# Seasonal herbage and animal production from three *Cynodon* species

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## Abstract

Pastures of 'Callie Hybrid 35-3' bermudagrass (*C. dactylon*, Callie), 'Florico' and 'Florona' stargrasses (*C. nlemfuensis* var *nlemfuensis*) were grazed rotationally by yearling steers from May to December of 1986, 1987 and 1988 in south Florida to compare herbage production, nutritive value and animal performance. Mean seasonal herbage accumulation was 12.8, 16.6 and 18.4 t/ha and carrying capacity was 1330, 1450 and 1550 kg/ha/d LW for Callie Hybrid 35-3, Florico and Florona, respectively. The mean *in vitro* dry matter digestibility level in the accumulated herbage of Florico was higher than Florona and Callie Hybrid 35-3. Mean daily liveweight gain for steers on Florico (0.5 kg/d) was higher than Callie Hybrid 35-3 (0.38 kg/d) and Florona (0.42 kg/d) pastures. Seasonal liveweight gains on Florico (742 kg/ha) and Florona (655 kg/ha) were higher than Callie Hybrid 35-3 (495 kg/ha).

## Resumen

*Con el fin de comparar la producción forrajera, el valor nutritivo y el desempeño animal, se pastoreo en forma rotacional las pasturas 'Callie Hybrid 35-3' pasto bermuda (*C. dactylon*), 'Florico' y 'Florona' pasto estrella (*C. nlemfuensis *var.* nlemfuensis*) con novillos de año, durante Mayo a Diciembre de 1986, 1987 y 1988 al sur de Florida. El promedio estacional de acumulación de forraje fue 12.8, 16.6 y 18.4 t/ha y la capacidad de carga fue 1330, 1450 y 1550 kg/ha/d peso vivo (PV) en las pasturas Callie Hybrid 35-3, Florico y Florona respectivamente. El nivel medio de la digestibilidad* in vitro *de la materia seca del forraje acumulado de Florico fue mayor que el de Florona y Callie Hybrid 35-3. La ganancia de peso promedio diaria de los novillos en pasturas de Florico (0.5 kg/d) fue superior a la obtenida en las pasturas de Callie Hybrid 35-3 (0.38 kg/d) y Florona (0.42 kg/d). Las ganancias de peso estacional en las pasturas de Florico (742 kg/ha) y Florona (655 kg/ha) fueron mayores que en Callie Hybrid 35-3 (495 kg/ha).*

## Introduction

Evaluation trials in south Florida indicate that 'Florico' and 'Florona' stargrasses (*Cynodon nlemfuensis* var. *nlemfuensis*) and 'Callie Hybrid 35-3' bermudagrass (*C. dactylon*), an experimental cultivar, have the potential for higher forage production and persistence under grazing in comparison with 'Ona' stargrass (*C. nlemfuensis* var. *nlemfuensis*), a commercial cultivar (Mislevy *et al.* 1980; Mislevy 1988; Kalmbacher *et al.* 1987). Their higher levels of crude protein and *in vitro* organic matter digestibility (IVOMD) were also reported as desirable attributes. As the quality of a forage is better assessed in terms of animal output (Moore 1980), this study was conducted to compare both seasonal forage production and animal performance on these pasture grasses.

## Materials and methods

### *Site*

The experiment was conducted over 3 grazing seasons (May to December of 1986 to 1988) at the University of Florida's Ona Agricultural Research and Education Center (27°25'N, 81°55'). The soil at the experimental site was a Pomona fine sand (sandy siliceous, hyperthermic Ultic Haplaquod), with a pH of 6.5. Mean maximum and minimum temperatures were 30.1 and 18.7°C, respectively, during the study period. Monthly rainfall totals during the 3 grazing seasons are presented in Table 1. The 1987 season was relatively dry.

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**Table 1.** Dates and days of grazing Callie Hybrid 35-3 bermudagrass, Florico and Florona stargrass pastures and monthly rainfall during the study period

| Year | Dates and days of grazing | | | | | |
|---|---|---|---|---|---|---|
| | Callie Hybrid 35-3 | | | Florico and Florona | | |
| | Start | End | Days | Start | End | Days |
| 1986 | 2 May | 24 Nov | 206 | 2 May | 24 Nov | 206 |
| 1987 | 21 May | 3 Dec | 196 | 21 May | 17 Dec | 210 |
| 1988 | 25 May | 21 Dec | 210 | 25 May | 21 Dec | 210 |

| | Monthly rainfall | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
| | | | | | (mm) | | | | |
| 1986 | 71 | 297 | 215 | 137 | 129 | 158 | 205 | 127 | 1160 |
| 1987 | 71 | 78 | 192 | 173 | 72 | 130 | 86 | 11 | 882 |
| 1988 | 87 | 219 | 219 | 324 | 217 | 49 | 43 | 23 | 1250 |
| 36-yr mean | 58 | 101 | 212 | 223 | 209 | 81 | 47 | 47 | 1078 |

*Treatments and experimental design*

There were 3 pasture treatments: Callie Hybrid 35-3 bermudagrass, Florico stargrass and Florona stargrass. These were replicated 4 times in a randomized block design. Four replications were used in 1986 and 1987 and only 2 in 1988 because a new trial was started on the other two replicates.

*Pastures*

Four 0.5 ha pastures of each of the grasses were established in June 1980. They were utilized for hay crop and grazing during the summers of 1981 to 1985. All pastures received annual applications of 23 kg/ha P, 90 kg/ha K and 20 kg/ha of a micronutrient mix (F-503) that supplied 0.3 kg B, 0.3 kg Cu, 1.8 kg Fe, 0.75 kg Mn, 0.02 kg Mo, and 0.7 kg Zn per hectare. Nitrogen was broadcast at an annual rate of 224 kg/ha in 4 equal applications in March, May, July and September. Prior to the commencement of the rains in the 1987 and 1988 seasons, the paddocks were topped and burnt.

*Grazing management*

Each pasture was divided into 3 equal size paddocks to allow a 42-d rotational grazing system with 14-d grazing and a 28-d resting periods. A modified put-and-take stocking system was used (Mott and Lucas 1952). Two yearling Brahman crossbred steers averaging 240, 245 and 260 kg/head in 1986, 1987 and 1988, respectively, were assigned as tester animals to each pasture each year. Grazers were added or removed at the end of each 42-d cycle, depending on forage availability. Steers had free access to mineralized salt and water.

Grazing dates and days for each grass over the study period are shown in Table 1. In 1987, grazing on Callie Hybrid 35-3 pastures was terminated earlier than Florico and Florona because growth was inadequate towards the end of the season.

*Animal and sward measurements*

Steers were weighed on 2 consecutive days at the start and end of each grazing season after overnight fasting. Weight data of testers were used to calculate daily liveweight gains. Carrying capacity was calculated using both tester and grazer animals (Mott and Lucas 1952). The gain per hectare was calculated as the product of daily liveweight gain and carrying capacity, adjusted for the average weight of the testers.

Three randomly placed 3 $m^2$ quadrats were cut from each pasture to a stubble height of 0.75 cm before and after grazing to estimate pregraze and postgraze herbage mass during the 1986 and 1987 seasons. Samples from cut quadrats were randomly taken, dried at 60°C for 48 h, ground to pass a 1 mm mesh for N and IVOMD analyses. Growth during each grazing was calculated from growth rates during the preceding rest period (Campbell 1966). Herbage-on-offer was estimated as the sum of the pregraze herbage mass and growth. Herbage accumulation during the rest periods was estimated by summing pregraze herbage mass over the season and subtracting the sum of all values of postgraze herbage mass except the last (Frame 1981).

**Table 2.** Seasonal herbage accumulation and carrying capacity of Callie Hybrid 35-3 bermudagrass (CH) and Florico (FC) and Florona (FO) stargrass pastures in 1986, 1987 and 1988

| Year | Herbage accumulation | | | Carrying capacity | | |
|---|---|---|---|---|---|---|
| | CH | FC | FO | CH | FC | FO |
| | | (t/ha) | | | (kg liveweight/ha/d) | |
| 1986 | 15.8c[1] | 18.5b | 20.1a | 1490b | 1470b | 1640a |
| 1987 | 9.7c | 14.6b | 16.6a | 1270b | 1490a | 1510a |
| 1988 | — | — | — | 1240c | 1400b | 1570a |
| Mean | 12.8c | 16.6b | 18.4a | 1330c | 1450b | 1570a |

[1]Means within years followed by the same letter do not differ significantly, P = 0.05.

### *Laboratory analyses of herbage*

Samples were digested for N determinations using a modification of the aluminium block digestion procedure (Gallaher) *et al.* 1975). Ammonia in the digestate was determined by semi-automated colorimetry (Hambleton 1977) and crude protein was calculated as N × 6.25. *In vitro* organic matter digestibility was determined by a modified two-stage procedure (Moore and Mott 1974).

### *Statistical analysis*

Data were analysed using the General Linear Model (GLM) procedure of the SAS system (SAS 1982). Means were separated using LSD at the 0.05 level of probability (Petersen 1985).

## Results

### *Herbage accumulation and carrying capacity*

Herbage accumulation differed between grasses (Table 2). Florona was the most productive in both years, whilst Callie Hybrid 35-3 was the least productive overall. Herbage accumulation was relatively higher in 1986 than in 1987.

Florona had the highest amount of herbage-on-offer in the earlier part of the season each year (Figure 1). While the herbage-on-offer of Callie Hybrid 35-3 was similar to Florico earlier in the season, it was much lower later in the season. There was a marked decrease in herbage-on-offer at the end of the season for all grasses.

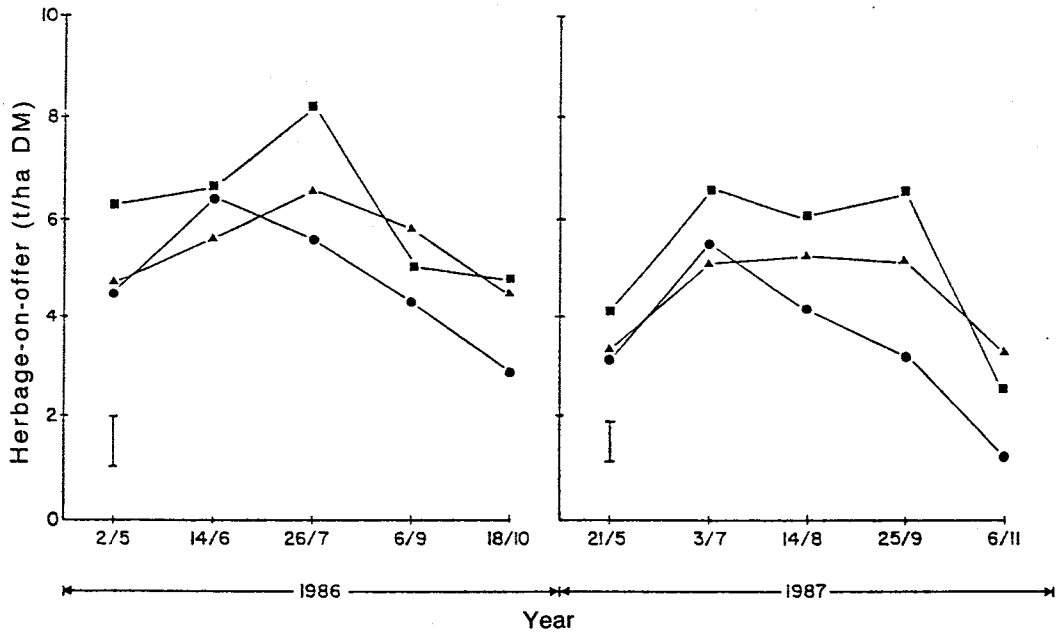


**Figure 1.** Seasonal profile of herbage-on-offer for Callie hybrid 35-3 bermudagrass (•), Florico (▲) and Florona (■) stargrass pastures under grazing in 1986 and 1987. Bars represent LSD (P = 0.05) for the date × grass interaction.

**Table 3.** Crude protein and *in vitro* organic matter digestibility (IVOMD) in accumulated herbage of Callie Hybrid 35-3 bermudagrass (CH) and Florico (FC) and Florona (FO) stargrass pastures in 1986 and 1987

| | Crude protein | | | IVOMD | | |
|---|---|---|---|---|---|---|
| Year | CH | FC | FO | CH | FC | FO |
| | | (%) | | | (%) | |
| 1986 | 7.9a[1] | 7.4a | 7.4a | 55.5a | 56.6a | 53.3b |
| 1987 | 9.2a | 10.1a | 7.9a | 52.6b | 57.1a | 52.0b |
| Mean | 8.2a | 8.8a | 7.7a | 54.1b | 56.9a | 52.7c |

[1]Means within years followed by the same letter(s) do not differ significantly, P = 0.05.

**Table 4.** The average daily and seasonal liveweight gain of steers grazing Callie Hybrid 35-3 bermudagrass (CH) and Florico (FC) and Florona (FO) stargrass pastures in 1986, 1987 and 1988

| | Daily gain | | | Seasonal gain | | |
|---|---|---|---|---|---|---|
| Year | CH | FC | FO | CH | FC | FO |
| | | (kg/d) | | | (kg/ha) | |
| 1986 | 0.30b[1] | 0.48a | 0.37b | 446c | 717a | 583b |
| 1987 | 0.48b | 0.62a | 0.49b | 604c | 919a | 750b |
| 1988 | 0.35b | 0.43a | 0.41a | 434b | 591a | 633a |
| Mean | 0.38b | 0.51a | 0.42b | 495b | 742a | 655a |

[1]Mean within years followed by the same letter do not differ significantly, P = 0.05.

The mean carrying capacity was higher on the Florona than the Florico and Callie Hybrid 35-3 pastures, being significantly higher in 1986 and 1988. In 1987 and 1988 both Florico and Florona had higher carrying capacity than Callie Hybrid 35-3.

### *Nutritive value of the accumulated herbage*

Overall, Florico had a higher IVOMD than Florona and Callie Hybrid 35-3 but was not higher than Callie Hybrid 35-3 in 1986. Florona had a lower IVOMD than Florico in both years. The levels of crude protein in the accumulated herbage were similar for all grasses in 1986 and 1987 (Table 3).

### *Liveweight gain*

Mean daily liveweight gains of steers were higher on Florico than on Florona and Callie Hybrid 35-3 throughout the study (Table 4). Daily gains on Florona were only higher than Callie Hybrid 35-3 in 1988. Daily liveweight gains were higher in 1987 than in 1986 and 1988. The same trends were evident in seasonal liveweight gain though Florico was not significantly different from Florona in 1988 (Table 4). Again seasonal liveweight gains were generally higher in 1987 compared to 1986 and 1988.

## Discussion

### *Herbage production*

Accumulated herbage of 16.6 and 18.4 t/ha for Florico and Florona respectively were in the upper side of the range of 11.4 to 19.9 and 10.8 to 20.4 t/ha for Florico and Florona reported by Mislevy *et al.* (1982). The exact reason for the low herbage accumulation of Callie Hybrid 35-3 is not known. The drier conditions in the 1987 growing season partly accounts for the low herbage accumulation in that year compared with 1986.

Carrying capacity is a measure of forage quantity under the put-and-take management system (Mott and Lucas 1952). Thus the lower carrying capacity on Callie Hybrid 35-3 was a direct reflection of the relatively low herbage accumulation, as well as the short grazing season in 1987. The mean carrying capacity values for the 3 grasses were higher than the 969 liveweight/ha/d reported for Ona stargrass (Hodges *et al.* 1976) and 829 to 975 kg liveweight/ha/d for McCaleb (*C. aethiopicus* cv McCaleb), Sarasota (*C. dactylon* var. *coursii*) stargrass and Callie bermudagrass (*C. dactylon* var. *aridus*) in south Florida (Adjei *et al.* 1980; Pitman *et al.* 1984).

*Nutritive value of the accumulated herbage*

In tropical forages, crude protein within the ranges of 6.0 to 8.0% or below may reduce forage intake below that limited by rumen distention (Minson 1980). Crude protein levels did not seem to have been a limiting factor to herbage consumption in this study, since steers might have selected diets of higher nutritive value than the accumulated herbage. Lack of differences in crude protein levels between grasses is quite common (Mislevy *et al.* 1982; Kalmbacher *et al.* 1987).

Higher IVOMD of Florico than Florona has been reported previously (Brown *et al.* 1988), and has been attributed to high retention of senescent leaves in Florona swards (Larbi 1989). In contrast, Kalmbacher *et al.* (1987) found no significant differences in the IVOMD of 35-d regrowth of Florico and Florona. Since grasses were similar in crude protein, the differences in IVOMD could partly account for the differences in daily liveweight gain. Pitman *et al.* (1984) reported significant correlations between daily liveweight gain and IVOMD for Callie bermudagrass and Sarasota stargrass.

*Liveweight gain*

While the higher ADG on Florico compared with Florona can be partly attributed to higher IVOMD, the differences in daily liveweight gains between Callie Hybrid 35-3 and Florico were probably due to differences in herbage accumulation. Daily liveweight gains in the present study (Table 4) were similar or higher than those reported for other stargrasses in south Florida (Hodges *et al.* 1976, 1979; Adjei *et al.* 1980; Pitman *et al.*; 1984 and Brown *et al.* 1988).

Low rainfall in the 1987 grazing season (Table 1) was partly responsible for the relatively higher daily liveweight gains (Table 4). Evans and Wilson (1984) reported higher daily liveweight gains for cattle on *Setaria sphacelata, Digitaria decumbens* and *Pennisetum clandestinum* pastures in the dry compared to the wet season in Australia. The mean seasonal gains in this study (Table 4) for Florico and Florona were slightly higher than reported previously (Hodges *et al.* 1976, 1979; Adjei *et al.* 1980, Pitman *et al.* 1984 and Brown *et al.* 1988).

This study has shown that Florico and Florona stargrass pastures have a higher potential for grazing than Callie Hybrid 35-3 due to their longer grazing days and higher forage accumulation. Florico was superior to Florona, in terms of liveweight gain and IVOMD. These higher quality *Cynodon* species offer a further option for interested producers.

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