International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(2): 363-365

Received: 20-01-2017
Accepted: 21-02-2017

DG Chaudhary
Department of Soil Science and Agricultural Chemistry, Anand Agricultural University, Anand, Gujarat, India

JK Parmar
Department of Soil Science and Agricultural Chemistry, Anand Agricultural University, Anand, Gujarat, India

NB Gohil
Department of Soil Science and Agricultural Chemistry, Anand Agricultural University, Anand, Gujarat, India

AP Chaudhary
Department of Agricultural Statistics, Anand Agricultural University, Anand, Gujarat, India

RB Patel
Department of Soil Science and Agricultural Chemistry, Anand Agricultural University, Anand, Gujarat, India

Correspondence
DG Chaudhary
Department of Soil Science and Agricultural Chemistry, Anand Agricultural University, Anand, Gujarat, India

Effect of potassium, zinc and FYM on content and uptake of micronutrients by forage maize (*Zea mays* L.) grown on loamy sand soil

DG Chaudhary, JK Parmar, NB Gohil, AP Chaudhary and RB Patel

Abstract

An investigation entitled "Effect of potassium, zinc and FYM on content and uptake of micronutrients by forage maize (*Zea mays* L.) grown on loamy sand soil" was carried out during summer season of the year 2015 at B. A. College of Agriculture, Anand on loamy sand soil. The present pot trial consisting of 18 treatment combinations involving with three levels of K_2O (0, 30 and 60 kg ha^{-1}) and Zn (0, 10 and 20 kg ha^{-1}) and two levels of FYM (0 and 10 t ha^{-1}) were tried in FCRD with three replications. The experimental results revealed that the significantly maximum Zn content was recorded under zinc application of 20 kg ha^{-1} over the rest of treatments at 30 DAS and at harvest. In uptake study, application of K_2O @ 60 kg ha^{-1}, Zn @ 20 kg ha^{-1} and FYM @ 10 t ha^{-1} recorded significantly the highest uptake of Fe, Mn, Zn and Cu by crop at harvest.

Keywords: Content and Uptake, FYM, Micronutrients, Potassium, Zinc

Introduction

Micronutrient deficiencies are becoming increasingly common in agriculture as a result of higher levels of removal by ever-more-productive crops combined with breeding for higher yields, at the expense of micronutrient acquisition efficiency (Havlin *et al.,* 2014) [4]. Increasing evidences indicate that food grown by applying adequate NPK fertilizers on soils with low levels of trace elements not only reduce the crop yield but, may also provide insufficient human dietary levels of certain elements, even though the crop plants themselves show no signs of micronutrient deficiency (Karak *et al.,* 2006) [7]. For, all these reasons, increasing attention is directed towards management of micronutrients in the soils.

Potassium activates many enzymes and plays an important role in the maintenance of electrical potential gradients across cell membranes and the generation of turgor in plants. It regulated for photosynthesis, protein synthesis and starch synthesis (Mengel and Kirkby, 1996) [9]. It is also the major cation for the maintenance of cation-anion balances. Potassium aids plant in resisting disease, insect, cold weather and drought. Zinc deficiency is prevalent worldwide in temperate and tropical climates. Nearly, 47 per cent of Indian soils are deficient in Zn element (Veeranagappa *et al.,* 2010) [15]. Moreover, among the cultivable soils of Gujarat, 24 per cent are Zn deficient (Dangerwala *et al.,* 1994) [1]. It is a major component and activator of several enzymes involved in metabolic activities. Zinc deficiency continues to be one of the key factors in determining maize production in several parts of the country. Zinc deficiency in rice is characterized by brown spots, which appear first on the younger leaves and later in the lower leaves.

FYM is the principle source of organic matter in our country and it is a source of primary, secondary and micronutrients to the plant growth. It is a constant source of energy for heterotrophic microorganisms, help in increasing the availability of nutrient quality and quality of crop produce. The entire amount of nutrients present in farmyard manure is not available immediately but about 30 per cent of nitrogen, 60 to 70 per cent of phosphorus and 70 per cent of potassium are available to the first crop, while remaining amount of nutrients will be available to succeeding crop (Kaihura, 1999) [6]. The application of FYM also enhanced the availability of plant nutrient present in soil. While, FYM applied with Zn and K increased the uptake of deficient nutrients as well as improving the soil chemical, biological and physical properties of soil.

FYM is a store house of nutrient, which contain all essential plant nutrients. It is beneficial as apply fertilizer like Zn and K in combination with FYM (Nawab *et al.*, 2011) [10].

Among the various cereals, maize (*Zea mays* L.) is one the most important economic crops and is almost an ideal cereal forage crop because of its quick growing nature, high yield, palatable nutritious quality and lactogenic effect. Moreover, its wider adaptability over a range of environmental conditions and cropping season signifies as a good forage crop and provide nutritious fodder throughout year under all management practices. Maize is used as green fodder, straw, hay or silage. It can be safely fed at any stage of crop growth. In addition to this, maize is a C_4 in nature and it is highly adaptable to subtropical climate and can grow well even at high temperature. Maize grows well in wide range of pH (5.5 to 8.0).

Materials and Methods

For achieving the objective of present investigation, a pot experiment entitled, "Effect of potassium, zinc and FYM on content and uptake of micronutrients by forage maize (*Zea mays* L.) grown on loamy sand soil" was carried out during summer season of 2015. The experiment was conducted in the net house of the department of Soil Science and Agricultural Chemistry, B. A. College of Agriculture, Anand Agricultural University, Anand. The experiment was laid out in a completely randomized design (factorial) with three repetitions. The three levels of K_2O (0, 30 and 60 kg ha^{-1}) and Zn (0, 10 and 20 kg ha^{-1}) and two levels of FYM (0 and 10 t ha^{-1}) were selected in the experiment.For conducting the pot experiment, the soil from surface layer (0-15 cm) was collected, after collecting the required quantity of bulk fill up the earthen pot of fifteen kg capacity. In each pot, treatment wise eight seeds of maize were sown. After germination, maize plants were thinned to five plants per pot. The recommended full dose of phosphorus was applied at the time of sowing, while half recommended dose of nitrogen were applied at sowing and half of the nitrogen was applied at 30 DAS. The K_2O and Zn were applied in the form of KCl (muriate of potash) and $ZnSO_4$ (zinc sulphate). After germination, maize plants were thinned to five plants per pot. Pots were regularly watered and weed free condition was maintained till 60 DAS required for tasseling stage of maize crop. Top dressing of 50 % N in the form of urea was done at 30 DAS. When the maize was at tasseling stage (60 DAS), the plants were uprooted carefully. The fresh and oven dry weight of shoot and roots were recorded from each pot. The soil of experimental site was *Typic Ustochrepts* having loamy sand soil texture, slightly alkaline in reaction (pH-8.05), EC (1:2.5) (0.18 dS m^{-1}), Organic carbon contents (0.35%), available N (197 kg ha^{-1}), available P_2O_5 (28 kg ha^{-1}) and DTPA- Zn (0.39 ppm) were low in status. While available K_2O (228 kg ha^{-1}) was medium in soil. All the data recorded during the study period were statistically analyzed by using standard methods as suggested by Steel and Torrie (1982) [13].

Result and Discussion

Content

An appraisal of data showed in table clearly indicate that the potassium and FYM treatments was found non-significant on plant content of Fe, Mn, Zn and Cu at 30 DAS and harvest. The perusal of data given in Table 1 indicated the zinc treatment had significant influence on plant content of Zn, whereas Fe, Mn and Cu not significantly influence by Zn application at 30 DAS. Significantly the highest content of Zn was found with Zn_3 (20 kg Zn ha^{-1}) over the rest of treatments. Shukla *et al*. (1978) [12] reported that Zn was involving in the metabolic activity, controlling auxin levels and nucleic acids in plants thereby contributing toward increase in growth and nutrient content in maize plant. Similar result conforms with Patel and Patel (1994) [11] in sorghum.

Table 1: Influence of potassium, zinc and FYM on micronutrients content in forage maize at 30 DAS and harvest

Treatments	Micronutrients content (mg kg^{-1})							
	Fe		MN		Zn		Cu	
	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS	30 DAS	60 DAS
[A] Potassium levels								
K_1 : 0 kg ha^{-1}	263	251	21.1	17.4	31.4	28.9	6.09	5.25
K_2: 30 kg ha^{-1}	264	252	21.4	17.3	31.8	29.1	6.16	5.34
K_3 : 60 kg ha^{-1}	263	251	21.6	17.8	31.9	29.6	6.13	5.25
S.Em ±	2.96	3.20	0.47	0.37	0.49	0.45	0.06	0.06
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS
[B] Zinc levels								
Zn_1 : 0 kg ha^{-1}	263	252	20.9	17.2	26.0	23.4	6.04	5.17
Zn_2 : 10 kg ha^{-1}	265	253	21.6	17.6	31.7	29.4	6.14	5.36
Zn_3 : 20 kg ha^{-1}	262	250	21.6	17.7	37.5	34.8	6.20	5.30
S.Em ±	2.96	3.20	0.47	0.37	0.49	0.45	0.06	0.06
C.D. (0.05)	NS	NS	NS	NS	1.41	1.28	NS	NS
[C] FYM levels								
F_1 : 0 t ha^{-1}	260	248	20.9	17.3	31.3	28.9	6.07	5.23
F_2 : 10 t ha^{-1}	267	255	21.9	17.8	32.1	29.4	6.18	5.33
S.Em ±	2.41	2.61	0.38	0.30	0.40	0.36	0.05	0.05
C.D. (0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Uptake

Significantly the highest uptake of Fe, Mn, Zn and Cu was found with K_3 (60 kg K ha^{-1}) and Zn_3 (20 kg Zn ha^{-1}) over the rest of treatments. This might be due to the Zn plays important role in biosynthesis enzymes and resulted in favorable effect of zinc on metabolic reaction within the plants which provide more uptakes of nutrients for plant reported by Dwivedi *et al*. (2002) [2]. Jain and Dahama (2005) [5] noticed that the uptake of Zn was increased with the increasing level of Zn in maize crop. Similar findings were also obtained by Meena *et al*. (2013) [8] in maize.

The application of FYM @ 10 t ha^{-1} recorded significantly higher nutrient uptake of Fe, Mn Zn and Cu by maize at harvest as compared to no application of FYM. The increase in Fe (20.54 %), Mn (20.68 %), Zn (19.46 %) and Cu uptake (18.86 %) by maize were observed with FYM @ 10 t ha^{-1} treatment over no application of FYM, respectively. This may be due to increase in microbial activity in soil and improvement in physical and chemical properties of soil which resulted in better utilization of nutrients as compared to no FYM reported by Totawat *et al*. (2001) [14]. The results are in line with earlier findings reported by Walia and Kler (2010) [16] and Faujdar *et al*. (2014) [3].

Table 2: Influence of potassium, zinc and FYM on micronutrients uptake by forage maize at harvest

Treatments	Micronutrients uptake (mg pot^{-1})			
	Fe	**MN**	**Zn**	**Cu**
[A] Potassium levels				
K_1 : 0 kg ha^{-1}	12.73	0.89	1.49	0.266
K_2: 30 kg ha^{-1}	13.68	0.94	1.62	0.289
K_3 :60 kg ha^{-1}	14.98	1.06	1.81	0.314
S.Em ±	0.40	0.03	0.05	0.008
C.D. (0.05)	1.14	0.08	0.14	0.024
[B] Zinc levels				
Zn_1 : 0 kg ha^{-1}	11.52	0.79	1.07	0.236
Zn_2 :10 kg ha^{-1}	13.84	0.96	1.61	0.294
Zn_3 :20 kg ha^{-1}	16.04	1.13	2.23	0.338
S.Em ±	0.40	0.03	0.05	0.008
C.D. (0.05)	1.14	0.08	0.14	0.024
[C] FYM levels				
F_1 : 0 t ha^{-1}	12.51	0.87	1.49	0.265
F_2 : 10 t ha^{-1}	15.08	1.05	1.78	0.315
S.Em ±	0.32	0.02	0.04	0.007
C.D. (0.05)	0.93	0.07	0.11	0.020

References

1. Dangerwala RT, Patel KP, Geeorge V, Patel KC, Ramani VP, Patel MS. Micronutrient and sulphur Research in Gujarat. Bulletin, Gujarat Agricultural University, Anand, 1994.
2. Dwivedi SK, Singh RS, Dwivedi KN. Effect of sulphur and zinc nutrition on yield and quality of maize in Typic Ustochrept soil of Kanpur. Journal of Indian Society of Soil Science. 2002; 50(1):70-74.
3. Faujdar RS, Sharma M, Solanki RL, Dangi RC. Effect of FYM, biofertilizers and zinc on yield and micronutrients uptake in maize. An Asian Journal of Soil Science. 2014; 9(1):121-125.
4. Havlin JL, Tisdale SL, Nelson WL, Beaton JD. In: Soil fertility and fertilizers: An introduction to nutrient management (8th ed.), PHI Learning Pvt. Ltd., Delhi, 2014, 261-300.
5. Jain NK, Dahama AK. Direct and residual effects of phosphoorus and zinc fertilization on productivity of wheat (Triticum aestivum)-pearlmillet (Pennisetumglaucum) cropping system. Indian Journal of Agronomy. 2005; 51(3):165-169.
6. Kaihura BS, Kullaya IK, Kilasara M, Aune JB, Singh BR, Lal R. Soil quality effects of accelerated erosion and management systems in three eco-regions of Tanzania. Soil Tillage Research, 1999; 53:59-70.
7. Karak T, Das DK, Debtanumaiti. Yield and Zn uptake in rice (Oryza sativa L.) as influenced by sources and times of Zn application. Indian Journal of Agricultural Science, 2006; 76(6):346-348.
8. Meena SK, Mundra SL, Singh P. Responce of maize (Zea mays) to nitrogen and zinc fertilization. Indian Journal of Agronomy, 2013; 58(1):127-128.
9. Mengel K, Kirkby EA. Principles of plant nutrition, book published by Panima Publishing Corporation, New Delhi/Bangalore. 1996, 427-446.
10. Nawab K, Shah P, Arif M, Khan M, Ali K. Effect of cropping patterns, FYM, K and Zn of wheat growth and grain yield. Sarhad Journal of Agriculture, 2011; 27(3):371-375.
11. Patel PC, Patel JC. Growth response, content and uptake of nutrients by different forage sorghum varieties (Sorghum bicolor (L.) Moench) as influenced by nitrogen and zinc fertilization. Gujarat Agricultural University, Research Journal. 1994; 19(2):9-14.
12. Shukla Hanshraj VC, Singh K. Effect of FYM and wheat straw on the response of maize to zinc-deficient soil. Indian Journal of Agriculture Science. 1978; 48:483-486.
13. Steel GD, Torrie JH. Principles and procedures of statistics. McGraw Hill Book Co. Inc. New York, 1982.
14. Totawat KL, Jangir RK, Nagar GL, Jat SL. Effect of flyash on the performance of wheat on Ustochrepts of sub – humid plains of India. 17th WCSS, 14-21 August 2002, Thailand, 2001.
15. Veeranagappa P, Prakash HC, Basavaraja MK, Mohamed SH. Effect of Zn enriched compost on yield and nutrient uptake of rice (Oryza sativa L.). European Journal of Biological Sciences, 2010; 3(1):23-29.
16. Walia SS, Kler DS. Effect of organic and inorganic source e of nutrition on growth, macro and micro nutrient uptake in maize under maize – wheat sequence. Indian Journal of Ecology. 2010; 12(2):212-214.