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EFFECT OF DIFFERENT LEVELS OF NITROGEN AND SEED RATES ON GROWTH, YIELD AND QUALITY OF MAIZE FODDER

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A field trial to study the effect of 0, 80 and 120 kg N and 75, 100 and 120 kg seed rates ha^{-1} on fodder yield and quality of maize (*Zea mays* L.) was conducted at Faisalabad, Pakistan. The nitrogen application significantly increased plant height, leaf area $plant^{-1}$, leaf number, stem diameter, green fodder yield, dry matter, crude protein, crude fibre and total ash percent but decreased ether extractable fat contents. Increase in seed rate significantly increased plant density, green fodder yield and dry matter contents but decreased number of leaves and leaf area $plant^{-1}$, stem diameter, ether extractable fat and ash contents. Plant height, crude protein and fibre contents were not influenced significantly by the seed rate. Based on these findings, both nitrogen and seed at the rate of 120 kg ha^{-1} found to be the best combination for getting higher green fodder yield of maize under Faisalabad conditions.
Key words: *Zea mays*, nitrogen, seed rate, fodder yield and crude fibre

INTRODUCTION

Fodder shortage is among the major limiting factor for prosperous livestock industry in Pakistan. Animals are deficient in energy and protein by 40 and 60 percent, respectively (Sial and Alam., 1988). Inspite of low protein contents maize fodder is relished by the animals due to being succulent and palatable (Delorit and Ahlgren, 1959). Although maize is extensively grown in Pakistan as a fodder crop but its yield is very low. Optimum application of nitrogen fertilizer and seed rate are two vital factors deciding the fodder yield of maize (Ayub *et al.*, 1999 and 2000). Nitrogen application and seeding density not only significantly affect fodder production but also affect the quality parameters of forage like crude protein, crude fibre total ash and ether extractable fat (Verma and Singh, 1976; Shun *et al.*, 1989 and Ayub *et al.*, 2002). Informations on interactive effects of nitrogen application and seeding rate on fodder yield and quality of maize are lacking in Pakistan. Therefore, a need was felt to improve the quality and quantity of its fodder. The present study was therefore, designed to determine optimum nitrogen and seed rate for obtaining higher maize fodder yield of good quality under Faisalabad conditions.

MATERIALS AND METHODS

A field experiment was conducted to evaluate the effect of different nitrogen levels and seed rates at the Agronomic Research Area, University of Agriculture, Faisalabad, during the year 1998, on a medium loam soil having 0.037 % nitrogen, 10.54 ppm available phosphorus and 2.69 ppm available potassium. The experiment was laid out in factorial randomized complete block design, having four replications and measuring a net plot size of 1.8 x 6 m. Maize cultivar 'Akbar' was grown using a seed rate of 75, 100 and 120 and nitrogen levels of 0, 80 and 120 kg ha^{-1} in the form of urea. The phosphorus as single super phosphate was applied at the rate of 60 kg ha^{-1} to all the treatments including control. Full dose of nitrogen and phosphorus was applied with first irrigation. The crop was sown with single row hand drill on a well prepared seed bed in 30 cm apart rows on 6th May, 1998, and was harvested on 10th July, 1998. All other agronomic practices were kept normal and uniform for all the treatments. Ten plants were selected at random from each plot to record individual plant observations like plant height, stem diameter and number of leaves and leaf area $plant^{-1}$. Plant height was taken with meter rod from ground level up to the highest leaf tip. Stem diameter was measured with the help of vernier calliper from the top, middle and bottom portions and then averages were calculated. Quality parameters like crude protein, crude fibre, ether extractable fat and total ash (%) were determined using the methods given by AOAC (1984). Data collected were analysed statistically by using Fisher's analysis of variance technique and least significant difference test at 5% probability level was used to compare the significance of treatments' means (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Growth parameters and yield

The application of nitrogen significantly influenced the plant height (Table 1). Plant height was increased significantly with each increment of nitrogen dose. Increase in plant height with nitrogen application has also been reported by Ayub *et al.* (2002) and Sharar *et al.* (2003). Plant height was not significantly affected by the seed rate. These results contradict the findings of Ayub, *et al.* (1999) and Shun *et al.* (1989). These contradictory results might have been due to variation in the fertility status of soil or variation in genetic traits of crop plants.

Table 1. Effect of different levels of nitrogen and seeding density on growth, yield and quality of maize fodder.

Parameters	Nitrogen level (kg ha^{-1})			Seed rate (kg ha^{-1})		
	0	80	120	75	100	120
Plant density (m^{-2})	42.67 NS	42.66	43.41	35.66 c	42.75 b	49.33 a
Plant height (cm)	148.04 c	175.10 b	186.96 a	164.24^{NS}	169.68	176.25
Leaves plant^{-1}	9.86 c	11.16 b	12.40 a	11.97 a	10.74 b	10.65 c
Stem diameter (cm)	1.06 c	1.166 b	1.25 a	1.23 a	1.16 b	1.08 c
Green fodder yield (t ha^{-1})	32.22 c	52.28 b	57.52 a	40.40 c	47.22 b	54.39 c
Dry matter (%)	14.34 c	19.62 b	22.29 a	15.21 c	16.81 b	18.75 a
Crude protein (%)	7.10 c	8.26 b	9.23 a	8.49 ^{Ns}	8.16 b	7.93
Crude fibre (%)	26.60 c	29.47 b	31.72 a	29.39 ^{NS}	29.20	29.19
Ether extractable fat (%)	1.25 a	1.16 b	1.04 c	1.19 a	1.15 b	1.10 c
Total ash (%)	8.43 b	9.15 a	9.29 a	9.26 a	8.98 ab	8.63 b

Means not sharing a letter in common differ significantly from each other at 5% probability level.

Plant density (m^{-2}) was statistically similar at all nitrogen levels but increase in seed rate significantly increased the stand density (Table 1). Since all treatments were sown with seeds having almost same viability and 1000-grain weight, so higher stand density was obtained at higher seed rate. Mahmood (1998) has also reported that plant density increased with increased seed rate.

The application of nitrogen fertilizer significantly increased the number of leaves plant^{-1} (Table 1). Maximum number of leaves plant^{-1} were recorded from plots fertilized with nitrogen at the rate of 120 kg ha^{-1}. Increase in number of leaves per plant with nitrogen application has also been reported by Khan (1986). Increase in seed rate significantly decreased number of leaves plant^{-1}. The decrease in number of leaves with increased plant density might have been due to more competition for space, water and nutrients. These results are in conformity with those of Shabbir (1997).

Application of nitrogen significantly affected the stem diameter (Table 1). The stem diameter was significantly increased with each increased nitrogen level. Similar results have been reported by (Ayub *et al.* 1999; 2000 and 2002). A progressive and significant decrease in stem diameter was observed with the increase in seed rate. Plots sown at a seed rate of 75 kg ha^{-1} had significantly higher stem diameter than 100 and 120 kg seed rate. The increased number of plants might have resulted in thin stemmed plants due to more competition. Decrease in stem diameter with increased seed rate has also been reported by Shun *et al.* (1989) and Ayub *et al.* (1999).

Leaf area per plant was significantly increased with increased nitrogen level (Table 2). The maximum and minimum leaf area plant^{-1} was recorded from plots receiving 120 kg N ha^{-1} and control, respectively. The results confirms the findings of Ayub *et al.* (2000 and 2002). Leaf area per plant was decreased with

Table 2. Leaf area per plant (cm^2) of maize as influenced by different levels of nitrogen and seeding rates.

Seed rates (kg ha^{-1})	Nitrogen levels (kg ha^{-1})			Means
	0	80	120	
75	2993.55d	4753.69b	5142.31a	4338a
100	2181.85e	3462.41c	4773.51b	3475b
120	1848.04f	3081.11d	4461.10b	3130c
Means	2274c	3768b	4792a	

Means not sharing a letter in common differ significantly from each other at 5% probability level.

increased seed rate and decrease was significant at each increased seed rate. The more leaf area with low seed rate can be due to availability of more space and less competition which might have resulted in better leaf growth. Ayub *et al.* (1999) also reported that leaf area was decreased with increased seed rate. The interaction between nitrogen levels and seeding rate was also significant. The plots sown at seed rate of 75 kg ha^{-1} and fertilized with 120 kg N ha^{-1} produced maximum leaf are $plant^{-1}$. Whereas, the plots sown at, a seed rate of 120 kg ha^{-1} and given no nitrogen produced the minimum leaf area.

Green fodder yield was increased with increased nitrogen and seed rate (Table 1). Plants fertilized with 120 kg N ha^{-1} produced significantly more green fodder yield than those fertilized with 80 kg N ha^{-1} and control. Increase in green fodder yield with increased nitrogen was mainly associated with greater plant height, number of leaves $plant^{-1}$ and stem diameter. These results confirm the findings of Ayub *et al.* (2000 and 2002). Significant increase in green fodder yield was observed with increased seed rate. The crop sown at seed rate of 120 kg ha^{-1} produced significantly higher green fodder yield than the other seed rates. The higher yield at higher seed rate was due to higher plant density m^{-2}. Increase in green fodder yield with increased seed rate has also been reported by Sencor *et al.* (1993) and Ayub *et al.* (1999).

Quality parameters

Dry matter contents were influenced significantly both by the nitrogen and seed rate (Table 1). increase in nitrogen and seed rate significantly increased dry matter percentage. Increase in nitrogen and seed rate might have resulted in more water competition due to better growth and higher plant population, respectively, which inturn have resulted in more dry matter percentage. Increase in dry matter contents with increased nitrogen and seed rate have been reported by Sencor *et al.*, (1993) and Ayub *et al.*, (1999, 2000 and 2002).

Crude protein contents were increased significantly by nitrogen application (Table 1). Highest crude protein percentage was obtained from plots fertilized at the rate of 120 kg N ha^{-1}. Increase in crude protein contents with nitrogen application in maize fodder has been reported by Ayub *et al.* (1999 and 2002). Crude protein percentage was not influenced significantly by seeding rates but there has been a decreasing trend with increased seed rate. The higher protein contents with low seed rate might have been due to less competition among the plants for nutrition. Decrease in protein contents with increase in seed rate have also been reported by Ayub *et al.*, (1999).

The application of nitrogen fertilizer significantly increased the crude fibre contents and all nitrogen levels differed significantly from one another (Table 1). These result are quite in line with those of Ayub *et al.*, (2000). Crude fibre contents were not significantly affected by the seeding density. The results are strongly supported by the findings of Shun *et al.* (1989) and Ayub *et al.* (1999).

Ash percentage was significantly increased with increase in nitrogen (Table 1). The plots fertilized with 120 kg N ha^{-1} gave significantly higher ash contents over control but it was statistically similar to nitrogen application of 80 kg ha^{-1}. Safdar (1997) had also reported an increase in ash contents with increase in nitrogen rate in maize fodder. Ash percentage was decreased with increase in seed rate. The seed rate of 120 kg ha^{-1} produced the minimum ash contents and it was statistically similar to 100 kg seed rate. Decrease in ash percentage with increased seed rate has also been reported by Shun *et al.*, (1998) and Ayub *et al.*, (1999).

Ether extractable fat percentage was decreased significantly with increasing the nitrogen and seed rate (Table 1). Both the nitrogen levels and seed rates differed significantly from one another. The results are quite in line with those of Ayub *et al.* (1999 and 2000). But these results are contradictory to those of Ayub *et al.*, (2002). They reported that fat contents were increased by increasing nitrogen rates. These contradictory results might have been due to differences in nutrients status of the soils.

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