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Growth and Yield Response of Maize (*Zea mays* L.) to Organic and Inorganic Sources of Nitrogen

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Abstract

A field experiment was conducted to study growth and yield response of maize to organic and inorganic sources of N at the Agronomic Research Area, Univ. of Agriculture, Faisalabad. Two maize varieties namely Composite-78 and Composite-79 were fertilized with farm yard manure @15000 kg ha^{-1} and urea @ 260 kg ha^{-1} on a sandy clay loamy soil. Composite varieties differed significantly in plant height, numbers of cobs per plant, number of grains per cobs, 1000-grains weight, grains yield and harvest index. Composite -78 performed best with respect to all growth and yield parameters expect numbers of plants per unit area and number of cob bearing plants. Combined use of urea and farm yard manure performed best than their sole application in respect of grain yield which was 6.13 tons ha^{-1}.

Key words: Urea, farm yard manure, nitrogen, maize, varieties, yield, yield components

Introduction

Maize (*Zea mays* L.) belongs to family Gramineae. It is the most important crop among cereals after wheat and rice in respect of area and production. In Pakistan it is grown on an area of 1030 thousand hectares with the total production of 3560 thousands tons (Anonymous, 2006). Maize grain contains starch (72%), protein (10%), oil (4.8%), fiber (5.8%), sugar (3.0%), and ash (1.7%) (Chaudhry, 1983).

Soil and climatic conditions of Pakistan are ideal for maize production. A number of factors are responsible for the low yield of the crop. Inappropriate crop nutrition management and poor soil fertility are the most important factors responsible for low yield. Nitrogen plays an important role in crop growth and yield (Arshad, 2003). It is highly associated with dark green colour of stem and leaves, vigorous growth, branching, leaf production and size enlargement.

Manures check soil erosion, leaching of nutrients, evaporation losses and have a residual effect for succeeding crops. The good effects of manures remain longer in soil as the nutrients of manures slowly become available to the plants (Malival, 2001; FAO, 2004; Das, 2005). Nevertheless, imbalanced use of fertilizer without application of farmyard manure (FYM) and without knowing the requirements of crops and fertility status of soil causes the problem such as deterioration of soil structure, environmental and ground water pollution etc. Similarly continuous use of chemical fertilizer without FYM causes the depletion of soil fertility.

The interaction between manure and N fertilizer enhanced N (58-63%) recovery (Nyamangara *et al*., 2003).Keeping in view the key role played by N in crop production a field experiment was conducted to study the effects of organic and inorganic sources of nitrogen on the growth and yield of maize.

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Materials and Methods

A field experiment was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during autumn season of 2006, to study the growth and yield response of maize to organic and inorganic sources of N. The trial was laid out in RCBD split plot arrangement with three replications. Treatments included two maize varieties: Composite-78 and Composite-79 and three nitrogen sources i.e. Chemical source (urea) @ 260 kg ha^{-1} and Farm yard manure (FYM) @15000 kg ha^{-1} and combination of chemical and farmyard manure in 1:1 ratio (weight/weight).Varieties were kept in main plot and nitrogen sources in sub plots. The experiment was conducted on sandy clay loam soil with 0.95% organic matter, 6.875ppm phosphorus, 225ppm potash, 0.21% nitrogen and FYM contains 0.81% organic matter, 5.815ppm phosphorus, 218ppm potash and 1.04% nitrogen. The crop was sown on well prepared seed bed on August 17, 2006 with a single row hand drill in 75cm apart rows using the seed rate of 25kg ha^{-1} .Plant to plant distance of 20cm was achieved through thinning at 3 to 4 leaf stage.Nitrogen from chemical source (urea) @260 kg ha^{-1} was applied 1/3 at sowing, 1/3 at 25 days after sowing and remaing1/3 at 55 days after sowing. The whole of well rottened farmyard manure was incorporated one month before sowing. All other

agronomic practices were kept normal for all the treatments. The crop was harvested on November 29, 2006. Data collected on various growth and yield parameters were subjected to analysis of variance techniques using appropriate statistical package. The treatments means was separated using LSD test at 0.05 probabilities (Steel and Torrie, 1984).

Results and Discussion

Combination of organic and inorganic sources of nitrogen significantly increased the plant height at maturity, numbers of cobs per plant, number of grains per cob, 1000-grain weight, grain yield and harvest index as shown in table-I.

Data pertaining to the plant height of two maize varieties as influenced by organic and inorganic sources of N is given in Table I. The data clearly reveals that plant height was affected significantly by nitrogen sources. The maximum plant height (197.50 cm) was recorded with Urea+FYM and it was followed by Urea (193.83 cm) alone while minimum plant height (191.75 cm) was recorded with FYM. This might be due to the availability of N required for plant growth and development. The varieties were also statistically significant to each other. The maximum plant height (196.00 cm) was recorded in V_1 (Composite-78) while minimum plant height (192.72 cm) was noted in V_2 (Composite-79). Similar results were reported by Ghafoor and Akhtar (1991) who stated that application of high N rates had significant effect on plant height of maize.

Number of cobs per plant is determined by the growth behavior of the plant, which is dependent upon management practices and edaphic and climatic factors. This is considered a main yield component as it defines the yield potential of crop. The data regarding number of cobs per plant of two maize varieties as influenced by organic and inorganic manures is given in Table I. The data clearly shows that number of cobs per plant was affected significantly by nitrogen sources. The maximum number of cobs per plant (1.127) was recorded in treatment where Urea+FYM (T_3) was applied and it was significantly higher than all other treatments and was followed by (1.075) Urea alone (T_1). This might be due to the availability of N in proper proportion and improvement in soil structure by FYM. These results are similar to the findings of Malaiya *et al*. (2004) who concluded that N fertilizer treatments in combination with FYM produced higher cobs. Minimum number of cobs per plant (1.020) was observed with FYM alone. The varieties were also significantly different to each other in producing number of cobs per plant. The maximum number of cobs per plant (1.120) was recorded in V_1 (Composite-78) while minimum number of cobs per plant (1.028) was noted in V_2 (Composite-79).

Comparision of individual treatments means, for number of grains showed that treatment (T_3) Urea+FYM produced significantly more number of grains per cob (514.43). This increase in number of grains per cob might be due to availability of N at proper time, which is required for better growth and development of plants and improvement in moisture retention and soil structure by FYM. The minimum number of grains per cob (421.27) was recorded from plot with FYM alone that was statistically at par with urea (455.24) alone. These results are similar to the findings of Kumar *et al*. (2002) who concluded that recommended dose of N fertilizer with FYM had a significant effect on number of grains per cob.As regards the varieties, they also statistically differed from each other. The maximum number of grains per cob was recorded in V_1 (Copmosite-78) and minimum number of grains per cob was observed in V_2 (Composite-79).

Among various parameters contributing to the economic yield of a crop, 1000-grain weight is of prime importance. It directly relates with the yield of the crop. Table I shows that both the varieties and N-sources had affected the 1000-grain weight in a significant way. It indicates the influence of different sources of N on 1000-grain weight. The data reveal that maximum 1000-grain weight (327.54 g) was recorded in treatment (T_3) Urea+FYM. It might be due to the proper dose of N in addition to FYM. It was followed by Urea (306.30 g) alone. The minimum 1000-grain weight (284.39 g) was noted with sole application of FYM. The minimum in 1000-grain weight with FYM might be attributed to deficiency of macro nutrients throughout the plant life especially at the time of flowering and seed setting. Data shows that varieties were also statistically significant to each other. The maximum 1000-grain weight was noted in V_1 (Composite-78) while minimum 1000-grain weight was observed in V_2 (Composite-79). Similar results were reported by Sharif *et al*. (2004) who reported that 1000-grain weight was significantly affected by recommended dose of fertilizer in combination with FYM. The data regarding grain yield of two maize varieties as influenced by organic and inorganic sources of nitrogen is given in Table I. The data clearly reveal that N-sources had a highly significant effect on grain yield. The maximum grain yield (6.13 t ha^{-1}) was noted with Urea+FYM and followed by urea (4.86 t ha^{-1}) alone. The better grain yield with combined application of urea and FYM was attributed to more number of grains per cob and 1000-grain weight. Minimum grain yield (3.76 t ha^{-1}) was recorded in treatment where only FYM was applied. Reduction in

yield might be due to the nutritional imbalance and deficiency of certain important plant growth elements at various important growth stages.These results are similar to the findings of Nagassa *et al*. (2005) who revealed that grain yield was significantly affected by N fertilizer in combination with FYM.The varieties were found to be significant to each other in producing total grain yield. The maximum grain yield (5.36 t ha^{-1}) was observed in V_1 (Composite-78) while minimum grain yield (4.47 t ha^{-1}) was noted in V_2 (Composite-79).

Table 1. Growth and yield response of maize to organic and inorganic sources of N

Treatments	Plant height (cm)	No. of cobs per plant	No. of grains per cob	1000-grain weight (g)	Grain yield (tha^{-1})	Harvest index (%)
T_1 N(Urea)@ 260 kg ha^{-1}	193.83b	1.075b	455.24b	306.30b	4.86b	32.58b
T_2 FYM @15000 kg ha^{-1}	191.75c	1.02c	421.27b	284.39c	3.76c	26.60c
T_3 Urea@ 260 kg ha^{-1} + FYM @15000 kg ha^{-1}	197.50a	1.127a	514.43a	327.54a	6.13a	38.16a
LSD at 5%	1.351	0.0304	40.50	9.934	0.478	3.242
V_1 Composite-78	196.00a	1.12a	487.64a	315.86a	5.36a	34.84a
V_2 Composite-79	192.72b	1.03b	439.65b	296.30b	4.47b	30.10b
LSD at 5%	2.82	0.090	45.87	18.93	0.705	4.449

Any two means not sharing a letter in common differ significantly at 5% probability level.

The harvest index is a measure of productive efficiency that how efficiently a crop can use its physiological inheritance. The data regarding harvest index of two maize varieties as influenced by organic and inorganic sources of N is given in Table I.N-sources had significantly affected the harvest index. The maximum harvest index (38.17 %) was recorded with combined application of Urea+FYM. It might be due to the timely availability of N and increase in water holding capacity of soil. It was followed by Urea (32.58 %) alone. While minimum harvest index (26.68 %) was observed with FYM. Similar results were reported by Brinton and Seekins (1994) who reported that harvest index was significantly affected by N fertilizers in combination with FYM.Varieties were also found to be significant to each other. The maximum harvest index (34.84 %) was recorded in V_1 (Composite-78) while minimum harvest index (30.10 %) was noted in V_2 (Composite-79).

Conclusion

On the basis of this experiment it can be concluded that combination of organic (FYM) and inorganic sources of N gave higher yield than either of the sole application of urea and FYM.

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