Dry Matter Yield and Chemical Composition of Pearl Millet (*Pennisetum typhoideum*) as Affected By Nitrogen Level

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ABSTRACT

A local variety of pearl millet was studied in a field experiment to assess the influence of five levels of nitrogen dressing (0, 28, 56, 84 and 112 kg N/ ha) on forage dry matter yield and proximate chemical constituents under optimal growing conditions. All plots were cut three times during each growing season. During the first cut increasing nitrogen levels up to 84 kg N/ ha increased forage dry matter yield. However, the increase in forage yield was not significant over this level. During the second and third cut, the difference among the N levels was not significant. Moreover, no significant differences was observed among N levels for the proximate chemical constituents during the three cuts.

INTRODUCTION

There is a need for high quality forage the year around in the Jamahiriya. Warm season annual grasses are being used as forage crops to supplement forage legumes in livestock forage programs. One of these crops is pearl millet *(Pennisetum typhoideum)*. However, little experience with the agronomy of this crop as a forage crop for maximum dry matter and animal production/ unit area is available.

Several investigators (2, 5, 9, 10) have studied the effects of management and environment on forage yield and quality of some summer annual grasses. Nitrogen supply is the main factor determining forage yield of grasses. The amount and timing of fertilizer nitrogen application can effect both dry matter yield and animal production (4). To derive the maximum benefits from a fertilizer, it is essential to have reliable information on the response of a crop to varying rates of fertilizer application. The objectives of this experiment were to study the effect of various levels of nitrogen application on the yield and proximate chemical composition of pearl millet under prevailing growing conditions.

MATERIALS AND METHODS

The experiment was conducted on sandy loam soil of the Faculty of Agriculture

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farm, Tripoli, during the summer of 1983 and 1984. The experimental area had received 18 kg/ ha of P in the form of superphosphate fertilizer applied broadcast and disked before planting. The experiment was arranged in a randomized block design with four replications. The local variety of pearl millet was seeded at 25 kg/ ha on April 3, 1983 and April 13, 1984, respectively. Individual plots in the experiment were 3 meters (10 rows, 30 cm apart) wide and 3 meters long. Five rates of N fertilizer (0,28, 56, 84 and 112 kg/ ha) were applied one week after seedling emergence and again after the first and second harvest. Weeds were controlled by cultivation. Plots were sprinkle-irrigated as needed. Cuts were made on June 20, July 27 and Sept. 2, for the first, second and third cuts, respectively, in 1983. Comparable dates for 1984 were June 26, July 26 and Sept 2, respectively.

At each cut, the plants were sampled for fresh yield determination, using a cutting guide to ensure a 20 cm stubble. A sample weighing approximately 2 kg fresh weight, was separated into component parts: stem, inflorescence and leaves. Moreover, plant samples were taken and dried in a forced air dryer at 75°C.

For each cut of the 1983 and the 1984 growing season, samples of dried forage were ground to pass through a no. 40 mesh screen and analyzed for forage quality using proximate analysis procedures, and nitrogen content following the procedures of the Association of Official Agriculture Chemists (1). Values for nitrogen free extracts were obtained by difference.

The data obtained were subjected to pooled statistical analysis (8). No significant interaction was found between nitrogen level and the measured parameters. Therefore data for each nitrogen level are presented as the average over the two years of the experiment.

RESULTS AND DISCUSSION

The dry matter yield for each cut separately and the cumulative total yield of the season are shown in Table 1. During the first cut, the N levels brought about a significant difference in dry matter yield.

Table 1 — Forage dry Matter Yield at Different Cuts and summed over growing season as affected by N Levels.

N-LEVEL	CUTTING			
kg/ ha.	First	Second	Third ton/ ha.	Total
0	1.87	1.08	1.37	4.32
28	3.49	2.96	1.48	7.93
56	4.50	3.08	1.52	9.10
84	5.62	2.52	2.10	10.24
112	5.85	2.12	2.07	10.04
Means	4.27	2.35	1.71	8.33
L.S.D (0.05)	1.19	ns	ns	2.51

It appears also that dry matter yield of the first cut increased with each successive increment of 28 kgN/ ha up to 112 kgN/ ha. However, the difference among the N levels for dry matter yield was not significant during the second and third cuts (Table.

1). The average yield was about 2.4 and 1.7 ton/ ha, for the second and third cut respectively. Moreover, Table. 1. shows a progressive reduction in the contribution of each successive cut to the cumulative total yield of the season. The contribution on the first, second, and third cut to the total seasonal yield was about 52, 29 and 19% respectively. This diminution was probably a reflection of the inability of this variety to produce a good regrowth. These data suggest that the local variety of pearl millet used in this experiment is not adapted to a multi cut forage management system. It is also suggested that a single application of fertilizer, and management of this crop for a single cut, or seeding this crop again for another growth would be more beneficial than management of this crop for several cuts during its growing season.

Taking this into consideration, the dry matter yield data of the first cut at different nitrogen levels were fitted to a quadratic regression function using the least square method. Calculated values are presented graphically in Figure 1 which depicts the law of diminishing returns.

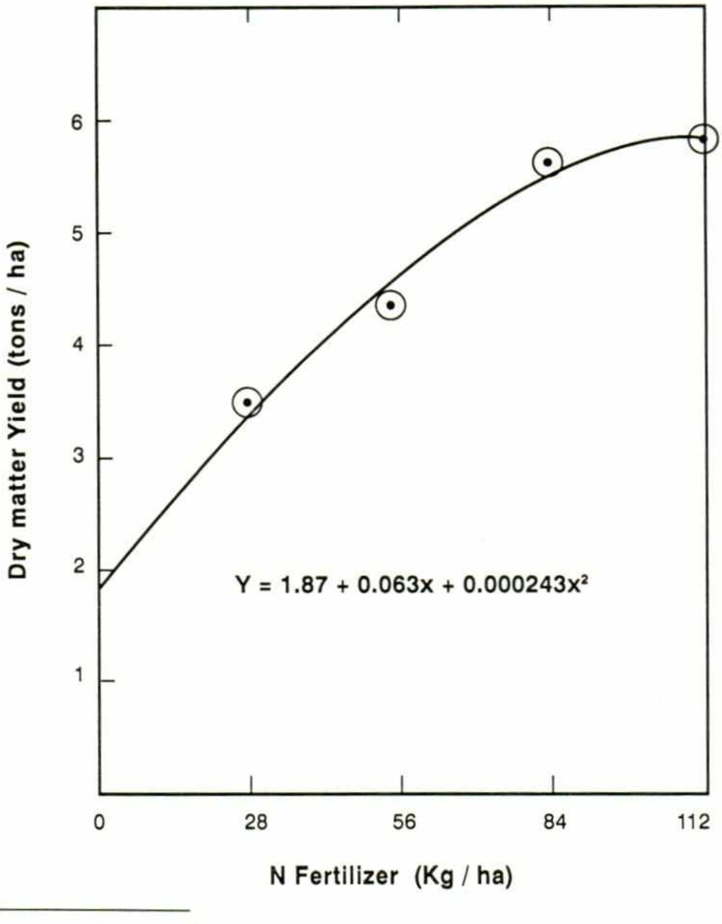

Fig. 1. Response of pearl millet to N Fertilization during the first cut.

As the derived function fitted the data with an R exceeding 0.9 the optimum economic nitrogen level for the first cut was derived from this function using the FAO 1965 formula:

$$X_0 = \frac{b - q/p}{2C}$$

Where X_0 is the optimum economic nitrogen level, b and c are coefficients of X and X^2 of the response function, q is the cost of application per unit of fertilizer, and p is the price per unit of dry matter yield. On the basis of the current prices of ammonium sulphate (21% N) and dry forage which are 36.79 L.D./ ton, and 100 L.D/ ton respectively, the economic level for the mean of the first cut was about 129 kgN/ ha. However, the general response level is expected for many reasons to be lower under farming conditions than in a carefully managed experiment. Taking this into account and allowing for discount factors of about 35% (Dr. Sgaier, personal communication), 84 kgN/ ha was considered an optimum economic nitrogen level.

The percentages of leaf, stem, and the proportion of leaf to stem on dry weight basis for each cut are presented in Table. 2. The proportion of leaf to stem during the three cuts showed an increase as the nitrogen level increased, (Table. 2). However, the percent of leaves in the second and third cut decreased to a mean of about 65 and 63%, respectively, as compared to about 73% in the first cut. This was probably because of the poor regrowth and non response of the regrowth to N fertilizer addition.

Table 2 — Ratio of leaf to stem at different nitrogen levels.

	N Level	Proportion of leaves	Proportion of stem	Proportion to stem
	Kg/ ha		%	
First Cut	0	60.2	39.8	1.5:1
	28	70.5	29.5	2.4:1
	56	73.1	26.9	2.7:1
	84	74.8	25.2	3.0:1
	112	86.6	13.4	6.5:1
Means		73.0	27.0	3.2:1
Second Cut	0	62.5	37.5	1.7:1
	28	62.5	37.5	1.7:1
	56	63.9	36.1	1.8:1
	84	66.1	33.9	2.0:1
	112	69.7	30.3	2.3:1
Means		64.9	35.1	1.9:1
Third Cut	0	60.3	39.7	1.5:1
	28	61.0	39.7	1.6:1
	56	63.4	36.6	1.7:1
	84	65.8	34.2	1.9:1
	112	65.3	34.7	1.9:1
Means		63.2	37.0	1.7:1

The results of analysis for crude protein, ether extract, crude fiber, silica free ash and nitrogen free extract are presented in Table 3. No significant difference was observed among N levels for the proximate chemical constituents during the three cuts (Table. 3).

Table 3 — Proximate chemical constituents for each cutting

Cutting	N Level	Crude Protein	Silica Free Ash	Ether Extract	Crude Fiber	N Free Extract
				%		
First	0	5.04	7.2	2.1	26.7	59.0
	28	5.50	7.5	2.1	26.4	58.5
	56	5.54	8.1	2.0	25.9	58.5
	84	5.75	8.3	2.1	26.8	57.1
	112	6.40	8.9	2.3	27.7	54.7
Means		5.65	8.0	2.1	26.7	57.6
LSD (0.05)		n.s.	n.s.	n.s.	n.s.	n.s.
Second	0	8.11	11.4	2.6	26.6	51.3
	28	6.18	10.7	2.3	26.8	54.0
	56	6.30	9.5	2.3	26.7	55.2
	84	7.04	9.9	2.4	26.0	54.7
	112	7.36	11.2	2.5	26.0	52.9
Means		7.00	10.5	2.4	26.4	53.6
LSD (0.05)		n.s.	n.s.	n.s.	n.s.	n.s.
Third	0	6.79	7.3	1.8	27.8	56.3
	28	7.49	7.8	1.9	28.7	53.1
	56	6.36	7.6	1.9	29.4	54.8
	84	6.96	7.9	1.7	29.8	54.6
	112	7.66	7.5	1.9	28.4	53.6
Means		7.05	7.6	1.8	28.8	54.5
LSD (0.05)		n.s.	n.s.	n.s.	n.s.	n.s.

Edwards *et al.*, (3) reported that digestible dry matter for a cultivar of sorghum-sudan grass hybrid was altered by variation in cutting management. They showed that the digestible dry matter of the whole plant was proportional to the proportion of leaves and inversly related to the proportion of stem. The decrease in digestible dry matter and nutrient value with maturity for stems is greater than for leaves (3). The high stem proportion would appear to account for the relatively low nutrient value obtained for this crop. Oyenuga (7) reported a crude protein value of about 11.4% for leaves of elephant grass *(Pennisetum purpureum)* cut at six week intervals. Moreover, Gupta (6) found that a greater number of leaves, thin stems, lower plant height and early maturity accounted for 87% of variation in protein content of Indian varieties of pearl millet. He also reported a crude protein range of about 11.2-13.7% and 9.4-13% for some Indian and African varieties of pearl millet. As the stem became lengthened and stout, the animals usually confine themselves to the leaf portion of the plant. Therefore, it is expected that the nutrient value of this portion of the crop would be higher than what was reported here for the whole plant, if feeding was restricted to the leaf portion.

In conclusion, although increased dry matter production was obtained with increased nitrogen levels, it is suggested that for maximum animal production, the effect of different cutting managements on the nutritive value of the forage should be further evaluated.

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تأثير مستوى النيتروجين على إنتاج الدخن من المادة الجافة والتركيب الكيميائي

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المستخلص

أجريت تجربة حقلية لغرض تقييم تأثير خمس مستويات من التسميد النيتروجيني (0 ,28 ,56 ,84 ,112 كجم ن/ هـ) على إنتاج صنف دخن محلي من العلف ومكوناته الكيميائية تحت ظروف نمو مثلى. لقد أخذت ثلاث حصدات من النباتات خلال كل موسم نمو. خلال الحصدة الأولى، أدت زيادة مستوى النيتروجين إلى حد 84 كجم ن/ هـ إلى زيادة في إنتاج المادة الجافة.

ولكن هذه الزيادة كانت غير معنوية بعد هذا المستوى من التسميد النيتروجيني. أما خلال الحصدتين الثانية والثالثة كانت الفروقات بين مستويات النيتروجين المختلفة غير معنوية. إلى جانب هذا، فإن مستويات النيتروجين لم تؤد إلى اختلافات معنوية في المكونات الكيميائية للمادة الجافة خلال الحصدات الثلاث.