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Impact of Foliar Application of Specialty Fertilizer on Growth, Yield, Quality and Macro and Micro Nutrient Uptake of Chickpea

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A B S T R A C T

A field experiment was conducted during *Rabi* 2010-11 on the Research Farm of Soil Science and Agricultural Chemistry department at MKV, Parbhani to study the effect of speciality fertilizers on chickpea (cv. Vijay) production. The treatments comprised of basal NPK soil application dose @25:50:00 kg ha^{-1} and foliar applications of starter (11:36:24 NPK), Booster (08:16:39 NPK) and multi micronutrient notified grade- II (Zn-3%, Fe-2.5%, Mn-1%, Cu-1%, B-0.5%, Mo-0.1%). The experiment was conducted in a randomized block design. There were total six treatments viz; T_1- Only RDF through soil (25:50:0 NPK kg/ha), T_2-RDF + water spray (4 sprays), T_3 - RDF + 1% Starter (2 sprays) and 1% Booster (2 sprays), T_4- RDF + 1.5% Starter (2 sprays) and 1.5% Booster (2 sprays), T_5- RDF + 2% Starter (2 sprays) and 2% Booster (2 sprays), T_6- RDF + 1% MS Govt. Notified multi-micronutrient grade II (4sprays). Among the treatments, the treatment T_4 (RDF + 1.5% starter and 1.5% booster -2 spray each) showed maximum growth in case of plant height which was increased from 28.70 to 36.34 cm, the number of branches $plant^{-1}$ was increased from 18.95 to 25.67, number pods $plant^{-1}$ was increased from 42.24 to 68.45. Also, yield attributes like grain yield increased from 10.35 to 14.74 q ha^{-1} in treatment T_4. In the case of quality parameters, test weight was increased from 13.67 to 17.57 gm and protein content from 17.2 to 20.0 percent in treatment T_4. These results of T_4 treatment were followed by treatment T_5 and treatment T_6. Thus the treatment of T_4 was found beneficial in the economics of speciality fertilizers by returning a maximum C: B ratio of 2.96. Hence, the application of speciality fertilizer may be beneficial in the production of chickpeas in rainfed conditions.

Introduction

Chickpea (*Cicer arietinum* L) is the premier pulse crop of the Indian subcontinent. India is the largest chickpea producer as well as consumer in the world. India grows chickpeas on about 6.67 million ha area producing 5.3 million tones which represent 30 percent and 38 percent of the national pulse acreage and production, respectively.

The area under chickpea production during 2008-09 was 8.26 million ha; total production was 6.2 million tones and productivity increased up to 751 kg ha^{-1}

Chickpea is one of the major Rabi pulse crops which have high digestible dietary protein (17.21 percent) and carbohydrates (55 percent). Chickpea is also rich in calcium and iron content, vital vitamins. Its leaves contain maleic acid. Being a rich source of protein pulses maintain soil fertility through biological nitrogen fixation.

It is universally accepted that the use of chemical fertilizers is an integral part of a package of practices for raising agricultural production to a higher place. Chemical fertilizers supply N, P, K, S, and micronutrients to plants for better growth and higher yield.

Among micronutrient deficiencies, Zn is widespread in India. Indian soils are generally deficient in micronutrients and also nitrogen and phosphorus. But deficiency can be met by applying deficient macro and micronutrients to plants.

Micronutrients besides increasing crop yield increase the crude protein content, amino acids, energy value, and total lipid in chickpea, soybean, black gram, etc.

Foliar fertilization is the most efficient way to increase yield and plant health. Tests have shown that foliar feeding can increase yield from 12 percent to 25 percent when compared to conventional fertilization. When fertilizers are applied through foliar, more than 90 percent of the fertilizers are utilized by the plant. When a similar amount is applied through the soil only 10 percent is utilized. Foliar feeding is an effective method for correcting soil deficiencies and overcoming the soil's inability to transfer nutrients to the plant under low moisture conditions.

Foliar fertilizers can be designed to meet a plant's specific needs for one or more micro and macronutrient especially trace minerals and enable you to correct deficiencies, strengthen weak or damaged crops, speed growth, and grow better plants, which is of course the bottom line.

Foliar application can be targeted to a particular stage of crop development to achieve a specific objective and is an excellent way to fine-tune a high fertility program.

The productivity of pulse crops is often constrained by an imbalanced and insufficient supply of nutrients to plants. In balanced proportion and uses of speciality fertilizers, appropriate quantities are essential for good productivity of the crop. Nowadays, speciality fertilizers are introduced for plant nutrition through fertigation and foliar application. They are water-soluble and specific/special for that crop. These fertilizers have different ratios of N, P, and K and are highly water soluble.

Foliar spray nutrition is important in specific cases, when the absorption of plant nutrients is disturbed by weed, poor aeration, low soil temperature, frequent rainfall, etc., when the root system suffers mechanical injuries or pest damage; it is helpful when prompt correction of nutrient deficiencies is required.

Therefore, the present investigation was undertaken with the objectives to determine the effect of speciality fertilizers on the growth, yield, and quality parameters of chickpea and work out the economics of speciality fertilizers usage for chickpea production.

Materials and Methods

This research study entitled "Effect of speciality fertilizers on growth, yield and quality of chickpea (*Cicer arietinum* L.)" was conducted during 2010-11 at Marathwada Krishi Vidyapeeth, at Departmental Research Farm of Soil Science and Agricultural Chemistry, Marathwada Krishi Vidyapeeth, Parbhani.

Geographically, Parbhani district is situated in the Godawari drainage basin in the central part of India between 76046' East longitude and 19016' North latitude having an elevation of 410 m above the mean sea level in the Marathwada division of Maharashtra state. The region has a semi-arid climate. The soils of the region are medium to a deep black (Inceptisol and or Vertisol).

Soil nutrient status of the experimental site

To determine the soil properties of experimental soil before sowing the surface (0-22.5 cm depth) soil samples were collected from randomly selected spots covering an experimental area. A composite soil sample was prepared and analyzed for its various Physico-chemical properties. The properties of experimental soil are given in Table 1.

Field experimental details

After completion of preparatory tillage operations, the experiment was laid out in Randomized Block Design comprising six (6) treatments replicated four (4) times in chickpea crops during the year 2010-11. The recommended dose of fertilizer was applied to the crop (25:50:00 kg NPK ha^{-1}).

Treatment details

Six treatments were formulated to evaluate the "Effect of speciality fertilizers on growth, yield and quality of chickpea" The details of the treatment are as follows. The foliar sprays were taken up at two critical growth stages of the chickpea crop viz., branching, flowering, and pod development stage.

Fertilizer application

The recommended dose of fertilizer was 25:50:00 kg NPK ha^{-1} applied for all six treatments in the experimental period. The nitrogen and phosphorus were applied through urea (46 percent N) and single super phosphate DAP (16 percent P_2O_5) respectively. An entire dose of nitrogen and phosphorus was applied at the time of sowing. Starter booster and grade II were applied to the crop at the 20, 40, 60, and 80 days after sowing.

Soil analysis

Initial and harvest soil samples were collected before sowing and at the harvest stage of the crop from the surface layer (15 cm) of each treated plot of the layout. Prepared for further analysis. These soil samples were subjected to various chemical estimations as per the methods given below.

Quality analysis

Test weight

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

Protein content

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

Uptake of nutrients

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

$$\text{Uptake (kg ha}^{-1}\text{)} = \frac{\text{Nutrient content (\%) x (Grain/dry matter yield (kg ha}^{-1}\text{)}}{100}$$

Results and Discussion

Effect of foliar application of speciality fertilizer on growth attributes

Plant height (cm)

The data presented in Table 5 revealed that the plant height was in the range of 28.70 to 36.34 cm and maximum plant height was observed in the treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) the increase in plant height may be attributed by increasing the N status in the plant system. Thus, the nitrogen-containing starter fertilizer dose applied through foliar spray has increased the height substantially compared to the soil application. A similar result was reported by Sritharan *et al.,* (2005) at Coimbatore in black gram crop with foliar application of 2% urea.

Number of branches per plant

The data on the mean number of branches per plant are presented in Table 5, which showed that the number of branches per plant was influenced by foliar spraying of speciality fertilizer.

Branches per plant the number were in the range of 18.95 to 25.67 and maximum branches per plant were observed in the treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each). The result was in conformation with the result reported by Chaurasia *et al.,* (2006) on the Tomato crop by using water-soluble fertilizers containing NPK (19:09:19) on sandy loam soil.

Number of pods per plant

Data in respect of a mean number of pods per plant presented in Table 5, the number of pods per plant, the pods were in the range of 42.24 to 68.45 and the maximum no. of pods per plant was observed in the T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each). A similar result was found by Venkatesh and Basu (2011) in Chickpea crops on Inceptisol by using 2% urea at 75 DAS.

Thus, all the growth parameters like plant height, number of branches per plant, and number of pods per plant have shown a similar trend of response for application of RDF + 1.5% starter and 1.5% booster (2sprays each). The enhanced growth parameters might be due to a balanced supply of nutrients at all the stages of crop growth and plant nutrients supplied through foliage might have been better used more efficiently by the plant.

Similar results were found by Krishnaveni *et al.,* (2004) in the Green gram crop by using DAP 2% + KCL 1% + $ZnSO_4$ 0.5% at 15, 30, and 45 DAS on clay loam soil.

Grain yield and dry matter yield of chickpea (q ha^{-1})

Grain yield (q ha^{-1})

Data presented in Table 6, shows the influence of speciality fertilizer on the grain yield of chickpea. The grain yield (qt ha^{-1}) was in the range of 10.35 to 14.74 qt ha^{-1}. The grain yield of chickpea was significantly higher (14.74 qt ha^{-1}) in the treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each). An increase in grain yield is the direct result of improvement in yield components. Grain size, number of grains per pod, and test weight had a positive correlation with grain yield and might be the direct effect of improvement in grain yield. Similar findings were reported by Palaniappan *et al.,* (1999) for Chilli and Tomato crops by using a foliar application of speciality fertilizers (100% NK + 2sprays of poly feed + 3 sprays of Multi –K) in Andhra Pradesh and Narayanamma *et al.,* (2006) in Brinjal crop by using water-soluble fertilizers containing NPK 15:15:30.

Dry matter yield (q ha^{-1})

The dry matter yield (q ha^{-1}) was in the range of 18.72 to 31.14 and maximum dry matter yield was observed in the treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) These findings might be due to the involvement of nutrients in a

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. The result was in conformation with Gupta *et al.,* (2010) in Green gram crop by using 2% urea through a foliar application on sandy loam soil.

Test weight (gm)

Data presented in Table 7 indicated that the test weight (gm per 100 seeds) was in the range of 13.67 to 17.57 and maximum test weight was observed in the treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each). Nitrogen helps in the transport of photosynthates to seed. This may be the reason for the increased 100 seed weight. Similar results were found by Setty *et al.,* (1992) in the Chickpea crop by using 0.5% DAP during *the Rabi* season and Choudhary and Yadav (2011) in the Cowpea crop by using 2% DAP spray.

Protein content (%)

The data on the influence of speciality fertilizers on protein content in grain is presented in Table 7. The protein content in grain was significantly higher in treatment T_4 (20.0 %) over T_1 (17.4 %) and T_2 (17.2 %). An increase in protein content may be due to the most important role of nitrogen fertilizer in a plant is mainly in its presence in the nucleic acid protein structure.

In addition, nitrogen is also found in the chlorophyll molecule. Chlorophyll enables a 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 those obtained by Cirak *et al.,* (2006) in Soybean crops by using a foliar application of boron @ 1.5 kg ha^{-1} on clay loam soil and Yassen *et al.,* (2010) in the Wheat crop by using 1% urea +Fe+Mn+Zn by using 2% urea at 75 DAS.

Effect of speciality fertilizer on uptake of the nutrient after harvest NPK and S uptake (kg ha^{-1})

The data presented in Table 8 shows the uptake of nutrients by plants and grains. The uptake of nutrients by a plant is calculated on a dry matter basis and by grain on the grain yield basis of chickpea.

N uptake (kg ha^{-1})

The plant uptake of N varied in range from 45.67 to 90.84 kg ha^{-1} and in grain from 28.87 to 47.20. Scrutiny of data revealed that the nitrogen uptake by chickpea was relatively higher due to foliar application of speciality fertilizer. The maximum uptake of nitrogen recorded with treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) followed by T_5 (RDF + 2% Starter and 2% Booster -2 sprays each), T_6 (RDF + 1% multi micronutrient grade II -4sprays) and T_3 (RDF + 1% Starter and 1% Booster 2 sprays each).

P uptake (kg ha^{-1})

The data on phosphorus uptake by chickpea as affected by different nutrient sources showed the uptake of phosphorus was significantly increased over control. The phosphorus uptake in plants varied between 5.39 to 13.23 kg ha^{-1} and in grains 5.51 to 11.55 kg ha^{-1}. The maximum uptake of phosphorus was recorded with T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) followed by T_5 (RDF + 2% Starter and 2% Booster -2 sprays each), T_6 (RDF + 1% multi micronutrient grade II -4sprays) and T_3 (RDF + 1% Starter and 1% Booster 2 sprays each). The role of nitrogen fertilizer in improving growth and dry matter accumulation led to increasing the uptake of most nutrients. The results achieved in this work are particularly compatible with those obtained by Manjula Devi and Pillai (1997) in the Black gram crop during *the Rabi* season by using 2% urea spray and Manivannan and Thanunathan (2003) in the Black gram crop by using micronutrient spray at 15, 30 and 45 DAS on Vertisol.

K uptake (kg ha^{-1})

The data of potassium absorption by chickpea as affected by various treatments is compiled in Table 9. From the data, it is seen that the total potassium uptake by chickpea was in a range between 26.47 to 67.85 kg ha^{-1}. The maximum uptake of potassium in plant 57.83 kg ha^{-1} and in grain 10.01 kg ha^{-1} was with T^4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) followed by T^5 (RDF + 2% Starter and 2% Booster -2 sprays each), T^6 (RDF + 1% multi micronutrient grade II -4sprays) and T^3 (RDF + 1% Starter and 1% Booster 2 sprays each.

S uptake (kg ha^{-1})

The uptake of Sulphur is also influenced by foliar application of speciality fertilizers. The total uptake of Sulphur varied in the range from 23.41 to 52.88 kg ha^{-1}. The maximum uptake of Sulphur in plant (23.04 kg ha^{-1}) and in grain (29.84 kg ha^{-1}) was observed in treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) followed by T_5 (RDF + 2% Starter and 2% Booster -2 sprays each) and T_6 (RDF + 1% multi micronutrient grade II -4sprays). The time of foliar application of nutrients coincides with the flowering and seed setting stage, wherein the nutrient requirement of the crop is higher. This might be the reason for the higher uptake of nutrients. Similar results were recorded by Pandrangi *et al.*, (1991) in green gram crops by using 40 kg P/ha + 0.5% SSP at Akola (Mh).

Effect of speciality fertilizer on uptake of micronutrients (Cu, Fe, Mn, Zn, Mo, and B) after harvest of chickpea (g ha^{-1})

Cu uptake (g ha^{-1})

The data on the uptake of Cu, Fe, and Mn by chickpea is influenced by speciality fertilizer treatments narrated in Table 8. The data indicated that the Cu uptake by chickpea varied in range from 31.73 to 64.20 g ha^{-1} in plant and from 13.81 to 28.21 g ha^{-1} in grain. Further, it was found that the Cu uptake in plant and grain was higher with the treatment T_6 (RDF + 1% multi micronutrient grade II -4sprays) followed by T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) and T_5 (RDF + 2% Starter and 2% Booster -2 sprays each).

Fe uptake (g ha^{-1})

Further, it was observed that Fe uptake was influenced by foliar feeding of speciality fertilizer. The uptake of Fe varied from 51.47 to 97.06 g ha^{-1} in plant and from 25.02 to 57.61 g ha^{-1} in grain respectively. The highest Fe uptake was found in T_6 (RDF + 1% multi micronutrient grade II -4sprays) followed by T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) and T_5 (RDF + 2% Starter and 2% Booster -2 sprays each) in both plant and grain. An increase in uptake may be due to an increase in dry matter production. Similar results were obtained by Manjula Devi and Pillai (1997) in the Black gram crop during *the Rabi* season by using 2% urea spray.

Mn uptake (g ha^{-1})

It was observed that the uptake of Mn varied from 26.02 to 16.49 g ha^{-1} in plants and from 20.88 to 66.37 g ha^{-1} in grain respectively. The maximum uptake of Mn was recorded in treatment T_6 (RDF + 1% multi micronutrient grade II -4sprays) followed by T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) and T_5 (RDF + 2% Starter and 2% Booster -2 sprays each).

Zn uptake (g ha^{-1})

The data on the uptake of Zn, Mo, and B by chickpea is influenced by speciality fertilizer treatments narrated in Table 9. It was found that the uptake of Zn varied from 134.12 to 516.14 g ha^{-1} in plant and from 422.27 to 963.96 g ha^{-1} in grain respectively. The maximum uptake of Zn was recorded in treatment T_6 (RDF + 1% multi micronutrient grade II -4sprays) followed by T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) and T_5 (RDF + 2% Starter and 2% Booster -2 sprays each) in both plant and grain.

Table.1 Mechanical composition and Physico-chemical properties of experimental soil (2010-11)

Sr. No.	Particular	Unit	Value
A.	**Chemical composition**		
1.	Soil reaction (pH)	-	8.4
2.	Electrical conductivity (EC)	dSm^{-1}	0.182
3.	Organic carbon (O.C.)	Per cent	0.290
4.	Calcium carbonate	Per cent	4.70
B.	**Fertility analysis**		
1.	Available nitrogen	kg ha^{-1}	152.8
2.	Available phosphorus	kg ha^{-1}	3.41
3.	Available potassium	kg ha^{-1}	676.6
4.	Available Sulphur	mg kg^{-1}	5.93
5.	DTPA Fe	mg kg^{-1}	0.96
6.	DTPA Zn	mg kg^{-1}	0.29
7.	DTPA Cu	mg kg^{-1}	1.78
8.	DTPA Mn	mg kg^{-1}	2.48
9.	HWS B	mg kg^{-1}	0.41
10.	Available Mo	mg kg^{-1}	0.13

Table.2 Details of experiment

1.	**Year of experiment**	**2010-11**
2.	Season of experiment	*Rabi*
3.	Crop	Chickpea
4.	Variety	Vijay
5.	Design of experiment	Randomized block design
6.	Number of treatment	Six
7.	Number of replication	Four
8.	Plot size	4.2 x 3.6 m^2
9.	Spacing	45 x 10 cm^2
10.	Method of sowing	Dibbling
11.	RDF	25:50:00 kg NPK ha^{-1}
12.	Date of sowing	2nd December, 2010
13.	Date of harvesting	5th March, 2011
14.	Plant protection measures	As per recommendations

Table.3 Treatment details

T_1	**Only RDF through soil (25:50:0 NPK kg ha^{-1})**
T_2	RDF + water spray
T_3	RDF + 1% Starter (2 sprays) and 1% Booster (2 sprays)
T_4	RDF + 1.5% Starter (2 sprays) and 1.5% Booster (2 sprays)
T_5	RDF + 2% Starter (2 sprays) and 2% Booster (2 sprays)
T_6	RDF + 1% MS Govt. Notified multi micronutrient grade 2 (4sprays)

Where,

RDF	=	**25:50:00 kg ha^{-1}**
Starter	=	11.36.24 NPK + TE (Zn-3%, Fe-2.5%, Mn-1%, Cu-1%, B-0.5%, Mo-0.1%).
Booster	=	08.16.39 NPK + TE (Zn-3%, Fe-2.5%, Mn-1%, Cu-1%, B-0.5%, Mo-0.1%).
Grade II	=	Multi micro nutrient notified grade for foliar application, (Zn-3%, Fe-2.5%, Mn-1%, Cu-1%, B-0.5%, Mo-0.1%).

Table.4 Soil sample analysis parameters and their methods

S.N.	Parameters	Name of method	Suggested by
	Soil analysis		
1.	Soil reaction (pH)	(1:2.5) soil water suspension	Jackson (1967)
2.	Electrical conductivity (EC)	Conductivity bridge	Jackson (1973)
3.	Organic carbon	Walkely and Black's rapid titration methods	Jackson (1973)
4.	Calcium carbonate	rapid titration method	Jackson (1973)
5.	Available nitrogen	Alkaline permagnate method	Subbiah and Asija (1956)
6.	Available phosphorus	0.5 M sodium bicarbonate extractant method	Olsen *et al*. (1954)
7.	Available potassium	Neutral normal ammonium acetate	Jackson (1973)
8.	Available Sulphur	Turbidimetry method	Chopra and Kanwar (1976)
9.	DTPA (Fe, Zn, Cu, Mn)	DTPA extractant	Lindsay and Norvell (1978)
10.	HWS Boron	HWS Azomethine- H	Gupta (1967)
11.	Available Molybdenum	Ammonium bicarbonate DTPA method	Soltanpur (1982)
	Plant analysis		
12.	Digestion of plant samples	Diacid mixture (HNO_3 and $HClO_4$ in 9:4)	Piper (1973)
13.	Nitrogen	Micro-kjeldahl's methods	A.O.A.C. (1975)
14.	Phosphorus	Vando phosphomolybdate method	Jackson (1973)
15.	Potassium	Flame photometer	Jackson (1973)
16.	Sulphur	Turbidimetric method	Tabatabai and Bremner (1970)
17.	Total micronutrients (Fe, Zn, Cu, and Mn)	Atomic absorption spectrophotometer	Lindsay and Norvell (1978)
18.	Total micronutrient (B)	Dry ashing Azomethine- H method	Gupta (1967)
19.	Total micronutrient (Mo)	Colorimetric method	Johnson and Arkley (1954)

Table.5 Effect of foliar application of speciality fertilizer on plant height, number of Branches/plant, and number of pods/plant

Tr. No.	Treatment Details	Plant height (cm) At 90 DAS	Number of Branches plant^{-1} At 90 DAS	Number of pods plant^{-1} At 90 DAS
T_1	Only RDF through soil (25:50:0 NPK kg ha^{-1})	28.70	18.95	42.24
T_2	RDF + water spray (4 sprays)	31.48	21.25	46.78
T_3	RDF + 1% Starter and 1% Booster (2 sprays each)	35.32	23.25	62.65
T_4	RDF + 1.5% Starter and 1.5% Booster (2 sprays each)	36.34	25.67	68.45
T_5	RDF + 2% Starter and 2% Booster (2 sprays each)	35.76	24.68	65.35
T_6	RDF + 1% MS Govt. Notified multi micronutrient grade-II (4sprays)	35.48	23.96	63.35
	SE ±	1.14	0.78	1.98
	CD (0.05)	3.37	2.31	5.86

Table.6 Effect of speciality fertilizers on grain yield, dry matter yield, and quality parameters of chickpea

Tr. No.	Treatment Details	Grain yield (q ha^{-1})	Dry matter yield (q ha^{-1})	Test Weight (gm/100seeds)	Protein in grain (%)
T_1	Only RDF through soil(25:50:00 NPK kg ha^{-1})	10.35	18.72	13.67	17.4
T_2	RDF + water spray (4 sprays)	11.46	23.87	14.78	17.2
T_3	RDF + 1% Starter and 1% Booster (2 sprays each)	13.65	28.97	16.32	18.6
T_4	RDF + 1.5% Starter and 1.5% Booster (2 sprays each)	14.74	31.14	17.57	20.0
T_5	RDF + 2% Starter and 2% Booster (2 sprays each)	14.32	30.67	17.22	19.6
T_6	RDF + 1% MS Govt. Notified multi micronutrient grade-II (4sprays)	13.85	28.94	16.82	19.0
	SE ±	0.37	0.74	0.49	0.16
	CD (0.05)	1.16	2.21	1.48	0.49

Table.7 Effect of speciality fertilizer on N, P, K and S uptake (kg ha^{-1})

Tr. No	Treatment Details	N (kg ha^{-1})			P (kg ha^{-1})			K (kg ha^{-1})			S (kg ha^{-1})		
		Plant	**Grain**	**Total**	**Plant**	**Grain**	**Total**	**Plant**	**Grain**	**Total**	**Plant**	**Grain**	**Total**
T_1	Only RDF through soil (25:50:0 NPK kg ha^{-1})	45.67	28.87	74.54	5.39	5.51	10.91	21.71	4.76	26.47	8.61	14.80	23.41
T_2	RDF + water spray (4sprays)	56.98	31.53	88.52	7.68	6.18	13.86	28.64	5.20	33.84	10.91	16.29	27.21
T_3	RDF + 1% Starter and 1% Booster (2 sprays each)	73.86	40.60	114.46	10.01	9.15	19.16	41.34	8.23	49.57	14.04	23.61	37.65
T_4	RDF + 1.5% Starter and 1.5% Booster (2 sprays each)	90.84	47.20	138.04	13.23	11.55	24.78	57.83	10.01	67.85	23.04	29.84	52.88
T_5	RDF + 2% Starter and 2% Booster (2 sprays each)	84.18	45.03	129.16	11.44	10.44	21.88	49.45	9.17	58.62	13.72	23.33	37.05
T_6	RDF + 1% MS Govt. Notified multi micronutrient grade-II (4sprays)	75.09	42.23	117.33	7.59	7.50	15.10	42.46	8.62	51.09	15.69	21.15	36.84
	SE±	0.6681	0.34	0.78	0.18	0.019	0.19	0.68	0.018	0.68	0.20	0.18	0.30
	CD (0.05)	2.0134	NS	2.3787	NS	NS	NS	2.06	0.05	2.07	0.62	0.56	0.93

Table.8 Effect of speciality fertilizer on Cu, Fe, and Mn uptake (g ha^{-1})

Tr. No.	Treatment Details	Cu (g ha^{-1})			Fe (g ha^{-1})			Mn (g ha^{-1})		
		Plant	Grain	Total	Plant	Grain	Total	Plant	Grain	Total
T_1	Only RDF through soil (25:50:0 NPK kg ha^{-1})	31.73	13.81	45.54	51.47	25.02	76.49	26.02	20.88	46.90
T_2	RDF + water spray (4 sprays)	50.36	16.11	66.47	60.86	27.33	88.19	40.22	24.66	64.88
T_3	RDF + 1% Starter and 1% Booster (2 sprays each)	62.13	22.52	84.65	89.22	38.93	128.15	70.91	38.11	109.0
T_4	RDF + 1.5% Starter and 1.5% Booster (2 sprays each)	62.20	27.12	89.32	95.21	45.28	140.49	138.88	47.20	186.08
T_5	RDF + 2% Starter and 2% Booster (2 sprays each)	61.02	24.98	86.00	96.27	40.81	137.08	101.82	41.63	143.45
T_6	RDF + 1% MS Govt. Notified multi micronutrient grade-II (4sprays)	64.20	28.21	92.41	97.06	57.61	154.67	164.95	66.37	231.33
	SE ±	0.20	0.21	0.21	0.17	0.93	0.16	1.789	4.245	3.561
	CD (0.05)	0.62	0.63	0.64	0.53	NS	0.49	5.39	12.93	10.73

Table.9 Effect of speciality fertilizer on Zn, Mo, and B uptake (g ha^{-1})

Tr. No.	Treatment Details	Zn (g ha^{-1})			Mo (g ha^{-1})			B (g ha^{-1})		
		Plant	Grain	Total	Plant	Grain	Total	Plant	Grain	Total
T_1	Only RDF through soil (25:50:0 NPK kg ha^{-1})	134.12	422.27	556.39	1.02	9.79	10.81	6.715	5.778	12.49
T_2	RDF + water spray (4sprays each)	175.80	471.57	647.37	1.26	10.90	12.16	8.562	6.677	15.24
T_3	RDF + 1% Starter and 1% Booster (2 sprays each)	255.22	758.59	1013.81	2.00	14.16	16.16	10.776	8.46	19.24
T_4	RDF + 1.5% Starter and 1.5% Booster (2 sprays each)	427.24	903.55	1330.79	2.51	17.55	20.05	11.871	9.19	23.06
T_5	RDF + 2% Starter and 2% Booster (2 sprays each)	343.96	825.18	1169.14	2.37	16.38	18.75	11.362	9.26	20.62
T_6	RDF + 1% MS Govt. Notified multi micronutrient grade-II (4sprays)	516.14	963.96	1480.1	2.89	18.97	21.86	12.10	13.13	25.23
	SE±	2.403	5.14	2.27	0.37	0.26	0.41	0.13	0.17	0.23
	CD (0.05)	7.24	15.50	6.87	1.12	0.81	1.26	0.41	0.52	0.70

Table.10 Effect of speciality fertilizer on Economics of chickpea

Tr. No.	Treatment Details	Cost of Cultivation (Rs)	Gross income (Rs)	Net income (Rs)	C:B Ratio
T_1	Only RDF through soil (25:50:00 NPK kg ha^{-1})	10300/-	31050/-	20750/-	1:2.01
T_2	RDF + water spray (4 sprays)	11100/-	34380/-	23280/-	1:2.09
T_3	RDF + 1% Starter and 1% Booster (2 sprays each)	11130/-	40950/-	29820/-	1:2.67
T_4	RDF + 1.5% Starter and 1.5% Booster (2 sprays each)	11145/-	44220/-	33075/-	1:2.96
T_5	RDF + 2% Starter and 2% Booster (2 sprays each)	11160/-	42960/-	31800/-	1:2.84
T_6	RDF + 1% MS Govt. Notified multi micronutrient grade-II (4sprays)	11130/-	41550/-	30420/-	1:2.73

Increased the uptake of micronutrients due to foliar application of the same nutrient is possibly due to nutrients applied through foliage would have easily absorbed and translocated in a plant without any loss. Similar results reported by Patel *et al.,* (2009) in Maize crop by using mixture of Grade III containing (Fe 6% + Mn1% + Zn 4% + Cu 0.3% + B 0.5%).

Mo uptake (g ha^{-1})

The uptake of Mo varied from 1.02 to 2.89 g ha^{-1} in plants and grains from 9.79 to 18.97 g ha^{-1}. It was recorded that the maximum uptake of Mo in plant 28.98 g ha^{-1}) and in grain 18.97 g ha^{-1} was recorded in treatment T_6 (RDF + 1% multi micronutrient grade II -4sprays) followed by T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) and T_5 (RDF + 2% Starter and 2% Booster -2 sprays each) in both plant and grain.

B uptake (g ha^{-1})

The data on the uptake of B are presented in Table 9. The uptake of B varied from 67.15 to 121.03 g ha^{-1} in plant and from 57.78 to 131.32 g ha^{-1} in grain and found maximum Uptake of Mo varied from 102.67 to 289.82 g ha^{-1} in plant and grain from 97.95 to 189.74 g ha^{-1}.

The time of foliar application of nutrients coincides with the flowering and seed setting stage, wherein the nutrient requirement of the crop is higher. This might be the reason for the higher uptake of nutrients. The finding is in conformation with Lalitha *et al.,* (2008) in Niger crop by using K2SO4 + H3BO3 at 60 DAS through foliar application.

Effect of speciality fertilizer on Economics of chickpea

The highest gross return, net return and benefit-cost ratio were recorded with treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each) followed by T_5 (RDF + 2% Starter and 2% Booster -2 sprays each) T_6 (RDF + 1% multi micronutrient grade II -4sprays) and T_3 (RDF + 1% Starter and 1% Booster 2 sprays each). The cost-benefit ratio varied in range from 2.01 to 2.96 Rs and was maximum in treatment T_4 (RDF + 1.5% Starter and 1.5% Booster -2 sprays each). Consequent to the favorable effect on growth attributes and yield due to foliar spray of speciality fertilizer, the gross return of Rs 44220/-, a net return of Rs. 33075/-, and cost benefit ratio of 1:2.96 also increased considerably.

The data on the economics of chickpeas influenced by speciality fertilizer treatments are presented in Table 10.

The variation in gross return, the net return, and the benefit-cost ratio were mainly due to variations in chickpea grain yield and dry matter yield. The increase in C: B ratio due to foliar application at various growth stages is supposed due to the enhanced grain yield and dry matter yield. Similar results are also obtained in different crops, Palaniappan *et al.,* (1999) in Tomato and Chilli with foliar application of speciality fertilizers. Shinde and Bhilare (2003) in chickpea by using DAP through foliar application and Patel *et al.,* (2009) in Cowpea by using a foliar application of ZnSO4 @ 0.5%.

These results lead to the following conclusions;

Application of RDF + 1.5% Starter and 1.5% Booster (2 sprays each) increased biological yield up to 45.88 q ha^{-1} of chickpea. The significant increase in grain yield from 13.50 to 14.74 q ha^{-1} and straw yield from 18.72 to 31.14 q ha^{-1} with each increment of dose of starter and booster through a foliar application, but decreased then after.

The quality of the chickpea-like seed protein content increased from 17.2 to 20.0 percent and test weight from 13.67 to 17.57 gm/100seeds were improved with the application of speciality fertilizer @ 1.5%. Starter and 1.5% Booster (2 sprays each) along with RDF.

The total uptake of nutrients significantly increased with a graded dose of speciality fertilizers @ RDF +

1.5% starter and 1.5% booster (2 sprays each) and RDF +Govt. Grade-II @ 1% (4sprays as increased the total uptake of macronutrients viz; N from 74.54 to 137.77 kg ha^{-1}, P from 10.72 to 23.63 kg ha^{-1}, K from 30.32 to 67.47 kg ha^{-1} and secondary nutrient viz; S from 23.41 to 52.88 kg ha^{-1} and micronutrients Cu from 45.54 to 92.41 g ha^{-1}, Fe from 76.49 to 154.67 g ha^{-1}, Mn from 46.90 to 231.33 g ha^{-1}, Zn from 556.39 to 1480.1 g ha^{-1}, Mo from 10.81 to 21.86 g ha^{-1} and B from 12.49 to 25.23 g ha^{-1} by chickpea.

Overall, foliar application of 1.5% Starter + 1.5% Booster along with a recommended dose of fertilizer was found superior for maximum yield of chickpea, quality of products and to restore the fertility of the soil.

References

A.O.A.C. (1975). Association of Official Analytical Chemists, Washington, D.C. U.S.A.

Chaurasia, S. N. S., Singh, K. P., Rai, M. (2006). Response of Tomato to foliar application of water-soluble fertilizers.*Veg. Sci*.33(1):96-97.

Chopra, S. L. and Kanwar, J. B. (1976). Analytical Agricultural Chemistry. Kalyani Publication, New Delhi.

Choudhary, G. L. and Yadav L. R. (2011). Effect of fertility levels and foliar nutrition on Cowpea productivity. J. Food Legume, 24(1): 67-68.

Cirak, C. Odabas, M. S. Ali Gulumaser (2006). Response of Soybean to soil and foliar applied boron at different rates. *Indian J. Agril. Sci*., 76(1): 603-606.

Gupta U. C. (1967). Simplified method for determining hot water soluble Boron in podzol soils. *Soil science* 103. 424- 428.

Gupta, S., Sengupta, K. and Banarjee, H. (2010). Effect of foliar application of nutrient and brassinolide on summer Green gram crop. *IJTA* 28(1-2): 123-125.

Jackson, M. L. (1973). Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi.

Johnson, C. M. and Arkley, T. H. (1954). Determination of molybdenum in plant tissue. *Anal. Chem*. 26:572-574.

Krishnaveni, S. A. Palchamy, A. and Mahedran, S. (2004). Effect of foliar spray of nutrients on growth and yield of a Green gram. *Legume Res*., 27(2): 149-150.

Lalitha, B. H., Yeledhalli, N. A., Ravi, M. V. (2008). Effect of foliar application of potassium suphate and boric acid on yield, nutrient uptake, and quality of Niger. *Karnataka J. Agric.Sci*.,21(2):282-283.

Lindsay, W. L. and Norvell, W. A. (1978). Development of DTPA soil testing for Zn, Fe, Mn, and Cu. *Soil Sci. Amer. Proc. J*. 42: 421-428.

Manivannan, V. and Thanunathan, K. (2003). Effect of foliar nutrition of major and chelated micronutrients and rhizobium seed treatment on Rice-fallow Blackgram. *Madras Agric.J*. 90(4-6):344-347.

Manjula Devi, M. and R. N. Pillai (1993). Effect of foliar fertilization of urea on yield and nutrient uptake by Urdbean. *Legume Res*earch 20(3/9): 221-223.

Narayanamma, M., Reddy, C S. Chiranjeevi, C. H. Reddy, L. P. (2006). Influence of water soluble fertilizers on yield of brinjals. *Veg. Sci*., 33(2): 94-95.

Olsen S. R. Cole, G. V., Watnable, F. S. and Dean, L. A. (1954). Estimation of available P in soils by extraction with sodium bicarbonate USDA. CRIC. 939.

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

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

Panse, V. G. and Sukhatme, P. V. (1967). Statistical Method for Agricultural Workers. *ICAR, New Delhi.*

Patel, K. P., Patel, G. J. Patel, K. C. 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.

Piper, C. S. (1966). Soil and plant Analysis. Hans publishers, Bombay.

Setty, R. A., Channabasavanna, S. A., Patil, S. A. (1992). Response of gram to foliar application of diammonium phosphate and single superphosphate.. Indian J. of Agron 37(4):828-829.

Shinde, S. H. and Bhilare, R. L. (2003). Response of Chickpea to soil and foliar application of DAP. *Madras Agri. J.*, 90(4-6): 352-354.

Soltanpour P. N, Johnson G. W., Workman S. N (1982). Optical emission spectrophotometry in A.L page et.al method of soil analysis part 2nd edition Agron. P.29-65

Sritharan, N., Aravazhi, A., Vanangammudi, M. (2005). Effect of foliar spray of nutrients andplant growth regulators for yield maximization in black gram. *Madras Agric.J.* 92(4-6):301-307.

Subbiah, B. V. and Asija, G. L. (1956). A rapid procedure for the estimation of available nitrogen in soils. *Curr. Sci*., 25:259-260.

Tabatabai, M. A. and Bremner, J. M. (1970). A simple turbidimetric method of determination of total S in a plant. *Agro.* 3(62): 805-806.

Venkatesh, M. S. and Basu, P. S. (2011). Effect of foliar application of urea on growth, yield, and quality of Chickpea under rainfed conditions. *J. of Food Legume*, 24(2): 110-112.

Yassen, A., Abou, El-Nour, E. A. A. and Shedeed, S. (2010). Response of Wheat to foliar spray with urea and micronutrients. *J. of American Science*, 6(9): 14-22.

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