

# Comparison of Heavily Fertilized Congo, Star and Pangola Grass Pastures in the Humid Mountain Region of Puerto Rico<sup>1, 2</sup>

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## ABSTRACT

The productivity of intensively managed pastures of Congo, Star, and Pangola grasses was compared in the mountain region of Puerto Rico under conditions typical of vast areas in the humid tropics. Stargrass produced higher weight gains (1,274 lb/acre (1,427 kg/ha) yearly) and had a higher carrying capacity (2.91/600-lb steers/acre or 7.27/273-kg steers/ha) than did Congo or Pangola grasses, which were similar in both these respects. Apparent *in vitro* digestibility (66%) and protein content (21.1%) of Stargrass was higher and lignin content (4.6%), lower than that of Congo or Pangola.

## INTRODUCTION

Stargrass (*Cynodon nlemfuensis*)<sup>4</sup> is rapidly becoming the most widely planted pasture grass in Puerto Rico; Pangolagrass (*Digitaria decumbens*) has been used extensively on the island for many years; but Congograss (*Brachiaria ruziziensis*) has been planted only on an experimental scale.

Caro, Abruña, and Figarella (2) determined the response of Stargrass (harvested by cutting) to N fertilization, harvest interval, and cutting height under conditions typical of the humid mountain region. Similar information was obtained for Congograss by Vicente-Chandler et al. (9) and for Pangolagrass by Vicente-Chandler and Figarella (8).

Caro, Vicente-Chandler, and Figarella (5) found that intensively managed Pangola, Guinea, and Napier grass pastures produced similar high beef yields, outyielding molasses and Para grass pasture in the humid mountain region of Puerto Rico. Caro, Abruña, and Vicente (3) found that intensively managed Stargrass pastures outyielded those of Pangolagrass in beef production and carrying capacity. Caro, Vicente-

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<sup>4</sup>Possibly a Puerto Rico cultivar of *Cynodon dactylon*.

Chandler, and Abruña (4) found that intensively managed Pangolagrass pastures responded to application of up to 2,400 lb/acre of 15-5-10 fertilizer (2,688 kg/ha) per year. Vicente-Chandler et al. (10) determined the effect of grazing interval and height on yields of Pangolagrass. Vicente-Chandler et al. (7) described the best methods for establishing and managing grasslands in Puerto Rico.

The present study was conducted to compare the productivity of intensively managed Congo, Pangola, and Star grass pastures growing on steep slopes under conditions typical of the humid mountain region of Puerto Rico, in terms of beef production and carrying capacity as well as yields and composition of the forage consumed by the grazing animals.

#### MATERIALS AND METHODS

The experiment was conducted over a 2-year period near Orocovis, at an elevation of about 2,000 ft (600 m) with a mean annual temperature of about 75° F (24° C) and a seasonal variation of less than 10° F (4° C). The soil was Humatas clay (Ultisol) with an average slope of 30%. A complete randomized block design was used with treatments replicated four times. Individual pastures, 1 acre in size, were provided with water and salt. The soil was limed to about pH 6.0, and 500 lb/acre (560 kg/ha) of 15-5-10 fertilizer were applied to all pastures every 3 months.

The pastures were grazed by young Holstein heifers initially weighing about 350 lb (160 kg) and replaced yearly. A different group of animals grazed the pastures of each grass species in rotation with 7 days of grazing followed by 21 days of rest. The heifers were treated periodically for parasites and received no feed other than that obtained from the pastures. Two "tester" heifers per acre were kept throughout the year and additional animals added as required to consume excess forage, using the "put and take" system.

Each time the heifers were moved from one pasture to another they were weighed. A record was kept of the grazing days and weight gains for each animal and each pasture. The total digestible nutrients (TDN) produced by each pasture were calculated from these data following recommendations of the Pasture Research Committee (1). Carrying capacity was also calculated and expressed in terms of 600-lb steers/acre (273-kg steers/ha).

During the first year of experimentation, eight areas (each 1 m<sup>2</sup>) in each pasture were cut to ground level before and after each grazing and the forage weighed and dried. The amount of dry forage actually consumed by the grazing cattle was determined from these data by difference. The areas cut in each grazing round were rotated to better reflect trampling and grazing effects.

Before each grazing, 10 forage samples were taken throughout each pasture by plucking to simulate grazing. These samples, which were considered to be typical of the forage consumed by the grazing cattle, were analyzed for crude protein, calcium, phosphorus, silica and lignin. In vitro digestibility of the samples was determined by R. J. Van Soest using his method (6).

During the second year two heifers were kept per acre throughout the year with no additional animals added during seasons of flush growth and only weight gains were determined.

### RESULTS AND DISCUSSION

Table 1 shows that rainfall was low for the area during both years of experimentation, averaging only 54.2 in (122 cm) with extended dry periods.

TABLE 1.—*Monthly rainfall at Orocovis during the 2 years of experimentation*

Month	First Year		Second Year	
	<i>In</i>	<i>Cm</i>	<i>In</i>	<i>Cm</i>
September	2.9	7.4	10.6	26.9
October	8.9	22.6	9.0	22.9
November	7.6	19.3	3.5	8.9
December	4.8	12.2	3.3	8.4
January	4.2	10.7	0.6	1.5
February	1.6	4.1	4.5	11.4
March	2.2	5.6	2.6	6.6
April	1.8	4.6	10.3	26.2
May	1.3	3.3	2.4	6.1
June	1.9	4.8	2.7	6.9
July	3.0	7.6	2.1	5.3
August	3.2	8.1	3.5	8.9
Total	53.4	135.6	55.1	140

Stargrass produced higher weight gain (1,274 lb/acre or 1,427 kg/ha per year) than did Congo or Pangola grasses which averaged 879 lb/acre (989 kg/ha) weight gain (table 2). Stargrass also produced highest average daily gain per head (1.29 lb or .59 kg).

Table 2 also shows that Stargrass produced more total digestible nutrients (TDN) (9,008 lb/acre or 10,089 kg/ha) per year and had a higher carrying capacity (2.91 600-lb steers/acre or 7.27 273-kg steers/ha) than did Congo or Pangola which averaged only 6,855 lb/acre (7,678 kg/ha) of TDN and a carrying capacity of 2.21 600-lb steers/acre (5.23 273-kg steers/ha).

This table also shows that Stargrass produced an average of 16,044 lb/acre (17,969 kg/ha) of dry forage yearly that was consumed by the grazing cattle compared to 13,687 lb/acre (15,329 kg/ha) for Pangola and 11,978 lb/acre (13,415 kg/ha) for Congo.

Apparent digestibility of the forage, calculated from the total digestible nutrients utilized by the cattle and the dry forage consumed, averaged 54.4% for the three grasses (table 2). The *in vitro* dry matter digestibility of Stargrass (table 3) was better than that of both Congo and Pangola grasses at all seasons of the year, averaging 66%. Pangola and Congo grasses had similar apparent dry matter digestibility, averaging 59.5% for the year. Dry matter digestibility of the grasses did not vary markedly with season of the year.

TABLE 2.—*Productivity of intensively managed Congo, Star, and Pangola grass pastures over a 1-year period at Orocovis*

Grass	Gain in weight yearly		Average daily gain per head <sup>1</sup>		Carrying capacity 600-lb <sup>2</sup> (273-kg) steers		Total digestible nutrients yearly <sup>3</sup>		Forage consumed by grazing cattle yearly		Apparent digestibility of consumed forage <sup>4</sup>
	Lb/acre	Kg/ha	Lb	Kg	Per acre	Per ha	Lb/acre	Kg/ha	Lb/acre	Kg/ha	%
Star	1,274	1,427	1.29	0.59	2.91	7.27	9,008	10,089	16,044	17,969	56.2
Pangola	913	1,023	1.18	0.54	2.26	5.65	6,996	7,836	13,687	15,329	51.1
Congo	845	946	1.04	0.47	2.17	5.43	6,715	7,521	11,978	13,415	56.1
LSD <sup>5</sup>	263	295	0.11	0.05	0.36	0.90	1,135	1,271	2,772	3,105	N.S.

<sup>1</sup> For testers cattle which remained on the pastures throughout the year.

<sup>2</sup> One 600-lb (273-kg) steer consumes 8.5 lb (3.86 kg) TDN daily.

<sup>3</sup> Calculated from body weight, days of grazing and weight gain following recommendations of the Pasture Research Committee (1).

<sup>4</sup>  $\frac{\text{Forage consumed}}{\text{TDN}} \times 100$

Table 3 shows that Stargrass had the lowest lignin content at all seasons (4.6% yearly average). Congograss had a lower lignin content (5.3% yearly average) than Pangola (6.3% yearly average) at all seasons. Lignin content of the grasses did not vary markedly with season of the year.

All three grasses had similar average silica contents (about 1.5%) which varied markedly with season of the year (table 3), ranging from .62 to 2.07% for Stargrass, from .80 to 2.18% for Pangola, and from .95 to 2.28% for Congograss. There was a strong tendency for silica content of the grasses to be lower during the seasons of flush growth (May–August).

Stargrass forage consumed by the grazing cattle had a higher crude protein content at all seasons of the year (21.1% yearly average) than did

TABLE 3.—Percent composition of Congo, Star, and Pangola grass samples obtained by plucking to simulate grazing, as affected by season of the year

Month	Apparent digestibility of dry matter <sup>1</sup>			Lignin			Silica			Crude protein			Phosphorus			Calcium		
	Star	Pangola	Congo	Star	Pangola	Congo	Star	Pangola	Congo	Star	Pangola	Congo	Star	Pangola	Congo	Star	Pangola	Congo
Nov./71	62	56	56	5.8	7.5	7.1	1.45	1.49	0.98	15.9	14.2	12.8	0.26	0.19	0.21	0.53	0.39	0.55
Dec./71	64	58	57	4.9	6.5	6.1	1.81	2.00	1.85	22.4	14.0	14.4	0.29	0.20	0.30	0.57	0.39	0.61
Jan./72	65	60	63	4.8	6.2	5.3	1.98	2.18	2.28	22.6	17.5	18.3	0.21	0.19	0.23	0.52	0.44	0.58
Feb./72	67	54	62	4.3	6.8	5.2	2.07	2.02	1.37	23.7	19.0	21.0	0.18	0.16	0.19	0.50	0.40	0.63
Mar./72	69	58	65	4.1	6.1	4.7	1.69	2.11	1.66	22.9	18.4	21.9	0.16	0.15	0.25	0.59	0.41	0.64
Apr./72	66	59	63	4.6	6.0	4.8	2.00	2.01	2.21	21.9	18.3	21.6	0.20	0.20	0.24	0.50	0.38	0.54
May/72	67	64	60	4.5	5.2	4.9	0.74	1.57	1.41	20.5	19.2	20.7	0.18	0.15	0.22	0.47	0.33	0.51
June/72	67	61	61	4.6	5.6	4.8	1.51	1.12	1.02	20.4	16.8	18.0	0.20	0.13	0.19	0.39	0.30	0.54
July/72	65	55	59	4.6	6.6	4.9	0.62	0.80	1.64	18.2	13.4	15.3	0.21	0.15	0.21	0.39	0.35	0.44
Aug./72	66	59	60	4.1	6.1	4.6	0.94	1.04	0.95	22.4	14.8	15.3	0.21	0.21	0.21	0.43	0.40	0.46
Average	66	58	61	4.6	6.3	5.3	1.48	1.58	1.54	21.1	16.6	17.9	0.21	0.17	0.23	0.49	0.38	0.55

<sup>1</sup> Determined by the "in vitro" method of Van Soest et al. (6).

Congo or Pangola grass which averaged 17.2% (table 3). It also had a rather uniform protein content throughout the year, which dropped below 20% only twice. Protein content of Congograss varied considerably throughout the year from a low of 12.8% in November, when it blooms profusely, to 21.9% in March–April.

Pangolagrass consumed by the cattle almost always had a lower P content than did Congo or Star grasses (table 3). Yearly average P contents were .17, .23 and .21% for Pangola, Star and Congo grasses, respectively.

Pangolagrass also had a lower Ca content at all seasons of the year than did Congo or Star grasses. Yearly average Ca contents were .38, .55 and .49% for Pangola, Congo, and Star grasses, respectively.

During the second year of grazing, when all grasses were stocked with 2 head/acre (5 head/ha) throughout the year, the three grasses produced an average of 1,050 lb/acre (1,176 kg/ha) per year weight gain (table 4).

TABLE 4.—*Productivity of Congo, Star, and Pangola grass pastures over a second 1-year period of grazing at Orocovis during which all pastures were stocked at a fixed rate of 2 head/acre throughout the year*

Grass	Weight gain		Average daily gain per head	
	Lb/acre	Kg/ha	Lb	Kg
Star	1,134	1,270	1.60	0.73
Pangola	1,085	1,215	1.53	0.70
Congo	932	1,044	1.31	0.60
LSD <sup>05</sup>	N.S.	N.S.	0.12	0.05

All the cattle had very high weight gains, but those on Star and Pangola grasses had higher daily weight gains per head (an average of 1.56 lb/d or .71 kg) than did those on Congograss which averaged 1.31 lb/d (.60 kg). Stargrass was much more susceptible to attacks by the fall army worm (*Tophygya frugiperda*) than were Congo or Pangola.

#### RESUMEN

Se determinó la producibilidad de pastos de las yerbas Congo, Estrella y Pangola cultivados intensivamente bajo condiciones típicas de la región montañosa de Puerto Rico y representativos de grandes extensiones en los trópicos húmedos aunque el período experimental fue más seco que lo normal para la región.

La yerba Estrella produjo mayores ganancias de peso (1,274 libras por acre ó 1,427 Kg./Ha. el año), y tuvo una mayor capacidad de pastoreo (2.91 novillos de 600 libras de peso por acre ó 7.28 novillos de 273 Kg./Ha.), que las yerbas Congo y Pangola las que tuvieron producciones similares en estos renglones. La digestibilidad in vitro de la yerba Estrella fue más elevada (66 por 100) y el contenido de lignina más bajo (4.6 por 100) que los

de la yerba Congo y Pangola. La yerba Estrella tuvo un contenido en proteína mayor durante todas las épocas del año (un promedio de 21.1 por ciento durante el año) que las otras yerbas. La yerba Pangola tuvo un contenido más bajo de fósforo y calcio que la Congo y Estrella. El contenido medio en sílice de las tres yerbas fue similar.

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