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Effect of Nitrogen and Phosphorus on the Fodder Yield and Quality of Two Sorghum Cultivars (*Sorghum bicolor* L.)

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ABSTRACT

Two sorghum cultivars (Hegari and JS 263) were grown with different doses of nitrogen and phosphorus fertilizers in the form of urea and single super phosphate. There was a gradual increase in plants height, stem diameter, number of leaves per plant, leaf area per plant and fodder yield with the increase in nitrogen and phosphorus. A progressive increase in crude protein, crude fiber, ash content and stem thickness was also observed. Maximum fodder yield (453.28 q ha^{-1}) and dry matter yield (162.2 q ha^{-1}) was obtained by the application of 100-100 kg N-P ha^{-1} (F5) followed by 100-50 kg N-P ha^{-1} (F4) in sorghum variety Hegari. However, F5 and F4 gave statistically similar plant height, stem diameter, fodder yield and dry matter. The variety Hegari produced taller plants, greater stem diameter and higher fodder yield as compared to JS 263. The variety Hegari also exhibited higher crude fiber, ash content and dry matter but protein content was non-significant between the two varieties. Thus, it can be concluded that the variety Hegari is better as compared to JS 263 grown for fodder purpose. The optimum and economical dose of fertilizer for fodder crop is 100-50 kg N-P ha^{-1} (F4).

Key Words: Sorghum; Fodder; Nitrogen; Phosphorus; Crude fiber; Ash content

INTRODUCTION

Sorghum (*Sorghum bicolor* L.) belonging to the family poaceae, is an important Kharif season (Summer) dual purpose crop. Sorghum fodder is the basic feed for livestock and is somewhat inferior in quality due to the presence of hydrocyanic acid (HCN) in the fodder. However, properly cured sorghum fodder, with a little protein supplement, can maintain cattle in good condition throughout the winter with little or no grain supplement. Its fodder contains more than 50% digestible nutrients which consist of 8% protein, 2.5% fat and 45% nitrogen-free-extract (NFE). Its feeding value has been reported as equal to that of corn and due to its palatability and succulence nature, it is relished well by animals (Wheeler, 1950).

Kharif fodders are comparatively poor yielder having low nutritive value and poor ratooning ability. To improve the quality and quantity of green fodder per hectare, it is much essential to determine its fertilizer requirements. Different varieties might respond differently to fertilizer application under changing soil and environmental conditions. The plant nutrition may not only affect the forage production but also improve the quality of forage from view point of its protein contents. Keeping this in view, the present research work was undertaken to assess the influence of different levels of N and P on the growth and quality of two sorghum cultivars under Faisalabad conditions.

MATERIALS AND METHODS

Two sorghum cultivars viz; Hegari and JS 263 were sown at the Agronomic Research Area, University of Agriculture, Faisalabad on a medium loam soil having 0.046% nitrogen, 10.67 ppm available phosphorus and 277 ppm available potassium. The experiment was laid out in a split plot design with three replications. The net plot size was 6.0 x 2.5 m. Varieties were randomized in main plots and fertilizers in subplots. The crop was sown with single row hand drill in 30 cm apart rows. The whole N-P were applied at the rate of 0-0 (F0), 50-0 (F1), 100-0 (F2), 50-50 (F3), 100-50 (F4) and 100-100 (F5) Kg ha^{-1} at the time of sowing in the form of urea and single super phosphate with the help of single row hand drill. Observations on plant height (cm), stem diameter (cm), number of leaves per plant, leaf area per plant (cm^2), fodder yield (q ha^{-1}) and dry matter (q ha^{-1}) were recorded using standard procedures.

The crude protein content was determined by using micro kjeldahl method (Jackson, 1962). Crude fiber and total ash were determined according to the methods given in AOAC (1984). Data on various growth and yield parameters were analyzed statistically (Steel & Torrie, 1984).

RESULTS AND DISCUSSION

Fodder yield characteristics. The variety Hegari produced taller plants, greater stem diameter and higher fodder yield as compared to JS 263 (Table I).

Table I. Comparison of different characteristics as influenced by sorghum varieties and fertilizer treatments

	Plant height (cm)	Stem Diameter (cm)	No. of Leaves per plant	Leaf area per plant (cm^2)	Fodder Yield (q ha^{-1})	Crude Protein (%)	Crude fiber (%)	Ash (%)	Dry Matter yield (q ha^{-1})
A. Varieties									
Hegari	160.22 a	1.06 a	9.72	2215.33 b	384.02 a	11.12	32.00 a	9.24 a	133.0 a
JS 263	151.00 b	1.02 b	9.78	2399.72 a	329.33 b	10.73	28.32 b	8.91 b	116.2 b
LSD α 0.05	6.4324	0.0907	1.2635	230.6414	6.8955	1.2667	3.0776	1.4933	19.3926
B. Fertilizer Levels N-P kg ha^{-1}									
F0 (0-0)	140.00 d	0.74 b	8.67 c	1510.33e	234.44 d	8.28 e	26.25 e	7.61 f	81.0 d
F1 (50-0)	153.00 c	1.08 a	10.00 ab	1824.00 d	329.96 c	9.63 d	28.10 d	7.68 e	110.3c
F2 (100-0)	159.50 ab	1.09 a	9.67 b	2277.83 c	387.76 b	9.98 d	28.92 d	8.62 d	133.4 b
F3 (50-50)	156.83 b	1.09 a	9.33 bc	1960.50 d	323.10 c	11.82 c	31.00 c	9.45 c	111.4 c
F4 (100-50)	162.16 a	1.12 a	10.67 a	2912.33 b	424.42 a	12.47 b	32.68 b	10.41 b	152.3 a
F5 (100-100)	162.16 a	1.13 a	10.17 ab	3360.17 a	438.82 a	13.37 a	34.02 a	11.14 a	156.8 a
LSD α 0.05	71.3643	1.7031	17.6838	3119.0587	55.2218	9.3599	17.5356	6.4632	108.7924

However, the variety JS 263 gave significantly higher leaf area per plant (2399.72 cm^2) than Hegari (2215.33 cm^2). Significant difference for leaf area per plant among the varieties has already been reported by Hussain *et al*. (1995). The results showed that there was a gradual increase in plant height, stem diameter, number of leaves per plant, leaf area per plant and fodder yield with the increase in fertilizer (Table I).

Fertilizer levels F5 (100 kg N+100 kg P_2O_5) and F4 (100 kg N + 50 kg P_2O_5) exhibited greater plant height, stem diameter, leaf area per plant and fodder yield as compared to other fertilizer levels, but differences between F5 and F4 were non-significant for plant height, stem diameter, number of leaves per plant and fodder yield. The fertilizer level F4 gave maximum number of leaves per plant (10.67). However, it showed non-significant differences with F5 and F1 (Table I). The results showed that application of N alone at higher rate may give more leaf area per plant than combined use of N and P at lower rate as earlier reported by Lohard-Bory and Nemeth (1989).

The fertilizer treatments significantly affected all the yield components. However, the interaction between variety and fertilizer treatment was found to be significant only for leaf area per plant and fodder yield. All the fertilizer treatments increased the fodder yield significantly over control. The increase in fodder yield with fertilizer application may be due to greater plant height, higher stem diameter, higher number of leaves per plant and greater leaf area per plant. The maximum fodder yield (453.28 q ha^{-1}) was received by the application of F5 (100 kg N +100 kg P_2O_5) followed by F4 (100 kg N + 50 kg P_2O_5) in sorghum variety Hegari (Table II). Significant differences for fodder yield among the sorghum varieties are in line with the findings of Zahid and Bhatti (1994) and Bhatti *et al*. (1996). Significant increase has already been observed in plant height, stem diameter and number of leaves per plant (Medina *et al*., 1984), fodder yield (Medina *et al*., 1984; Waheed, 1995) with N and P application. Chouhan and Dighe (1999) obtained highest straw yield with 8:40 kg N P in sorghum.

Table II. Comparison of green fodder yield and dry matter yield of two sorghum cultivars

Fertilizer N-P kg ha^{-1}	Green Fodder Yield (q/ha)		Dry matter yield (q ha^{-1})	
	Hegari	JS 263	Hegari	JS 263
F0 (0-0)	264.46 e	204.44 f	87.7	74.2
F1 (50-0)	371.096 d	228.83 e	121.0	99.6
F2 (100-0)	413.29 c	362.16 d	144.2	122.6
F3 (50-50)	359.96 b	228.83 e	125.2	103.0
F4 (100-50)	442.155 ab	406.62 c	157.9	146.6
F5 (100-100)	453.28 a	424.42 bc	162.2	151.4

Quality of sorghum fodder. The variety Hegari produced higher crude fiber (32%) than JS 263 (28.36%). These results are comparable with Ashraf *et al*. (1995) and Hussain *et al*. (1995). The variety Hegari also gave significantly higher dry matter yield (133.0 q ha^{-1}) than JS 263 (116.2 q ha^{-1}). The results are in line with Zahid and Bhatti (1994) who stated that N application increased dry matter. The fertilizer treatments significantly affected all the quality parameters tested in the present study. The interaction between variety and fertilizer treatment was found to be significant for crude fiber and ash while non-significant for crude protein and dry matter yield.

A progressive increase in crude protein, crude fiber, ash and dry matter was observed with the increase in N and P levels. The two varieties Hegari and JS 263 gave equal response for crude protein to the changing level of N and P. The increase in protein contents with the increase in fertilizer levels may be the result of enhancement in amino acid formation due to fertilization. Tanacs *et al*. (1997) observed 14.36% increase in amino acid due to higher N doses in wheat. The increase in protein content with N and P fertilization is also in line with the finding of Shinde *et al*. (1993). The increase in protein with the increasing rates of N was also observed by Patal *et al*. (1993) and Pankhaniya *et al*. (1997). But they failed to find out any significant effect of P rate in fodder sorghum. The variation may be due

to the differences in soil fertility and environment factors etc. F5 (100 kg + 100 kg P_2O_5) and F4 (100 kg + 50 kg P_2O_5) produced statistically similar dry matter (Table I). However, the maximum dry matter (162.2 q ha^{-1}) was observed by the application of F5 followed by F4 (157.9 q ha^{-1}) in sorghum variety Hegari (Table II). Malik *et al*. (1992) reported significant effect of N and P application on dry matter. Gill *et al*. (1995) also demonstrated that P application increased dry matter in sorghum. But Pankhaniya *et al*. (1997) found that dry matter was not affected by phosphorus rate. This difference may be due to different soil and climatic conditions.

CONCLUSIONS

The variety Hegari exhibited better yield and quality characteristics. The fertilizer treatments significantly affected all the yield and quality parameters tested in the present study. The increase in fodder yield with fertilizer application may be due to greater plant height, higher stem diameter, higher number of leaves per plant and greater leaf area per plant. The maximum fodder yield and dry matter yield was obtained by the application of 100-100 kg N-P ha^{-1} (F5) followed by 100-50 kg N-P ha^{-1} (F4). However, the difference between F5 and F4 was non-significant for different yield and quality characteristics. Thus, it can be concluded that the variety Hegari is better as compared to JS 263 grown for fodder purpose and the optimum and economical dose of fertilizer for fodder crop of sorghum cultivar is 100-50 kg N-P ha^{-1} (F4).

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