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EFFECT OF DIFFERENT NITROGEN LEVELS AND HARVEST STAGES ON THE YIELD AND QUALITY OF SORGHUM FODDER

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To determine the nitrogen utilization efficiency of sorghum fodder harvested at different growth stages, an experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad and it was observed that the height of the plant and number of leaves per plant increased significantly by the application of nitrogen over control. Similarly stages of harvesting differed considerably from one another in these respects. There was a linear increase in green fodder yield as the nitrogen rate was increased from 24 to 48 Kg/acre. Moreover it was observed that there was relative increase in protein and fat contents with the increase of nitrogen rate but these contents were considerably decreased when the crop was harvested 75 days after planting.

INTRODUCTION

Sorghum (*Sorghum vulgare*) is a valuable and important "Kharif" fodder crop of Pakistan and possesses wide range of ecological adaptability. Its feeding value has been reported to be equal to that of corn, and due to its palatability and succulence it is relished well by the animals [1].

Animals are still the main source of farm draught power due to many hazards in the use of farm machinery. They are also responsible for the supply of protein, milk and milk products in addition to the valuable organic manure but they are physically weak and poor yielder in every field due to inadequate supply of green fodder of good quality. Besides regular, and abundant supply of succulent fodder is difficult for farmers to maintain throughout the year is a serious problem of our farmers especially during the Kharif season, because all Kharif fodders are comparatively poor yielding with low nutritive value and have no ratooning ability. Therefore, to improve the quality and quantity of green fodder per acre, it is much essential to determine the fertilizer requirement and its optimum stage of growth at which it can be utilized with best results. Keeping in view, the present study was planned to investigate the effect of different levels of nitrogen and the harvesting stages on fodder yield of sorghum and its quality under irrigated conditions of Faisalabad.

MATERIALS AND METHODS

The effect of varying nitrogen levels and stages of cutting on the yield and quality of sorghum fodder was studied at the Agronomic Research Area, University of Agriculture, Faisalabad. The treatment studied during the course of experiment were as follows:

(A) *Nitrogen levels*

F_O = Control
F_1 = 24 Kg N/acre in the form of urea
F_2 = 36 Kg N/acre in the form of urea
F_3 = 48 Kg N/acre in the form of urea

(B) *Harvesting dates*

D_1 = 45 days after sowing
D_2 = 60 days after sowing
D_3 = 75 days after sowing

The experiment was laid out as a split plot design with three replications. The main plot treatments were nitrogen levels. The sub plot size was $\frac{1}{96.8}$ of an acre sorghum variety "JSI" was seeded on a well prepared seed bed in rows 22.5 cm apart during the first week of July, 1978 using a seed rate of 30 Kg/acre. The whole of the nitrogen in the form of urea was applied at first irrigation. The observations recorded during the course of the experiment were as follows:

1. Plant height at harvest (m)
2. Number of leaves per plant at harvest
3. Crude protein contents (%)
4. Fat contents (%)
5. Green fodder yield per acre (quintals)

For quality evaluation analyses of protein and fat were done by using standard procedure of A.O.A.C. [2]. The data obtained were statistically analysed by the method described in Snedecor [3].

RESULTS AND DISCUSSION

The data regarding the final plant height given in

Table 1 indicate significant differences among the various fertilizer treatments. Plants fertilized with different levels of nitrogen were considerably taller than those in the control. Within the fertilizer treatments, applications of 36 and 48 Kg. N/acre showed a non-significant difference. However, the plants of those treatments were significantly taller than those fertilized with 24 Kg of nitrogen per acre. These observations are in accord with those of Tiwari, *et al.* [4]. A comparison of different stages of harvesting showed than the height of the plant increased progressively with delay in harvesting. The maximum plant height of 2.49 meters was recorded when the plants were 75 days old and this was significantly higher than the other two treatments. Plant height continued to increase vigorously even after 45 days and the growth rate of plants with nitrogen were much higher than those of control plants as reported by Gill [5] and Varma [6]. They obtained an increase in the yeild of "Jawar" with 90 Ibs. of nitrogen per acre applied as urea or ammonium sulphate. The interaction between harvesting dates and nitrogen levels was found to be statistically significant and the tallest plants were found when the crop was fertilized at the rate of 36 Kg nitrogen per acre and harvested 75 days after sowing. The plots receiving no fertilizer and harvested 45 days after sowing produced the shortest plants.

The data pertaining to the number of leaves per plant at harvest presented in Table 1 show that all the fertilizer treatments increased the number of leaves per plant significantly over control. The number of leaves per plant increased linearly with the increase of nitrogen rates. Similar results were reported by Tiwari, *et al.* [4]. These authors reported that increased plant height, higher number of leaves and greater diameter of the stalks were obtained with application of 200–240 Kg N/ha. There was a considerable increase in the number of leaves per plant with each delay of 15 days in harvesting from 45 to 75 days. The maximum number of leaves per plant was recorded in 75 days and this was significantly higher than other two treatments. This could be due to the continued vegetative growth of the fertilized plants. The interaction between harvesting dates and nitrogen levels was statistically non significant.

The quality of fodder is influenced by the application of fertilizers and growth stages of crop plants is evident from the data given in Table 2. The percentage of protein increased progressively with increasing rate of nitrogen. Plants fertilized with 48 Kg N/acre showed the highest protein content of 11.40 %, which was significantly higher than all other treatments. However, the plots fertilized with 24 Kg. N/acre did not show significant increase in protein content of the fodder over the control. These findings are quite in agreement with those of Khamraev and Kim [7]. They observed that the application of 90 Kg N90 Kg ha, for sorghum and maize is the most suitable dose for getting good quality fresh fodder yields. A comparison of stages of harvesting treatment revealed that protein contents of sorghum stalk decreased significantly when the crop was harvested 75 days after planting. The decrease in protein contents with delay in harvesting was attributed to successive development of fibrous tissue as plants advanced towards saturity. This view is strongly supported by the work of Owen and Webster [8], Osman and Saeed [9] and Olsen [10]. They observed that a significant decrease in crude protein had occurred by hard dough stage. As regards interaction of harvesting dates and nitrogen levels significant differences were observed among various combinations. Highest protein percentage of 12.50 was found in the plants fertilized at the rate of 48 Kg

Table 1. Effect of different harvest dates and nitrogen levels on plant height and number of leaves per plant of sorghum.

Treatments Harvesting dates (days after planting)	Leaves	
	Plant height (m)	Number of leaves per plant
A. D_1 = 45 days	1.28 c +	6.15 c
D_2 = 60 days	1.64 b	8.24 b
D_3 = 75 days	2.48 a	13.91 a
B. *Nitrogen levels*		
F_0 = control	1.52 c	8.50 c
F_1 = 24 kg N per acre	1.70 b	9.25 b
F_2 = 36 kg N per acre	1.90 a	9.83 ab
F_3 = 48 kg N per acre	2.10 a	10.19 a
C. *Harvesting dates x nitrogen levels*		
D_1f_0	1.12 f	5.15 N.S.
D_1f_1	1.23 ef	6.00
D_1f_2	1.30 ef	6.58
D_1f_3	1.45 e	6.90
D_2f_0	1.30 ef	7.68
D_2f_1	1.51 e	7.25
D_2f_2	1.50 e	8.73
D_2f_3	2.29 bcd	9.33
D_2f_0	2.13 cd	12.67
D_3f_1	2.34 bc	14.50
D_3f_2	2.88 a	14.17
D_3f_3	2.59 ab	14.33

+Duncan's multiple range test at 5 % probability any two means not showing a letter in common differ significantly.

nitrogen per acre and harvested 45 days after sowing. It was followed by 11.43 % protein, which was obtained from these plants which were treated with 36 Kg nitrogen and harvested 60 days after sowing. These data suggested that at higher nutritional level the plants were able to synthenize more protein at comparatively early growth stage. The results are in agreement with those obtained by Wheeler [1] and Ruebenbauer and Lonc [11]. They concluded that with delayed harvesting of sorghum fodder the contents of dry matter and crude fibre were increased, and those of total protein and crude fat were decreased. The interaction between stage of harvesting and fertilizer levels indicated significant differences and the highest percentage of fat (5.06) was found in plants treated with 36 Kg nitrogen and harvested 45 days after sowing.

There was a linear increase in green fodder yield/acre as nitrogen was increased from 24 to 48 Kg N/acre. The maximum fodder yield of 147.92 quintals per acre (on a fresh weight basis) was obtained when the crop was fertilized with 48 Kg N/acre as against 84.52 quintals per acre in the control, and was significantly superior to the others. Similar results were reported by Burleson, *et al.* [12], who observed that the application of 120 lb of nitrogen per acre significantly increased the total yield of grain and forage. A comparison of stages of harvesting treatment means revealed that the yield of the crop harvested 60 and 75 days after planting showed a non-significant difference but both

Table 2. Effect of different harvest dates and nitrogen levels on quality of sorghum fodder.

Treatments	Means	
Harvesting dates (day after planting)	Crude protein contents (%)	Fat contents (%)
A. D_1 = 45 days	10.76 a+	4.43 a
D_2 = 60 days	10.82 a	3.18 b
D_3 = 75 days	9.75 b	2.88
B. *Nitrogen levels*		
F		
F_0 = control	9.81 c	2.85 d
F_1 = 24 kg N per acre	9.77 c	3.21 c
F_2 = 36 kg N per acre	10.80 b	3.86 b
F_3 = 48 kg N per acre	11.40 a	4.05 a
C. *Harvesting dates x nitrogen levels*		
D_1f0 =	10.00 gh	3.53 dc
D_1f1 =	9.57 ghl	4.53 b
D_1f2 =	10.97 bcd	5.06 a
D_1f3 =	12.50 a	4.60 b
D_2f0 =	10.27 efg	2.53 h
D_2f1 =	10.47 ef	2.56 gh
D_2f2 =	11.43 b	3.53 dc
D2f3 =	11.13 b	3.53 dc
D_2f3 =	11.13 bc	4.10 c
D_3f0 =	9.17 b	2.50 b
D_3f1 =	9.27 l	2.53 h
D_3f2 =	10.00 gh	3.00 f
D_3f3 =	10.57 dc	3.50 c

+Duncan's multiple range test at 5 % probability any two means not sharing a letter in common differ significantly.

Table 3. Effect of different harvest dates and nitrogen levels on the fodder and protein yield of sorghum.

Treatment	Means	
Harvesting dates (days after planting)	Green fodder yield per acre (quintals)	Protein yield per acre (quintals)
A. D_1 = 45 days	33.70 b	3.63 b
D_2 = 60 days	14.71 a	15.73 a
D_3 = 75 days	171.38 a	16.28 a
B. *Nitrogen levels*		
Fo = control	84.52 d	7.91 d
F1 = 24 kg N per acre	106.04 c	10.01 c
F2 = 36 kg N per acre	133.24 b	13.81 b
F3 = 48 kg N per acre	147.92 a	15.80 a
C. *Harvesting dates x nitrogen levels*		
D_1f0 =	18.03 I	1.76 c
D_1f1 =	27.03 hi	2.49 c
D_1f2 =	38.53 gh	4.09 d
D_1f3 =	51.23 g	6.19 cd
D_2f0 =	100.75 f	10.00 c
D_2f1 =	127.86 c	12.96 bc
D_2f2 =	172.40 cd	19.07 ab
D_2f3 =	193.83 ab	20.88 a
D_3f_o =	134.77 c	11.96 c
D_3f1 =	163.23 d	14.56 bc
D_3f2 =	188.80 abc	18.27 b
D_3f3 =	198.70 a	20.33 a

+Duncan's multiple range test at 5 % probability any two means not sharing a letter in common differ significantly.

the treatments were significantly better than the first one where the yield of sorghum fodder was only 33.70 quintals per acre. These results are in accordance with those reported by Burton, *et al.* [13], who found that the maximum yield of green material and crude protein could be obtained if the crop was harvested 60 days after sowing.

From the proceeding discussion it can be concluded that the crop harvested 60 days after planting proved to have the most desirable quality and also a relatively good yield of sorghum fodder which can be significantly improved when the nitrogen levels is increased from 24 to 48 Kg/acre. For getting a higher yield and a better quality crop. The interaction between the harvesting dates and fertilizer levels showed significant differences. The highest fresh fodder yield of 198.70 quintals per acre was obtained from plots fertilized with 48 Kg nitrogen per acre and harvested 75 days after sowing.

The data on protein yield per acre indicated that crop harvested at 60 or 75 days after sowing gave more protein yield than harvesting done 45 days after sowing. On the other hand there was progressive increase in the protein yield as the nitrogen application was increased from 24 to 48 Kg nitrogen per acre. The interaction results indicated the highest protein yield of 20.88 quintals per acre was obtained by the application of 48 Kg N/490 and harvesting it 60 days after sowing (D_2 F_3).

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