

COMPARISON OF GUINEA GRASS-TROPICAL KUDZU, PARÁ GRASS, PANGOLA GRASS, AND ST. AUGUSTINE GRASS AS PASTURE CROPS IN THE YABUCOA VALLEY IN EASTERN PUERTO RICO¹

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INTRODUCTION

Puerto Rico is rather a small Island but with very marked soil and climatic differences between regions. Therefore it was decided to extend the Station's work on pasture improvement and evaluation to regions of the Island other than the north coast where the Main Station is located. Hence, an experiment was carried out on a farm of Agripino Roig, at Yabucoa. This experiment lasted for 2 years.

LITERATURE REVIEW

The carrying capacity of Pará grass in a well-drained soil on the Agricultural Experiment Station's Farm, at Río Piedras, was determined as one-half an adult head per acre (1)³. Because of the topography of the soil and a prolonged drought this was a rather brief experiment. The carrying capacity of an unfertilized Guinea grass-tropical kudzu mixture in the same location was found to be one adult head per acre (4). The results obtained demonstrated that this grass-legume combination is a very desirable pasture crop.

Unpublished results for fertilized St. Augustine grass pasture on the same farm (5) showed a carrying capacity of nearly one adult head per acre. This grass matures very fast, becoming hard and unpalatable.

¹ This is the fifth in a series of papers published under the general title: The utilization of grasses, legumes, and other forage crops for cattle feeding in Puerto Rico. Previous papers in this series appeared as follows: I, Comparison of Guinea grass, Pará grass "Malojillo", and a mixture of Pará grass and tropical kudzu as pasture crops, L. Rivera-Brenes, *J. Agr. Univ. P. R.* **31** (2) 180-89 1947. II, Comparison of fertilized guinea grass, Pará grass and tropical kudzu, and tropical kudzu alone as pasture crops, L. Rivera-Brenes, F. J. Marchán, and J. I. Cabrera, *J. Agr. Univ. P. R.* **33** (3) 85-97 1949. III, Comparison of fertilized guinea grass, Pará grass and tropical kudzu, and Guinea grass and tropical kudzu, L. Rivera-Brenes, F. J. Marchán, and J. I. Cabrera, *J. Agr. Univ. P. R.* **34** (4) 309-15 1950. IV, Comparison of Fertilized Guinea grass, Pará grass, tropical kudzu and Guinea grass, and tropical kudzu, L. Rivera-Brenes, F. J. Marchán, and J. I. Cabrera, *J. Agr. Univ. P. R.* **36** (2) 108-14 1952.

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³ Numbers in parentheses refer to Literature Cited, p. 104.

No grazing experiments had yet been performed with Pangola grass on the Main Station Farm.

PROCEDURE

The procedure followed was the same as for previous experiments performed at the Station (1). Three grasses and a grass-legume combination were included in the trial: Pangola, *Digitaria decumbens*; long-stemmed St. Augustine, *Stenotaphrum secundatum*; Pará, *Panicum purpurascens*; and Guinea grass-tropical kudzu, *Panicum maximum-Pueraria phaseoloides*.

The experiment was established on a farm near La Laura village at Yabucoa, Puerto Rico, in a Viví loam—a Talante loam complex with the Viví loam predominating. These soils are alluvial, deep and fertile, and derived from coarse-grained granitic material. Normally, this soil (Viví loam) drains well, but since a large quantity of water comes down from the nearby hills, good and deep drainage ditches had to be provided to remove a great volume of water as fast as possible. The land was prepared as usual for grasses and the drainage ditches were properly located.

Pieces of stems were used for planting Pangola, St. Augustine, and Pará grasses. They were planted in furrows 12 to 15 inches apart so as to get the plots covered as fast as possible. Pieces of roots ("macollas") were used for planting Guinea grass. It was planted in rows as usual, but instead of the rows being 24 to 30 inches apart, they were 40 to 50 inches apart. The tropical kudzu was planted in between the rows of Guinea grass at a rate of 8 pounds of seed per acre. The seed was pregerminated to ensure the stand.

A 15-4-7 fertilizer was applied to the grasses at a rate of 400 pounds per acre per application. Three applications were made during the first year of the experiment and two during the second.

The animals used were scrub bullocks bought by the cooperator for that purpose. They ranged in age from 7 to 12 months and each group was balanced as closely as possible as to weight and age. They were in fairly good condition when the experiment started.

The animals were weighed at the beginning of the trial and from there on once monthly at around 8:30 a.m.

Rotational grazing was followed as in previous trials (2), (3), (4). The "put-and-take" system was used to ensure a complete utilization of the roughage by the animals. Only during the early phases of the trial was there need to cut some excess roughage. No extra animals were available to add to the plots at that period.

The first year the grazing of each of the grass or grasslegume mixture enclosures started with two animals per acre. Additions were made to the Pangola, St. Augustine, and Guinea-tropical kudzu. One of the animals had

to be taken from the Pará grass for some time; later it was returned. The second year Pangola and Guinea-tropical kudzu were started with three animals per acre, St. Augustine with four, and Pará grass with two. Additions and subtractions were made as the conditions of the pastures required.

In 1951, the first year of the trial, the experiment lasted 273 days for Pangola and Pará grasses, and for the Guinea grass-tropical kudzu mixture, and only 193 days for St. Augustine grass. In 1952, the second year of the experiment, it lasted 306 days for Pangola, Guinea grass-tropical kudzu, and St. Augustine, and 179 days for Pará. The animals used during 1951 were sold at the end of the year, when they weighed between 700 to 800 pounds. The end of the first grazing year coincided with the beginning of the dry period and the plots were rested for a little over a month. Animals comprising the second bunch of bullocks were similar to those in the first as to weight, age, and breeding.

RESULTS AND DISCUSSION

Carrying Capacities

The calculated carrying capacity, as well as the number or grazing days for each grass under trial, are given in table 1.

The grasses were planted at the same time, so, the differences in number of grazing days were due to the fact that some of them were ready for grazing sooner than others. The first year the experiment started in February for Pangola, Pará, and Guinea-tropical kudzu, while St. Augustine was not ready until the beginning of May. St. Augustine grass was very slow in covering the ground. The Guinea-tropical kudzu mixture was first, St. Augustine second, and Pangola third in carrying capacity. Pará grass made the poorest performance.

Income

The results obtained for the Guinea grass-tropical kudzu combination were in line with the results of previous trials (4). The performances of Pangola and St. Augustine were very satisfactory also as compared to re-

TABLE 1.—*Grazing days and carrying capacities of the different pastures under trial, 1951-52*

Pasture	Grazing days	Standard cow-days	Carrying capacity per acre
	<i>Number</i>		<i>Adult-head</i>
Pangola grass.....	579	651	1.12
Guinea grass-tropical kudzu.....	579	820	1.42
St. Augustine grass.....	499	616	1.23
Pará grass.....	452	392	.87

TABLE 2.—*Gross incomes obtained from grazing the different pastures under trial, 1951-52*

Pasture	1951		1952	
	Gain in weight	Gross income	Gain in weight	Gross income
	<i>Lb./A.</i>	<i>Dollars</i>	<i>Lb./A.</i>	<i>Dollars</i>
Pangola grass	697	118	933	159
Guinea grass-tropical kudzu	807	137	1,053	179
St. Augustine grass	573	97	730	124
Pará grass	513	87	400	68

sults obtained at the Main Station Farm with the same and other grasses, (2), (3), (4). The gains in weight of the animals and the gross incomes obtained with the difference pastures per acre per year are given in table 2. These gains in weight represent total gains of two, three, and in some cases four bullocks grazing per acre on these grasses during each year. As noted earlier, the bullocks used weighed between 300 and 400 pounds at the beginning of each trial.

Although the gross income per acre was high for Pangola, Guinea-tropical kudzu, and St. Augustine, that for Pangola and Guinea-tropical kudzu was much better. The gross income for Pará grass was low, probably because of poor adaptability of this grass to a light soil.

Estimating the average expenses on a commercial farm to be around \$50 per acre, the net incomes obtained with the Guinea grass-tropical kudzu mixture and with Pangola grass would compare favorably with the average net incomes for sugarcane and plantains in Puerto Rico, \$85 (6) and \$111 (1) per acre, respectively. These estimated average expenses per acre may seem to be somewhat high but in making this estimate the initial cost of establishing the pasture and the sizes of the pastures were taken into consideration.

Another point to be considered in judging the practical value of these results is that the animals used were scrub cattle which do not have the efficiency of well-bred animals, especially those of the standard beef breeds.

Analyses and T.D.N. of Grasses

The average chemical analysis of the grasses is presented in table 3. St. Augustine grass matures very fast. This characteristic is reflected in the average crude-protein content as compared with that of the other grasses. It is interesting to notice the higher protein content of the grass-legume mixture. These results are very similar to others obtained in previous trials in this Station, (2), (3), (4).

The average production of total digestible nutrients per acre is given

TABLE 3.—Average chemical analyses of the different pasture grasses under trial, 1951-52

Pasture	Samples	Total moisture	Ash	Crude protein	Fat	Fiber	Nitrogen free extract
	Number	Percent	Percent	Percent	Percent	Percent	Percent
Pangola grass.....	13	78.99	9.78	10.18	2.01	29.84	48.18
St. Augustine grass.....	14	77.51	9.43	8.14	1.55	29.79	51.39
Guinea grass-tropical kudzu...	13	78.61	11.18	12.75	1.98	30.23	43.09
Pará grass.....	12	78.87	10.46	11.21	2.20	29.25	46.87

TABLE 4.—Average production of total digestible nutrients per acre by the different pastures under trial, 1951-52

Pasture	Mean yield of total digestible nutrients
	<i>Lb./A.</i>
Pangola grass.....	5,805
St. Augustine grass.....	4,661
Guinea grass-tropical kudzu.....	7,484
Pará grass.....	3,457
Least significant differences between means:	
At 5-percent level.....	43
At 1-percent level.....	65

in table 4. A highly significant difference was found between grasses, the legume-grass mixture taking first place.

The differences in the number of grazing days were responsible for much of the difference in total digestible nutrients per acre for the 2 years of the experiment. But the real differences between the grasses are expressed much better by the figures obtained for carrying capacity which take into consideration both the number of grazing days and total digestible nutrients produced. We must realize though, that the differences in number of grazing days between the grasses resulted from their different capacities to establish themselves, or to recuperate from the effects of grazing or drought, sufficiently to warrant the initiation of grazing. All of them were planted at the same time and given equal care. For example, the first year the grazing trial started in February for all grasses except St. Augustine which was not ready until 3 months later. At the start of the second year Pará grass was not in grazing condition until 4 months later than the others. These facts are very important and must be considered in selecting a pasture grass.

Rainfall was plentiful during the 2 years of the grazing trial, as shown in

TABLE 5.—*Monthly rainfall during the pasture trials from records kept by Central Roig, Yabucoa, P.R., 1951-52*

Month	1951	1952
	<i>Inches</i>	<i>Inches</i>
January.....	2.11	2.30
February.....	.91	1.65
March.....	1.06	2.65
April.....	2.68	8.35
May.....	10.14	10.05
June.....	8.32	5.95
July.....	14.20	12.00
August.....	7.30	10.80
September.....	15.37	17.50
October.....	11.19	11.85
November.....	7.56	3.40
December.....	8.83	.50
Total.....	89.67	87.00

table 5. As a matter of fact this region of the Island is characterized by heavy rainfall.

Rotational Intervals

The average rotational interval for Pangola, Guinea-tropical kudzu, and Pará for the first year of trial was 18.2 days and for St. Augustine 15.2 days. For the second year of trial the interval for Pangola, St. Augustine and Guinea-tropical kudzu was 12.2 days and for Pará grass 10.5 days.

The difference in rotational interval between the first and second year of the experiment probably resulted from the fact that the first trial was started with two bullocks per acre while in the second year it started with three. The average rotational interval for the whole experimental period was 14.5 days for Pangola and Guinea-tropical kudzu, 14.1 for Pará, and 13.1 for St. Augustine grass.

Comparative Advantages of the Pastures

In Puerto Rico, where land is a limitation, we must select forage grasses that can establish themselves and cover the ground fast in comparison with other grasses and weeds. This character substantially influences the cost of establishing the stand and also determines the time when the pasture will be ready to receive the animals. We must select grasses which permit the use of the stand very soon after planting, to reduce the time during which the land is idle to the minimum.

In this respect Pará, Pangola, and Guinea grasses, (Guinea grass when planted using pieces of roots) were superior to St. Augustine grass. They covered the ground fast and were ready to be used 4 to 5 months after planting, while St. Augustine took 3 to 4 months more.

Although the expenses of establishing the experiment were relatively high as compared to those for commercial plantings where most of the practices can be mechanized, the cost of one of the practices reflects the disadvantages of a long period for the establishment of the sod. The cost of replanting St. Augustine was \$46 per acre while it was only \$5 for Pangola and \$3.66 for Guinea-tropical kudzu. Pará needed no replanting at all. The cost included the collection of planting material. St. Augustine needed two replantings with plenty of material while the others required only one and this one quite light.

Additional information on the grasses studied is presented below.

(1) Pangola grass covers the ground so fast that it permits very little competition from weeds. It is very aggressive. (2) It forms a very thick mat protecting the soil very well. (3) It is resistant to trampling, especially when the land is well-drained, and, if rainwater is not drained off fast, trampling does some harm. (4) It recovers very fast after the animals are removed, even if overgrazed, though of course overgrazing is not recommended. Under favorable conditions of rain and fertilizer, the fields are ready to receive animals again in from 15 to 20 days. (5) It is very tender and palatable. (6) It is very easy to establish a field of Pangola grass using the vegetative material. (7) It is attacked by the yellow aphid of sugarcane, but this is very easy to control with insecticides. Heavy showers also help to control the pest.

(1) St. Augustine grass takes quite a long time to become well established but once it is established, a very thick mat is formed. In spite of this, it permits competition from weeds. (2) It is very resistant to trampling, especially in a well-drained soil. (3) When not overgrazed it recovers fast after the animals are removed. If overgrazed, then the recovery is slow. (4) Is very palatable when young and tender, but it matures fast and the foliage then gets fibrous and loses palatability. The nutritive value is also reduced.

Except for the fact that Pará grass is not well adapted for grazing on light soils, its other characters have been discussed adequately in previous publications from this Station, (2), (3).

Observations made on the combination of Guinea grass with tropical kudzu have been discussed in previous publications also (2), (3), and are similar to those reported in the present work.

SUMMARY

A grazing trial was carried out at Yabucoa, on the eastern coast of Puerto Rico to determine the usefulness for this purpose of several grasses and a grass-legume mixture. It followed the same pattern and procedure as those which had been performed previously at the Main Station Farm located in the northern humid section of the Island.

In the trial, which lasted for 2 years, Pangola grass, Pará grass, St. Augustine grass, and a Guinea grass-tropical kudzu combination were compared as to carrying capacity and other characters to determine their pasture values.

The carrying capacities of these grasses were as follows: Pangola, 1.12; Guinea-tropical kudzu, 1.42; St. Augustine, 1.23; and Pará grass, 0.87 head per acre. The gross returns per acre for the first year were, \$118, \$137, \$97, and \$87, respectively. For the second year they were: \$159, \$179, \$124, and \$68, respectively.

Besides the information obtained on the carrying capacity of the pastures, the results show that well-managed pastures are at least as profitable as many of the cash crops actually grown in the Island. This does not take into consideration additional soil- and water-conservation benefits which accrue from having the soil covered by a sod.

Pangola and St. Augustine grasses are good pasture crops that can be used in the eastern coastal region satisfactorily. The Guinea-tropical kudzu mixture, however, is better than these grasses by themselves. The superiority of the legume-grass combination was again demonstrated by the results of this experiment. Pará grass was not well adapted for grazing in the light soil in which the experiment was planted.

RESUMEN

Se llevó a cabo un experimento sobre pastoreo en Yabucoa, en la costa este de Puerto Rico, para probar la utilidad de algunas yerbas y de una combinación de yerba y leguminosa. Siguió el mismo patrón y procedimiento de aquéllos anteriormente verificados en la finca de la Estación Central y en la sección húmeda del norte de la Isla.

En este experimento, el cual duró dos años, las yerbas Pangola, Pará y San Agustín, y la combinación de yerba Guinea y kudzu tropical se compararon en cuanto a su capacidad para sostener el ganado y en otros caracteres que pudieran demostrar el valor de estos pastos. La capacidad para sostener el ganado que demostraron estas yerbas fué como sigue: Pangola, 1.12; asociación Guinea y kudzu tropical, 1.42; San Agustín, 1.23 y Pará 0.87. Los ingresos brutos por acre para el primer año fueron: Pangola \$118, combinación Guinea-kudzu tropical \$137, San Agustín \$97

y Pará \$87. El segundo año fueron, en el mismo orden: \$159, \$179, \$124 y \$68.

Además de la información que se obtuvo en cuanto a la capacidad de estos pastos para sostener el ganado, otros resultados demostraron que los pastos bien manejados pueden ser tan remunerativos como son muchas de las principales cosechas que actualmente se cultivan en la Isla. Sin contar, además, con los beneficios que se derivan de tener el terreno constantemente cubierto de vegetación, lo cual significa una mejor conservación del suelo y un más adecuado aprovechamiento del agua.

Las yerbas Pangola y San Agustín son buenos pastos, los cuales pueden usarse en la región costanera oriental de manera satisfactoria. Sin embargo, la combinación Guinea-kudzu tropical resultó mejor que las yerbas por sí solas. Otra vez se demostró en este experimento la superioridad de la combinación de las yerbas con leguminosas, como ya se había comprobado en otros experimentos. La yerba Pará no se adaptó bien para el pastoreo en los terrenos ligeros en los cuales se instaló el experimento.

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