INTERNATIONAL JOURNAL OF AGRICULTURE & BIOLOGY
1560–8530/2000/02–3–253–254

Response of Maize Fodder to Muriate of Potash

ATTA MUHAMMAD RANJHA, S.M. MEHDI AND M. IQBAL
Department of Soil Science, University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

The effect of chloride applied @ 0, 200, 400, 500, 600, 800 and 1000 ppm as KCl on the growth of maize plant and uptake of nutrients was noted under hydroponic system. Growth of maize plant was improved by applying KCl @ 400 ppm and significantly depressed at 800 and 1000 ppm Cl. There was linear increase in the uptake of Cl and K with a corresponding decrease in the uptake of Ca and Mg. With the increasing rates of KCl the absorption of N was not affected by Cl application.

Key Words: Muriate of Potash; Chloride; Maize

INTRODUCTION

There are two main sources of K for crops i.e. sulphate of potash (SOP), and muriate of potash (MOP). MOP is cheaper source of K than SOP but its use in Pakistan is minimum due to the fear of its adverse effects on plant growth resulting from chloride accumulation. Recent studies in the Northern Great Plains confirm that Cl component of fertilizers can in some instances increase the yield of wheat and barley (Engel & Grey, 1991), while Ranjha (1998) observed that Cl application upto 400 ppm rate increased the vegetative growth of rice and wheat in soil and solution culture studies.

The ability of Cl to move rapidly across cell membrane and its biochemical inertness are the two important properties that allow Cl to serve as a key osmotic solute in plant. Still much work is required on this issue, thus the present study was conducted.

MATERIALS AND METHODS

A solution culture study was performed on maize in the growth chamber, University of Agriculture Faisalabad. Medium of growth was Johnson's modified nutrient solution (Johnson *et al.,* 1957). Chloride as KCl was applied @ 0, 200, 400, 500, 600, 800 and 1000 ppm.

Seven days old nursery seedlings of maize were transplanted into foam plugged holes in the lids of 3L capacity containers having continuously aerated nutrient solution prepared in distilled water. pH of the solution was adjusted at 5.5 $\pm$ 0.5. There were four plants in each container. Chloride as KCl was applied four days after the nursery transplantation. The substrate solution was changed after one week and plants were harvested 14 days after the application of chloride. Fresh and oven dry (70°C) weights were recorded for roots and shoots. Properly ground plant samples were analyzed for K, Cl, N, Ca and Mg by using the standard methods (Chapman & Pratt, 1961). The data obtained were subjected to statistical analysis according to Steel and Torrie (1980) for the interpretation of the results.

RESULTS AND DISCUSSION

Fresh and dry weights of roots and shoots. Fresh weight of roots was increased significantly by applying KCl @ 200 ppm Cl and the treatments from 200 to 600 ppm Cl were non-significant with each other and further application of Cl @ 800 and 1000 ppm decreased fresh root weight. Control and 800 ppm were non-significant with each other, while 1000-ppm treatment gave lower yield than the control due to excess of KCl salt or nutritional imbalance. Shoot fresh weight improved upto 400 ppm but 500 ppm Cl remained non-significant with 400 ppm. Control and 600 ppm treatments remained non-significant with each other, while further application of Cl @ 800 and 1000 ppm reduced yield to the level less than that from the control treatment (Table I).

Table I. Effect of Chloride on fresh and dry weights of roots and shoots of maize plants

Treatments	Fresh Weight (g)		Dry weight (g)	
KCl (ppm)	Root	Shoot	Root	Shoot
0	2.66b	10.55c	0.17b	0.75a
200	3.54a	11.26b	0.19a	0.81a
400	3.52a	12.18a	0.18ab	0.83a
500	3.70a	12.00a	0.18ab	0.81a
600	3.37a	10.83bc	0.17b	0.76a
800	2.52b	7.91d	0.14c	0.63b
1000	1.81c	4.42e	0.11d	0.45c

Mean values with different letters(s) differ significantly at P = 0.05

Root dry weight improved with Cl application upto 200 ppm but remained non-significant with 400 and 500 ppm doses. Control and 600 ppm remained non-significant with each other while further Cl application reduced yield significantly. Shoot dry weight remained non-significant upto 600 ppm Cl application rate with control. While further application of Cl @ 800 and 1000 ppm decreased it significantly (Table I).

Table II. Effect of chloride on K, Cl, Ca, Mg and N concentration in maize shoots and roots

Treatment Cl (ppm)	Roots				Shoot				
	Cl	K	Ca	Mg	Cl	K	Ca	Mg	N
	(g kg^{-1})	%			(g kg^{-1})	%			
0	2.70 g	1.75 f	0.38 a	0.29a	5.41g	3.47f	0.59a	0.41a	5.23
200	6.46 f	2.34 e	0.36ab	0.27b	12.84f	4.50e	0.52b	0.39b	5.24
400	8.72 e	3.02 d	0.32bc	0.26b	19.21e	5.88d	0.49b	0.36c	5.23
500	9.70 d	3.37 c	0.30cd	0.24c	22.98d	6.94c	0.48bc	0.35c	5.20
600	10.78 c	3.74 d	0.27cde	0.22d	25.56c	7.38b	0.43cd	0.33d	5.22
800	12.41 b	3.96 ab	0.25de	0.20e	31.71b	7.97a	0.41d	0.31e	5.23
1000	15.74	4.17 a	0.22e	0.18f	35.78a	8.12a	0.38d	0.28f	5.23

Mean values with different letter(s) differ significantly at P = 0.05

The increase in growth of maize plant upto 400 ppm Cl level could be attributed to higher levels of thiamin due to chloride (Monooki, 1974), or it might be the result of increased turgor potentials caused by K and Cl (Christensen *et al.,* 1981). Whereas, the reduction in growth of the maize plant as indicated by fresh and dry weight at higher chloride levels could be linked with profound cellular depolarization at increased Cl concentration (Akhundova *et al.,* 1990) or due to inhibited photosynthesis or sugar accumulation in leaves. Another reason could be the decreased uptake of Ca and Mg with increasing level of K along-with Cl (Table II).

Chemical composition of plants. Potassium and Cl concentrations increased (Table II) linearly with increasing rate of Cl in both shoots and roots while Ca and Mg contents decreased linearly with increasing Cl level and this decrease was statistically significant. There was no effect of Cl or K on the absorption of N by maize plant. The increase in K and Cl contents was due to their increased level of application while decrease in Ca and Mg uptake could be attributed to the antagonistic effect of K on Ca and Mg. Similar results were reported by Brod (1988) and Li *et al.,* (1989). Therefore KCl can be used upto 400 ppm Cl i.e. 1700 kg ha^{-1} safely for maize fodder.

CONCLUSION

Potassium chloride @1600Kg ha^{-1} will not adversely affect the growth of maize. Thus we can use MOP as source of potassium. Higher rates are injurious.

REFERENCES

Akhundova, T.S., A.A. Mardanovand and V.M. Ali-Zade, 1990. Effect of Kinet on the membrane potantial of root epidermal cells of Traines bogotenses in nutrient medium with an excessive amount of chloride. *Izu Aka Nauk Azerb Ser Biol Nauk* 0 (1); 12–7.

Brod, H.G., 1988. The effect of isoosmotic single and mixed multiflorum. *Zeitschrift fur vegetation technik in landschafts – und sport – stattendau.* 11(4): 215–19.

Chapman, H.D. and P.F. Pratt, 1961. Methods of analysis for soils plants and waters. Div. Agri. Sci. Uni. California ,U.S.A., p. 309.

Engel, R.E. and W.E. Grey, 1991. Chloride fertilizer effects on winter wheat included with *Fusarium culmorum. Agron. J.,* 83: 204–8.

Johnson, C.M., P.R. Stout, T.C. Broyer and A.B. casltom, 1957. Comparative chlorine requirements of different plant species. *Plant and Soil,* 8: 337–57.

Li, J.F., P.G.G. Wo and D.Q. Wang, 1989. Effect of chlorine on plant growth, yield and quality of soybean. *J. Soil. Sci.,* 20: 80–2.

Monooki, T., 1974. Morphogenetic sutides of the influence or ammonium chloride on the growth of rice plant, especially on its root development. *Memoirs of the Tokyo University of Agriculture,* 16: 1– 30.

Ranjha, A.M., 1998. Relative efficiency of MOP and SOP for maize fodder (Un-published data).

Steel, R.G.D. and J.H. Torrie, 1980. Principles and procedures of statistics, McGraw Hill Book Co. In. New York, USA.

(Received 29 May 2000; Accepted 15 June 2000)