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Quantitative and Qualitative Response of Maize (*Zea mays* L.) to EM Bioaab and Fertilizers

SHAMSHAD H. SHAH, M. BASHIR AND M. SHAHID IBNI ZAMIR
Department of Agronomy, University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

An attempt was made to examine growth, yield and quality performance of maize treated with EM 'Bioaab' and fertilizers under agro-ecological conditions of Faisalabad. The treatments included were Control, FYM (50 t ha^{-1}), EM 'Bioaab' (60 l ha^{-1}), FYM (50 t ha^{-1}), + EM 'Bioaab' (60 l ha^{-1}), NPK (150-75-50 kg ha^{-1}), NPK (150-75-50 kg ha^{-1}) + EM 'Bioaab' (60 l ha^{-1}), NP (150-75 kg ha^{-1}) + EM 'Bioaab'(60 l ha^{-1}), NK(150-50 kg ha^{-1}) + EM 'Bioaab' (60 l ha^{-1}), PK (75-50 kg ha^{-1}) + EM 'Bioaab' (60 l ha^{-1}). The results indicated that grain yield of 4.05 t ha^{-1} was recorded in plots receiving FYM + EM 'Bioaab' (50 t ha^{-1} + 60 l ha^{-1}) and it was statistically same as obtained either with the application of NPK (150-75-50 Kg ha^{-1}) or NPK + EM 'Bioaab' (60 l ha^{-1}). The increase in yield was attributed to increase in number of grains per cob and leaf area per plant. Grain protein percentage was maximum (9.86) when the crop was treated with NK @ 150-50 kg ha^{-1} + EM 'Bioaab' (60 l ha^{-1}). Effects of different treatments on growth and yield parameters of maize are discussed.

Key Words: Maize; Effective Micro-organisms; Bioaab; Fertilizers

INTRODUCTION

Maize (*Zea mays* L.) is an important cereal and serves as a good source of food for millions of people in the world. Statistics show that average grain yield of maize in Pakistan is lower than that recorded in many maize growing countries of the world. Many factors are responsible for low yield and the most important one is the poor soil fertility owing to low organic matter content of soil, which is less than 1% (Azam, 1988). Soil fertility can be enhanced through the utilization of mineral fertilizers as well as with addition of organic matter to the soil (Azad & Yousaf, 1982). Imbalanced use of fertilizers without application of Farm Yard Manure (FYM) and without knowing the requirements of crops and fertility status of soil causes problems such as deterioration of soil structure, environmental and groundwater pollution. Similarly, continuous use of chemical fertilizer without FYM causes depletion of soil fertility.

Thus, there is a need to explore possible strategies, which can increase crop production with minimum use of synthetic chemical fertilizers. Nature farming is considered to be a solution to many problems related to the present chemical input farming system. Nature farming involves use of organic amendments viz. green manuring, Farm Yard manuring etc., but decomposition of organic matter in the soil is an acute problem. However, with the use of Effective Micro-organisms (EM), decomposition of organic matter is enhanced and crop yields are at par with that obtained with the use of chemical fertilizers. Application of EM enhanced the decomposition of organic and minimized the immobilization of soil nitrogen (Myint, 1996). It was, therefore, planned to examine the efficacy of organic and inorganic fertilizers with and without EM Bioaab on growth, yield and quality performance of maize under agro-ecological conditions at Faisalabad.

MATERIALS AND METHODS

Investigations were carried out at the Agronomic Research Area, University of Agriculture, Faisalabad on a sandy clay loam soil having 0.032% N, 8.24 ppm available phosphorus and 195 ppm potassium. The experiment was laid out in a RCBD and replicated thrice. The treatments included were Control; FYM (50 t ha^{-1}); EM 'Bioaab' (60 l ha^{-1}), FYM (50 t ha^{-1}) + EM 'Bioaab' (60 l ha^{-1}); NPK (150-75-50 Kg ha^{-1}); NPK (150-75-50 Kg ha^{-1}) + EM 'Bioaab' (60 l ha^{-1}); NP (150-75 Kg ha^{-1}) + EM 'Bioaab' (60 l ha^{-1}); NK (150-50 Kg ha^{-1}) + EM 'Bioaab'(60 l ha^{-1}) ; PK (75-50 Kg ha^{-1}) + EM 'Bioaab' (60 l ha^{-1}).

Maize cv. Composite-17 was sown in lines (75 cm apart) on a well prepared seedbed with the help of a hand drill and the seed rate used was 30 kg ha^{-1}. FYM (50 t ha^{-1}) was applied during seedbed preparation. The whole phosphorus, potash and 1/3rd nitrogen were side dressed along with seed rows as a basal dose about 5 cm deep into the soil and about 10 cm away from plant row. Remaining nitrogen was applied in two doses i.e. 1/3rd with second irrigation and 1/3rd at the initiation of tasseling. When crop was at 3 to 4 leaf stage, thinning was done. All other agronomic practices were kept normal and uniform for all the treatments. EM 'Bioaab' was prepared by mixing one litre basic EM solution and one kg molasses in 20 litres of water and EM 'Bioaab' was applied along with each irrigation to the crop at 60 l ha^{-1}. Data on the agro-economic aspects of crop were recorded and analyzed statistically.

RESULTS AND DISCUSSION

Leaf area per plant was the maximum in T_4 where the crop was treated with NPK @ 150 + 75 + 50 kg ha^{-1} but non-significant differences were found among T_4, T_3, T_8 and T_6 treatments showing 4701.05 cm^2, 4471.03 cm^2, 4263.00 cm^2 and 4150 cm^2 leaf area/plant, respectively (Table I). The minimum total leaf area per plant (2728.17 cm^2) was recorded in the control but it was statistically similar to that found in treatment T_5 (2992.32 cm^2). Non-significant differences were found among T_1, T_7, and T_2 with the total leaf area of 3427.26 cm^2, 3606.13 cm^2 and 3957.21 cm^2, respectively. Increased leaf area recorded in NPK, FYM + EM, PK + EM, NP + EM. compared to zero fertilizer treatment is attributed to increased vegetative growth of plants. Similar findings were reported by Shahzad *et al.* (1996). Out of the yield contributing factors, data recorded revealed that maximum number of grains per cob (542.59) was produced in T_5 where the crop was treated with NPK @ 150-75-50 kg ha^{-1} along with 60 l ha^{-1} EM 'Bioaab' but it did not differ significantly from T_3, T_2 and T_6 producing 497.06, 493.69 and 479.50 grains per cob, respectively. Non-significant differences were recorded among treatments T_3, T_2, T_6, T_1 and T_7, which on an average produced 458.39 grains per cob. The number of grains produced per cob was the lowest 412.36 in T_4 but it did not differ significantly from T_0, T_1, T6, T_7 and T_8. The results indicate that number of grains per cob increased with a supply of more nutrients by NPK + EM, and these findings are in accordance with those reported by Maqsood (1996) and Rizal (1997). The weight per 1000 grains was maximum (245.16 g) in T_8 where crop was treated with PK @ 75-50 kg ha^{-1} + EM 'Bioaab' (60 l ha^{-1}). It did not differ significantly from either T_4 (150-75-50 kg NPK ha^{-1}) or T_5 (150-75-50 kg NPK ha^{-1} + EM 'Bioaab' 60 l ha^{-1}). Non significant differences were found among treatments T_4, T_3, and T_6 but these were significantly different from T_0, T_1, T_2 and T_7. Weight per 1000 grains in T_0 was the lowest (200.74 g) of all the treatments but it was statistically the same as recorded in T_1 and T_7. The results show that EM 'Bioaab' applied to the crop with PK or application of complete fertilizer to the crop significantly increased the weight per 1000 grains as compared to other treatments. Increase in 1000-grain weight might be due to the formation of less but healthy and bold grains in NPK and EM 'Bioaab' + PK treatments as compared to others. These results are in line with those obtained by Muhammad (1994) and Zahir *et al.* (1996). Maximum grain yield (4.05 t ha^{-1}) was obtained in plots where the crop was treated with 50 t ha^{-1} FYM + 60 l ha^{-1} EM 'Bioaab' (T_3), but it was statistically at par with T_4 (3.85 t ha^{-1}) and T_5 (3.98 t ha^{-1}) where the crop received NPK @ 150-75-50 kg ha^{-1} + 60 l ha^{-1} EM 'Bioaab', respectively. Non significant differences were found among treatments T_1, T_2 and T_7 which differed significantly from that of T_0 (control) producing minimum (2.14 t ha^{-1}) of all treatments under study.

Significant increase in grain yield with FYM + EM might be attributed to an appreciable increase in total leaf area per plant, grains per cob and 1000-grain weight. These results are in line with the findings of Filho *et al.* (1993) and Rashid *et al.* (1993) who observed that FYM + EM increased the grain yield significantly over the control. In case of stalk yield, it was the highest (10.08 t ha^{-1}) in T_6 (NP @ 150-75 kg ha^{-1} + EM 'Bioaab' @ 60 l ha^{-1}) and was followed by that produced from T_3 (FYM @ 50 t ha^{-1} + EM 'Bioaab' 60 l ha^{-1}) which was at par with T_5 and T_4 producing 8.92 t and 8.74 t ha^{-1}, respectively. No difference was found between T_4 and T_7. The lowest stalk yield of 6.24 t ha^{-1} was found in T_2 but it was at par with that of either T_1 (6.83 t ha^{-1}) where crop was treated with 50 t ha^{-1} FYM alone or T_0 with zero fertilizer. Data showed that a

Table I. Effect of EM 'Bioaab' and fertilizers on agronomic and quality characteristics of maize

Treatments	Total leaf area per plant at maturity (Cm^2)	Grains per cob	1000-grain weight (g)	Grain yield (t ha^{-1})	Stalk yield (t ha^{-1})	Protein content (%)
T_0	2728.17 f*	422.25 c	200.74 e	2.14 e	6.51 f	9.13 d
T_1	3427.26 de	445.48 bc	207.77 de	3.15 cd	6.83 ef	9.40 cd
T_2	3957.21 bcd	493.69 ab	202.33 e	2.96 d	6.24 f	9.95 a
T_3	4471.03 ab	497.06 ab	230.61 b	4.05 a	9.11 b	9.68 abc
T_4	4701.05 a	412.36 c	236.45 ab	3.85 a	8.74 bc	9.78 ab
T_5	2992.32 ef	542.59 a	217.20 cdd	3.98 a	8.92 b	9.81 a
T_6	4150.30 abc	479.50 abc	228.27 bc	3.54 b	10.08 a	9.31 cd
T_7	3606.13 cd	461.30 bc	206.67 de	2.97 d	7.94 cd	9.86 a
T_8	4263.00 ab	419.42 e	245.16 a	3.28 c	7.52 de	9.12 d

T_0 = Control, T_1 = FYM (50 t ha^{-1}), T_2 = EM 'Bioaab' (60 l ha^{-1}), T_3 = FYM (50 t ha^{-1} + EM 'Bioaab' (60 l ha^{-1}), T_4 = NPK (150-75-50 kg ha^{-1}), T_5 = NPK (150-75-50 kg ha^{-1} + EM 'Bioaab' (60 l ha^{-1}), T_6 = NP (150-75 kg ha^{-1} + EM 'Bioaab' (60 l ha^{-1}), T_7 = NK (150-50 kg ha^{-1} + EM 'Bioaab' 60 l ha^{-1}), T_8 = PK (75-50 kg ha^{-1} + EM 'Bioaab' (60 l ha^{-1}); * Treatments not sharing the small letter differ significantly at 5% level of probability

significant increase in stalk yield occurred by the application of EM 'Bioaab' in addition to fertilizer or FYM. These results support the findings of Myint (1996) and Razzaq (1995).

Highest protein contents in grains (9.95%) were recorded in T_2 (EM 'Bioaab' @ 60 l ha^{-1}), but it was at par with T_7, and the protein percentage in these treatments was 9.86, 9.81, 9.78 and 9.68, respectively. The lowest protein content (9.13%) was recorded in the control (T_0) but it did not differ significantly from treatments T_1, T_6 and T_8 in which protein concentration on an average was 9.27%. Grain protein significantly increased over the control when crop was treated with EM 'Bioaab', NK + EM, NPK + EM, NPK and FYM + EM 'Bioaab'. This was due to increased supply of nitrogen to crop. Similar findings were reported by Javed (1982) and Iqbal (1997).

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