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Response of Maize (*Zea mays* L.) Fodder to Different Levels of Nitrogen and Phosphorus

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Abstract: A field experiment was conducted to evaluate the effect of different combination of nitrogen and phosphorus on the fodder yield and quality of maize (*Zea mays* L.). The maize cultivar Pak. Afgoyee sown on 1st August, 2000 was given NP fertilizers at the rate of 0-0, 120-40, 120-60, 120-80, 160-40, 160-60, 160-80, 200-40, 200-60, and 200-80 kg ha^{-1}. Growth characteristics like plant height, number of leaves plant^{-1}, stem diameter, leaf area plant^{-1}, green fodder yield, dry matter yield and dry matter percentage were influenced significantly by the application of nitrogen and phosphorus. Maximum green fodder yield was obtained when nitrogen and phosphorus were applied at the rate of 200-80 kg ha^{-1} but it was statistically similar to NP application of 200-60 kg ha^{-1}. The increase in yield was mainly due to increased plant height, number of leaves plant^{-1} and stem diameter. Quality parameters such as crude protein, crude fibre and ash contents were also influenced significantly by the application of NP fertilizers. All NP combination produced higher crude protein, crude fibre and ash contents over control. Keeping in view both yield and quality NP levels of 200 + 60 kg ha^{-1} seems to be the best combination under Faisalabad conditions for maize cultivar Pak. Afgoyee.

Key words: Maize (*Zea mays* L.), nitrogen, phosphorus, fodder yield and quality

Introduction

Maize (*Zea mays* L.) is grown as a food, feed and fodder crop in Pakistan. It plays a key role in the human diet and animal feed and provide adequate amount of energy and protein. It is indispensable part of human diet and animal feed (Maiti and Wesche-Ebeling, 1998). It is most important constituent of cattle fodder and poultry feed (Chaudhary, 1983).

Although the soil and climatic conditions of Pakistan are favourable for maize production but its per hacter fodder yield is very low as compared to other maize growing country of the world. Low yield of maize fodder is due to many constraints but fertilizer application is considered one of the major factors, which can increase fodder production on per unit area basis. The application of nitrogen not only affects the forage yield of maize but also improves its quality especially its protein contents (Khandaker and Islam, 1988). Similarly Baran (1987) reported that application of nitrogen to maize increased fodder nutritive value by increasing crude protein and by reducing ash and fibre contents. Safder (1997) concluded that plant height, stem diameter, green fodder yield, protein, fibre and total ash contents were increased by increasing nitrogen levels.

Phosphorus is also considered an essential nutrient for plant growth and development. It is an integral part of nucleic acid and is essential for cellular respiration and for metabolic activity. Therefore, use of phosphorus along with nitrogen and potash will help to increase yield of maize. However, the effect of phosphorus application on the protein contents of maize fodder is somewhat controversial. Chaudhary and Karwasra (1984) reported that crude protein contents were increased with increase in phosphorus application. Similarly Hussain (1991) also reported that protein contents were increased with phosphorus application. But Patel *et al.* (1993) reported that protein yield and protein contents were not affected by phosphorus application. Whereas, Patel *et al.* (1997) reported that phosphorus had influence on both maize forage yield and quality. Phosphorus application increased fodder yield and quality by increasing plant height, number of leaves plant^{-1}, crude protein and ash content (Cheema, 2000).

The study was therefore, designed to evaluate the effect of different levels of nitrogen and phosphorus on fodder yield and quality of maize cultivar Pak. Afgoyee under the agro climatic conditions of Faisalabad.

Materials and Methods

The experiment was conducted to study the effect of different levels of nitrogen and phosphorus on fodder yield and quality of maize cultivar Pak. Afgoyee at the Agronomic Research Area, University of Agriculture, Faisalabad, during year 2000. The NP fertilizers were applied at the rate of 0-0, 120-40, 120-60, 120-80, 160-40, 160-60, 160-80, 200-40, 200-60 and 200-80 kg ha^{-1}. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications, using a net plot size of 2.4 x 9.0 m^2. The crop was sown in 30 cm spaced rows with single row hand drill on 1st August, 2000 and harvested on October 4, 2000. Whole of nitrogen and phosphorus were applied at the time of sowing in the form of urea and triple super phosphate, respectively. All other agronomic practices were normal and uniform for all the treatments. Ten plants were selected at random in each plot to record individual observations like plant height, stem diameter, and leaf area plant^{-1}. Plant height was taken from soil level up to the tip of highest leaf with a meter rod. Stem diameter was measured with the help of vernier caliper from top middle and bottom portions of the stem and then there averages were worked out. Leaf area was measured by using portable leaf area meter model LI-300. Quality parameters like crude fibre, crude protein and total ash percent were determined by using method recommended by AOAC (1984).

The data collected were analyzed statistically by using Fisher's analysis of variance technique and least significant difference test (LSD) test at 5% probability level was used to compare the significance of treatments means (Steel and Torrie, 1984).

Results and Discussion

Plant height (cm): The plant height was influenced significantly by different levels of nitrogen and phosphorus. Significant increase in plant height was observed by all the fertilizer level except NP level of 120-40, which did not differ significantly from control. The NP levels of 200-80 and 200-60 kg ha^{-1} produced statistically similar plant height but significantly higher than all other NP combinations (Table 1). The difference between NP levels of 160-80 and 200-40 kg ha^{-1} was not significant. The maximum and minimum plant height was recorded at NP levels of 200-80 and 0-0 kg ha^{-1}, respectively. Increase in plant height with nitrogen and phosphorus application has also been reported by Ayub *et al.* (1997) and Cheema (2000).

Stem diameter (cm): Stem diameter, which directly influence the yield potential of fodder crops was influenced significantly by NP application. The NP levels of 200-80 kg ha^{-1} remained at par with NP levels of 200-40 and 200-60 kg ha^{-1} but produced significantly thicker stem than all other treatments. The minimum (1.16 cm) stem diameter was recorded with out the application of NP fertilizer and did not differ significantly from plots receiving 120-40, 120-60 and 120-80 NP kg ha^{-1} (Table 1). The significant effect

Table 1: Growth, yield and chemical composition of maize fodder as influenced by different levels of nitrogen and phosphorus

N-P levels (kg ha^{-1})	Plant height (%)	Stem diameter (cm)	Leaf area plant^{-1} (cm^2)	Green fodder yield (t ha^{-1})	Dry matter percentage (%)	Crude protein (%)	Crude fibre (%)	Total ash (cm)
0-0	157.0f	1.16f	2508h	34.43g	14.29f	7.73g	28.83f	8.17d
120-40	162.9ef	1.23ef	2692g	37.07f	14.97f	8.71f	31.17e	8.33cd
120-60	167.2de	1.26def	2807fg	38.40ef	16.15e	8.78ef	31.50de	8.33cd
120-80	170.6d	1.28def	2922f	39.44e	17.27d	9.10de	32.00de	8.50cd
160-40	174.1cd	1.33de	3182e	44.76d	16.97d	9.03ef	33.00cde	8.83bcd
160-60	174.2cd	1.37cde	3317d	46.10cd	17.43e	9.43cd	33.33bcd	9.17abcd
160-80	179.3bc	1.40bcd	3557c	47.51c	19.18c	9.62bc	34.17abc	9.83ab
200-40	185.5b	1.49abc	3825b	50.51b	19.18c	9.98ab	34.67ab	9.33abc
200-60	194.3a	1.53ab	4150a	55.47a	20.61b	10.17a	34.83ab	10.17a
200-80	198.8a	1.58a	4218a	55.59a	21.39a	10.21a	35.50a	10.17a

Any two means not sharing a common letter differ significantly from each other at 5% level of probability

of NP application on stem diameter has also been reported by Ayub *et al*. (1997, 1999) Safder (1997) and Tariq (1998).

Leaf area plant^{-1} (cm^2): The application of NP fertilizer significantly affected the leaf area plant^{-1}. The application of 200 kg N along with 60 and 80 kg P ha^{-1} produced statistically similar leaf area plant^{-1} but significantly higher than all other NP combinations. The NP application at the rate of 120+60 kg ha^{-1} also produced statistically similar leaf area plant^{-1} to NP application of 120+40 and 120+80 kg ha^{-1}. The maximum (4218 cm^2) and minimum (2508 cm^2) leaf area plant^{-1} was recorded at NP levels of 200-80 and 0-0 kg ha^{-1}, respectively (Table 1). Similar results have also been reported by Dobos and Nagy (1998) and Ayub *et al*. (1999).

Green fodder yield (t ha^{-1}): All NP levels produced significantly higher fodder yield than control. The NP rate of 200-60 and 200-80 kg ha^{-1} produced statistically similar green fodder yield but significantly higher than all other NP combinations. The maximum green fodder yield (55.59 t ha^{-1}) was recorded with NP rate of 200-80 kg ha^{-1} (Table 1). The control produced the lowest fodder yield (34.43 t ha^{-1}) than all other NP levels. Increase in yield was mainly due to greater plant height, stem diameter and leaf area plant^{-1}. Increase in fodder yield with NP application has also been reported by Ayub *et al*. (1997, 1999), Ali (2000), Cheema (2000) and Husnain (2001).

Dry matter (%age): Dry matter percentage was affected significantly with the application of NP fertilizers (Table 1). All plots receiving NP fertilizers gave significantly higher dry matter percentage than control except NP levels of 120-40 kg ha^{-1}. The difference between NP levels of 120-80, 160-40 and 160-80 were not significant. The difference between NP levels of 160-80 and 200-40 also could not reach to significant level. The maximum (21.39%) dry matter percentage was recorded with NP levels of 200-80 kg ha^{-1}. Significant increase in dry matter percentage with NP application has also been reported by Ahmad (1999).

Crude protein (%age): Protein contents were influenced significantly by the application of NP fertilizers. The application of nitrogen at the rate of 200 kg ha^{-1} along with phosphorus at the rates of 60 and 80 kg ha^{-1} produced statistically similar crude protein percentage but significantly higher than all other NP combinations except NP levels of 200-40 kg ha^{-1} (Table 1). The maximum (10.21%) and minimum (7.73%) crude protein contents were observed at NP levels of 200+80 kg ha^{-1} and control, respectively. The increase in crude protein concentration with increased nitrogen level may be due to the reason that nitrogen applications have enhanced the amino acid formation. The increased in crude protein concentration with NP application has also been reported by Ayub *et al*. (1997), Husnain (2001), Tariq (1998) and Cheema (2000).

Crude fibre (%age): Crude fibre contents were influenced significantly by the application of nitrogen and phosphorus fertilizers (Table 1). All plots receiving NP fertilizers produced significantly higher crude fibre percentage than control. The NP levels of 200-80 produced the maximum (35.50%) crude fibre percentage but it did not differ significantly from NP levels of 160-80, 200-40 and 200-60 kg ha^{-1}. The control produced the minimum (28.83%) crude fibre percentage. The results are quite in line with those of Ayub *et al*. (1999), Ahmad (1999), Ali (2000) and Husnain (2001) but these results are contradictory to those of Cheema (2000). He reported that crude fibre contents were not influenced significantly by different levels of phosphorus. These contradictory results might have been due to the differences in fertility status of the soil, climatic conditions or variation in genetic make up of the variety.

Total ash (%age): The ash percentage was influenced significantly by different levels of nitrogen and phosphorus fertilizers (Table 1). The application of 120 kg nitrogen along with phosphorus up to 80 kg ha^{-1}, and nitrogen level of 160 kg ha^{-1} along with phosphorus up to 60 kg ha^{-1} produced statistically similar ash percentage to control. The difference between nitrogen levels of 200 kg ha^{-1} along with phosphorus levels of 40, 60 and 80 kg ha^{-1} and NP levels of 160-80 and 160-60 were also not significant. The minimum (8.17%) ash percentage was recorded in control. The increase in ash percentage with NP fertilizers application has also been reported by Ayub *et al*. (1997, 1999), Cheema (2000) and Husnain (2001).

In conclusion NP level of 200+40 kg ha^{-1} seems to be the best combination for getting higher fodder yield of better quality under Faisalabad conditions for maize cultivar Pak. Afgoyee.

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