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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

Response of two sorghum cultivars namely Hegari and JS-263 to different NP levels of 0-0, 50-0, 100-0, 50-50, 100-50 and 100-100 kg ha^{-1} was studied under field conditions. The cultivar Hegari gave significantly higher green fodder and dry matter yield due to greater plant height, stem diameter and leaf area $plant^{-1}$. The crude fiber per cent and ash per cent were also significantly higher for cultivar Hegari. A progressive increase in yield was observed with fertilizer application up to 100 kg N + 50 kg P_2O_5 ha^{-1} whereas, the quality parameters such as protein content, crude fiber and ash percent were significantly higher with NP application of 100 + 100 kg ha^{-1}. The cultivar Hegari and fertilizer level of 100 kg N + 50 kg P_2O_5 ha^{-1} seems to be the best combination for harvesting higher fodder yield of sorghum under Faisalabad conditions.

Introduction

Sorghum plants can be fed to the animals as green fodder and also in the form of silage. Silage is an excellent feed stuff for dry season when grass and legume crops can not be grown successfully (Pholsen *et al*., 1998). The importance of fodder crops needs no emphasis because of the fact that the regular, an adequate and nutritious fodder is a basic requirement for livestock production to meet the demand of milk, butter and other byproducts for human consumption. Fodder scarcity is a major limiting factor for the development of livestock industry in Pakistan. The available fodder production is approximately 62-54 percent less than actual requirement (Bhatti, 1988).

Varieties vary in yield and quality traits (Ashraf *et al*., 1995). Zahid and Bhatti (1994) reported that green fodder yield of 8 sorghum hybrids ranged from 26.09 (BR-319) to 46.79 t ha^{-1} (FS-25E). Similarly, Hussain *et al*. (1995) compared seven cultivars of forage sorghum for yield and quality and they recommended Hegari, Roma No. 119 and No.94 for general cultivation due to better yield and quality traits. These varieties have more crude protein and less crude fiber. Bhatti *et al*. (1996) evaluated the performance of various sorghum varieties at different locations and they reported that sorghum CV. Sarokartuko gave highest green fodder yield (30.00 t ha^{-1}) at AARI, Faisalabad followed by FS-466 (27.77 t ha^{-1}), local Quetta (25.51 t ha^{-1}) and No.1572 (25.36 t ha^{-1}). Pholsen *et al*. (1998) reported that out of the ten cultivars used, 15-23585 and Rio could be considered the best cultivars for feed stuffs of ruminants animals.

The varieties also vary in their response to fertilizer application (Chandravanshi *et al*., 1973). Mishra and Singh (1978) studied the effect of 0-160 kg N and 0-40 kg P_2O_5 ha^{-1} on two sorghum cultivars under rained conditions. They noted that application of 120 kg N + 40 kg P_2O_5 ha^{-1} to cultivar Mau T-1 gave the highest grain yield. Muhammad and Hasan (1994) reported that CSH6 and CSH9 responded better to applied nitrogen than CSH14 and SPV 946. Waheed (1995) recommended 90 kg N and 60 kg P_2O_5 ha^{-1} for getting maximum fodder yield of sadabahar. The N application not only affect the forage production but also improve the quality of forage from view point of protein contents (Patel *et al*., 1994). Matowo *et al*. (1997) reported that increase in nitrogen rate increased the yield and protein concentration in flag leaf. The role of P_2O_5 on protein contents is somewhat controversial. Patel *et al*. (1993) reported that protein yield and protein contents were unaffected by P application. But Patel *et al*. (1994) obtained the highest protein yield of 0.64 t ha^{-1} with the application of 120 kg N + 20 kg P ha^{1}. Whereas, Choudhary and Karwasra (1984) reported that crude protein contents were increased with the increase in P.

To improve the quality and quantity of green fodder, it is therefore much essential to determine The fertilizer requirements of varieties. The purpose of present study was to evaluate the effects of different NP levels on fodder production and composition of two sorghum cultivars in Faisalabad conditions.

Materials and Methods

Experiment to determine the effect of NP application on fodder yield and quality of two sorghum cultivars was conducted on a medium loam soil having 0-046 percent N, 10.67 PPM available P and 277 PPM K. The crop was sown with the help of single row hand drill on a well prepared seed bed in 30 cm apart rows on August 17, 1996. The experiment was laid out in a split plot design with three replications using a net plot size of 2.5 m x 6.0 m. Two sorghum cultivars Hegari and JS-263 were randomized in main plots and NP levels of 0-0, 50-0, 100-0, 50-50, 100-50, 100-100 in sub plots. The whole quantity of nitrogen and phosphorus was side drilled at the time of sowing in the form of urea and single super phosphate, respectively. All the treatments were sown by using a seed rate of 100 kg ha^{-1}. All other cultural practices were kept normal and uniform for all the treatments. Ten plants per plot were

selected randomly for recording individual plant observation like, plant height, stem diameter, number of leaves and leaf area per plant. Stem diameter was measured with the help of vernier calliper from the base, middle and top portion and averages were recorded. Leaf area was measured with the help of leaf area meter model LI-3000. Quality parameters like crude protein, crude fibre and ash percentage were determined by using methods recommended by AOAC (AOAC, 1984). Data collected were analyzed statistically by using Fisher's analysis of variance technique and Duncan's Multiple Range Test at $p<0.05$ was used to compare the significance of treatments means (Steel and Torrie, 1984).

Results and Discussion

Plant height was influenced significantly ($p<0.05$) by levels of nitrogen and phosphorus (Table 1). Significant increase in plant height over the control was observed by all fertilizers levels. The NP levels of 100-0, 100-50 and 100100 produced statistically similar plant height. The differences between 100-0 (159.50) and 50-50 (156.83) were non-significant. The maximum (162.18 cm) and minimum (140.00 cm) plant height was recorded at 0-0 and 100-100 NP kg ha^{-1} respectively. The application of P seems to be ineffective in improving the plant height of sorghum. The increase in plant height with nitrogen fertilizer have also been reported by Abbas and Younis (1988) and Abdel-Gawad (1993). But Medina *et al*. (1984) reported that NP application up to 150 and 90 kg ha^{-1} showed nonsignificant effect on the plant height. These contradictory results might be due to variation in the fertility status of the soil or differences in genetic make up of the varieties. The variety Hegari produced significantly taller plants (160.22 cm) as compared to JS-263 (151.0 cm). Naeem *et al*. (1992) have also reported significant differences among 25 exotic sorghum entries.

Application of nitrogen alone or in combination with phosphorus produced significantly thicker stem than control but the differences with in fertilizer levels were not significant. Maximum (1.13 cm) and minimum (0.74 cm) stem diameter was recorded with NP application of 100-100 kg ha^{-1} and control respectively. The results are contradictory to those of Medina *et al*. (1984). They reported that basal stem diameter was not influenced significantly by NP application. These contradictory results can be attributed to differences in genetic traits of the varieties. The variety Hegari has thicker stem (1.06 cm) than JS-263 (1.02 cm). The results are quite in line with those of Zahid and Bhatti (1994).

The crop fertilized at NP rate of 100-100 kg ha^{-1} resulted in significantly more leaf area per plant (3360.17 cm^2) than all other fertilizer levels. The next follower NP levels were 100-50, 100-0 and 50-50 kg ha^{-1} producing leaf area of 2912.33 cm^2, 2277.83 cm^2 and 1960.50 cm^2 respectively. The control produced the minimum leaf area per plant (1510.33 cm^2). The results indicated that application of nitrogen alone at higher rate can give more leaf area per plant than combined application of NP at lower rate. The variety JS-263 gave significantly higher leaf area per plant (2399.72 cm^2) than Hegari (2215.33 cm^2). This may be attributed to their genetic traits of the crop plants. Hussain *et al*. (1995) have also reported significant differences for leaf area per plant among the varieties.

Green fodder yield was affected significantly both by the fertilizer levels and varieties. The application of 100 kg N + 100 kg P remaining at par with NP level of 100-50 kg ha^{-1} produced significantly higher yield (43.9 t ha^{-1}) than the remaining fertilizer levels. The minimum green fodder yield (23.4 t ha^{-1}) was recorded in control plots. The differences between NP levels of 50-50 and 50-0 kg ha^{-1} were not significant. Significant effect of NP application on fodder yield of sorghum have also been reported by Medina *et al*. (1984) and Thakre (1994). Hegari gave significantly higher green fodder yield (38.4 t ha^{-1}) than JS-263 (32.9 t ha^{-1} The results are similar to those of Bhatti *et al*. (1996) and Zahid and Bhatti (1994).

The trend of dry matter yield for both fertilizer and varieties was exactly similar as was recorded for green fodder yield. The maximum dry matter yield (15.68 t ha^{-1}) was recorded with NP application of 100-100 kg ha^{-1} and minimum (8.10 t ha^{-1}) was recorded in control. Hegari and JS-263 produced yields of 13.30 t ha^{-1} and 11.62 t ha^{-1} respectively and differences were significant. These results are quite in line with those of Gill *et al*. (1995) and Zahid and Bhatti (1994).

Protein content is one of the major ingredients determining the quality of fodder crops and were influenced significantly by application of fertilizers. A progressive increase in protein contents was observed with increased NP levels except the increase could not reach to a significant extent between NP levels of 50-0 and 100-0 kg ha^{-1}. The maximum (13.37%) and minimum (8.28%) protein contents were observed at NP levels of 100-100 kg ha^{-1} and control respectively. The increase in protein contents with the increase of NP levels may be due to the reason that fertilizer has enhanced the amino acid formation. The increase in protein contents with NP application have also been reported by Path *et al*. (1984), Choudhary and Karwasra (1984), Patel *et al*. (1994) and Matowo *et al*. (1997). The results are contradictory to those of Patel *et al*. (1993). These contradictory results might have been due to differences in genetic make up of the varieties or differences in the fertility status of the soil. The varieties did not differ significantly from each other for crude protein contents and values were 11.12 percent and 10.37 percent for Hegari and JS-263 respectively.

The fodder having less crude fiber percentage is considered a good quality because higher the crude fiber percentage lesser will be digestibility. The trend of fertilizer levels on crude fiber was exactly similar as was observed for crude protein percentage. A significant increase in crude fiber percentage was observed with the increase in NP levels except that the increase could not reach to a significant level between NP levels of 50-0 and 100-0 kg ha^{-1}. The

Table 1: Effect of nitrogen and phosphorous on the fodder yield and quality of two sorghum cultivars

Treatments	Plant height (cm)	Stem diameter (cm)	Leaf area per plant (cm^2)	Green fodder yield (t ha^{-1})	Dry matter (t ha^{-1})	Protein content (%)	Crude fibre (%)	Ash (%)
NP (kg ha^{-1})								
0-0	140.00d	0.74b	1415.33e	23.40d	8.10d	8.28e	26.25c	7.16f
50-0	153.00c	108.a	1824.00d	33.33c	11.03c	9.63d	28.10d	7.68e
100-0	159.50ab	1.09a	2277.83c	38.80b	13.34b	9.98d	28.92d	8.62d
50-50	156.83b	1.09a	1960.50d	32.40c	11.41c	11.82c	31.00c	9.45c
100-50	162.16a	1.12a	2912.33b	42.40a	15.23a	12.47b	32.68b	10.41b
100-100	162.18a	1.13a	3316.17a	93.90a	15.68a	13.37a	34.02a	11.14a
Varieties								
Hegari	160.22a	1.06a	2215.33b	387.40a	13.30a	11.12NS	32.00a	9.14a
JS-263	151.00b	1.02b	2399.72a	32.9b	11.62b	10.73	28.32b	8.91b

Any two means, not sharing a letter in each column differ significantly ($p < 0.05$)

maximum (34.02 %) and minimum (26.25 %) crude fiber percentage was observed at NP levels of 100-100 kg ha^{-1} and control respectively. Almost similar results have been reported by Medina *et al*. (1984). The differences between varieties were also significant. The Hegari produced higher crude fiber percentage (32.0 %) than JS-263 (28.32 %). Ashraf *et al*. (1995), Hussain *et al*. (1995) and Pholsen *et al*. (1998) have also reported significant differences for crude fiber percentage among the different sorghum varieties.

The ash percentage was affected significantly both by fertilizer levels and varieties. The variety Hegari gave significantly higher ash percentage (9.24%) than JS-263 (8.91%). The variety Hegari seems to be more efficient in nutrient uptake than JS-263. A progressive and significant increase in ash percentage was noted at each NP levels. The maximum (11.14%) and minimum (7.16%) ash percentage was observed with NP application of 100-100 kg he and control respectively. These results are quite in line with those of Choudhary and Karwasra (1984) and Harumoto *et al*. (1986).

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