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A study on total nutrient uptake in chickpea of Karnataka state: Approach for nutrient management practices

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Abstract
A field experiment was conducted at Krishi Vignana Kendra, Kalaburagi, University of Agricultural Sciences, Raichur, conducted during *rabi* 2015-16. To study the "Nutrient management in chickpea (*Cicer arietinum* L.) in black soil under rainfed situation. The findings conveys that total uptake of nutrients like nitrogen, phosphorous, potassium and sulpur of chickpea was significantly increased by the application of FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha followed by the treatments like VC @ 2.5 t ha^{-1} + 100% RDF. Significantly lower uptake of chickpea was recorded in RDF treatment. However, in case of total uptake of micro nutrients like zinc, Iron, cupper, manganeese and bboron of chickpea was significantly increased by the application of FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha followed by the treatments like VC @ 2.5 t ha^{-1} + 100% RDF.

Keywords: Nitrogen, potassium, iron, zinc and nutrient management

Introduction
Nutrient management plays a vital role among the various factors affecting the growth and yield of crops. In crop production, chemical fertilizers are the major source of nutrients, but escalating cost, coupled with increasing demand of chemical fertilizers and depleting soil health necessitates the safe and efficient use of organics in crop production, which is gaining much popularity. It helps to enhance and maintain soil organic carbon status for sustained crop yield. However, under arable production systems, organic manures suffer from the drawback of slow release of nutrients, which may cause significant reduction in crop yield and net farm income. This could be overcome by use of judicious combination of organic manures. Combined application of green manures, crop residues and composts along with liquid manures mainly jeevamrutha, panchagavya, bio-digester solution, beejamrutha, biogas spent slurry and vermiwash, *etc.* in a more synchronized system can release the nutrients as per the need of crop to sustain higher productivity (Kanwar *et al.*, 2006) [1].

In this context, it is worth noting that nutrient management through organics plays a major role in maintaining soil health due to build up of soil organic matter, beneficial microbes, enzymes, besides improving soil physical and chemical properties. To achieve the sustained soil fertility and crop productivity the role of organic manures and other nutrient management practices like use of fermented organic nutrient like, jeevamrutha, beejamrutha, panchagavya, cow urine, bio-digester solution etc, are very important. These fermented liquid organic manures, contain in additions to nutrients they have microbial load and growth promoting substances which helps in improving the plant growth, metabolic activity and resistance to pest and diseases.

In many studies Bachhva *et al.* (2012) [2] and Chesti *et al.* (2013) [3] reported that application of FYM increase organic carbon and also availability of Phosphorous and available potassium than rest of the treatments in general and on mustard and wheat respectively.

In addition Patil and Udmele (2016) [4] reported that total uptake of nitrogen, phosphorus and potassium by soybean was significantly higher due to application of FYM + vermicomopst (50 % each) + Jeevamrut 2 times (30 and 45 DAS) to soybean. The above studies reveal that different appropriate combinations will yield good results on nutrient management especially in pulse crops. As we all know pulse crops play an important role in Indian agriculture. Besides being rich in protein, they sustain the productivity of cropping systems. Their ability to use atmospheric nitrogen through biological nitrogen fixation (BNF) is economically more

sound and environmentally acceptable. Pulses constitute an important ingredient in predominantly vegetarian Indian diet.

Methodology

A field experiment was conducted at Krishi Vignana Kendra, Kalaburagi, University of Agricultural Sciences, Raichur, conducted during *rabi* 2015-16. To study the "Nutrient management in chickpea (*Cicer arietinum* L.) in black soil under rainfed situation". The experiment consisted of eleven treatments comprised of RDF alone, in combination of FYM @ 5 t ha^{-1} with (50%, 75%, 100% RDF and Jeevamrutha), vermicompost @ 2.5 t ha^{-1} with (50%, 75%, and 100% RDF and Jeevamrutha), FYM @ 5 t ha^{-1} + vermicompost @ 2.5 t ha^{-1} + Jeevamrutha and RDF + Jeevamrutha. The trial was laid out in randomized complete block design with three replications. Treatments details are given below

Treatments details are given below

Treatment details	
T_1 : RDF (10:25:0 N:P_2O_5:K_2O kg ha^{-1})	T_7 : VC @ 2.5 t ha^{-1} + 75% RDF
T_2 : FYM @ 5 t ha^{-1} + 50% RDF	T_8 : VC @ 2.5 t ha^{-1} + 100% RDF
T_3 : FYM @ 5 t ha^{-1} + 75% RDF	T_9 : VC @ 2.5 t ha^{-1} + Jeevamrutha
T_4 : FYM @ 5 t ha^{-1} + 100% RDF	T_{10} : RDF + Jeevamrutha
T_5 : FYM @ 5t ha^{-1} + Jeevamrutha	T_{11} : FYM @ 5t ha^{-1} + VC @ 2.5t ha^{-1} + Jeevamrutha
T_6 : VC @ 2.5 t ha^{-1} + 50% RDF	

Sum of uptake in grain and haulm was used to represent total uptake in kg ha^{-1}. Using the formula.Total uptake was calculated by using following formula.

$$\text{Total Uptake (Kg ha}^{-1}\text{)} = \frac{\left(\text{N concentration in grain (\%)}\right) \times \left(\text{grain yield (kg ha}^{-1}\text{)}\right)}{100} + \frac{\left(\text{N concentration in straw (\%)}\right) \times \left(\text{Straw yield (kg ha}^{-1}\text{)}\right)}{100}$$

Results and Discussion

Major nutrient uptake by chickpea

The major nutrient uptake (kg ha^{-1}) of chickpea at harvest stage of crop as influenced by different treatments in the experimentation is presented in the Table 1. The data on nitrogen, phosphorus potassium and sulpur uptake by stalk and grain of chickpea were statistically significant. Among different treatments, higher nitrogen uptake at harvest was recorded with FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha (119.11 kg ha^{-1}) application which was significantly superior over other treatments which inturn was on par with. VC @ 2.5 t ha^{-1} + 100% RDF (23.77 kg ha^{-1}). All the treatments which received FYM, vermicompost, with inorganic fertilizers and Jeevamruta were at par with each other. Treatment supplemented with only RDF recorded significantly lower nitrogen uptake (53.79 kg ha^{-1})

Significantly higher phosphorus uptake was obtained with FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha application (24.56 kg ha^{-1}) over other treatments which inturn was on par with. VC @ 2.5 t ha^{-1} + 100% RDF (23.77 kg ha^{-1}). Significantly lower uptake of phosphorus was noticed with RDF (14.36 kg ha^{-1}**)** as compared to rest of the treatments which inturn was on par with FYM @ 5 t ha^{-1} + 50% RDF (15.50 kg ha^{-1}).

Among various treatments, significantly higher potassium uptake at harvest was recorded with FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha application (129.07 kg ha^{-1}) which was on par with treatment supplemented with VC @ 2.5 t ha^{-1} + 100% RDF (125.50 kg ha^{-1}), Significantly lower total uptake of potassium was noticed with RDF (53.40 kg ha^{-1}) as compared to other treatments which inturn on par with FYM @ 5 t ha^{-1} + 50% RDF (60.75 kg ha^{-1}).

Among various treatments, significantly higher sulphur uptake was obtained with FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha application (32.67 kg ha^{-1}) over other treatments which inturn on par with VC @ 2.5 t ha^{-1} + 100% RDF (30.83 kg ha^{-1}), Significantly lower uptake of sulphur was noticed with RDF (21.17 kg ha^{-1}) as compared to rest of the treatments.

Table 1: Nutrient uptake after harvest of the crop in grains and straw as influenced by nutrient management practices

Treatment details	N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})		S (kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T_1 : RDF(10:25:0 N:P_2O_5:K_2O kg ha^{-1})	26.51	27.28	6.93	7.44	24.14	29.26	9.83	11.34
T_2 : FYM @ 5 t ha^{-1} + 50% RDF	29.75	30.58	7.43	8.07	27.92	32.83	10.61	11.91
T_3 : FYM @ 5 t ha^{-1} + 75% RDF	37.00	39.90	8.75	9.33	39.05	44.07	12.10	14.00
T_4 : FYM @ 5 t ha^{-1} + 100% RDF	45.18	50.80	9.85	10.46	49.50	55.03	13.22	15.06
T_5 : FYM @ 5t ha^{-1} + Jeevamrutha	46.49	54.52	10.14	11.10	51.33	59.38	13.52	15.29
T_6 : VC @ 2.5 t ha^{-1} + 50% RDF	35.84	38.02	8.45	9.10	32.73	48.24	11.78	13.35
T_7 : VC @ 2.5 t ha^{-1} + 75% RDF	42.99	46.33	9.45	9.95	45.21	49.72	12.77	14.72
T_8 : VC @ 2.5 t ha^{-1} + 100% RDF	54.19	59.06	11.16	12.61	58.37	67.13	14.37	16.46
T_9 : VC @ 2.5 t ha^{-1} + Jeevamrutha	50.94	56.39	10.74	11.86	55.42	63.78	14.04	15.89
T_{10} : RDF + Jeevamrutha	33.45	35.37	8.13	8.57	31.78	37.20	11.38	12.75
T_{11} : FYM @ 5t ha^{-1} + VC @ 2.5t ha^{-1} + Jeevamrutha	56.22	62.89	11.55	13.01	58.66	70.41	15.11	17.56
S.Em ±	2.28	3.13	0.69	0.75	2.04	2.98	0.98	1.02
CD (0.05)	6.73	9.24	2.04	2.23	6.01	8.80	2.89	3.00

RDF: Recommended Dose of Fertilizer, FYM: Farm Yard Manure, VC: Vermicompost

Micronutrient uptake by chickpea (Table 2)

The micronutrient uptake by chickpea as influenced by different treatments in the study is presented in the Table 2. The data on uptake of Zn, Fe, Cu, Mn and B by stalk and grain of chickpea were statistically significant. Significantly higher zinc, copper, iron, manganese and boron uptake was obtained with FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha application (142.41 g ha^{-1}, 52.11 g ha^{-1}, 1306.80 g h^{-1}, 211.79 g ha^{-1}, 62.01 g ha^{-1} respectively) over other treatments which inturn on par with VC @ 2.5 t ha^{-1} + 100% RDF (137.27 g ha^{-1}, 47.46 g ha^{-1}, 1268.80 g ha^{-1}, 198.97 g ha^{-1} and 57.05 g ha^{-1}, respectively). Significantly lower uptake of zinc, copper, iron, manganese and boron was noticed with RDF (91.33 g ha^{-1}, 25.26 g ha^{-1},897.80 g ha^{-1}, 109.35 g ha^{-1} and 28.60 g ha^{-1}) as compared to rest of the treatments which inturn onpar with FYM @ 5 t ha^{-1} + 50% RDF (93.73 g ha^{-1}, 27.13 g ha^{-1}, 929.98 g ha^{-1}, 117.97 g ha^{-1} and 32.78 g ha^{-1} respectively).

Table 2: Total micronutrient (grain + straw) uptake after harvest of the crop as influenced by nutrient management practices.

Treatment details	Micronutrient (g ha^{-1})				
	Zn	Fe	Cu	Mn	B
T_1 : RDF(10:25:0 N:P_2O_5:K_2O kg ha^{-1})	91.33	897.80	25.26	109.35	28.60
T_2 : FYM @ 5 t ha^{-1} + 50% RDF	93.73	929.98	27.13	117.97	32.78
T_3 : FYM @ 5 t ha^{-1} + 75% RDF	111.64	1050.13	35.25	144.24	41.42
T_4 : FYM @ 5 t ha^{-1} + 100% RDF	119.21	1149.83	39.70	168.64	48.15
T_5 : FYM @ 5 t ha^{-1} + Jeevamrutha	124.70	1191.61	42.88	177.46	50.63
T_6 : VC @ 2.5 t ha^{-1} + 50% RDF	103.81	1017.61	32.63	133.85	39.28
T_7 : VC @ 2.5 t ha^{-1} + 75% RDF	115.94	1089.32	38.71	152.85	44.72
T_8 : VC @ 2.5 t ha^{-1} + 100% RDF	137.27	1268.80	47.46	198.97	57.05
T_9 : VC @ 2.5 t ha^{-1} + Jeevamrutha	131.56	1247.11	45.99	187.23	53.69
T_{10} : RDF + Jeevamrutha	99.30	950.57	29.89	127.24	36.80
T_{11} : FYM @ 5t ha^{-1} + VC @ 2.5t ha^{-1} + Jeevamrutha	142.41	1306.80	52.11	211.79	62.01
S.Em ±	1.93	33.99	1.85	5.44	0.08
CD (0.05)	5.71	100.28	5.46	16.05	0.24

RDF: Recommended Dose of Fertilizer, FYM: Farm Yard Manure, VC: Vermicompost.

Discussions

The data on nutrient content in seed and straw significantly differed with the application of sources of organic and inorganic on chickpea are presented in (Fig.01 to 04). Application of sources of organic and inorganic influenced the nitrogen content in seed, haulm and total uptake in chickpea crop. The higher nitrogen content in seed, straw and total uptake was found in application of (T_{11}) FYM @ 5 t ha^{-1} + VC @ 2.5t ha^{-1} + Jeevamrutha (Fig.01). It was superior over all other treatments. Higher nitrogen uptake was due to higher mineralization of nitrogen from applied organic source. The results of present investigation are in conformity with Singh *et al*. (2000) [5] and Ganeshappa (2000) [6] reported that, uptake and availability of nutrients *i.e*., N, P and K were significantly higher due to the application of vermicompost.

The higher phosphorus content in seed, straw and total uptake was recorded in (T_{11}) FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha (Fig.2). It was superior over (T_8) VC @ 2.5 t ha^{-1} + 100% RDF. However, lowest phosphorus content in seed, straw and total uptake was noticed in the T_1 (RDF alone) treatment. Higher phosphorus uptake was due to higher P application through inorganic fertilizer and organic source, this has created surplus P in the soil. The mineralization of this organic source in addition to soil had provided ample opportunity for plants to uptake this element in addition to fixation that normally takes place. Vermicompost, farm yard manure and jeevamrutha application reduced the loss of nutrients through leaching and made available to plant which created a balancing effect on supply of nitrogen, phosphorus and potassium. These results are in support with the findings of (Vijayapriya *et al*. 2005) [7].

The highest potassium and sulphur content in seed, straw and total uptake was recorded in (T_{11}) FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha. However, lowest potassium and sulphur content in seed, straw and total uptake was noticed in the T_1 (RDF alone) treatment. It might be due to direct addition of nutrients through vermicompost, farm yard manure and jeevamrutha and it might have improved availability of native soil nutrients and their uptake by chickpea crop. The results of this investigationare agree with the findings of Gopal Reddy (1997) [8]. Similar results were found in Ganeshmurthy (1996) [9].

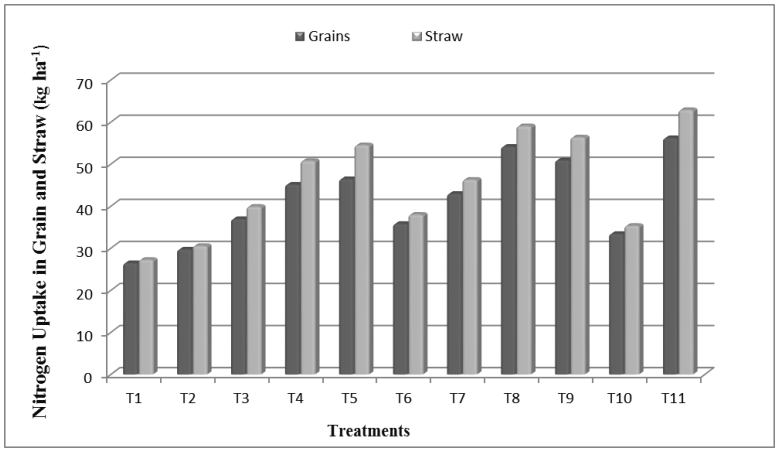

Fig 1: Nitrogen uptake on grain and straw of chickpea as influenced by nutrient management practices.

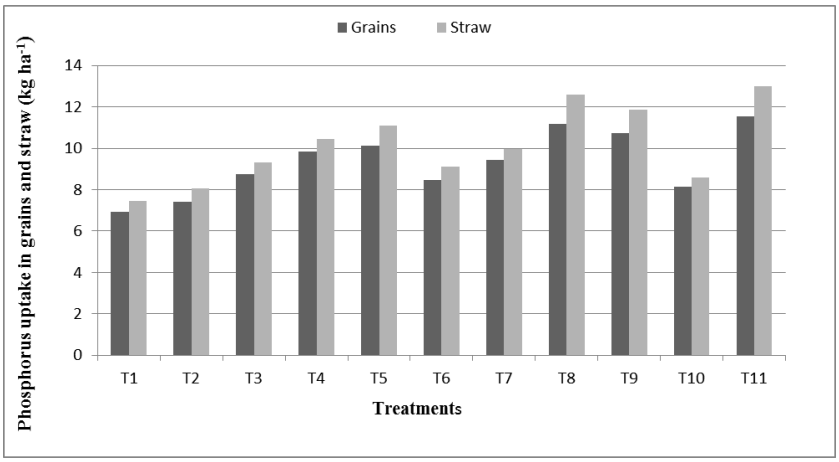

Fig 2: Phosphorus uptake on grain and straw of chickpea as influenced by nutrient management practices

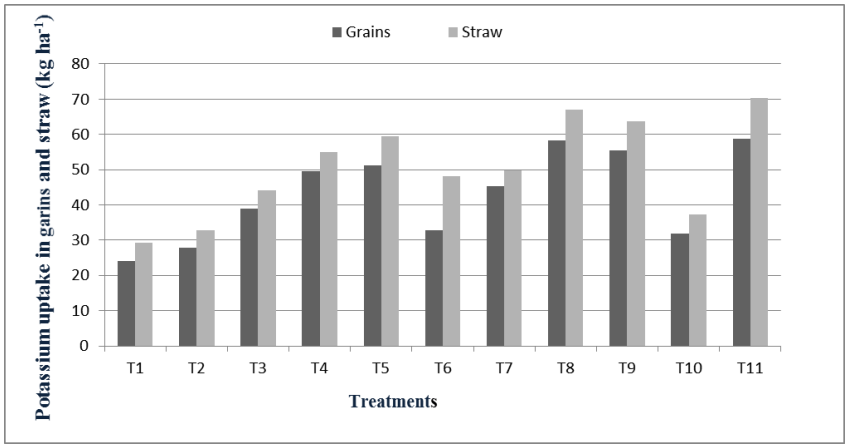

Fig 3: Potassium uptake on grain and straw of chickpea as influenced by nutrient management practices.

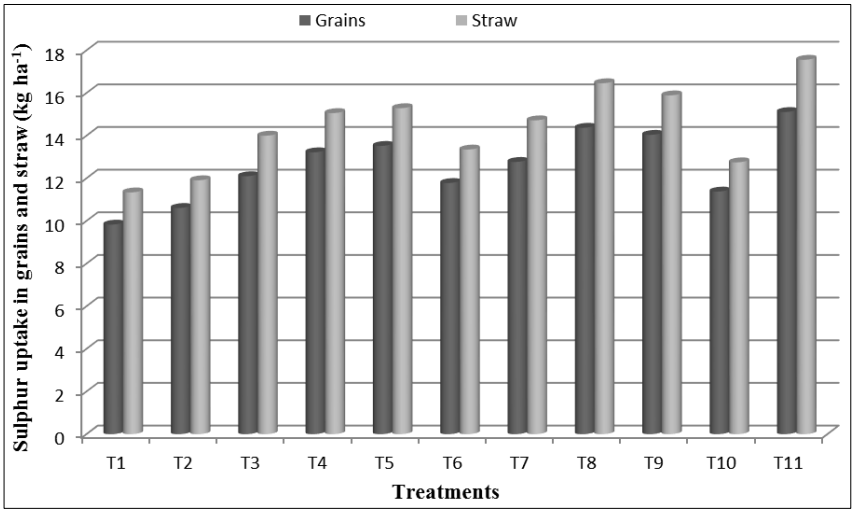

Fig 4: Sulphur uptake on grain and straw of chickpea as influenced by nutrient management practices.

Iron, manganese, zinc, boron and copper content and uptake of these micro nutrients was significantly increased with application of organic manures. The treatment receiving at (T_{11}) FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha was recorded higher iron, manganese, zinc, boron and copper concentration in seed, straw and total uptake. However, lowest microneutrient content in seed, straw and total uptake was noticed in the T_1 (RDF alone) treatment. It might be due to microbial decomposition of organic manures with simultaneous release of organic acid might have favoured the availability of micronutrients in soil and their uptake by chickpea. This may be due to faster the decomposition of organic manures as results of narrowing of C:N ratio with the application of organic sources. These results are in support with the findings of Sakal *et al.* (1993) [10]. Addition of organic manures to soil besides increasing the availability of micronutrients in soil, the complexing properties of these manure with micronutrients might have prevent the precipitation, fixation, leaching and kept them in soluble form which might have resulted in higher uptake of these micronutrients by soybean crop. Similar results were reported by Ghosh *et al.* (1999) [11].

Conclusion

The findings on nutrient management reveals that, the total uptake of major nutrients like nitrogen, phosphorous, potassium, sulpur and micronetrients like zinc, Iron, copper, manganeese, and boron of chickpea was significantly increased by the application of FYM @ 5 t ha^{-1} + VC @ 2.5 t ha^{-1} + Jeevamrutha followed by the treatments like VC @ 2.5 t ha^{-1} + 100% RDF, VC @ 2.5 t ha^{-1} + Jeevamrutha and FYM @ 5 t ha^{-1} + Jeevamrutha. Significantly lower uptake was recorded in RDF treatment.

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