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Influence of nutrient management on content and uptake of nutrients by chickpea under south Gujarat conditions

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Abstract
To investigate the impact of nutrient management on chickpea, a field study was held at the Hill Millet Research Station, Waghai (Gujarat), during 2019-20 and 2020-21. The study consisted of seven nutrient management treatments to chickpea, replicated three times in a randomized block design. The results revealed that applying FYM 2.5 t/ha + 100% RDF to chickpea resulted in significantly higher values for nutrient content and uptake by seed and stover and remained at par with application of vermicompost 2.5 t/ha + 75% RDF and bio compost 2.5 t/ha + 75% RDF.

Keywords: Chickpea, FYM, Bio compost, Vermicompost

1. Introduction

Pulses are among the most important crop groups worldwide due to their higher protein content and they also contribute significantly to exports, which results in significant revenues. The main protein sources in the diet of vegetarians are pulses. The chickpea, also known as gram is an annual legume of the Fabaceae family. For millions of people in underdeveloped nations who are primarily vegetarians, particularly in South Asia, chickpea provide a significant source of protein. In addition to this, chickpea is also a source of fibre and minerals like calcium, phosphorus and zinc. Chickpea have the ability to fix atmospheric nitrogen, which contributes significantly to increasing soil fertility. Chickpeas can fix up to 80% of their nitrogen needs through symbiotic nitrogen fixation. Chickpea is grown on 10.91 million hectares in India, producing 13.75 million tons and yielding 1063 kg per hectare (Anon., 2022) [1]. Low pulse yields in India are a result of a number of factors, including a lack of high-quality seeds of improved, short-duration varieties, the use of low input and rain-fed farming methods, moisture stress, ineffective pest and disease management and sloppy post-harvest handling and storage methods. The intensive system of cultivation practices and persistent application of large quantities of synthetic chemical fertilizer without the use of organic manures have changed the physio-chemical condition of soil and nutritional deficiencies of crucial plant nutrients are widespread. In addition to polluting the environment, the indiscriminate and persistent use of chemical fertilizers has negative effects on soil properties. The key objective of integrated nutrient management is to enhance the benefits of all available sources of plant nutrients efficiently while maintaining soil productivity and providing plant elements at an optimum level to support target crop yields. The use of organic manures such as FYM, bio-compost and vermicompost improves soil health by increasing the availability of nutrients, the physical properties of the soil and microbial activity.

2. Materials and Methods

The current study was held at Rajendrapur Farm, NAU, Waghai, on chickpea crop to assess the effect of nutrient management practices on the content and uptake of nutrients by chickpea two consecutive years (2019–20 and 2020–21) during the *rabi* season. Waghai falls under the South Gujarat Heavy Rainfall Zone with a height of 145 meters above MSL. This region has a warm, humid monsoon with heavy rainfall, a moderately hot summer and a fairly cool winter. The soil of the experimental field is classified as Inceptisols, with a sub-group of Haplustept.

The soil was clayey textured, medium in organic carbon (0.63%), low in available N (215.00 kg/ha), medium in available P_2O_5 (35.00 kg/ha), high in available K_2O (310.15 kg/ha) and slightly acidic in reaction (pH 6.9). The chickpea crop was treated with various doses of fertilizers combined with organic manures (FYM, vermicompost and bio compost). The experiment was set up using a randomized block design. Seven treatments, *viz*., T_1 (FYM 2.5 t/ha + 50% RDF), T_2 (FYM 2.5 t/ha + 75% RDF), T_3 (Bio compost 2.5 t/ha + 50% RDF), T_4 (Bio compost 2.5 t/ha + 75% RDF), T_5 (Vermicompost 2.5 t/ha + 50% RDF), T_6 (Vermicompost 2.5 t/ha + 75% RDF), T_7 (FYM 2.5 t/ha + 100% RDF) were applied to chickpea. The desired quantity of organic manures (FYM, bio compost and vermicompost) was calculated and they were applied to the chickpea crop in accordance with the treatments and evenly distributed and mixed in that particular plot. Urea was used to apply nitrogen, while SSP was used to apply phosphorus. Representative seed samples from each treatment were obtained, dried for 24 hours in an oven and powdered with a mechanical grinder. Nitrogen, phosphorus and potassium contents from seed, stover and fodder were estimated using standard procedures given by Jackson (1973) [5]. The nutrient (N, P_2O_5 and K_2O) uptake was calculated using the formula below:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%)}}{100} \times \text{Biomass (kg/ha)}$$

The chickpea variety GG 5 was chosen for the experiment and 30 cm X 10 cm spacing was used for sowing at a rate of 60 kg/hectare.

3. Results and Discussion

3.1 N content and uptake

The results summarized in Tables 1 and 2 stated that treatment T_7 registered significantly higher N content in seed and was found at par with T_6, T_4 and T_2 during individual years. However, in pooled studies, it was found statistically equal with T_6 and T_4 only. The treatment T_7 recorded significantly higher values of N content (Stover) and remained at par with T_6 and T_4 during both years of experimentation and in pooled studies. The data summarized in Tables 3 and 4 indicated that the application of treatment T_7 resulted in significantly higher N uptake by chickpea (seed and stover) and was found statistically similar with treatments T_6 and T_4 during individual years and in pooled studies. The incorporation of nitrogen from both inorganic and organic materials led to a rise in nitrogen content. Integrating manures and fertilizers led to the formation of clay-humus components in the soil, which promoted increased and more sustained crop nitrogen availability. Similar outcomes were also witnessed by Duhan (2013) [4], Dixit *et al*. (2015) [3], Mansuri *et al*. (2016) [9], Singh *et al*. (2017) [12], Kemal *et al*. (2018) [8], Chaudhari (2019) [2] and Jakhar *et al*. (2020) [6] in chickpea.

3.2 P_2O_5 content and uptake

The information in Tables 1 and 2 showed that the application of T_7 resulted in higher P_2O_5 content in chickpea (seed) and was found statistically similar with T_6 and T_4 during years and pooled analysis. P_2O_5 content in stover was significantly higher under treatment T_7, which remained at par with treatments T_6 and T_4 during the first year and in a pooled analysis, however, in second year, it was found at par with treatments T_6, T_4 and T_2. Treatment T_7 recorded higher P_2O_5 uptake by chickpea and remained at par with treatments T_6 and T_4 for both years and in the pooled analysis. The treatment T_1 recorded significantly lower P_2O_5 content and uptake (seed and stover) in individual years and in the pooled studies (Tables 3 and 4). An increase in phosphorus content may be the result of increased phosphorus availability to plants as a result of increased fertilizer levels and increased supplies of organic manure. Chaudhary (2016) [2], Kemal *et al*. (2018) [8], Patel (2020) [11], Jakhar *et al*. (2020) [6] and Parmar (2022) [10] also observed similar results in chickpea

3.3 K_2O content and uptake

The results (Tables 1 and 2) showed that the application of various treatments failed to exert a significant effect on the K_2O content in the seed and stover of chickpea during the first and second years, as well as in the pooled results. Whereas the K_2O uptake by chickpea was significantly impacted by various nutrient management treatments. The application of T_7 resulted in significantly higher K_2O uptake by chickpea (seed and stover) during 2019-20, 2020-21 and in pooled results and was found at par with T_6 and T_4 (Tables 3 and 4). Significantly lower K_2O uptake in seed and stover was observed with the application of treatment T_1 during both years of research and in pooled studies. Similar trends were also noticed by Patel (2020) [11] in chickpea and Joshi *et al*. (2020) [7] in green gram.

Table 1: Nutrient content of chickpea (seed) as influenced by different treatments

Treatment	N content (%)			P2O5 content (%)			K2O content (%)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	3.037	2.918	2.977	0.464	0.478	0.471	0.564	0.662	0.613
T_2	3.233	3.183	3.208	0.520	0.528	0.524	0.597	0.679	0.638
T_3	3.170	3.070	3.120	0.502	0.514	0.508	0.587	0.664	0.626
T_4	3.385	3.361	3.373	0.551	0.576	0.563	0.600	0.675	0.638
T_5	3.183	3.104	3.144	0.510	0.520	0.515	0.577	0.686	0.631
T_6	3.416	3.393	3.404	0.571	0.561	0.566	0.621	0.688	0.655
T_7	3.463	3.490	3.477	0.594	0.597	0.596	0.626	0.692	0.659
S.Em+	0.086	0.102	0.067	0.023	0.021	0.015	0.029	0.047	0.027
CD (P=0.05)	0.266	0.313	0.195	0.070	0.064	0.045	NS	NS	NS
CV (%)	4.58	5.48	5.04	7.38	6.70	7.04	7.10	11.02	9.38
Interaction (Y x T)									
S.Em±	0.094			0.022			0.040		
CD (P=0.05)	NS			NS			NS		

Table 2: Nutrient content of chickpea (stover) as influenced by different treatments

Treatment	N content (%)			P2O5 content (%)			K2O content (%)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	1.12	1.17	1.15	0.237	0.246	0.241	0.816	0.837	0.827
T_2	1.20	1.25	1.22	0.273	0.284	0.279	0.826	0.858	0.842
T_3	1.18	1.22	1.20	0.264	0.273	0.269	0.825	0.849	0.837
T_4	1.28	1.31	1.30	0.307	0.319	0.313	0.837	0.860	0.848
T_5	1.22	1.23	1.22	0.270	0.271	0.270	0.830	0.841	0.835
T_6	1.31	1.32	1.31	0.316	0.309	0.312	0.839	0.872	0.855
T_7	1.35	1.37	1.36	0.31	0.324	0.32	0.841	0.876	0.858
S.Em+	0.039	0.038	0.027	0.014	0.015	0.010	0.024	0.017	0.015
CD (P=0.05)	0.121	0.118	0.080	0.044	0.047	0.030	NS	NS	NS
CV (%)	5.50	5.20	5.35	8.78	9.13	8.96	5.04	3.49	4.31
Interaction (Y x T)									
S.Em±	0.038			0.014			0.021		
CD (P=0.05)	NS			NS			NS		

Table 3: Nutrient uptake by chickpea (seed) as influenced by different treatments

Treatment	N uptake (kg/ha)			P_2O_5 uptake (kg/ha)			K_2O uptake (kg/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	61.70	57.82	59.76	9.49	9.39	9.44	11.47	13.16	12.31
T_2	75.30	74.10	74.70	12.11	12.24	12.18	13.99	15.73	14.86
T_3	67.24	70.22	68.73	10.68	11.71	11.20	12.40	15.20	13.80
T_4	91.15	89.87	90.51	14.87	15.44	15.16	16.18	18.05	17.11
T_5	73.02	70.30	71.66	11.68	11.75	11.72	13.25	15.58	14.42
T_6	93.73	91.27	92.50	15.69	15.11	15.40	17.06	18.51	17.79
T_7	95.36	94.66	95.01	16.42	16.21	16.31	17.30	18.74	18.02
S.Em+	3.50	4.84	2.99	0.978	0.70	0.60	1.02	0.94	0.69
CD (P=0.05)	10.80	14.91	8.72	3.01	2.16	1.75	3.14	2.91	2.03
CV (%)	7.62	10.70	9.26	13.04	9.26	11.29	12.14	9.90	10.95
Interaction (Y x T)									
S.Em±	4.22			0.85			0.98		
CD (P=0.05)	NS			NS			NS		

Table 4: Nutrient uptake by chickpea (stover) as influenced by different treatments

Treatment	N uptake (kg/ha)			P_2O_5 uptake (kg/ha)			K_2O uptake (kg/ha)		
	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled	2019-20	2020-21	Pooled
T_1	35.95	36.08	36.01	7.55	7.53	7.54	26.14	25.62	25.88
T_2	42.07	45.61	43.84	9.58	10.35	9.96	29.16	31.37	30.26
T_3	38.51	42.47	40.49	8.60	9.45	9.03	26.70	29.53	28.11
T_4	49.62	49.93	49.77	11.77	12.13	11.95	32.16	32.64	32.40
T_5	41.70	42.70	42.20	9.23	9.33	9.28	28.37	29.04	28.71
T_6	50.83	50.68	50.76	12.26	11.77	12.01	32.35	33.30	32.83
T_7	55.19	57.65	56.42	13.15	13.45	13.30	34.47	36.46	35.47
S.Em+	2.925	2.799	2.024	0.777	0.543	0.474	1.62	1.55	1.12
CD (P=0.05)	9.012	8.626	5.908	2.395	1.672	1.383	5.01	4.78	3.28
CV (%)	11.30	10.44	10.86	13.06	8.89	11.12	9.41	8.63	9.01
Interaction (Y x T)									
S.Em±	2.86			0.67			2.10		
CD (P=0.05)	NS			NS			NS		

4. Conclusion

Two years of research have revealed that chickpea fertilized with biocompost 2.5 t/ha along with 75% RDF (15:30:00 N:P_2O_5:K_2O kg/ha) is advantageous in terms of content and nutrient uptake.

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