Forage Yield of Five Grasses Under Intensive Grazing Management in the Humid Region of Puerto Rico[1,2]

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ABSTRACT

Three grasses on intensively managed and grazed 10 × 10 m plots produced statistically similar yields of dry forage over a 3-year period expressed in kg/ha/yr as follows: Stargrass—12,445; Coast Cross #1—12,285; and *Hemarthria* PI 299995—13,685. *Hemarthria* PI 299994 produced significantly higher yields—15,370 kg/ha/yr. *Cynodon plectostachyus*, on the other hand, did not tolerate intensive grazing and produced only 4,695 kg/ha during the second year. Yields of Star and *Hemarthria* PI 299995 were comparable to yields obtained in a large scale grazing experiment nearby, which confirmed the validity of the small experimental plot technique in determining yield potential of grazed forage grasses.

INTRODUCTION

The productivity of many of the best known tropical grasses in terms of carrying capacity and milk or meat production, has been determined in numerous grazing experiments on steep Ultisols in the humid mountain region of Puerto Rico. Caro-Costas et al. (3) determined the productivity of intensively managed Para (*Brachiaria purpurascens* (Raddi) Hnr.), Molasses (*Melinis minutiflora* Beauv), Guinea (*Panicum maximum* Jacq.), Pangola (*Digitaria decumbens* Stent), and Napier (*Pennisetum purpureum* Schumach) grass pastures. Pangola, Guinea and Napier grass pastures produced similar weight gains, outyielding those of Para and Molasses pastures. Caro-Costas et al. (2) found that Star grass (*Cynodon nlemfuensis*) pastures produced higher weight gains than did those of Pangola grass. Caro-Costas et al. (4) found that Star grass pastures produced higher weight gains than did those of Congo (*Brachiaria ruziziensis*), or Pangola grass.

The numerous experiments conducted in Puerto Rico to determine the productivity of Napier, Pangola, Guinea, Star, Congo and Para grasses under cutting management have been summarized by Vicente-Chandler et al. (7, 8). The performance of these grasses under cutting was often different from performance with grazing management.

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Many other grasses have been introduced to Puerto Rico, yet there is little information on their productivity with grazing management under local conditions similar to those of vast areas in the humid tropics.

Determining the productivity of grasses when harvested by cutting is relatively easy, but such experiments do not provide reliable information on their performance under grazing conditions, which includes selective grazing by the cattle, trampling of the forage, soil compaction and voiding of urine and feces. On the other hand, it is very costly to evaluate large numbers of grasses when their productivity is determined in full scale grazing experiments in terms of carrying capacity and milk or meat production.

Vicente-Chandler, et al. (9) devised a low cost method for determining the performance of grasses or the effect of management systems on forages under actual grazing conditions. This system has been successfully used by Vicente-Chandler et al. (9) and Rodríguez and Silva (5) to determine the effect of grazing heights and intervals on the performance of Pangola and Star grasses, and by Rodríguez, et al (6) to compare the productivity of four grasses under grazing management. In the latter study, results obtained with this technique were comparable to those obtained in nearby large scale grazing experiments with three of these grasses.

The present study determined the production of dry forage by five tropical grasses under actual grazing conditions using the above mentioned techniques.

MATERIALS AND METHODS

The experiment was conducted over a 3-yr period (July 1, 1975–June 30, 1978) at the Corozal Substation. Elevation is about 200 m and average annual temperature is about 25° C with seasonal variations of about 4° C. The soil is Corozal clay (Aquic Tropudults), on a 25% slope.

The five grasses listed in table 1 were tested in 10 × 10 m plots replicated five times in a randomized block design. A solid stand was established in each plot; the soil was limed to about pH 5.5. A 15-5-10 fertilizer was applied at the rate of 2.2 metric tons/ha/yr divided in four equal applications.

The plots, each surrounded by a barbed and chicken wire fence to prevent cattle from grazing adjacent plots, were grazed at 3- to 4-week intervals. One Holstein heifer was confined to each plot until the grass had been grazed to a height of about 15 cm, a period of 1 to 2 days.

The forage consumed by the cattle in each plot at each grazing was determined as follows: Five pairs of 0.4 m^2 sampling areas, which were representative of the forage in the plots, were located in each plot before each grazing round. The forage in one of each pair was cut to a height of

TABLE 1.—*Productivity of five grasses under grazing management in the humid region of Puerto Rico*

Grass	Yields of dry forage (kg/ha/yr)				Nearby large grazing experiments[1]
	1975–76	1976–77	1977–78	Average	
Star (*Cynodon nlemfuensis*)	13,145 b[2]	12,610 a	11,580 a	12,445 b	13,820
Coast Cross #1 (*C dactylon*)	13,575 b	13,420 a	12,860 a	12,285 b	—
Cynodon plectostachyus	13,970 b	4,695 b	—	—	—
Greenalta (*Hemarthria altissima*)—PI 299994)	17,970 a	13,420 a	14,720 a	15,370 a	—
Bigalta (*Hemarthria altissima*—PI 299995)	15,180 b	11,800 a	14,080 a	13,685 b	12,740

[1] From Caro-Costas (1).

[2] Values followed by the same letter do not differ significantly at the 5% level. (Duncan's new multiple range test).

5 cm, dried, and weighed. These data provided an estimate of the quantity of forage available to the grazing cattle. After grazing, the forage in the remaining five sampling areas was also cut to a height of 5 cm, dried, and weighed. These data provided an estimate of the forage remaining after grazing. The forage consumed by the grazing cattle was calculated by substracting the quantity of forage remaining on the plots after grazing from that available before grazing. This procedure was repeated over a 3-year period providing a total of over 40 yield determinations in each plot.

RESULTS AND DISCUSSIONS

Annual rainfall was similar during the first and third years, averaging 1,755 mm, but there was only 1,198 mm during the second year (table 2). Monthly rainfall varied from as low as 35 mm to as high as 378 mm.

Hemarthria PI 299994 outyielded all the grasses, averaging 15,370 kg of dry forage/ha/yr (table 1). There were no significant differences in the productivity of Star, Coast Cross #1 and *Hemarthria* PI 299995.

Cynodon plectostachyus produced much lower yields than did any of the other grasses during the second year. Apparently this grass could not tolerate the intensive management and grazing and the plots had to be excluded from the experiment during the third year due to the very poor stand.

Yields of forage consumed by the cattle in this experiment were similar to those in a nearby large scale grazing experiment (1). To make this comparison the total digestible nutrients produced/ha/yr in the large grazing experiment were calculated from the number of head carried/ha, their weight, and the weight gains made. It was assumed that 0.8 kg of total digestible nutrients is required daily for maintenance per 100 kg of liveweight and 3.53 kg for each kg of weight gain. The dry forage

TABLE 2.—*Monthly rainfall at the experiment site (mm)*

Month	First year	Second year	Third year
July	74	35	165
August	178	96	315
September	183	131	103
October	201	378	98
November	273	57	295
December	280	90	49
January	97	122	35
February	119	20	68
March	130	49	128
April	145	98	276
May	78	80	89
June	35	42	95
Total	1,793	1,198	1,716

consumed by the grazing cattle was then calculated from these data assuming that the ingested forage was 55% digestible as indicated by the experiments summarized by Vicente-Chandler et al. (7, 8).

Table 1 shows that in the large grazing experiment, Star grass produced an average of 13,820 kg of dry forage/ha/yr compared to 12,445 kg/ha/yr in the experiment discussed in this paper. *Hemarthria* PI 299995 produced 12,740 kg of dry forage/ha/yr in the large grazing experiment compared to 13,685 kg/ha/yr in the present experiment.

There is thus reasonable agreement between forage yields produced in the large scale grazing experiment and those produced using the small enclosures and techniques described in this paper.

RESUMEN

Se determinó el forraje producido por cinco gramíneas pastadas en parcelas repetidas de 10 × 10 m en un experimento de tres años en Corozal.

Hemarthria PI299994 produjo rendimientos significativamente más altos, 15,370 kg de forraje seco/ha y año, que los de las otras gramíneas. No hubo diferencia significativa entre la producción de las siguientes gramíneas expresada en kg de forraje seco/ha y año: Estrella, 12,445; Bermuda Coast Cross #1, 12,285; *Hemarthria* PI 299995, 13,685. De otro lado, la *Cynodon plectostachyus* no toleró el pastoreo intensivo practicado en este experimento y sólo produjo 4,695 kg de forraje seco/ha durante el segundo año, por lo cual se descartó el tercer año.

La producción de forraje por las yerbas Estrella y *Hemarthria* PI 299995 fue comparable a la obtenida en un experimento de pastoreo adyacente con parcelas de 0.4 ha.

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