PN-ABK-392,
75514

Bahamas Agricultural Research Training And Development Project

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A.E. & R.S. BAHAMAS
FINAL REPORT NO. 47

931-09891
62
ISN 3491

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November, 1977

BAHAMAS AGRICULTURAL
RESEARCH, TRAINING AND
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INTRODUCTION

In several small plot and grazing-scale trials in the Bahamas Agricultural Research, Training and Development Project, various grasses have been compared for productivity. It became apparent through early trials at BARTAD, that tropical and temperate legumes (i.e., alfalfa) would make a significant contribution to animal performance, net pasture production cost, and most measures of animal productivity. The objectives of this trial were to compare the productivity of rhodesgrass (*Chloris gayana*), bigalta (USDA, PI299995; *Hemarthria altissima*) and buffelgrass (*Cenchrus ciliarus*), each of which were interplanted with legume mixtures and grazed by cattle with yield, carrying capacity and beef production per acre measured. Information from such controlled grazing trials is useful, and in fact necessary, to develop viable livestock-forage programs.

PROCEDURES

The land used for this trial was initially cleared in the spring of 1974. Initial fertilization was with 1500 pounds per acre of a 8-18-8 fertilizer, after which the land was seeded to sorghum-sudan grasses. At least one cutting of sorghum-sudan silage or grazing was taken from the land. In the spring of 1975, the field was disked. The trial pastures were planted in late September and early October, 1975. At planting, 500 pounds per acre of 8-18-8 was used. The subsequent fertilization schedule throughout the trial is presented in Table 1.

Table 1. Fertilizer Application Rates and Dates[a]

Date		Nitrogen (Source)	Phosphorus (Source)	Potassium Lbs./A. (Source)
January	1976	-	50 (0-46-0)	50 (0-0-22)
April	1976	-	50 (0-46-0)	50 (0-0-22)
July	1976	50 (21.5-0-0)	50 (0-46-0)	50 (0-0-22)
October	1976	-	50 (0-46-0)	50 (0-0-22)
January	1977	-	50 (0-20-15)	35 (0-20-15)
April	1977	-	50 (0-20-15)	35 (0-20-15)
July	1977	-	50 (0-20-15)	35 (0-20-15)

[a]Initial fertilization for sorghum-sudan planting (summer, 1974) was 1500 lb./A 8-18-8; with additional September, 1975 pre-planting fertilization of 500 lb./A. of 8-18-8.

The different grass-legume combinations were seeded in four replicates, with each replicate containing one of the three grasses each with the same legume combination. The bigalta was planted with a Bermuda King Sprigger, the Rhodesgrass was seeded by hand, and the buffelgrass and the legumes were seeded with a Brillion seeder. Seeding rates were 2 pounds per acre for buffelgrass, 0.5 pound of Florida variety and 1.5 pounds per acre of Bell rhodesgrass, with the bigalta vegetatively propagated by the King Sprigger.

A mixture of three legumes, siratro (Macroptilium atropurpureum), greenleaf desmodium (Desmodium intortum) and tinaroo glycine (Glycine wightii) were established with the grass in each pasture plot. Each legume was seeded at the rate of 2 pounds per acre with a Brillion Seeder. The arrangement of different grass-legume plantings, within replicate, is diagrammed in Figure 1. The swards were lightly rotationally grazed until October, 1976, when the grazing trial was initiated. Bred, first-calf Santa Gertrudis heifers were allotted to each plot within the first replicate. Grazing was conducted on a rotational basis with each plot grazed for 7 days and rested for 21 days. Cattle were weighed at 28-day intervals and animal numbers altered within each treatment at that time. Reserve animals were maintained and added to each plot on a put-and-take basis during times of excess forage production. Alteration of stocking rate was based on animal performance during the previous weigh period and on a visual assessment of pasture quality and quantity. Trace mineral salt, monosodium phosphate and water were available to the livestock at all times. Calves born to heifers on trial were weighed at birth and at 28-day intervals. Weaning weights were adjusted for age of dam and age and sex of calf.

Pasture plots were sampled weekly prior to the introduction of animals into the replication to be grazed. Forage from four random strips, 39 inches

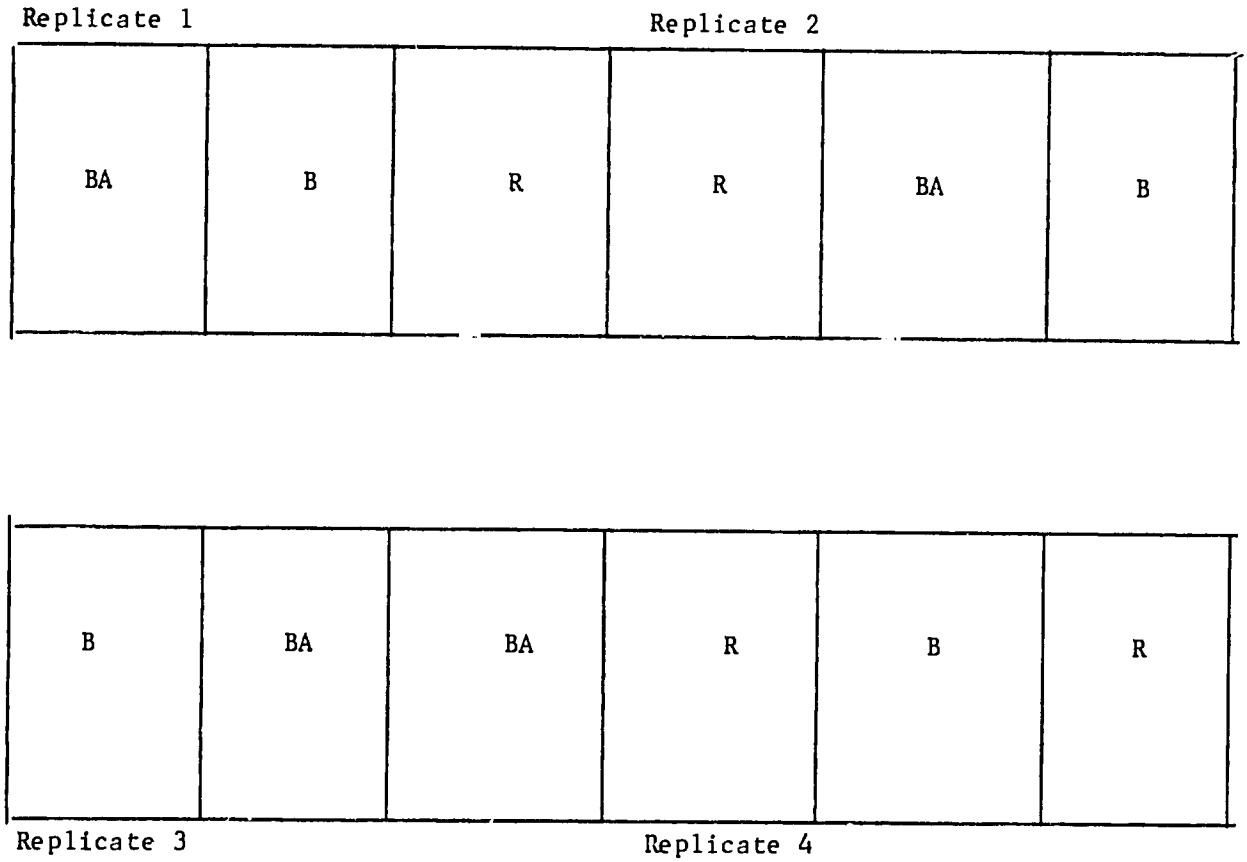

Figure 1. Experimental pasture plot layout.

(R = Rhodesgrass and legumes; BA = Bigalta hemarthria and legumes; B = Buffelgrass and legumes).

wide and 10 feet long was cut with a Gravely tractor and sickle bar mower from each 1-acre field. Gross forage weights were obtained and subsamples were dried at 140°F for 1 week to determine moisture and dry matter yields. Samples were ground with a Wiley Mill (1 mm screen), composited and shipped to The Pennsylvania State University for chemical analyses. Total yield of dry matter, digestible dry matter, protein per acre and variations in the chemical composition of the pastures for the different seasons were obtained.

RESULTS AND DISCUSSION

The averages for dry matter, estimated digestible energy, and crude protein for each 28-day period during the grazing trial, from October 28, 1976, through September 5, 1977, are presented in Table 2. Pounds of digestible dry matter and pounds of crude protein were calculated from the amount of dry matter production, dry matter digestibility, and crude protein percent. As expected from the seasonal amounts of rainfall, minimum production for all three mixtures occurred during the January-February period, with the greatest amount of dry matter production observed in July-September. Averages for tons of dry matter (28-day periods) over the 12 months of sampling were 0.71, 0.69 and 0.70 for the legume in combination with Rhodesgrass, bigalta, and buffelgrass.

One reason for the similar dry matter production from the three grasses was the relatively high proportion of legumes. Approximate percentages of the legumes in the pastures for the "wet" and "dry" periods of the year were 78 and 70 percent, respectively. There was a tendency for the buffelgrass to be more competitive with the legumes. However, in practically all cases, the pastures were legume dominant. Total annual production averaged 9.23, 8.97 and 9.10 tons per acre for the Rhodesgrass, bigalta and buffelgrass, respectively.

Table 2. Dry Matter (DM), Estimated Digestibility, Crude Protein and Protein Production Per Acre from Mixed Tropical Legume-Rhodegrass (R), Legume-Bigalta (BA) and Legume-Buffelgrass (B) Pastures.

	DM, Tons			Digestible DM, %			Digestible DM, Lbs.			Crude Protein, %			Crude Protein, Lbs.		
	R	BA	B	R	BA	B	R	BA	B	R	BA	B	R	BA	B
Oct. 28, 1976	0.78	0.74	0.71	54.1	55.9	49.5	844	827	703	21.13	14.21	12.83	329.6	210.3	182.2
Nov. 29	0.50	0.65	0.64	51.5	50.9	47.5	515	662	608	16.80	12.13	14.56	168.0	157.7	186.4
Dec. 27	0.67	0.69	0.75	49.2	45.0	46.0	659	621	690	14.24	10.49	12.32	190.8	144.8	184.8
Jan. 24, 1977	0.45	0.40	0.53	46.9	39.2	45.0	422	314	477	11.68	8.86	10.09	105.1	70.9	107.0
Feb. 21	0.38	0.48	0.51	40.8	47.3	42.8	310	454	437	12.58	13.68	12.29	95.6	131.3	125.4
Mar. 21	0.65	0.55	0.59	59.5	57.9	53.3	774	637	629	18.71	18.43	16.23	243.2	202.7	191.5
Apr. 18	0.61	0.57	0.60	51.8	53.5	49.8	632	610	598	15.87	15.14	13.88	193.6	173.0	166.6
May 16	0.71	0.66	0.58	54.9	55.0	52.4	780	726	608	17.93	17.70	15.72	254.6	233.6	182.4
June 13	0.83	0.78	0.71	57.1	58.2	53.6	948	908	761	17.86	18.65	17.95	296.5	290.9	255.0
July 11	0.95	0.93	0.90	49.0	51.8	47.7	931	964	859	17.83	17.41	17.37	338.8	323.8	312.7
Aug. 8	1.03	0.94	0.85	47.7	52.4	40.3	983	985	685	16.96	15.47	16.21	349.4	290.8	275.6
Sept. 5	0.98	0.92	1.01	46.2	56.7	46.4	906	1043	937	16.31	17.11	16.60	319.7	314.8	335.3
Avg. 28 days	0.71	0.69	0.70	50.7	52.0	47.8	720	718	669	16.49	14.94	14.67	234.2	206.2	205.4
Total Annual Production/Acre	9.23	8.97	9.10	--	--	--	9360	9334	8597	--	--	--	3045	2681	2670

Over the entire 12-month sampling period, percent digestible dry matter averaged 50.7, 52.0, and 47.8 percent, respectively, for Rhodesgrass, bigalta and buffelgrass. Percent digestible dry matter tended to be positively related with dry matter production, with those periods of high amount of dry matter production also being those periods of a relatively high energy digestibility. The lowest percentage digestible dry matter was noted for the December-February samplings, with the highest percentages of dry matter digestibility noted in October, March, May and June, although the bigalta remained relatively high in August-September. A comparison of the pastures in terms of pounds of digestible dry matter produced per acre indicates that approximately one-half of the digestible dry matter per acre is produced in the June-September period

Percent crude protein, averaged over the 12-month period, was 16.49, 14.94, and 14.67 percent, for Rhodesgrass, bigalta and buffelgrass, respectively, in combination with the tropical legume mixtures. With the exception of crude protein content in the January sampling of bigalta and buffelgrass and the December sampling of bigalta, the NRC requirements for practically all types of growing or finishing steers and lactating mature beef cows were met or exceeded. Even during this period, the Rhodesgrass-tropical legume mixture averaged 11.68 percent, which will still meet the requirements for most types and classes of beef cattle and sheep. The highest crude protein percent for the Rhodesgrass-legume combination was obtained in October, 1976, the highest for bigalta was in March and June, and for buffelgrass, June and July. The combined effect of the variation in crude protein percent and dry matter production over the 12-month period is emphasized in calculation of pounds of crude protein produced by the 28-day sampling period. As an example, the average 28-day production over all

Table 3. Average Weights and Daily Gains (ADG) of Heifers and Calves on Mixed Tropical Legume - Rhodesgrass, Legume - Bigalta, and Legume - Buffelgrass Pastures.

DATE	Legume-Rhodesgrass		Legume-Bigalta		Legume-Buffelgrass	
	Wt., lbs. (no. obs.)	ADG, lbs. (no. obs.)	Wt., lbs. (no. obs.)	ADG, lbs. (no. obs.)	Wt., lbs. (no. obs.)	ADG, lbs. (no. obs.)
Growing-Gestating Heifers						
October 27, 1976	859.8 (4)		857.5 (4)		856.5 (4)	
November 24	894.8 (4)	1.25 (4)	905.3 (4)	1.70 (4)	927.0 (5)	1.90 (4)
December 22	936.0 (4)	1.48 (4)	946.0 (4)	1.46 (4)	960.0 (5)	1.18 (5)
January 19, 1977	982.3 (4)	1.65 (4)	988.3 (4)	1.51 (4)	1017.0 (5)	2.04 (5)
February 16	980.0 (4)	0.12 (4)	991.8 (4)	0.13 (4)	973.4 (5)	-1.56 (5)
March 16	1025.8 (4)	1.63 (4)	1052.0 (4)	2.15 (4)	1031.4 (5)	2.07 (5)
Avg., 10-27 to 3-16	946.5	1.23	956.6	1.39	960.9	1.13
Lactating First Calf Heifers						
April 13	1078.0 (4)	2.02 (4)	1088.0 (4)	1.29 (4)	1049.4 (5)	0.64 (5)
May 11	1094.5 (4)	0.59 (4)	1073.0 (4)	1.96 (4)	1048.6 (5)	-0.03 (5)
June 8	1087.3 (4)	-0.26 (4)	1065.8 (4)	-0.26 (4)	1009.8 (5)	2.61 (5)
July 6	1087.3 (4)	0.00 (4)	1094.0 (4)	0.76 (4)	1053.4 (5)	1.54 (5)
August 3	1072.0 (4)	-0.54 (4)	1081.8 (4)	-0.43 (4)	1024.8 (5)	-1.03 (5)
October 13	1129.3 (4)	0.81 (4)	1073.0 (4)	-0.12 (4)	1026.8 (5)	0.03 (5)
Avg. 4-13 to 10-13	1091.4	0.44	1079.3	0.53	1035.5	0.63
Calves						
165-Day Weaning Wt., lbs.[a]	572.3 (3)[c]	3.46 (3)[c]	596.3 (3)[c]	3.61 (3)[c]	479.0 (3)[b]	2.90 (3)[b]

[a]Adjusted for sex of calf and age of dam.

[b,c]Means of the same trait, followed by different superscripts, were significantly different from each other ($P<.05$).

three grass-legume combinations during January-February was 34.3 percent of the average protein production per acre during the June-September samplings.

Total digestible dry matter produced per acre per year averaged 9360, 9334 and 8597 pounds, respectively, for the Rhodesgrass, bigalta and buffelgrass in combination with the legume mixtures. Corresponding averages for protein per acre were 3045, 2681 and 2670 pounds.

The average weights and daily gains of the first-calf heifers and their calves used on this trial are presented in Table 3. Initially, four heifers were stocked on each of the three pastures. However, the number of heifers was increased to five for the buffelgrass-legume treatment group after a 28-day period. The five heifers remained on the buffelgrass treatment, whereas there were no further additions of cattle to the Rhodesgrass or bigalta treatments. Through the January weigh day, gains on all three of the treatments were quite satisfactory.

It should be emphasized that these heifers had been exposed to bulls for spring, 1977 calving. Therefore, a significant portion of the weight gains which were observed were not actually growth, but rather an increase in weight because of advanced gestational stages. The average initial weight was approximately 658 pounds.

It is interesting to note that the lowest average daily gain in the October-March (pre-calving) was during February, which was the same period of lowest dry matter production, digestible energy and crude protein percent.

Although weight loss of the heifers at calving within each of the three groups is included in the lower one-half of the averages presented in Table 3, (following lactating first-calf heifers), cattle in most of the treatments gained weight during most of the periods. However, the heifers essentially maintained

Table 4. Animal Units[a] Carried on Four Acres of Mixed Tropical Legume-Grass Pastures (4-acre swards)

Date	Legume-Buffelgrass	Legume-Rhodesgrass	Legume-Bigalta
October 27, 1976	3.20	3.20	3.20
November 24	4.00	3.20	3.20
December 22	4.20	3.20	3.60
January 19, 1977	4.40	3.40	3.60
February 16	4.60	3.80	3.80
March 16	4.80	3.80	4.00
April 13	5.05	4.25	4.25
May 11	5.50	4.25	4.75
June 8	5.75	4.25	4.75
July 6	5.75	4.75	4.75
August 3	5.90	4.90	5.05
August 31	6.20	4.90	5.20
September 28	6.20	5.20	5.20
October 26	6.20	5.20	5.20
Average, 28-day period	5.13	4.16	4.33
Average, 28-day period/acre	1.28	1.04	1.08

[a]Animal unit equivalents: Yearlings 12 to 17 months = 0.65
Yearlings 17 to 24 months = 0.80
Mature cow, maintenance or gestation = 1.00
Mature cow with calf, birth to 3 months = 1.25
Mature cow with calf, 3 months to weaning = 1.40

their weight during the April-October period, with the exception of the Rhodesgrass treatment which averaged 51 pounds increase in weight from April 13 through October 13. The heifers in the buffelgrass treatment lost approximately 23 pounds during this same period. In addition, in comparing the results of the Rhodesgrass and the buffelgrass pastures, there was a significant difference ($P < .05$) between the 165-day average weights of calves from the Rhodesgrass *versus* the buffelgrass treatment. Calves suckling dams on the Rhodesgrass pastures weighed an average of 98 pounds more than did calves suckling dams on the buffelgrass treatment. Although the first-calf heifers on the bigalta pastures essentially maintained their weight from April 13 through October 13, calves from these dams weighed slightly more, but not significantly more, than did calves from the Rhodesgrass pastures.

The numbers of animal units carried on the four acres of each grass-tropical legume mixture is presented in Table 4. Definition of animal units, in terms of different types of cattle, are presented at the bottom of Table 4. As expected from the numbers of animals allotted to each treatment throughout the trial (Table 3), the average per 28-day period, and hence per year, was greatest for buffelgrass (1.28 animal units per 28-day period per acre), with Rhodesgrass and bigalta averaging 1.04 and 1.08 animal units per acre per 28-day period, respectively.

CONCLUSIONS

First-calf Santa Gertrudis heifers were used in a comparison of Rhodesgrass, bigalta and buffelgrass, each of which was planted with the same tropical legume mixture. Although the buffelgrass-legume mixture supported more animal units per acre essentially throughout the entire trial and over all seasons, the average 165-day weight of calves born to and raised at side of the first-calf

heifers from the Rhodesgrass and the bigalta pastures were significantly greater than calves produced from the buffelgrass-legume treatments. All of the pastures were legume-dominant through all the seasons, with crude protein percent, dry matter production, and digestibility of dry matter least desirable during January-February for all three treatments.