Response of Pensacola Bahiagrass to Irrigation and Time of N. Fertilization

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Highlight: *Irrigated and not-irrigated Pensacola bahiagrass (*Paspalum notatum *var.* saurae Parodi*) was fertilized with 0, 84, 168, and 336 kgN/ha in six combinations of split applications during the season. Forage yields showed the following responses:*

Irrigation increased the average forage yield 2165 kg/ha in a dry year and 1303 kg in a wet year. Largest forage yields were obtained when irrigation was combined with the highest N rates.

Average forage yield was 2967 kg/ha without fertilization and 12,017 kg with fertilization at a 336 kgN/ha rate.

When N was applied to bahiagrass grown on soil low in N, best yields were obtained when 50% or more of the N was applied before growth starts in March or April. On similar soils application of N after August 1 was not as effective in increasing forage yields as March or April applications, but N applied in August or September increased forage production the following year.

Nitrogen level is known to influence growth and quality of grass herbage and the timing of N application has economic, convenience, production, and quality considerations.

Pensacola bahiagrass (*Paspalum notatum* var. *saurae* Parodi) is one of the major forage grasses in the Southeast, a region extending from Texas to North Carolina. This region produces 47% of the beef cows in the United States, and stocking rates may exceed two cows with calves per ha on more than 2.5 million ha of Pensacola bahiagrass (Blakely, 1964).

Bahiagrass is an important species in the developing regions of Central America and the tropics. Little published information is available on the advantages of time of N application on Pensacola bahiagrass production. In an area where drouth frequently modifies the response of a grass to N fertilization it is reasonable to suspect that irrigation would enhance production. This investigation provides data to alleviate part of the data deficiency.

Literature Review

Previous work has shown that Pensacola bahiagrass is a satisfactory forage grass, but it is susceptible to drouth and produces most of its growth in June, July, and August. It responds to nitrogen fertilization both in yield and protein content (Beaty et al., 1960; Burton and DeVane, 1954) but no data are available concerning the effect of time of N application on forage production. Burton and DeVane (1954), Burton and Jackson (1962), Coats (1957), and Morris and Celecia (1962) have reported that N applied in split applications to Coastal bermudagrass (*Cynodon dactylon*) produced higher yields and resulted in greater N recovery than did a single application in the spring. However, Morris and Celecia (1962) found little advantage from splitting applications of P and K for Coastal bermudagrass.

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Manuscript received December 5, 1973.

Procedure

Beginning in 1962, fertilizer treatments were applied for 2 years to an 18-year old stand of Pensacola bahiagrass growing on Eustis loamy sand at the Americus Plant Materials Center, Americus, Georgia. No fertilizer had been applied to this stand during the 3 years prior to 1962. Plots were not fertilized in 1964, but they were harvested to measure forage production from fertilizer carry-over. Soil test showed the area to be high in P and medium in K, with a surface pH of 6.1. Nitrogen rates applied were 0, 84, 168, and 336 kg/ha in split applications as shown in Table 1. N, P, and K were applied in a 4.00 – 0.44 – 1.67 ratio, and P and K were applied at the time of the first N application only. Sources of N, P, and K were ammonium nitrate (34% N), superphosphate (8.8% P), and muriate of potash (50% K), respectively.

Fertilizers were broadcast on the soil surface. The first application each year was made in late March or early April, and later applications were made following the June, July, August, and September harvests.

Plots, separated by plowed furrows, were 1.84 by 3.05 m in size. Forage yield samples were collected from an area 1.2 by 2.54 m. Samples were dried at 66° C. and yields were computed on an oven-dry basis. Beginning June 1, plots were harvested at monthly intervals 6 times in 1962 and 5 times in each of 1963 and 1964. The forage was harvested at a height of 6.6 cm.

Treatments were replicated three times in a split plot-randomized complete block design with water level as main plots; N rates and time of application as sub-plots. Irrigation was used to provide 32 mm of water weekly. Six 0-N plots were included per replication and were averaged for yield determinations.

Results and Discussion

Forage yields for each treatment for 1962 and 1963 are presented in Table 1. The 1962 season was relatively dry with May to August rainfall 145 mm below that of 1963. The average 1962 forage yield of 7076 kg was 603 kg/ha less than the 1963 yield. The larger forage yields in 1963 can be attributed in part to more rainfall and in part to carry-over of N, particularly at the higher N levels.

In 1962, 130 mm of water added in seven irrigations added 2289 kg/ha to the average yield, whereas in 1963 the average increase from 112 mm of water added in four irrigations was

Table 1. Yields (kg/ha, oven-dry)[1] of Pensacola bahiagrass as influenced by irrigation and time and rate (kg/ha) of nitrogen (N) fertilization.

Year and Plot	Percent of total N applied each month					Rate of N applied								
						0		84		168		336		
	Apr.	June	July	Aug	Sept	Irr.	Dry	Irr.	Dry	Irr.	Dry	Irr.	Dry	Avg
1962														
1	100							8858	5153	10847	7972	13888	9770	9415
2	20	20	20	20	20			5592	5524	9073	6852	12861	9970	8312
3		50	50					7624	4769	9624	7469	9493	8693	7962
4	50		50					7078	7372	11473	8310	13920	8679	9472
5	33		33		33			6447	4148	8370	5803	11691	8121	7430
6	10	30	30	20	10			6581	4806	7671	6758	12184	9732	7955
Average						3989	2575	7030	5295	9510	7194	12356	9161	
1963														
1	100							6593	5854	10222	8841	14131	12669	9718
2	20	20	20	20	20			6276	5011	9339	7727	14716	11599	9111
3		50	50					6326	5593	10935	9020	13418	12057	9558
4	50		50					6433	5687	10087	8625	14272	11735	9473
5	33		33		33			6755	4864	9024	7747	14969	12123	9247
6	10	30	30	20	10			5658	5041	8569	7418	15122	12494	9050
Average						2862	2440	6340	5342	9696	8230	14438	12113	

[1] Least significant differences for 5% and 1% levels are as follows:

Treatment	1962 .05	1962 .01	1963 .05	1963 .01
Irrigation	638	1472	668	1543
N rate	522	731	449	631
Time of N application	668	886	NS	NS

1281 kg/ha. In 1962 irrigation increased forage production at each N level. Without N, irrigation increased forage production significantly in 1962. At the 84 kg N rate, irrigation increased forage production by 2069 kg and at the 336 kg N rate the increase for irrigation was 3195 kg/ha. These increases in forage production in 1962 were highly significant. In 1963, increases in forage produced due to irrigation were 421, 998, 1466, and 2325 kg for the 0, 84, 168, 336 kg N applications, respectively. Irrigation increased forage production significantly with the 84 and 168 kg N rates; with the 336 kg N rate, the increase was highly significant. As a practical solution to forage production programs involving bahiagrass, it is doubtful that irrigation can be justified since most of the extra production from irrigation could have been obtained from less than 100 kg of N/ha and probably at a considerable saving of labor and equipment.

In 1962, the forage increases resulting from the interaction of N rate and time of application were highly significant. However, since the same interaction showed no significant difference in 1963, it was concluded that significance in 1962 was due to the low soil N level when treatments were initiated. Once N treatments were applied, enough N was carried over annually in the soil or in plants to sustain spring growth of bahiagrass on these treatments until N was applied the following year.

Responses in forage production due to N rate were similar to those previously reported. The decrease in forage yield without N fertilizer in 1963 as compared to 1962 probably represents removal of nutrients previously available and has been experienced before when old bahiagrass sods were used for research. At 84 kg of N, forage production was stable at approximately 5880 kg/ha per year. At the 168 and 336 kg N rates, forage production during 1963 was 564 and 2516 kg higher than in 1962. The forage increase in 1963 at the higher N rates was probably due either to a carry-over of N in the soil to the following year or to more primordia being stimulated to active growth. Nitrogen application also increases the weight of stolons available to produce growth (Beaty et al., 1964).

In 1962, applying 50% or more of the N (treatments 1 and 4) well before growth started in the spring was superior to applying 50% of the N after June 1 (treatment 5). Delaying N application (treatments 2, 3, 5, and 6) reduced forage yield by an average of 1592 kg in 1962 as compared to applying 50% or 100% of the N in March or April. In 1963, the difference in forage production due to time of N application dropped to 352 kg/ha.

In 1963, no significant differences in forage production attributable to time of N application were obtained, and the N rate by time of application interaction was not significant. The lack of response to time of N application in 1963 probably can be explained by carry-over of N applied in August and September of 1962 and not used in forage production until the following season. In 1964 no N was applied and forage production for the 0, 84, 168, and 336 kg N rates was 2496, 3423, 5783, and 6752 kg, respectively. Forage produced attributable to N carry-over minus forage produced at 0-N was 927, 3287, and 4256 kg for the 84, 168, and 336 kg N rates.

Due to past treatment of the area (harvesting forage or seed without applying fertilizer), the soil N level in the spring of 1962 was relatively low. Data reported here indicate that when bahiagrass grown under low fertility is to be fertilized for increased production, a major part of the N should be applied early in the growing season if maximum yields are to be obtained. Other experiments have shown that fertilizing bahiagrass with N increases root and stolon production by up to 16,300 kg/ha (Beaty et al., 1964). It appears logical to assume that on areas where stolons and roots have been built up by high N applications over a period of years, roots and stolons will die and the organic N contained in them will be mineralized; therefore, forage production will remain above that of the unfertilized check until nutrients released by mineralization are exhausted, if mineralization rate can keep up to the demands of the plants.

It is apparent that no yield advantage is to be gained in forage production of Pensacola bahiagrass from splitting N applications. A single application of N before growth starts in the spring appears to be equal to or superior to splitting N in any combination. Splitting N had little influence on seasonality of forage production as compared to applying it in a single application. Since bahiagrass growth usually slows down in August, N applications after July 15 are not likely to be fully utilized until the following year.

Forage produced in years following N fertilization indicates that significant quantities of N are carried over in the sod parts, and additional research could quantitate the amount. Applying N to bahiagrass to increase hay production in August or September would not appear to be valid. Perhaps the most serious deficiency of bahiagrass, poor seasonal distribution of forage production, cannot be significantly modified by seasonal applications. Consequently the practice of using split N applications on perennial forage grasses cannot be justified for use on bahiagrass.

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