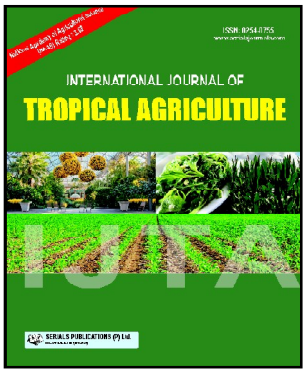

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Influence of High-P-Chelated Micronutrients on Nutrient Uptake of Chickpea Under Vertisols

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Abstract: Experiment was conducted to "study the influence of high-P-chelated micronutrient on nutrient uptake pattern of chickpea". The experiment was conducted on experimental farm of Department of soil science and Agricultural Chemistry Vansantrao Naik Marathawada Krishi Vidyapeeth, Parbhani, during $2009^{-1}0$ and $2010^{-1}1$. The application of RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS showed marginally higher increase in available N, P and K in soil throughout the growing period of the crop. The maximum availability of micronutrients (Zn, Fe, Mn and Cu) was observed with RDF + Grade 2@ 5 g/L (3 sprays) at 30, 45 and 60 DAS and RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS. The higher N, P, and K concentration in plant were recorded with treatments receiving RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS. Micronutrients concentration in plant was observed maximum with treatment RDF + Grade 2@ 5 g/L (3 sprays) at 30, 45 and 60 DAS. The highest uptake of N, P, K was noticed in RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS and higher uptake of micronutrients (Zn , Fe, Mn,and Cu) was noticed in RDF + Grade 2@ 5 g/L (3 sprays) at 30, 45 and 60 DAS.

Key words: Nutrient uptake, chickpea, high-P-chelated micronutrient, vertisols.

INTRODUCTION

Chickpea is one of the major *rabi* pulse crop which has high digestible dietary protein (17.21%) and carbohydrate (55%). It is also a good source of calcium, iron and vital Vitamin like A, B1, B2, B3, C, D, E and K. The leaves of chickpea contain malic acid which is very useful for stomach ailments and blood purification. In addition to, rich source of

protein, it also maintain soil fertility through biological nitrogen fixation and thus play a vital role in sustaining agriculture. The phosphorus content in most Indian soil are low. Motsara (2002) reported that 60 per cent soils are low to medium in soil available P content. Consequently, large amounts of phosphatic fertilizers are needed to achieve reasonable crop yield.

Foliar fertilization is the most efficient way to increase yield and research finding revealed that, foliar feeding can increase the yield from 12 to 25 per cent when compared to conventional fertilization. Pandragni *et al.* (1991) conducted field experiment to study the response of green gram to soil and foliar application of phosphatic fertilizers. It was observed that, the nutrient uptake of N (164.2 kg ha^{-1}), P (20.6 kg ha^{-1}) and K (89.8 kg ha^{-1}) was significantly higher with 40 kg P ha^{-1} (soil application) + 0.5 per cent P (foliar) applied through SSP. Foliar feeding is a technique of feeding plants by applying liquid fertilizer directly to their leaves. For intensive high yield and quality crop production, the best ever answer to this challenge is "Foliar spray nutrition", where soluble fertilizers are delivered to crop through foliar spray feeding system and thus ensure plant nutrients such as N, P, K and micronutrients are directed to the plant through foliage in well proportion. It is a well-established tool to supplement and to enrich plant nutrition. Hence this experiment is carried out to find the influence of high-P-chelated micronutrient on nutrient uptake pattern of chickpea under Vertisols.

MATERIALS AND METHODS

1. Site and Location

The experiment was conducted at Departmental Research Farm of Soil Science and Agricultural Chemistry, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani.

Geographically, Parbhani district is situated in the Godawari drainage basin in the central part of the India between 76°46′ East longitude and 19°16′ North latitude having elevation of 410 m above the mean sea level in Marathwada division of Maharashtra state. The region has a semi-arid climate. It is under assured monsoon rainfall agro climatic zone with an average annual precipitation of 918 mm. The major portion of precipitation (75 per cent) being received through South-West monsoon from June to September. The mean maximum temperature varies from 26.9°C in winter to 42.4°C in summer and the mean minimum temperature varies from 5.8°C to 25.6°C. The climate is suitable for *rabi* crop like chickpea, sorghum and safflower. The soils of the region are medium (Inceptisol) to deep black (Vertisol).

2. Field Experimental Details

After completion of preparatory tillage operations, the experiment was laid out in Randomized Block Design comprising eight (8) treatments replicated three times (Table 3). Recommended dose of fertilizer was applied to the crop (25:50:00 kg NPK ha^{-1}).

Details of experiment

1.	Year of experiment	:	2013
2.	Season of experiment	:	*Rabi*
3.	Crop	:	Chickpea
4.	Variety	:	Akash
5.	Design of experiment	:	Randomized block design
6.	Number of treatment	:	Eight
7.	Number of replication	:	Three
8.	Plot size	:	4.5 × 3.6 m^2
9.	Spacing	:	45 × 10 cm^2
10.	Method of sowing	:	Line sowing
11.	RDF	:	25:50:00 kg NPK ha^{-1}

12.	Date of sowing	: 9 November, 2012
13.	Date of harvesting	: 2nd March, 2013
14.	Plant protection measures	: As per recommendations

3. Treatment Details

Eight treatments were formulated to evaluate the "Studies on influence of high-P chelated micronutrient foliar spray on growth, yield and uptake of chickpea". The details of the treatment are as follows. The foliar sprays were taken up at 30, 45 and 60 days after sowing.

Treatment details

T1 Absolute Control (No Fertilizers)

T2 Only RDF through soil (25:50:0 NPK kg/ha)

T3 RDF + water spray

T4 RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS

T5 RDF + Mangala 3X@4 ml/L (2 sprays) at 30 and 45 DAS

T6 RDF + Mangala 3X@3 ml/L (3 sprays) at 30,45 and 60 DAS

T7 RDF + Mangala 3X@4 ml/L (3 sprays) at 30,45 and 60 DAS

T8 RDF + Grade 2@ 5 g/L (3 sprays) at 30,45 and 60 DAS

Where, RDF = 25:50:00 NPK kg/ha, Grade 2 = Multimicronutrient notified grade for foliar application (Zn-3%, Fe-2.5%, Mn^{-1}%, Cu^{-1}%, B-0.5%, Mo-0.1%)

4. Fertilizer Application

The recommended dose of fertilizer was (25:50:00 kg NPK ha^{-1}) was applied to seven treatments in experimental period. The nitrogen and phosphorus were applied through urea (46 per cent N), and single super phosphate (16 per cent P_2O_5), respectively. Entire dose of nitrogen and phosphorus was applied at the time of sowing. Mangala and grade II were applied to the crop at 30, 45 and 60 days after sowing.

5. Uptake of Nutrients

Nutrient uptake *i.e.* uptake of N, P, K, S, Fe, Zn, Cu, Mn was calculated by considering grain and dry matter yield at harvest in relation to concentration of the particular nutrient in respective plot using the formula.

$$\text{Uptake (kg ha}^{-1}) = \text{Nutrient content (\%)} \times \text{(Grain/dry matter yield (kg ha}^{-1})$$

RESULTS AND DISCUSSION

Nutrient uptake as influenced by different macro and micronutrient foliar application under rainfed condition have been studied and these finding are presented and discussed briefly under the following heads.

1. Effect of foliar application of high phosphorus chelated micronutrient on uptake of N, P, K and S in plant and grain of chickpea at harvest stage.
2. Effect of foliar application of high phosphorus chelated micronutrient on uptake of Cu, Fe, Mn and Zn in plant and grain of chickpea at harvest stage.

Effect of Foliar Application of High Phosphorus Chelated Micronutrient on Uptake of N, P, K and S in Plant and Grain of Chickpea at Harvest Stage

N Uptake

The data showed in Table 1 indicated plant uptake of N varied in the range from 53.23 to 87.51 kg ha^{-1}, 52.92 to 85.10 kg ha^{-1}, and 49.65 to 82.56 kg ha^{-1} at flowering, pod development and at harvest stage, respectively. Scrutiny of the data revealed that, the nitrogen uptake by chickpea was relatively higher due to foliar application of high P chelated micronutrient.

The maximum uptake of nitrogen was recorded in treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) which were at par with treatment T7 (RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS). The minimum uptake was seen in treatment T1 (Control) Similar type of results was observed by Hanan *et al.*, (2012) and El-Fouly *et al.* (2012) concluded that, the treatment of NPK based on soil testing plus foliar application of micronutrients resulted in improving nutrient concentration in maize leaves. This might be due to increasing plant physiological processes which led to more nutrient absorbance by the plant.

P uptake

The data presented on Table 1 revealed that, the phosphorus uptake by chickpea as affected by foliar spray high P chelated micronutrient and showed that, the uptake of phosphorus was significantly increased over control. The phosphorus uptake in plant varied in the range of 11.06 to 18.98 kg ha^{-1}, 09.89 to 17.21 kg ha^{-1}, 08.33 to 13.56 kg ha^{-1} at flowering, pod development and at harvest stage respectively and in grain it was ranged between 13.92 to 25.82 kg ha^{-1}. The maximum uptake of phosphorus was recorded in treatment T4 (RDF + Mangala 3X-3 ml/L (2 sprays) at 30 and 45 DAS) followed by T7 (RDF + Mangala 3X-4 ml/L (3 sprays) at 30, 45 and 60 DAS), which were at par with each other and significantly superior over all other treatments at flowering, pod development and at harvest stage respectively. The minimum uptake of phosphorus was observed in treatment T1 (Control). The results are in conformity with the finding of Yuncai *et al.*, (2008) they reported the foliar fertilization increased uptake of K, Ca, Mg and P elements, which may be attributed to decreased transpiration.

K uptake

The data represent Table 1 on potassium uptake by chickpea are affected by the application of different high P chelated micronutrient foliar spray and noticed that, the uptake of potassium was significantly increased in treatment T4 (RDF + Mangala 3X-3 ml/L (2 sprays) at 30 and 45 DAS. The potassium uptake in grain ranged between 8.64 to 22.40 kg ha^{-1} and in plant it ranged from 23.76 to 51.75 kg ha^{-1}, 23.31 to 49.21 kg ha^{-1} and 22.09 to 22.40 kg ha^{-1} at flowering, pod development and at harvest stage respectively and in grain it was ranged from 8.64 to 22.40 kg ha^{-1}. The maximum uptake of potassium was recorded in treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) followed by treatment T7 (RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS) and were at par with each other at flowering stage and significantly superior over all other treatments. The minimum uptake of potassium was observed in treatment T1 (control). The similar findings were also reported by Khan *et al.* (2010). The integrated application of N, P and K in wheat recorded highest uptake of these elements in straw and grain.

S uptake

The data represent Table 1 regarding uptake of sulphur as influenced by foliar application of high P chelated micronutrient. The total uptake of sulphur varied in the range from 11.99 to 20.51, 9.45 to 19.19 and 8.91 to 15.55 kg ha^{-1} at flowering, pod development and at harvest stage respectively in plant and in grain 26.70 to 46.75 kg ha^{-1} in treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) followed by treatment T7 (RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS) which were at par with each other and significantly superior over all other treatments. The minimum uptake of sulphur was noticed in treatment T1 *i.e.* control. The timely foliar application of nutrients coincides with the flowering and seed setting of the crop, when nutrient requirement of the crop is higher. This might be the reason for higher uptake of nutrients. Similar results were also recorded by Pandrangi *et al* (1991).

Table 1
Effect of foliar application of high phosphorus chelated micronutrient on uptake of Nutrients (kg ha^{-1}) in plant and grain of chickpea at harvest stage

		N Uptake		*P Uptake*		*K Uptake*		*S Uptake*	
Tr. No.	*Treatment*	*Plant*	*Grain*	*Plant*	*Grain*	*Plant*	*Grain*	*Plant*	*Grain*
T1	Control	49.65	44.08	08.33	13.92	22.09	8.64	8.91	26.70
T2	Only RDF through soil (25:50:0 NPK kg/ha)	55.35	46.01	09.43	14.35	28.14	9.85	9.39	33.53
T3	RDF + water spray	63.45	53.07	10.39	16.72	34.80	12.77	11.31	36.16
T4	RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS	82.56	74.97	13.56	25.82	44.25	22.40	15.55	46.75
T5	RDF + Mangala 3X@4 ml/L (2 sprays) at 30 and 45 DAS	72.32	65.31	11.77	18.66	35.47	16.06	12.25	41.02
T6	RDF + Mangala 3X@3 ml/L (3 sprays) at 30, 45 and 60 DAS	75.97	66.07	12.03	22.25	40.29	19.78	14.40	43.58
T7	RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS	79.99	72.06	12.62	23.59	41.37	20.36	14.94	44.60
T8	RDF + Grade 2@5 g/L (3 sprays) at 30, 45 and 60 DAS	70.71	61.54	10.80	17.92	35.55	15.83	14.05	39.26
	SE(m) ±	1.13	2.90	0.28	0.35	0.57	0.37	0.48	0.67
	CD (0.05)	3.42	9.60	0.86	1.07	1.73	1.12	1.46	2.05

Effect of foliar application of high phosphorus chelated micronutrient on uptake of Cu, Fe, Mn and Zn in plant and grain of chickpea at harvest stage.

Cu uptake

The data represented in table 2 on uptake of Cu varied from 61.24 to 76.54 g ha^{-1} at harvest stage in plant and in grain it was ranged between 14.12 to 22.24 g ha^{-1} The maximum uptake of Cu was recorded in treatment T8 (RDF +Grade 2@5 g/L (3 sprays) at 30, 45 and 60 DAS) and treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) was at par with T8 and significantly superior over all other treatments. The minimum cu uptake was recorded in treatment T1. The micronutrient uptake was lower in treatments supplied with only RDF. Foliar application of these nutrients can increase macro and micronutrient balance in grain and straw as reported by Shaaban (2001) and Aref (2012).

Fe uptake

The results obtained from table 2 indicated that, the Fe uptake was influenced by foliar application to high P chelated micronutrient which was varied from 122.63 to 152.86 g ha^{-1}, 121.77 to 144.53 g ha^{-1} and 121.43 to 137.51 g ha^{-1} at flowering, pod development and at harvest stage in plant respectively and in grain it was ranged between 86.94 to 121.23 g ha^{-1}. The maximum uptake of Fe was recorded in treatment T8 (RDF + Grade 2@5 gm/L (3 sprays) at 30, 45 and 60 DAS) and was at par with treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) and significantly superior over all other treatments. The minimum uptake of Fe in plant was recorded in treatment T1 (Control). Similar results was obtained by Yassen *et al.* (2010) and reported that, the efficiency of foliar feeding is suitable for the supply of required nutrient which goes directly to the location of the high demand in leaves and its relatively quick absorption shows positive systems in plants.

Table 2
Effect of foliar application of high phosphorus chelated micronutrient on uptake of Micronutrients (g ha^{-1}) in plant and grain of chickpea at harvest stage

		Cu Uptake		*Fe Uptake*		*Mn Uptake*		*Zn Uptake*	
Tr. No.	*Treatment*	*Plant*	*Grain*	*Plant*	*Grain*	*Plant*	*Grain*	*Plant*	*Grain*
T1	Control	61.24	14.12	121.43	86.94	145.93	82.35	129.23	93.60
T2	Only RDF through soil (25:50:0 NPK kg/ha)	61.85	15.80	124.15	97.04	147.99	85.31	134.37	106.96
T3	RDF + water spray	62.16	16.34	126.53	106.82	156.73	95.68	133.25	119.03
T4	RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS	75.88	21.20	136.48	120.65	166.40	121.71	141.66	126.12
T5	RDF + Mangala 3X@4 ml/L (2 sprays) at 30 and 45 DAS	64.63	18.24	130.84	114.07	159.61	116.28	137.81	122.41
T6	RDF + Mangala 3X@3 ml/L (3 sprays) at 30, 45 and 60 DAS	71.60	19.12	133.20	113.68	163.05	118.95	138.24	123.64
T7	RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS	72.32	21.93	135.04	119.75	164.62	119.48	140.65	124.52
T8	RDF + Grade 2@5 g/L (3 sprays) at 30, 45 and 60 DAS	76.54	22.25	137.21	121.23	167.44	122.62	142.87	127.07
	SE(m) ±	2.52	4.12	2.52	2.12	3.26	3.58	4.02	3.35
	CD (0.05)	7.53	12.67	7.59	6.43	9.89	10.80	12.18	10.17

Mn uptake

The data presented in table 2 indicated that, the Mn uptake was influenced by high P chelated micronutrient spray and it was varied from 151.30 to 178.92 g ha^{-1}, 150.94 to 176.98 g ha^{-1}and 145.93 to 167.44 g ha^{-1} at flowering, pod development and at harvest stage in plant respectively and in grain it was ranged between 82.35 to 122.62 g ha^{-1}. The maximum uptake of Mn was recorded in treatment T8 (RDF + Grade 2@5 g/L (3 sprays) at 30 , 45 and 60 DAS) followed by T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS), T7 (RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS) followed by T6 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30, 45 and 60 DAS) and T4 and at par with T8 at flowering stage in plant. The minimum uptake of Mn was noticed in treatment T1 (Control). Foliar application of Fe, Mn, and Zn significantly increased plant height and nutrients uptake of maize as reported by Hanan *et al.* (2012).

Zn uptake

The data presented in table 2 indicated that, the uptake of Zn varied from 132.51 to 145.27 g ha^{-1}, 130.02 to 144.12 g ha^{-1} and 129.23 to 142.87 g ha^{-1} at flowering, pod development and at harvest stage in plant respectively. In grain, it was ranged from 93.60 to 127.07 g ha^{-1}. The maximum uptake of Zn was recorded in treatment T8 (RDF + Grade 2@ 5 g/L (3 sprays) at 30, 45 and 60 DAS) followed by T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) which were at par with each other and significantly superior over rest of the treatment in both grain and plant. The lowest uptake was recorded in treatment T1 (control). Increased uptake of micronutrients was due to foliar application of same nutrient possibly due to nutrients applied through foliage would have easily absorbed and translocated in plant without any loss. Similar results were reported by Patel *et al.* (2009).

CONCLUSIONS

The N, P, K and S uptake in straw and grain significantly increased with the application of RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS. While, micronutrient uptake in straw and grain significantly increased with the application of RDF + Grade 2@5 g/L (3 sprays) at 30, 45 and 60 DAS which was followed by treatment receiving RDF + Mangala 3X@4ml/L (3 sprays) at 30, 45 and 60 DAS.

REFERENCES

Aref Farshid (2012), Manganese, iron and copper contents in leaves of maize plants (*Zea mays* L.) grown with different boron and zinc micro nutrients. *African J. of Biotechnology*, **11**(4): 896-903.

El-Fouly, M.M., El-Nour, Abou. E.A.A, Shaaban S.H.A., Zeidan, M.S. (2012), Effect of different levels of NPK and micronutrients fertilizer on yield and nutrient uptake of maize plants. *Afr. J. Plant Sci.*, **5**(5): 209-213 http://www.americanscience.org.

Hanan, Siam, S., Mona, G., El-Kader Abd El-Fattah Abd M.S. (2012), Effect of ammonia gas and some micronutrients on maize plants (*Zea mays*) I-Plant growth and mineral uptake. *Aus. J. Basic Applied Sci.* **6**(3): 462-473.

Khan, M.B., Farooq, M., Hussain, M., Shahnawaz and Ghulam Shabir (2010), Foliar application of micronutrients improves wheat yield and net return. *International J. Agri. & Bio.*, **12**(6): 953-956.

Palaniappan, S.P., Jeyabal, A. and Chellian, S. (1999), Response of tomato and chilli to foliar application of specialist fertilizers. *Veg. Sci.*, **26**(2): 198-200.

Pandrangi, R.B., Wankhede, S.G. Nasre, R.A. (1991), Response of mung to soil of foliar application of phosphoric fertilizer. *Legume Res.*, **14**(4): 187-188.

Patel, K.P., Patel, G.J. Patel, K.C. and Ramani, V.P. (2009), Effect of multi-micronutrient application on yield and their uptake by maize (*Zea mays* L.) of middle Gujarat region. *Indian J. Dryland Agric. Res. and Dev.* **24**(1): 45-51.

Shaaban, M.M. (2001), Effect of trace-nutrient foliar fertilizer on nutrient balance, growth, yield and yield components of two cereal crops. *Pak. J. Bio Sci.*, **4**(7): 770-774.

Yucani, H.U., Zoltan B., Schmidhalter U. (2008), Effect of foliar fertilization application on the growth and mineral nutrient content of maize seedlings under drought and salinity. *Soil Sci. and Plant Nutrition*. **54**: 133-141.