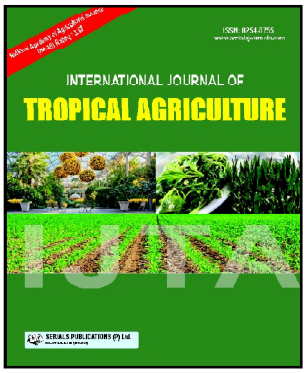

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Effect of High-P-Chelated Micronutrient Foliar Spray on Yield and Quality of Chickpea

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Abstract: Chickpea is an important pulse crop and has considerable potential to increase its yield by nutrient management. For this, a field experiment was conducted to find out influence of high P chelated micronutrient foliar spray on yield and quality of chickpea" The experiment was laid out in Randomised Block Design with 8 treatments and replicated thrice in Vertisols. The soil of experimental plot was clayey in texture, low in organic carbon, calcareous in nature, alkaline in reaction, low in available N and P and medium in Fe and high in K, Zn and Cu. The application of RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS showed maximum height, number of leaves and number of pods per plant. Similarly, higher grain and dry matter yield was achieved with the application of RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS. The quality parameters *viz.* protein content and test weight were found higher in same treatment.

Key words: Chickpea, High-P-Chelated Micronutrient, Foliar Spray , Yield and Quality.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the premier pulse crop of Indian subcontinent as it occupies third largest position in most important pulse crop in the world after dry bean. India is the larger chickpea producer as well as consumer in the world. The major chickpea growing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka and Andhra Pradesh which contribute 90 per cent area and 91 per cent production of the country. The macro and micronutrients play decisive an important role for higher yield. The continuous use of high analysis chemical fertilizers leads to micronutrient deficiency in soil. Among the micronutrients, deficiency of Zn

and Fe is wide spread in India and these soils are generally deficient in macronutrients like nitrogen and phosphorus. But deficiency in plants can be recovered by applying such macro and micronutrient to plant through foliar spray. Micronutrients not only increase crop yield but also crude protein, amino acids, energy value and total lipid content in chickpea, soybean, black gram etc. 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. The productivity of pulse crop is often constrained by imbalanced and insufficient supply of nutrients to plant. To mitigate this situation, it is worthwhile to adopt the use of speciality fertilizer in precise amount for enhancing the crop productivity.

Now a day, high-P chelated micronutrients are introduced for plant nutrition through fertigation and foliar application. These fertilizers are available in different ratio, which are highly soluble in water and with little or no visible residue at harvest. Foliar feeding is a technique of feeding plants by applying liquid fertilizer directly to their leaves. Therefore the present investigation was undertaken to find out the influence of high-P chelated micronutrients on yield and quality of chickpea.

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 m2
9.	Spacing	:	45 × 10 cm2
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 micro-nutrient 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.

Table 1
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. Yield of Chickpea

Chickpea yield was recorded from each net plot and converted into hectare basis.

6. Dry Matter Yield

The weight of dry matter accumulated in plant is an index of plant growth. The plant uprooted for dry matter study, excluding root system were air dried under sun for eight days and subsequently dried in the thermostatic oven at 64°C till they were completely dried. The final constant dry weight was recorded as total dry matter accumulation per plant and per hectare yield was calculated.

7. Quality Parameters

(a) Test weight

The weight of 100 seeds of chickpea from each net plot was recorded and designated as test weight of chickpea.

(b) Protein content

It was multiplying the per cent of N in grain sample by constant factor 6.25 as described by A.O.A.C. (1975).

RESULTS AND DISCUSSION

The various aspects of chickpea such as growth, yield, and quality as influenced by different macro and micronutrient foliar application under rainfed condition have been studied and discussed under following heads.

1. Effect of foliar application of high phosphorus chelated micronutrient on number of pods per plant, grain and dry matter yield of chickpea.
2. Effect of foliar application of high phosphorus chelated micronutrient on quality parameters of chickpea.

Soil Nutrient Status of Experimental Soil

The soil analysis was carried out before the establishment of chickpea field experiment during

the experimental year 2013. The experimental soil was fine, smectitic (calcarious), isohyperthermic Typic Haplusters. It was slightly alkaline in reaction (7.83), safe in soluble salt concentration (EC 0.52 dSm^{-1}) and medium in organic carbon content (4.35 g kg^{-1}) for chickpea crop grown during the year 2013. The Free calcium carbonate was (57.00 g kg^{-1}).

The nutrient status of experimental soil before sowing chickpea was as the available N, P, K is 187.80, 12.34 and 756.90 kg ha^{-1} respectively. The available S was 19.67 mg kg^{-1} and micronutrient status was Zn (0.72 ppm), Fe (0.96 ppm), Mn (2.4 ppm) and Cu (2.2 ppm).

No of Pods, Grain and Dry Matter Yield of Chickpea

1. No of Pods

The number of pods at pod development and harvesting stage were influenced significantly due to treatments administrated. The highest number of pods was observed in treatments T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) which was at par with treatment T7 (RDF + Mangala 3X@4 ml/L (2 sprays) at 30, 45 and 60 DAS) followed by T6 and T5. This might be due to the favorable influence of optimum potash application on metabolism and biological activity and its stimulatory effect on growth of plant. Similar findings were also observed by Talooth *et al. (2006) and* Venkatesh and Basu (2011).

2. Grain yield

Data presented in Table 7 and Figure 4 indicated that, the influence of high phosphorus chelated micronutrient foliar application on grain yield of chickpea was in the range of 11.45 to 14.89 q ha^{-1} and highest grain yield was recorded in treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) which was at par with treatment T7 (RDF + Mangala 3X@4 ml/L (2 sprays) at 30, 45 and 60 DAS), and followed by T6 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30, 45 and 60 DAS) and T5 (RDF + Mangala 3X@4 ml/L (2 sprays) at 30 and 45 DAS). The lowest grain yield was observed in (Control). The increased in grain per yield is a direct result of improvement in yield components, *i.e.* grain size, number of grains per pod and test weight. The quality parameter had positive correlation with grain yield and this might be due to added major nutrient such as N and P thereby improved in yield. Narayanamma *et al.* (2006) also reported that in Brinjal crop by using water soluble fertilizers containing NPK 15:15:30.

3. Dry Matter Yield

The data reported in table 7 and Figure 5 indicated that, the dry matter yield varied from of 19.22 to 33.11(q ha^{-1}). The highest dry matter yield was observed in the treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) which was followed by treatment T7 (RDF + Mangala 3X@4 ml/L (2 sprays) at 30, 45 and 60 DAS), T6 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30, 45 and 60 DAS) and lowestdry matter yield was recorded in the (Control). These findings might be due to involvement of nutrients in variety of physiological and biochemical processes, culminating in more dry matter production. More than one foliar spray of different nutrients mixture at various growth stages improved straw yield. Foliar application of macro and micronutrient increased biological yield as reported earlier by Piri Issa *et al.*, (2012).

Effect of Foliar Application of High Phosphorus Chelated Micronutrient on Quality Parameters of Chickpea

1. Test weight

Data furnished in table 8 and Figure 6 indicated that, the test weight (g 100 $seeds^{-1}$) was in the range of 22.93 to 29.05 g and highest test weight was observed in treatment T4 (RDF + Mangala 3X@3 ml/L

Table 2
Effect of foliar application of high phosphorus chelated micronutrient on No of pods per plant, grain and dry matter yield (q ha^{-1}) of chickpea

Treat	*TreatmentDetails*	*No of Pods/plant*	*Grainyield (q ha^{-1})*	*Dry matteryield (q ha^{-1})*
T1	Control	48.27	11.45	19.22
T2	Only RDF through soil (25:50:0 NPK kg/ha)	57.27	12.16	23.45
T3	RDF + water spray	59.20	13.19	27.59
T4	RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS	69.32	14.89	33.11
T5	RDF + Mangala 3X@4 ml/L (2 sprays) at 30 and 45 DAS	64.70	13.66	27.87
T6	RDF + Mangala 3X@3 ml/L (3 sprays) at 30, 45 and 60 DAS	65.97	14.41	32.26
T7	RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS	67.30	13.60	31.82
T8	RDF + Grade 2@5 gm/L (3 sprays) at 30, 45 and 60 DAS	62.83	13.29	28.29
	SE(m) ±	0.61	0.32	0.27
	CD (0.05)	1.85	0.98	0.84

(2 sprays) at 30 and 45 DAS) which was at par with treatment T5 (RDF + Mangala 3X@4 ml/L (2 sprays) at 30 and 45 DAS) and closely followed by treatment T7 (RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS) and T6 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30, 45 and 60 DAS). The minimum test weight was observed in the Nitrogen helps in transport system of photosynthesis to seed. This may be the reason for increased in test weight of chickpea. Setty *et al.* (1992) and Choudhary and Yadav (2011) reported similar type of observations.

2. Protein content

The data presented in Table 3 depicted the protein content in grain of chickpea, which was in the range of 17.80 to 22.37 per cent and maximum protein content was observed in treatment T4 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS) which at par with treatment T7 (RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS) and significantly superior over all other treatment. The next best treatment for higher protein content was T6 (RDF + Mangala 3X@3 ml/L (2 sprays) at 30, 45 and 60 DAS) and T5 (RDF + Mangala 3X@ 4 ml/L (2 sprays) at 30,and 45 DAS) and minimum protein content was noticed in treatment T1(Control). Increase in protein content may be attributed to most important role of nitrogen in plant

Table 3
Effect of foliar application of high phosphorus chelated micronutrient on quality parameters of chickpea

Tr. No.	*Treatment Details*	*Test weight (gm 100 seeds^{-1})*	*Protein (%)*
T1	Control	22.93	17.80
T2	Only RDF through soil (25:50:0 NPK kg/ha)	23.27	17.97
T3	RDF + water spray	25.56	18.63
T4	RDF + Mangala 3X@3 ml/L (2 sprays) at 30 and 45 DAS	29.05	22.37
T5	RDF + Mangala 3X@4 ml/L (2 sprays) at 30, and 45 DAS	27.17	19.20
T6	RDF + Mangala 3X@3 ml/L (3 sprays) at 30, 45 and 60 DAS	26.40	20.41
T7	RDF + Mangala 3X@4 ml/L (3 sprays) at 30, 45 and 60 DAS	27.71	21.03
T8	RDF + Grade 2@5 g/L (3 sprays) at 30, 45 and 60 DAS	24.60	19.17
	SE(m) ±	0.49	0.38
	CD (0.05)	1.50	1.15

mainly its presence in the nucleic acid in protein structure. In addition, nitrogen is also beneficial in chlorophyll molecule. Chlorophyll enables plant to transfer energy from sunlight by photosynthesis to assimilate (chemical energy form). Therefore, the nitrogen supply to the plant will influence the amount of protein. These results are in agreement with the findings of Cirak *et al.* (2006).

CONCLUSION

From this investigation it is concluded that application of RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS gives significantly highestnumber of pods per plant grain and dry matter yield of chickpea. Quality parameter of chickpea *viz.* test weight and protein content of grain increased significantly due to application of RDF + Mangala 3X@3ml/L (2 sprays) at 30 and 45 DAS followed by treatment receiving RDF + Mangala 3X@4ml/L (3 sprays) at 30, 45 and 60 DAS.

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