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THE EFFECTS OF HARVEST INTERVAL AND IRRIGATION ON GREEN PANICGRASS WITH NITROGEN FERTILIZER OR SELECTED TROPICAL LEGUMES

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Irrigation, Harvest Interval and Nitrogen Effects on the Yield of Forage, Crude Protein and Digestible Dry Matter from - Green Panicgrass Alone and With Centro, Siratro or Stylo

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Upon achieving independence, the Government of the Bahamas Islands initiated a program to develop a viable agricultural system to reduce their dependency upon other countries for their food requirements, including meat. As part of this program the Bahamas Agricultural Research Training and Development Project (BARTAD) was established on North Andros Island, Bahamas.

Since several livestock enterprises were to be introduced early in the life of the BARTAD project the production of forage for livestock feed was given high priority. However, prior to the initiation of the project there was little or no information available locally on the performance of various tropical legumes and grasses as affected by fertilization, management or irrigation. A study was initiated, therefore, to determine the effect of these factors on one grass, greenpanic, and three legumes, centro, siratro and stylo, believed to be adapted to the soils and climate of the area. It is part of a thesis study in Agronomy by Ronald F. Guyton submitted in partial fulfillment of the requirements for a Ph.D. degree at The Pennsylvania State University.

Soils and Weather

Soils at the BARTAD site are composed of oolitic limestone sediments formed during the Pliestocene Era. Solution of the limestone by rain and sea water during the ice age resulted in the typical flat topography containing numerous sink holes and solution channels. The water table at the experimental site is approximately 4 feet below the soil surface.

The pH values of the soils on site range from 7.8 to 8.2. Typically for the site soil P levels are very low, K levels are low to medium, calcium levels are very high and magnesium levels medium. Typical soil levels of several other elements are: aluminum .20 ppm (very low), manganese 3.00 ppm (very low), iron 10.00 ppm (low), copper 14.00 ppm (normal), zinc less than 20.00 ppm (low) and sodium less than 50.00 ppm (normal).

Rainfall and temperature data for the period of the study taken from official BARTAD records are given in Table 1. Precipitation at the site is approximately 46-52 inches annually with the dry season beginning in December and ending in May. However, seasonal rainfall from year to year may be highly variable and has a marked influence on total and seasonal crop production.

Materials and Methods

Species

The species used in this experiment were chosen based on their observed

performance in plant introduction plots at the BARTAD site and from their known performance in other tropical areas of the world.

Green panicgrass (Panicum maximum var. trichoglume Eyles) is a botanical variety of guineagrass which was first popularized in Australia. It is a tall, perennial bunch grass with slender stems and fine leaves. The root system is finely branched and concentrated near the soil surface. Despite the root concentration near the soil surface, green panicgrass is very drought tolerant. Green panicgrass is extremely adaptable and will grow in areas with an annual rainfall as low as 22 inches and as high as 70 inches. It is very responsive to plant nutrients and very palatable. Green panicgrass is compatible with a wide range of legumes.

Centro (Lentrosema pubescens Benth) is a native of tropical South America and is a vigorous trailing and twining legume. It is adapted to different soil types and will grow under medium fertility levels. Centro has a high mineral and protein content. It is very acceptable to cattle and will withstand heavy grazing. In Queenslands, Australia, centro-guineagrass pastures have maintained an excellent grass-legume balance over periods of 20 to 25 years.

Siratro (Macroptilium atropurpureum D. C.) is a widely used tropical legume which is native to many countries of Central and South America. It is a long lived perennial with trailing stems which root at the nodes. Siratro is versatile in its soil and moisture requirements. Among its desirable characteristics are: its compatibility with a wide range of grasses; its tolerance to grazing once well established; and its contribution of nitrogen to the associated grass.

Townsville (stylosanthes humilis HFK) stylo is a free-seeding annual legume which is native to South America. It is low growing but has erect, narrow, fibrous stems. Townsville stylo prefers well drained, light textures soils, but is well adapted to a wide range of soils. However, it will not withstand water logging. It has a remarkable ability to extract phosphorus from low phosphate soils, but is also extremely responsive to applications of superphosphate. Townsville stylo germinates at the beginning of the wet season, grows during the summer and flowers in late autumn. During the winter, Townsville stylo remains green, thus providing some dry season feed.

Soil Preparation

The land area for the experiment was cleared in the fall of 1973. Vegetation was mainly Caribbean pine (Pinus caribeae). On May 15, 1974 the plot area was rock plowed. Then the land was disked with a 30 inch Rome disk and grid rolled. Stones larger than 6 inches in diameter were removed from the soil surface. On July 1, 1974 an 8-18-8 fertilizer, containing .04 percent Mg, .02 percent Mn, 0.003 percent B, .01 percent Cu, and .02 percent Zn, was broadcast at the rate of 1500 lb/A and incorporated to a depth of 2 inches with a disk harrow. The seedbed was then cultipacked. Any stones with a diameter larger than 3 inches were removed from the surface during seedbed preparations.

Table 1. Average temperature and rainfall data by months, April 1974 - December 1975 (BARTAD)

	1974				1975			
	Rainfall inches	Temperature F° Avg.	Min.	Max.	Rainfall Inches	Temperature F° Avg.	Min.	Max.
January	---	---	---	---	4.43	70	51	84
February	---	---	---	---	3.65	70	55	86
March	---	---	--	---	1.42	69	47	88
April	1.72	---	---	---	.69	73	51	89
May	2.87	75	55	91	5.63	75	59	90
June	8.00	79	63	91	6.75	78	63	91
July	6.17	79	70	88	5.19	79	66	90
August	6.93	79	68	91	2.33	80	63	91
September	5.68	80	68	91	5.39	80	68	89
October	5.84	76	61	88	4.41	78	60	88
November	3.11	71	51	84	6.44	74	50	85
December	.47	66	45	84	1.80	68	48	83
Total	40.79				48.43			

Planting and Uniformity Treatment

After the removal of stones over 3 inches in diameter, the plots were planted by hand. The seeding rates were: green panicgrass when seeded alone 6 lb/A; green panicgrass when seeded with legumes 4 lb/A; centro, siratro, and Townsville stylo 3 lb/A. To minimize grass competition, the plots were clipped 60 days after planting to a height of 6 inches to give the legumes a better chance for establishment. Then 120 days after planting all plots were harvested and the various managements imposed.

Uniform amounts of fertilizer were applied to all plots at planting and 9 weeks after planting, bringing the total fertilizer applied to 2000 lb/A of 8-18-8.

Treatments Applied

The treatments applied were: (a) irrigation vs. non-irrigation; (b) grass plus nitrogen fertilizer vs. three grass-legume mixtures; and (c) cutting intervals of 3-, 4- and 5 weeks. This time interval was selected so that the different cutting treatments could be compared with each other for total yield at the end of the experiment. The life of the experiment also included the entire cycle of wet and dry seasons.

Plot Design and Description

The experimental design was a split plot, randomized block with four replications, Each block was 99.5 ft x 13 ft. Four of the preceding blocks made up the irrigated section. These blocks were separated by a 20 ft alley from four more blocks which were not irrigated. Each block was divided into 12 plots with plots 6 x 13 ft in size. Each plot within a block was separated by a 2.5 ft alley to keep the vining legumes from running together.

Harvesting Procedure

Prior to each harvest, an estimation of the botanical composition (grass and legumes), percentage of plants heading or flowering by observation and plant heights were recorded for each plot.

Because of the difference in the amount of material present among different treatments, two harvesting procedures were used. First, the grass plus nitrogen plots were harvested with a Gravely sickle bar mower. A strip 3.25 x 9.75 ft was cut from the center of the plot. Second, on the grass-legume plots a one foot square quadrat was used and two random samples were harvested with hand operated grass shears. The total herbage from either the strip or two quadrats was weighed. A subsample was taken, weighed and dried for six days in a forced air dryer at 138°F. The subsample was then reweighed to determine the percent dry matter.

Dried subsamples from similar treatments were composited. These samples were then ground through a .04 inch screen in a Wiley mill and sent to the Pennsylvania State University, University Park Campus. There the samples were analyzed for crude protein and IVDMD (in vitro dry matter disappearance). All results are reported on a dry matter basis. The crude protein content of the forage was calculated by multiplying the nitrogen percentage of the samples by the factor of 6.25. The yield of digestible dry matter was calculated by multiplying the dry matter yield times the percent IVDMD.

Fertilization

All fertilizer was broadcast by hand. Sulphate of ammonia was applied to the grass plus nitrogen plots after each harvest at the rate of 30 lb/A of N for the 3-week harvest interval, 40 lb/A of N for the 4-week, and 50 lb/A of N for the 5-week harvest interval. The total nitrogen applied to all plots over the life of the experiment was 600 lb/A. All plots received a uniform application of P_2O_5 and K_2O, totaling 200 lb/A of each. This was applied in two applications during the 60-week life of the experiment.

Cultural Practices

All vegetation was removed from alleys. Irrigation was applied as needed during dry periods using overhead sprinklers. Each application was for a period of 2 hours at a rate of one-half in/hr for a total of approximately 1 inch of water/application. Irrigation was applied 30 times during the 60 weeks.

RESULTS AND DISCUSSION

The results presented are based on a 60-week time period so that the 3-, 4-, and 5-week harvest intervals could be compared with each other.

Forage Production

Effect of Irrigation

Irrigation did not significantly increase the total dry matter production of any of the four species. However, yields of green panicgrass + N at the 4- and 5-week harvest intervals and panicgrass + siratro at all three harvest intervals were slightly higher with irrigation than without irrigation, Table 2. The non-irrigated green panicgrass + N at the 3-week harvest interval outyielded the irrigated grass 11.53 to 8.88 T/A. Also, the non-irrigated grass + stylo out-yielded the irrigated grass + stylo at all three harvest intervals: 8.84 to 6.14 T/A at the 3-week interval, 7.57 to 3.84 T/A at the 4-week intervals, and 6.96 to 4.72 T/A at the 5 week interval. These differences were statistically significant.

Mean dry matter yields of irrigated green panicgrass + N tended to be higher than the yields of non-irrigated grass + N during the dry season, Tables 3, 4 and 5.

But during the wet season, the non-irrigated panicgrass + N tended to out-yield the irrigated grass + N. The green panicgrass + siratro or centro mean yields were quite similar both with and without irrigation. Green panicgrass + stylo mean dry matter yields were similar for both the irrigated and non-irrigated treatments during the dry season. But during the wet season, the non-irrigated grass + stylo was generally higher than the irrigated treatment.

The mean yields of both irrigation treatments of green panicgrass + N and green panicgrass + legumes increased at the beginning of the rainy season.

There are several factors which may have influenced the yields of the irrigated treatments. First, the grass and legume species used were tropical species and the cool temperatures during the dry season may have reduced growth rates. Second, the amount of water applied by irrigation may have been too low.

Non-irrigated yields of green panicgrass + N may have been influenced by: first, a build up of nitrogen in the soil during the dry season because moisture levels were too low for the grass to utilize the nitrogen fertilizer; second, the non-irrigated grass may have developed a deeper root system during the dry season and then been able to make better use of the moisture and accumulated nitrogen during the wet season.

The green panicgrass + stylo yields were higher without irrigation because the stylo stands were better without irrigation than with irrigation.

Effect of Species and Harvest Intervals

N-fertilized green panicgrass produced the highest forage yields, regardless of the management variable imposed. Yields of this species ranged from 8.01 to 11.53 T/A, Table 2. Its yield under irrigation was not affected significantly at any of the harvest intervals. The most productive treatment of the N-fertilized grass was the 3-week harvest interval without irrigation which yielded 11.53 T/A. Yields at this harvest interval for the panicgrass exceeded the 4-week non-irrigated interval by 3.52 T/A and the 5-week non-irrigated interval by 2.94 T/A. These differences were significant. The only management treatment for panicgrass with a legume that approached the N-fertilized grass alone was when grown with siratro, with irrigation and harvested at the 3-week interval. This produced a yield of 8.87 T/A. Panicgrass + siratro produced the highest yields at the 3-week interval, second highest at the 5-week interval, and lowest at the 4-week harvest interval. Forage yields of grass + centro did not differ significantly with irrigation treatments but did differ significantly with harvest intervals. The 3-week interval with yields of 6.99 T/A with irrigation and 7.44 T/A without irrigation was significantly higher than both the irrigated and non-irrigated treatments of the 4-week and 5-week intervals.

Table 2. Total Dry Matter Production of Four Species With and Without Irrigation and at the 3-, 4-, and 5-week Harvest Intervals

Species	Harvest Interval					
	3-week		4-week		5-week	
	Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.
	T/A					
Green panicgrass + N	8.88	11.53	9.09	8.01	9.25	8.59
Green panicgrass + siratro	8.87	7.74	6.22	5.92	7.69	7.31
Green panicgrass + centro	6.99	7.44	5.65	5.80	5.45	5.46
Green panicgrass + stylo	6.14	8.84	3.84	7.51	4.72	6.96
L.S.D. (.05)			1.17			

Table 3. Mean Dry Matter Production of Four Species With and Without Irrigation When Harvested Every Three Weeks.

Harvest Number	Harvest Date	Species: Green panicgrass + N		Green panicgrass + siratro		Green panicgrass + centro		Green panicgrass + stylo	
		Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.
		T/A							
1	November 27, 1974	.11	.11	.17	.09	.13	.08	.14	.16
2	December 18, 1974	.48	.31	.36	.14	.14	.30	.20	.12
3	January 8, 1975	.33	.17	.34	.33	.31	.41	.35	.29
4	January 29, 1975	.22	.26	.17	.13	.09	.12	.08	.11
5	February 19, 1975	.54	.34	.19	.17	.06	.18	.12	.17
6	March 12, 1975	.23	.38	.29	.18	.15	.17	.18	.19
7	April 2, 1975	.44	.36	.35	.38	.12	.23	.12	.24
8	April 23, 1975	.37	.31	.27	.35	.23	.24	.29	.24
9	May 14, 1975	.74	.59	.63	.39	.27	.31	.38	.29
10	June 4, 1975	.67	1.33	.92	.66	.50	.50	.33	.52
11	June 25, 1975	.50	.53	.50	.68	.48	.57	.42	.45
12	July 16, 1975	.58	.82	.45	.47	.33	.33	.30	.33
13	August 6, 1975	.45	.75	.60	.62	.45	.35	.42	.51
14	August 27, 1975	.20	.62	.45	.46	.44	.38	.34	.49
15	September 18, 1975	.89	.93	.57	.49	.48	.43	.44	1.08
16	October 8, 1975	.61	.64	.29	.27	.24	.23	.12	.70
17	October 29, 1975	.28	.28	.76	.54	.69	.51	.38	.56
18	November 14, 1975	.21	.28	.46	.41	.60	.44	.30	.90
19	December 10, 1975	.19	.20	.58	.45	.74	.66	.53	.83
20	December 31, 1975	.24	.19	.49	.50	.48	.96	.27	.63
	L.S.D. (.05)			.42					

Table 4. Mean Dry Matter Production of Four Species With and Without Irrigation When Harvested Every Four Weeks.

Harvest Number	Harvest Date	Species: Green panic-grass + N		Green panic-grass + siratro		Green panic-grass + centro		Green panic-grass + stylo	
		Irr.	N-Irr	Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.
		T/A							
1	December 4, 1974	.19	.36	.14	.12	.20	.03	.14	.18
2	January 2, 1975	.48	.28	.25	.27	.26	.32	.25	.32
3	January 30, 1975	.49	.39	.14	.11	.11	.11	.14	.10
4	February 26, 1975	.64	.59	.18	.32	.21	.13	.18	.24
5	March 27, 1975	.43	.28	.38	.28	.17	.35	.38	.19
6	April 24, 1975	1.06	.24	.39	.34	.28	.28	.39	.37
7	May 21, 1975	1.36	1.03	.41	.38	.26	.28	.41	.41
8	June 19, 1975	.82	1.09	.66	.71	.51	.48	.66	.75
9	July 16, 1975	.66	.71	.59	.45	.34	.45	.59	.46
10	August 13, 1975	.61	.60	.50	.44	.35	.47	.5	.5
11	September 10, 1975	.84	.55	.49	.53	.44	.42	.49	.66
12	October 8, 1975	.59	.73	.60	.61	.71	.52	.60	.84
13	November 5, 1975	.26	.36	.49	.47	.59	.54	.49	.89
14	December 3, 1975	.45	.28	.45	.34	.54	.73	.45	.58
15	December 31, 1975	.33	.26	.53	.53	.66	.62	.53	.98
	L.S.D. (.05)				.45				

Table 5. Mean Dry Matter Production of Four Species With and Without Irrigation Harvested Every Five Weeks.

Harvest Number	Harvest Date	Species: Green panic-grass + N		Green panic-grass + siratro		Green panic-grass + centro		Green panic-grass + stylo	
		Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.
		T/A							
1	December 11, 1974	.45	.34	.24	.23	.16	.30	.31	.41
2	January 15, 1975	.61	.26	.23	.24	.22	.25	.21	.24
3	February 19, 1975	1.22	.73	.38	.27	.21	.25	.26	.27
4	March 27, 1975	.59	.39	.45	.47	.22	.25	.20	.29
5	April 30, 1975	1.05	.38	.38	.46	.39	.27	.25	.53
6	June 4, 1975	1.72	2.05	1.15	1.08	.61	.84	.67	.81
7	July 9, 1975	.93	1.31	1.04	1.16	.65	.81	.71	.71
8	August 13, 1975	.63	.92	.71	.54	.38	.38	.37	.42
9	September 17, 1975	.80	.77	.84	.74	.50	.51	.44	.85
10	October 22, 1975	.72	.75	.80	.38	.72	.55	.46	.88
11	November 26, 1975	.34	.41	.82	.75	.48	.58	.27	.62
12	December 31, 1975	.22	.20	.63	.53	.93	.44	.54	.90
	L.S.D. (.05)					.56			

Protein and Digestible Dry Matter Production

Effect of Irrigation on Crude Protein Production

The most noticeable effect of irrigation was the depression of crude protein production of the irrigated green panicgrass + stylo. The non-irrigated treatments produced a total yield of crude protein of .74 to 1.07 T/A while the irrigated treatments produced .38 to .60 T/A, Table 6. The differences were significant at all three harvest intervals and were caused by the much lower stands of stylo in the irrigated plots.

Irrigated green panicgrass + siratro produced significantly more total crude protein per care than non-irrigated grass + siratro at the 3- and 4-week harvest intervals but not at the 5-week interval.

Green panicgrass + centro had only one significant difference between irrigated and non-irrigated treatments and that was at the 5-week harvest interval where the irrigated treatment outyielded the non-irrigated by .16 T/A crude protein.

Total yield of crude protein from N-fertilized green panicgrass was not significantly increased by irrigation.

Effect of Species and Harvest Intervals on Crude Protein Production

Total crude protein production of N-fertilized green panicgrass and panicgrass + siratro was generally higher than that of panicgrass + centro and panicgrass + stylo, Table 6.

At the 3-week harvest interval with irrigacion, green panicgrass + siratro produced the highest total yield of crude protein, 1.28 T/A and panicgrass + stylo produced the lowest yield, .06 T/A. However, without irrigation N-fertilized green panicgrass had the highest yield, 1.24 T/A and grass + centro had the lowest yield .83 T/A.

The only difference in the ranking of the species at the 4-week interval was that with irrigation, the green panicgrass + N produced the highest yield of crude protein.

At the 5-week interval the only change was that non-irrigated grass + siratro had a higher yield of crude protein than N-fertilized grass.

Total crude protein production of three out of four of the species declined as harvest interval increased. The exception was the panicgrass + siratro which declined at the 4-week interval but increased at the 5-week interval to almost the same levels as the 3-week intervals. At the 5-week interval the grass + siratro had the highest total yield of crude protein.

Table 6. Total Crude Protein Production of Four Species With and Without Irrigation and at 3-, 4-, and 5-week Harvest Intervals.

Species	Harvest Interval					
	3-week		4-week		5-week	
	Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.
	Crude Protein T/A					
Green panicgrass + N	1.22	1.24	1.06	.93	.91	.81
Green panicgrass + siratro	1.28	1.04	.98	.81	1.09	1.04
Green panicgrass + centro	.99	.83	.76	.66	.70	.54
Green panicgrass + stylo	.60	1.07	.38	.86	.43	.74
L.S.D. (.05)	.19		.14		.14	

Effect of Irrigation on Digestible Dry Matter Production

Irrigation produced significant increases in digestible dry matter of N-fertilized green panicgrass at the 4-week harvest interval, .65 T/A; and of N-fertilized grass and panicgrass + siratro at the 5-week interval, 1.01 and .24 T/A, respectively, Table 7.

Non-irrigated green panicgrass + stylo yielded from 1.40 to 2.14 T/A more digestible dry matter than irrigated grass + stylo. The difference was significant at all three harvest intervals.

Table 7. Total Digestible Dry Matter Production of Four Species With and Without Irrigation and at Three Harvest Intervals.

Species	Harvest Interval					
	3-week		4-week		5-week	
	Irr.	N-Irr.	Irr.	N-Irr.	Irr.	N-Irr.
	Dig. dm T/A					
Green panicgrass + N	5.73	5.91	5.52	4.87	5.70	4.69
Green panicgrass + siratro	5.43	4.79	3.93	3.68	4.77	4.53
Green panicgrass + centro	4.05	4.35	3.31	3.34	3.19	3.25
Green panicgrass + stylo	3.72	5.16	2.29	4.43	2.69	4.09
L.S.D. (.05)	.87		.60		.21	

Effect of Species and Harvest Intervals on Digestible Dry Matter Production

N-fertilized green panicgrass produced the highest total yield of digestible dry matter regardless of harvest interval or irrigation treatment, Table 7. The difference between the N-fertilized grass and the next highest yielding species was not always significant. Grass plus siratro produced the second highest yields except at the 3- and 4-week intervals (non-irrigated) when grass plus stylo was second highest panicgrass plus centro at all harvest intervals was the third highest yielding species under irrigation but the lowest yielding species without irrigation. Grass plus stylo produced the lowest yields of digestible dry matter at all three harvest intervals with irrigation, but without irrigation it was the second highest yielding species at the 3- and 4-week intervals and third highest at the 5-week harvest interval.

Stand Changes

Green Panicgrass plus Nitrogen

N-fertilized green panicgrass stands remained about the same under all harvest intervals with and without irrigation.

Green panicgrass plus Centro

Centro stands were thin at the beginning of the experiment in all treatments and provided a low percentage of the harvested material. Stands of centro improved slowly as the plants became better established. By the fifth month of harvest, April 1975, the legume was providing up to an estimated 30 percent of the harvested material. The legume stands continued to improve during the life of the experiment. This improvement was due partly to the older plants being vinier and partly to new plants produced by seed from old plants. The irrigated treatments were from 3 to 21 percent higher in estimated legume yield than the non-irrigated treatments. The lowest percentage was found in the non-irrigated, 3-week harvest interval plots.

Green panicgrass plus Siratro

Siratro stands were also thin at the beginning of the experiment in all treatments and provided a low percentage of the harvested material. The legume made up a higher percentage of the yields as stands increased in age with the highest estimated percentages occurring in the summer and early fall. The siratro percentage dropped at intervals due to insect damage or a leaf spot disease. The irrigated treatment usually recovered faster after damage. The siratro made up a larger percentage of the material at the 4-week and 5-week harvest intervals.

Green panicgrass plus Stylo

The largest difference in legume stands occurred in the stylo treatments. The stylo provided a very low percentage of the harvested material at the start of the experiment. In the irrigated treatments the stylo germinated during the early summer but a large percentage of the seedlings died and therefore stylo provided a fairly low percentage of harvested material during the fall and winter of 1975. In the non-irrigated treatments the stylo germinated during the summer of 1975 and provided up to an estimated 99 percent of the harvested material. The green panicgrass stand in the irrigated treatments with stylo was reduced during the life of the experiment at all three harvest intervals because of lack of nitrogen.

Relative Cost Analysis

These anlayses were done by projecting that: (1) under field conditions, yields of forage consumed by grazing livestock would equal research plot yields; and (2) irrigation would be applied with big gun type equipment. The dry matter yields are based on a one year time period and were calculated from the plot yields which were based on a 60-week period, by dividing by 60 and then multiplying by 52. The cost figures are from machinery and supply budgets developed at the BARTAD Project.

The costs per pound of dry matter produced by green panicgrass + N and green panicgrass + siratro are presented in Table 8. These figures were calculated using information presented in Tables 9 and 10.

Table 8. Cost per Pound of Dry Matter Produced by Green Panicgrass + N and Green Panicgrass + Siratro With and Without Irrigation at Three Harvest Intervals.*

Harvest Interval	Green Panicgrass + N		Green Panicgrass + Siratro	
	Irr.	Non-Irr.	Irr.	Non-Irr
	$/lb of dm			
3-week	0.04	0.02	0.03	0.01
4-week	0.04	0.03	0.04	0.02
5-week	0.04	0.02	0.03	0.01

* Costs per pound of dry matter were calculated using information in Tables and

Table 9. Calculated Yearly Dry Matter Yield of Green Panicgrass + N and Green Panicgrass + Siratro With and Without Irrigation at Three Harvest Intervals.

Harvest Interval	Green Panicgrass + N		Green Panicgrass + Siratro	
	Irr.	Non-Irr.	Irr.	Non-Irr
	dm T/A			
3-week	7.69	9.98	7.68	6.70
4-week	7.87	6.93	5.38	5.12
5-week	8.01	7.43	6.66	6.33

Table 10. Total Costs Per Acre to Produce Green Panicgrass + N and Green Panicgrass + Siratro With and Without Irrigation at Three Harvest Intervals.

Harvest Interval	Costs	Green Panicgrass +N		Green Panicgrass + Siratro	
		Irr.	N-Irr.	Irr.	N-Irr.
3-week	Annual	$174.40	$161.68	$174.42	$161.19
	Irrigation	253.01	---	253.01	---
	Nitrogen	214.93	214.09	---	---
	Total	$642.34	$375.77	$427.43	$161.19
4-week	Annual	$174.40	$161.68	$174.42	$161.19
	Irrigation	253.01	---	253.01	---
	Nitrogen	202.81	202.81	---	---
	Total	$630.22	$364.49	$427.43	$161.19
5-week	Annual	$174.40	$161.68	$174.42	$161.19
	Irrigation	253.01	---	253.01	---
	Nitrogen	196.26	196.21	---	---
	Total	$623.67	$357.89	$427.43	$161.19

Irrigated N-fertilized green panicgrass had the same cost per pound of dry matter, $0.04, at all three harvest intervals, Table 8. Without irrigation the N-fertilized cost ranged from $0.02 to $0.03 per lb of dm. Thus the average cost per pound of dry matter of N-fertilized green panicgrass without irrigation was 50 percent less than the cost per pound of irrigated grass + N.

Green panicgrass + siratro cost per pound of dry matter ranged from $0.03 to $0.04 for the irrigated treatment and $0.01 and $0.02 for the non-irrigated treatment, Table 8. The non-irrigated dry matter costs averaged 66 percent less than the irrigated costs.

The least expensive source of forage dry matter production of the alternatives included in this analysis was the non-irrigated green panicgrass + siratro at

either the 3-week or the 5-week harvest interval, (Table 8). The second least expensive source was non-irrigated green panicgrass + N at the same intervals and non-irrigated green panicgrass and siratro at the 4-week harvest intervals.

From a practical viewpoint the 3-week harvest interval is more desirable for a farmer to use due to reduced fencing costs because fewer fields would be needed for a rotational system of grazing.

Application of Findings to Andros

The results indicate that with weather conditions such as those during the sixty weeks of the experiment, irrigation did not significantly increase the total dry matter production of any of the four species grown. In fact, irrigation reduced the percentage of Townsville stylo in a grass + stylo mixture because the stylo seedlings died and therefore reduced the yield of the mixture.

A 3-week harvest interval resulted in the highest total yields of dry matter, digestible dry matter, and protein for all of the four species used. The difference in yield of protein and digestible dry matter would not be significantly different between irrigation and non-irrigated treatments except in the case of a grass + stylo mixture and then it would be significantly higher when not irrigated.

Calculated costs showed that non-irrigated green panicgrass + siratro harvested at a 3- or 5-week interval had the lowest cost, $0.01, per pound of dry matter. N-fertilized green panicgrass produced the highest dry matter yields but its cost per pound of dry matter was higher than the cost per pound of dry matter of green panicgrass + siratro. Therefore, taking into account the production of total dry matter, crude protein and digestible dry matter and cost per pound of dry matter, it appears that the best forage of the four species tested, for an Andros farmer would be non-irrigated green panicgrass + siratro harvested or grazed every three weeks.

This investigation demonstrated that it is possible to grow forage to support a livestock industry on the oolitic limestone soil and under the climatic conditions of Andros Island, Bahamas. Under the conditions of this study, irrigation, while helpful during critical dry periods, did not increase total dry matter production and was uneconomical.