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## THE UTILIZATION OF GRASSES, LEGUMES AND OTHER FORAGE CROPS FOR CATTLE FEEDING IN PUERTO RICO

### III. COMPARISON OF FERTILIZED GUINEA GRASS, PARA GRASS AND TROPICAL KUDZU AND GUINEA GRASS AND TROPICAL KUDZU.

L. RIVERA BRENES,<sup>1</sup> F. J. MARCHÁN<sup>2</sup> AND J. I. CABRERA<sup>3</sup>

This is the third of a series of grazing trials which started in 1945 for the evaluation of the most important pasture crops found in the Island and of those introduced.

As it is recommended by the Joint Pasture Research Committee (1) duration of pasture experiments of six to ten years should be preferred, but we think that under our conditions, where we have almost 365 grazing days, there is no need for such a long time to get reliable results. The only large variation in climate in the Island is the amount of rain. There are two or three dry months during the year, especially in the southern part of the Island. In this respect the northern part of the Island has been lucky for the past three years.

The results of these grazing trials have been reported individually in order to have the information available to the farmers as soon as possible. After the end of the fourth trial, to be finished in 1950, all the data will be compiled in one final report.

#### LITERATURE REVIEW

In the first grazing trial (2) the carrying capacity of Para grass-Tropical Kudzu mixture was 1 head and in the second trial (3) it was also nearly 1 head per acre. Unfertilized Guinea grass had a carrying capacity of 0.5 in the first trial and for the second trial, when it was fertilized, the carrying capacity was increased to 1.12 heads per acre.

In these two trials it was also found that fertilization increases the protein content as well as the total tonnage. The inclusion of a legume with

<sup>1</sup> Acting Head, Animal Husbandry Department.

<sup>2</sup> Assistant Chemist, Animal Husbandry Department.

<sup>3</sup> Assistant Animal Husbandman, Animal Husbandry Department.

the grass increased and maintained a more uniform and permanent protein content. It also increased the total tonnage of the forage.

#### PROCEDURE

The procedure followed has been the same as for the first trial (2). The grasses compared were Para grass-Kudzu mixture, Guinea grass-Kudzu mixture and Guinea grass alone. This time the Guinea grass was fertilized with 100 pounds of ammonium nitrate per acre at the beginning of the trial and a second application of 200 pounds of ammonium sulphate per acre three months later. To save time in the establishment of the Guinea grass-Kudzu mixture, the Guinea grass was planted in the old Kudzu stand. The land was not plowed to avoid killing the already established Kudzu, but was furrowed with a small plow at the proper distance. Pieces of roots were used and in seven months an excellent Guinea grass-Kudzu stand was obtained.

The heifers used were Holstein-Native and Brown Swiss-Native crosses, and purebred Holsteins. They were distributed among the grasses to avoid breed differences. The trial lasted 221 days, and was divided in three periods according to the number of animals grazing in each grass at one time. During the first and third periods there were two heifers per acre plot of grass and during the second period two heifers in each acre plot of Para grass-Kudzu and Guinea grass-Kudzu and one in each acre of Guinea grass alone. For the purpose of calculating gain in weight and differences in gain in weight periods one and three were put together and analyzed separately from period two. Total digestible nutrients and carrying capacity were calculated for the trial as a whole. They were calculated using the coefficients of digestibility recommended by the Pasture Research Committee (1) instead of using 72 per cent of the dry matter as in previous trials.

#### RESULTS AND DISCUSSION

As in previous reports weight gains and differences are presented to show probable differences in nutritive value between the grasses and legume-grass mixtures.

There was no significant difference between the average gain in weight of the animals that grazed in Para grass-Kudzu and in the Guinea grass-Kudzu mixture for the first and third periods together. The differences between the mean gain in weight in the legume grass mixtures and Guinea grass alone were significant at the 5 per cent level. No significant difference was found between the mean gains in weight during the second period. A most probable explanation to the results obtained in the second period is the following: the Guinea grass plots were fertilized with ammonium sulphate the same day (8-4-48) this second period started. The addition of

nitrogen to the soil improved the nutritive value of the grass considerably. This is sustained by the average daily gain in weight per animal. During the first and third periods together the average daily gain in Guinea grass was of 0.30 pounds and for the second period 1.19 pounds, of course, we must consider the lengths of the periods 158 and 63 days respectively which might have affected the averages. In general, the daily gain in weight per animal for the first and third periods together for all the roughages in the trial was lower than in the second period: for Para grass-Kudzu, 0.68

TABLE 1

*Gain in pounds per group, mean gain per animal and least significant difference*

Grasses	No. of heifers	Initial wt. of groups in lbs.	Wt. of groups at end of period in lbs.	Gain in lbs.	Mean wt. in pounds per animal in lbs.	Least Significant Difference
First and third periods together 5-12-48 to 8-3-48 and 10-6-48 to 12-18-48						
PK	3	862.0	1097.0*	235.0	78.33	69.12 at 5 per cent level
PK	3	1270.0	1677.0	407.0	135.67	
GK	3	761.0	1008.0	247.0	82.33	159.60 at 1 per cent level
GK	3	1103.0	1444.0	341.0	113.67	
G	3	932.0	1052.0	120.0	40.00	
G	3	832.0	1004.0	172.0	57.33	
Second Period 8-4-48 to 10-5-48						
PK	3	1279.0	1451.0	172.0	57.33	45.75 at 5 per cent level
PK	3	1229.0	1469.0	240.0	80.00	
GK	3	1059.0	1278.0	219.0	73.00	
GK	3	1273.0	1499.0	226.0	75.33	
G	3	1004.0	1228.0	224.0	74.66	
G	3	1004.0	1228.0	224.0	74.66	

\* The final weights for these animals were taken as the initial weight plus the gain in weight during the first and third periods because the second period was analyzed separately.

pounds and 1.09 pounds per animal; and for Guinea grass-Kudzu, 0.62 pounds and 1.17 pounds respectively.

The average chemical analysis for the grass samples taken during the grazing trial are presented in table 2.

The crude protein content of the legume grass mixtures is higher than that of the grass alone, this is something to be expected, and has been true in this and the previous trials (1-3). Guinea grass received only two fertilizations instead of three, as was the case in the second experiment. The reason for this was that fertilizer was applied according to the observations made on the conditions of the grass; that is, color and growth. In trial

number 2 (3) the average analysis of protein for Guinea grass was 8.56 per cent and in this trial only 5.21 per cent, dry basis. This might be explained by the amount of fertilizer received during the experimental periods, and also to the difference in quality of the samples taken from the clippings. The grass received only two applications of nitrogen because as pointed above, observations indicated that it was green and having good growth.

The analysis of crude protein of the mixture of Guinea grass and Kudzu compares very well with the over all analysis for fertilized Guinea grass in

TABLE 2

*Average analysis of the three forage crops during the whole trial in per cent dry basis*

Grasses	No. of samples	% Moisture	% Ash	% Crude Protein	% Fat	% Fiber	% Nitrogen Free Extract
PK	33	75.86	8.58	9.83	1.34	32.10	48.25
GK	33	76.64	9.52	8.34	1.19	35.85	45.12
G	33	70.24	9.43	5.21	1.07	36.11	48.12

TABLE 3

*Clippings and dry matter content in pounds by periods\**

Grasses	First Period		Second Period	
	lbs. Clippings	lbs. Dry matter	lbs. Clippings	lbs. Dry Matter
PK	—	—	—	—
GK	20303.0	4742.78	750.0	175.20
G	3908.0	1663.02	5929.0	1764.47

\* No clippings in the third period.

trial number 2 (2); 8.34 and 8.56 per cent respectively. These results obtained emphasize the importance of the legumes in grass mixtures.

Nothing was clipped from the Para grass-Kudzu plots during the entire experimental period. Table 3 presents the amount of clippings from the other two roughages and the dry matter content. No residue was clipped during the third period in any of the roughages.

As pointed out in the procedure, the Guinea grass was planted in the old Kudzu stand. On account of that the grass was favored by a large accumulation of nitrogen in the soil. The growth obtained during the pre-experimental period was abundant. Of the 20303.0 pounds of clippings from the Guinea grass-Kudzu mixture during the first period, 18810.0

pounds were obtained after the first rotation in the three acres. From then on the heifers ate nearly all the roughage produced. This is demonstrated by the small amount obtained in the second period and by none in the third.

The effects of fertilization of the Guinea grass is demonstrated by the increase in the amount of clippings in the second period as compared with the first. An application of ammonium sulphate was made just at the start of the second period.

The calculated carrying capacity is presented in table 4.

Although the Guinea grass plots looked in good condition with only two applications of nitrogen, the carrying capacity was lower than in trial number 2 (3). Apparently two applications of nitrogen were not enough to maintain the grass as in the previous trial. Analyzing periods 1 and 3 (158 days) separately from period 2, (63 days) the carrying capacity was 0.58 and 0.92 respectively. The results in the second period demonstrate

TABLE 4  
*Approximate carrying capacity for the grasses in trial*

Grass	Cow days	No. of days on trial	Carrying capacity
PK	169.73	221	0.77
GK	241.61	221	1.09
G	149.70	221	0.68

the favorable effects of nitrogen fertilization. The same thing has been happening with the Para grass-Kudzu mixture although the variation has not been great. The results obtained with the mixture of Guinea grass-Kudzu are encouraging; Kudzu mixes very well with the grass and there has been no sign of incompatibility, but further trials are needed to determine this.

The statistical analysis of the calculated total digestible nutrient yields is given in table 5 for the entire experimental period.

There was no significant difference at the 1 per cent level.

The mixture of Guinea grass-Kudzu was superior in T.D.N. yield to the other forages tested. This was due, of course, to the larger amount of clippings during the first period. As explained before, the Guinea grass in the mixture had the benefit of the accumulation of nitrogen in the soil which produced an exuberant growth before the experiment started. When the heifers were put to graze on it they were not able to eat all the roughage at the time the other grass sub-plots were due for rotation. There

was no significant difference between Guinea grass alone and Para grass and Kudzu.

The rainfall figures for the eight months of the trial are shown in table 6.<sup>4</sup>

The water supply was more or less the same as for the previous trial. The monthly average was 7.35 inches of rainfall, which eliminates this as a factor affecting growth.

TABLE 5  
*Mean total digestible nutrients yield per acre and least significant difference*

Grasses	T.D.N. mean yield per acre in pounds
PK	2898.33
GK	3929.66
G	2379.33
L.S.D. 949.67 at 5% level	

TABLE 6  
*Precipitation from May to December 1948*

Month	Inches of rainfall
May.....	10.91
June.....	8.01
July.....	8.79
August.....	7.33
September.....	10.07
October.....	4.14
November.....	9.69
December.....	9.85
Total.....	58.79

Everything tends to indicate that the mixture of Guinea grass and Kudzu is a good combination for pasture. They mix well and apparently there is no incompatibility, but due to the fact that Guinea grass is more adapted to drier places it needs further investigation in other places around the Island.

There is no doubt as to the benefits of nitrogen fertilization of grasses; this has been demonstrated in two consecutive trials with Guinea grass. But in the long-run the use of a legume should be more economical and

<sup>4</sup> Records kept by the Experimental Station farm.

preferable in view of the fact that the composition and yield of the forage is more uniform.

#### SUMMARY AND CONCLUSIONS

A third grazing trial of 221 days was conducted under the same procedure as in trial number one (2). A modification was introduced consisting in that the calculation of T.D.N. was made using the chemical analysis of the roughages, and the digestion coefficients given by the Pasture Research Committee (1).

The grasses under trial were: Para grass-Kudzu, in its third year; Guinea grass-Kudzu, in its first year; and fertilized Guinea grass, in its second year. In this experiment Guinea grass received only two applications of nitrogen instead of three as in trial number 2. This was due to the fact that according to the observations of the investigator the grass was growing well and having a nice green color. Nitrogen was applied when the leaves began turning yellowish.

Para grass-Kudzu has been uniform in performance; the carrying capacity being one head in the first trial, one head in the second and 0.77 for this trial. The carrying capacity of the mixture of Guinea grass and Kudzu was 1.09, but due to the fact that this grass was planted in the old Kudzu stand, it received the benefits of the nitrogen accumulation in the soil, producing an exuberant growth at the beginning of the trial. As a result of this, larger amounts of residue were clipped after rotations affecting favorably the carrying capacity. Although the results are encouraging, further investigations are needed to make definite recommendations. Guinea grass alone had a carrying capacity of 0.68. It was lower than in the previous trial. The difference can be attributed to the difference in nitrogen supplied, as nitrogen increases the amount of roughage produced and the nutritive value of the forage.

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