INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/99/01–4–267–269

Response of Hybrid Maize to Potassium

MUMTAZ AKHTAR CHEEMA, M. IQBAL, Z.A. CHEEMA, BASHARAT ULLAH† AND MUHAMMAD RAFIQUE‡
Department of Agronomy, University of Agriculture, Faisalabad–38040
† *Department of Land Reclamation, Faisalabad,*
‡ *Department of Soil Conservation, Murree, Pakistan*

ABSTRACT

A field experiment to study the effect of potassium nutrition on the growth and yield of spring planted hybrid maize was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during the year, 1998. Potassium levels of 25, 50, 75, 100, 125 and 150 kg ha^{-1} were evaluated, using a basal dose of 150 kg ha^{-1} of nitrogen and 100 kg ha^{-1} of phosphorus. The results revealed that potassium application improved maize yield and the highest grain yield of 6.87 mg ha^{-1} was obtained with potassium at the rate of 125 kg ha^{-1}. This increase in yield was attributed to greater number of grains per cob and 1000-grain weight. Application of higher potassium level i.e. 150 kg ha^{-1} was uneconomical.

Key Words: K; Hybrid; Spring planted maize

INTRODUCTION

Soils of Pakistan are generally deficient in nitrogen and phosphorus, while deficiency of potassium is not common; however, in certain places potassium fertilization would be required. Intensive and continuous cropping of high fertilizer requiring crops as sugarcane, potato, rice, use of unsuitable irrigation water from tubewells, improper fertilizer use and low organic contents in our soils, has lead into potassium deficiency. The physiological role of potassium is indispensable for the maintenance of cell turgor pressure that is required for cell expansion. Potassium also plays a key role in osmoregulation of plant cell and regulates the opening and closing of stomata. Potassium is not constituent of organic structure, but regulates enzyme activities and translocation of photosynthates (Mangel & Kirkby, 1987). The application of adequate amount of potassium fertilizer is considered imperative for enhancing maize productivity.

Maize hybrids have high yield potential and could meet our food demand and industrial needs. The nitrogen and phosphorus requirements of the maize crop are thoroughly investigated but the proper dose of potassium for maize under our conditions is yet to be determined. The objective of the study was to investigate the potassium requirement of a new maize hybrid under agroecological conditions of Faisalabad.

MATERIALS AND METHODS

This experiment was conducted to study the effect of different levels of potassium in combination with uniform dose of nitrogen and phosphorus, on growth and yield of spring planted hybrid # 7878. The study was carried out at the Agronomic Research Area, University of Agriculture, Faisalabad in spring season during the year, 1998. The experiment was laid out in Randomized Complete Block Design with four replications keeping a net plot size 7m x 3m. The experiment comprised the following potassium levels i.e. 0, 25, 50, 75, 100, 125 and 150 kg ha^{-1}, control treatment where no potassium was applied.

Maize hybrid # 7878 was sown in the first week of March 1998, with the help of a dibbler maintaining a planting distance of 75 cm inter row spacing and 30 cm intra row spacing. Other agronomic practices and plant protection measures were applied uniformly in all the treatments during the study period. The crop was harvested and observations on various growth and yield parameters were recorded during the course of study. The data collected were tabulated and analyzed statistically by using Fisher's analysis of variance technique and least significant difference (LSD) at 5% probability levels was applied to compare the difference among the treatment means (Steel & Torrie, 1984). Economic and marginal analysis of treatments was performed following the procedure laid down by Byerlec (1988).

RESULTS AND DISCUSSION

The growth and yield of maize was significantly influenced by potassium application (Table I). Potassium application levels improved plant height over control (T1) except 25 kg. Application of 150 kg ha^{-1} potassium produced the tallest plants (226.5 cm) this was, however, statistically at par with (50, 75, 100 and 125 kg ha^{-1} potassium). The increase in plant

Table I. Effect of different levels of potassium on spring planted hybrid maize

Treatments (Potassium kg ha^{-1})	Plant height (cm)	Number of grains/cob	1000-grain weight (g)	Grain yield (t ha^{-1})	% increase in yield over control
(Control)	197.7b	417.3d	221.3c	4.64b	-
25	206.9b	456.6cd	241.7bc	4.35b	6.66
50	222.2a	467.2bcd	262.5b	5.16b	18.62
75	223.1a	492.8abc	219.5a	6.13a	40.91
100	225.1a	519.7abc	313.9a	6.56a	50.80
125	223.9a	534.7a	315.9a	6.78a	55.86
150	226.5a	528.8ab	307.3a	6.39a	46.89
LSD value	12.74	80.16	32.58	1.14	

Figures sharing the same letter(s) are statistically similar at P= 0.05.

height in response to application of various combinations of NPK have been reported by Rhodes, 1976.

The number of grains per cob was the maximum with application of potash at the rate of 125 kg ha^{-1} and it was statistically at par with 75, 100 and 150 kg ha^{-1} of potassium. Lower levels of potash i.e. 25 and 50 kg ha^{-1} improved grain number per cob however, were statistically similar to control. The 1000-grain weight was affected significantly by potassium application in Table II. The highest 1000-grain weight 315.9 g was obtained with 125 kg ha^{-1} potassium because potassium regulates enzyme activities and translocation of photosynthats (Mangel & Kirkby, 1987). It was statistically at par with 75, 100 and 150 kg ha^{-1} potassium. The lowest level of potassium i.e. 25 kg ha^{-1} did not differ from control. The increase in weight with potassium is reported by Rasool *et el.* (1987).

The data on grain yield presented in Table I indicate that potassium application generally improved grain yield. The highest grain yield of 6.78 ton ha^{-1} was obtained with 125 kg potassium per hectare which was 55% higher than control, this was however statistically at par with 75, 100, 150 kg ha^{-1} potassium. The lower levels of potash i.e. 25 and 50 kg ha^{-1} were statistically equal to control. These results are in agreement with those of Neilson *et el.* (1963) and Hera, (1972), who reported that application of potassium increased the grain yield significantly when applied in combination with nitrogen and phosphorus.

The economic analysis revealed (Table II) that 125 kg ha^{-1} potassium application was the best treatment with maximum net benefits. Similarly marginal analysis (Table III) showed that the marginal rate of return increased up to 125 kg ha^{-1} potassium but

Table II. Economic analysis

	T_1	T_2	T_3	T_4	T_5	T_6	T_7	Remarks
Total yield	4.35	4.64	5.16	6.13	6.56	6.78	6.39	t ha^{-1}
Adjusted yield	3.92	4.18	4.64	5.52	5.90	6.10	5.75	10% less than actual yield
Value in (Rs)	23520	25080	27840	33120	35400	36600	34500	Rs. 240/40 kg of maize
Cost of K_2SO_4 applied (in Rs.)	-	560	1120	1680	2240	2800	3360	Rs. 560 per bag of 50 kg
Cost that vary (Rs.)	-	560	1120	1680	2240	2800	3360	Cost of potassium
Net Benefits (Rs.)	23520	24520	26720	31440	33160	33850	31140	

Note: T_1 = 0 kg K_2O ha^{-1} T_3 = 50 kg K_2O ha^{-1} T_5 = 100 kg K_2O ha^{-1} T_7 = 150 kg K_2O ha^{-1}
T_2 = 25 kg K_2O ha^{-1} T_4 = 75 kg K_2O ha^{-1} T_6 = 125 kg K_2O ha^{-1}

Table III: Marginal analysis

	Reatment	Cost that vary (Rs.ha^{-1})	Net Benefit (Rs. ha^{-1})	Marginal rate of return (%)
T_1	Control	0	23520	-
T_2	25 kg K_2O ha^{-1}	560	24520	178.6
T_3	50 kg K_2O ha^{-1}	1120	26720	392.9
T_4	75 kg K_2O ha^{-1}	1680	31440	842.9
T_5	100 kg K_2O ha^{-1}	2240	33160	307.1
T_6	125 kg K_2O ha^{-1}	2800	33800	114.3
T_7	150 kg K_2O ha^{-1}	3360	31140	-

MRRI = $\frac{\text{Change in benefits}}{\text{Change in cost}} \times 100$

D = Dominated due to less benefits.

the application of 150 kg ha^{-1} was uneconomical due to higher cost and was dominated due to lower net benefits. Therefore on the basis of these results it could be concluded that 125 kg ha^{-1} was the best potassium level in this study however it is suggested that studies of similar nature with different nitrogen, phosphorus and potassium levels may be continued to determine the suitable combination of NPK for maize hybrid at agroecological conditions of Faisalabad.

REFERENCES

Anonymous, 1997. Agricultural Statistics of Pakistan. Ministry of Food, Agriculture and Co-operatives. Food and Agriculture Division, (Economic Wing) Islamabad, pp:18–9.

Byerlec, D., 1988. From Agronomic data to farmer recommendation: An economics training manual. Maxico, D.F.

Hera, C., 1972. Aspects of the effect of applied K fertilizer on wheat and maize. *Anallc institululuc de cerectari pentru cereal si planto technice fundulla, B. Publi.* 38: 141–9 (*Field Crop Absts.*, 28: 282; 1973).

Mangel, K. and E.A. Kirkby, 1987. Principles of Plant Nutrition, pp: 100–5. West Publishing Co., Inst. Potash Inst. Bern, Switzerland.

Moslov, V. and E.S. Chernova, 1976. Maize yield in relation to nitrogen potassium nutrition. *Agrochimiya,* 5: 37–9.

Neilson, K.F., R.B. Carron and I. Hoffman, 1963. A study of iron interaction in the uptake of N, K, Ca, Cl and S by corn. *Soil Sci.*, 95: 315–21.

Rasool, G., J.K. Khattak and A. Bhatti, 1987. Comparative effect of potassium sulphate vs potassium chloride on the yield and chemical composition of maize under D.I. Khan conditions. *Pak. J. Agric. Res.*, 8: 29–33.

Rhodes, F.M., 1976. Leaf area and plant height as indicators of plant response to fertilization of corn. *Proc. Soil. and Crop Sci., Soc. Florida, USA,* 35: 36–8 (*Field Crop Absts.*, 30: 3221; 1977).

Steel, R.G.D. and J. H. Torrie. 1984. Principles and Procedures of Statistics. A Biometrical Approach, McGraw Hill, Book Co., New York USA.

(Received 10 July 1999; Accepted 01 October 1999)