-grazed calves (French et al., 1987). This indicates that creep-grazing RPP may not only improve the preweaning performance of calves, but also might improve the subsequent reproductive performance of their dams by reducing weight loss and body condition during lactation, thus shortening the length of time between calvings. The objective of this 3-yr study was to determine the effect of creep grazing of RPP on the performance of cows and calves in a subtropical environment.

MATERIALS AND METHODS

The study was conducted at the Main Station of the USDA-ARS Subtropical Agricultural Research Station (STARS), Brooksville, FL (28°37′ N, 82°22′ W). The pastures were located on poorly to moderately well-drained Arrendondo, Sparr, and Kendrick soils (loamy, siliceous, hyperthermic Grossarenic or Arenic Paleudults). The base pastures for the creep- or no-creep-grazing treatments consisted of predominantly bahiagrass with or without an adjacent RPP creep-grazing area, and grazing treatments were replicated twice. The bahiagrass base pastures and RPP creep-grazing areas were in excess of 10 yr old and had been hayed or grazed in previous years. Total area in each base pasture treatment was variable due to the presence of timbered or marshy areas, but open pasture area in each base pasture treatment was approximately 10 ha. The RPP creep pastures were approximately 2 ha. Each year of the study, the bahiagrass pastures were rotationally grazed during the spring and fertilized with 76 kg ha⁻¹

Abbreviations: ADG, average daily gain; BCS, body condition score; CP, crude protein; DM, dry matter; IVOMD, in vitro organic matter disappearance; PUN, plasma urea nitrogen; RPP, rhizoma perennial peanut.
of N as NH₄NO₃ in March or early April. Before initiation of the creep-grazing study each year, an additional 76 kg ha⁻¹ of N as NH₄NO₃ was applied in early June to each bahiagrass pasture. The RPP creep areas were a mixture of ‘Florigraze’ RPP, bahiagrass, common bermudagrass (Cynodon dactylon (L.) Pers.), and forbs. The creep areas were fertilized each year in March or early April with 336 kg ha⁻¹ of 0–10–20 NPK fertilizer.

At the end of a natural breeding season in mid-June, Angus cows (Bos taurus L.) with Romosinuano embryo transfer calves in 1997 and natural-sired Angus calves in 1998 and 1999 and Romosinuano cows with natural-sired Romosinuano calves were set-stocked (n = 24, 20, and 32 cow/calf pairs per pasture treatment–replicate combination in 1997, 1998, and 1999, respectively) for an 84-d grazing period ending in early September. Stacking rate varied over years due to the availability of cattle, but stocking rate was not in excess of pasture production potential during the grazing period. The cow–calf pairs were stratified by breed and cow age and randomly assigned to pasture treatment to balance as much as possible breed and cow ages across treatment–replicate combinations.

At the initiation of the creep-grazing period and every 28 d thereafter, weight (kg), hip height (cm), BCS (1–9 scale; Kunkle et al., 1994), and plasma urea N (PUN, mg dL⁻¹; Marsh et al., 1965) were determined for all cows and calves. Additionally, pasture availability was determined for the bahiagrass base pastures and the creep-grazing areas by disk meter (0.25 m²) using a double-sampling technique (Ortega-S. et al., 1992) with approximately two disk meter samples per hectare and four to five clipped samples per pasture per sample date. Clipped samples were dried at 60°C to constant weight and used to generate separate predictive regression equations. Single equations across years for base pasture (g DM = 17.1334 + 5.40259 × height, r² = 0.60) and creep area (g DM = 41.84810 + 3.23687 × height, r² = 0.44) were used because the equations for individual years had similar r², standard errors of the estimate, slopes, and intercepts. Additionally, clipped subsamples from the RPP creep areas were separated into grass, RPP, and forb components before DM determination to determine percentage contribution to the sward. After DM determination, all clipped samples were ground in a Wiley mill to pass a 1-mm screen and used for CP determination (N × 6.25) on a DM basis following the procedures of Gallaher et al. (1975) and Hambleton (1977). In vitro organic matter disappearance was determined using a modified two-stage digestion procedure (Moore and Mott, 1974).

Calves in the creep-grazing treatment had access to RPP for the entire 84-d period. For 3 d at the start of the study each year, both cows and calves were herded onto the creep area for approximately 3 h each day to familiarize the calves with the creep pasture; after Day 3, the creep gates were closed, and only calves had access to RPP. Two weeks after the initiation of the creep study and every 2 wk thereafter, utilization of the creep areas was determined by recording the presence of individual calves on the creep areas every 2 h from 0600 to 2000 h.

Treatment effect on DM, CP, IVOMD, and botanical composition was analyzed using a split-plot model of PROC GLM (SAS Inst., 1990), with grazing treatment as the main plot, year as the subplot, and date as the sub-subplot. The main effect was tested using the treatment × rep effect, year and year × treatment interactions were tested by treatment × year × rep effect, and date and its interaction terms were tested with the residual error term. Animal data were separated by breed because of missing calf subclasses within years (Romosinuano in all 3 yr but Angus in 1998 and 1999 only), and ADG, weaning weight, BCS, and hip height of calves were analyzed using a split-plot model and error terms as indicated for pasture parameters. Cow data were handled the same as calf data except all dams nursing Romosinuano embryo transfer calves in 1997 were included in the Romosinuano data set that year.

RESULTS AND DISCUSSION

In all 3 yr, rainfall was below average in the month (May) preceding the grazing period (Fig. 1), and only in 1999 did rainfall during the grazing period (June–September) approach or exceed normal amounts. In spite of this, forage DM availability on the base pastures (Fig. 2) was similar (P > 0.05) for 1997, 1998, and 1999 (avg. 2.81, 2.63, and 3.13 Mg ha⁻¹) and for creep and no-creep treatments (2.84 and 2.87 Mg ha⁻¹). There was a year × date interaction (P < 0.0001) due to forage DM not increasing as much in July 1998 as it did in 1997 or 1999 even though stocking density, at approximately two cow–calf pairs per hectare of grass area, was lowest that year. This indicates that in spite of the variable stocking density (approx. 50% higher in 1999 than the two previous years), herbage growth rate exceeded animal intake during the 84-d period and forage quantity on base pastures was not limiting to animal performance.

Forage DM availability in the creep areas, which averaged approximately 3.0 Mg ha⁻¹, was similar to what has previously been reported for mixed grass–RPP swards under grazing during the summer at this location (Valencia et al., 2001). As with the base pastures, there was a year × date interaction (P < 0.0001) for forage DM availability in creep areas due to rainfall distribution (Fig. 2); but regardless of year, forage DM availability increased each year after the grazing started, indicating that calves should have been able to exhibit a high degree of selective grazing throughout the grazing season (Matches and Burns, 1995). This ability to be selective was important because the creep areas were not pure RPP.

The creep area was composed mainly (approx. 60%) of bahiagrass and common bermudagrass, and this
Fig. 2. Base pasture and creep area dry matter (DM, g kg\(^{-1}\)) availability during the 1997–1999 grazing season. Bars represent standard error.

Fig. 3. Botanical composition of creep area during grazing the 1997–1999 season. Bars represent standard error.

Fig. 4. Crude protein (g kg\(^{-1}\)) concentration and in vitro organic matter disappearance (IVOMD, g kg\(^{-1}\)) of base pasture during the 1997–1999 grazing season. Bars represent standard error.

centage did not differ \((P > 0.05)\) across years (Fig. 3) or dates within years. Forbs constituted a minor component (avg. 7%) of the sward and, as with the grass, did not differ \((P > 0.05)\) across years or dates. There was a year \(\times\) date interaction for percentage forb due to a higher forb (>10%) content in June 1998 than any other year (3 and 5% in 1997 and 1999, respectively) and was probably due to the drier conditions that year in June compared with the other years. Rhizoma perennial peanut constituted about 30% of the sward and did not differ \((P > 0.05)\) across dates during the grazing season any year. There was a year effect \((P = 0.004)\), with RPP declining from 36% in 1997 to 28% in 1999 (Fig. 3). Reasons for this decline are unknown and may represent only long-term variation in RPP content of mixed swards due to cyclical droughts. Visual observation of the stand does not indicate that there has been a continued decline in RPP content since 1999 (M.J. Williams, personal observation, 2002).

As would be expected, creep- or no-creep-grazing treatment did not affect \((P > 0.05)\) the nutritive value of base pastures, but there was a year \(\times\) date interaction \((P < 0.0001)\) for both CP and IVOMD (Fig. 4). This type of interaction was similar to what has been observed with other grazing studies at this location (Williams et al., 1991; Bennett et al., 1999; Valencia et al., 2001) and is a consequence of yearly variation in onset of summer rains and relative drought. Studies have shown that factors that limit growth rate of tropical grasses slow the rate of nutritive value decline (Minson and Wilson, 1980). The general trend for both CP and IVOMD was to decline as the season progressed and can be attributed to increasing maturity of the herbage and to changes in leaf/stem ratio. Minimal nutritive values were similar to what has previously been reported for bahiagrass (Moore et al., 1969; Williams et al., 1991).
Similar to what was observed in the base pastures, there was a year \times date interaction \((P < 0.001)\) for both CP and IVOMD of both the grass and RPP component of the creep grazing areas (Fig. 5 and 6). The major difference between the base pasture and the creep areas was the presence of RPP, which had consistently higher nutritive value \((P = 0.0002)\) than the associated grass. Rhizoma perennial peanut was usually 60 mg kg\(^{-1}\) higher for CP and 200 mg kg\(^{-1}\) higher for IVOMD at all dates compared with the associated grass (97.7, 200, and 106.5 g kg\(^{-1}\) CP for 1997, 1998, and 1999, respectively). The difference between the CP and IVOMD of the creep grazing areas (Fig. 5 and 6). The major difference between the base pasture and the creep areas was the presence of RPP, which had consistently higher nutritive value \((P = 0.0002)\) than the associated grass. Rhizoma perennial peanut was usually 60 mg kg\(^{-1}\) higher for CP and 200 mg kg\(^{-1}\) higher for IVOMD at all dates compared with the associated grass (97.7 mg kg\(^{-1}\) CP and 415.8 mg kg\(^{-1}\) IVOMD) and never declined below 120 g kg\(^{-1}\) CP and 580 g kg\(^{-1}\) IVOMD.

Averaged across observation dates, there was a bimodal distribution of calf presence during daylight hours on creep areas all years (Fig. 7). This distribution is similar to what was found previously by Hammond and Olson (1994) with mature cattle during daylight hours at this location. In that study, a third grazing period was noted to occur between 2400 and 0300 h, and it would be assumed that the calves in this study exhibited a similar night grazing period, but this cannot be verified. Calves were not observed on the creep area as much in 1998 as the other two years (Fig. 7). The reason calves utilized the creep area less in 1998 than the other years is unknown but may be related to the CP of the base pasture remaining higher \((P = 0.04)\) in 1998 due to drought (108.9, 126.3, and 106.5 g kg\(^{-1}\) CP for 1997, 1998, and 1999, respectively).

During 1998 and 1999, when purebred Angus calves were present, we observed less than 10% of the potential number of Angus calves utilized the creep area at any observation period compared with as many as 50% of the Romosinuano calves. One explanation could be that the Angus calves shifted their grazing activity into nighttime hours to avoid the heat of the day. Hammond and Olson (1994) showed that non-tropically adapted cattle had higher rectal temperatures than tropically adapted cattle, and there was a trend for non-tropically adapted cattle to shift their grazing activity to nighttime hours. The Romosinuano is a tropically adapted \(B. taurus\) breed native to Colombia (Hammond et al., 1996; Chase et al., 1998). Another possibility is that the nutrient requirements of the Romosinuano calves were not being met by their dam’s milk production as well as the Angus calves. Lower milk production of Romosinuano cows compared with Angus cows (S.W. Coleman, unpublished data, 2002) supports the latter explanation.

While on the creep area, calves were observed to almost exclusively selectively graze RPP (M.J. Williams, personal observation, 1997–1999). Previous diet composition work with mixed RPP–grass swards has shown that cattle will selectively graze RPP, particularly in the late summer and fall when nutritive value of tropical grasses declines (Bennett et al., 1995; Valencia et al., 2001). Although there was a decline of 8% units in RPP content in the creep area swards from 1997 to 1999, lack of significant date or year \times date interaction for RPP content indicates that RPP was not limiting any year.

There was no effect of creep- or no-creep-grazing treatment or its interaction with year or date on Angus calf weight, hip height, BCS, PUN, or season-long ADG (Table 1). Lack of treatment difference for Angus reflects the general lack of utilization of the creep area that was noted for this breed during daylight hours and suggests little nighttime creep grazing occurred.

The creep- or no-creep-grazing treatment or its interaction with year or date also did not affect hip height or
Table 1. Least square means for average weight, hip height, body condition score (BCS), plasma urea N (PUN) across years and dates, and full-season average daily gain (ADG) of Angus and Romosinuano (Romo) calves across years.

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<th>Creep</th>
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<td>Weight, kg</td>
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<td></td>
<td>Hip height, cm</td>
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<td></td>
<td>Season ADG, kg/d</td>
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<td>0.66</td>
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<td>5.9</td>
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<td>Season ADG, kg/d</td>
<td>0.77</td>
<td>0.91</td>
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† Angus, 2-yr average; Romo, 3-yr average.
‡ Parameter means within rows differed (P < 0.06).

weight of Romosinuano calves (Table 1). Interestingly, PUN also did not differ (P > 0.05, Table 1) for Romosinuano calves even though they were observed selectively grazing RPP. In previous studies with yearling cattle, PUN levels were always higher when grazing RPP compared with bahiagrass (Williams et al., 1991; Bennett et al., 1995). Plasma urea N levels on average were high, >11 mg dL⁻¹ for all calves regardless of their creep or no-creep treatment status, and probably reflected more the milk component of their diet than the forage component (Hammond, 1997; Hammond et al., 1993).

There was a trend (P = 0.06) for treatment to affect season-long ADG of Romosinuano calves. Calves on creep treatment gained on average 0.14 kg d⁻¹ more than calves just grazing bahiagrass pastures (Table 1). This improvement in gain was similar to that previously reported from RPP creep by Ocumpaugh (reported in French et al., 1987) and for ‘Tifleaf 1’ pearl millet [Pennisetum americanum (L.) Leeke] or hairy indigo (Indigofera hirsuta L.) creep grazing reported by Ocumpaugh and Dusi (1981). There was a treatment × year × date interaction (P = 0.005) for 28-d ADG, with the greatest difference in ADG due to creep grazing occurring during the last grazing period in August, particularly in 1997 and 1999 when utilization was highest (Fig. 8). On average, BCS did not differ (P > 0.05) due to treatment (Table 1), but there was a grazing treatment × date interaction (P = 0.02) that reflected improving BCS for Romosinuano calves on creep treatment as the season progressed (Fig. 9). Excessively increased BCS in heifers is not necessarily desirable because fat deposition in mammary tissue can be detrimental to subsequent milk production (Buskirk et al., 1996).

As expected, because the Angus calves did not utilize the creep area, none of the cow parameters measured for the Angus cows was affected by grazing treatment (Table 2). Unlike the 20-kg difference reported by Ocumpaugh (reported in French et al., 1987) for dams of calves utilizing RPP creep, there was only about a 5-kg difference in weight of Romosinuano cows due to treatment (Table 2). This was not significant and is explained by a lack of any difference in full-season ADG due to grazing treatment (0.13 vs. 0.04 kg d⁻¹ creep vs. no creep, respectively, P > 0.05). For all other cow parameters measured for Romosinuano cows, there was no effect (P > 0.05) of grazing treatment, nor were there any grazing treatment × year, grazing treatment × date, or grazing treatment × year × date interactions.

Table 2. Least square means for average weight, hip height, body condition score (BCS), plasma urea N (PUN) across years and dates, and full-season average daily gain (ADG) of Angus and Romosinuano (Romo) cows across years.

<table>
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† Angus, 2-yr average; Romo, 3-yr average.
‡ Includes Angus cows nursing Romosinuano embryo transfer calves in 1997.
CONCLUSIONS

Calf performance was variable in part due to yearly variation in utilization and, possibly, breed effect. Improvements in calf gains and body weight due to creep-grazing RPP were similar to what had been previously reported for RPP, but no effect on cow parameters was noted. For the calves that utilized the creep area, the benefits due to creep grazing were greater later in the grazing season as quality of the bahiagrass base pasture and cow milk production declined.

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