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SK Parmar
Department of Agronomy, NM College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

HM Virdia
Department of Agronomy, NM College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

RM Pankhaniya
Department of Agronomy, NM College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Corresponding Author:
SK Parmar
Department of Agronomy, NM College of Agriculture, Navsari Agricultural University, Navsari, Gujarat, India

Response of integrated nutrient management on growth and yield of chickpea (*Cicer arietinum* L.)

SK Parmar, HM Virdia and RM Pankhaniya

Abstract
Field experiments were conducted at Navsari (Gujarat) during *rabi* 2019-20 and 2020-21 to evolve an integrated nutrient management strategy for chickpea. The experiment was laid out in randomized block design and replicated three times. The trial consist of nine treatments *viz.,* T_1 - (Control), T_2 - (Bio compost 2.5 t/ha), T_3 - Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS), T_4 - (50% RDF + Bio compost 2.5 t/ha), T_5 - (50% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS), T_6 - (75% RDF + Bio compost 2.5 t/ha), T_7 - (75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS), T_8 - (100% RDF (20-40-00, N-P_2O_5-K_2O kg/ha), T_9 - (Fallow). Plot receiving 75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS (T_7) gave significantly superior periodical plant height, number of branches per plant, dry matter accumulation, number of pods per plant, seed yield and stover yield.

Keywords: Biocompost, banana pseudostem enriched sap, chickpea, seed yield, stover yield

Introduction
Chickpea is the most important *rabi* pulse crop. In India pulses have low productivity when compared to other country's productivity. Lack of a balanced application of nutrients, improper management, and other factors may be to blame for low chickpea output. In India, chickpea are grown in an area of 10.56 million hectares with total production of 11.23 million tonnes with productivity of 1063 kg per hectare. While in Gujarat, chickpea is grown in an area of 0.29 million hectares producing 0.37 million tonnes with the productivity of 1253 kg per hectare (Anon., 2018) [1]. Chickpea productivity can be increased by giving the plant the proper nutrition, especially through organic nutrition, which is a crucial natural resource for any pulse production. The most important and costly inputs in crop production are fertilisers like nitrogen and phosphorus. The growth and development of plants are highly related to the availability of chemical fertilisers. Only using chemical fertilisers on a regular basis degrades soil quality, which hinders the response of agricultural inputs and makes crop output unsustainable. In this experiment as an organic sources use of biocompost and banana pseudostem sap. Biocompost is mass of rotted organic matter made up of decomposed plant debris, which contains 1.08-1.13% N, 0.80-0.86% P_2O_5 and 0.98-0.95% K_2O. The liquid obtained from the separation of fibers from the banana pseudo stem is known as banana pseudo stem sap. Banana pseudostem enriched sap has contain macro and micro nutrients *viz*., N (620 mg/l) P (181.4 mg/l) K (1800.0 mg/l), Ca (310.0 mg/l), Mg (920.0 mg/l), S (100.2 mg/l), Fe (109.3 mg/l), Mn (5.73 mg/l), Zn (2.92 mg/l), Cu (0.40 mg/l). It has plat growth hormones such as cytokinin, gibberellic acid, IAA, Urease activity and total phenol. It has also present microbes populations like *Rhizobium*, *Azotobacter*, PSB, fungal count and total viable count (Desai C. S. *et al*. (2016) [2].
Hence, to combat this problem and to sustain production the present investigation was carried out to find out appropriate integrated nutrient management including inorganic fertilizers, biocompost and banana pseudostem enriched sap as foliar spray for chickpea.

Materials and Methods
The investigation was conducted on assessment of integration of organic and inorganic sources of nutrients on growth and yield of chickpea **c**omprise of a field experiment which was carried out at college farm, N.M. College of Agriculture, Navsari Agricultural University, Navsari during *rabi* season 2019-20 and 2020-21. The soils of south Gujarat is locally known as "Deep Black Soil". According to its agro-climatic conditions, Navsari falls under south Gujarat

Heavy Rainfall Zone I. The climate of this region is typically tropical monsoon type characterized by three well defined seasons *viz*., warm and humid monsoon with heavy rainfall, moderately cold winter. Healthy seeds of chickpea GG-5 was procured from Mega Seed, Main Pulses Research Unit, Navsari Agricultural University, Navsari. GG-5 was moderately resistant with wilt and resistant stunt. The experimental plot was ploughed and fine seedbed was prepared by subsequent harrowing with tractor drawn harrow in both directions, followed by planking. Irrigation channels were prepared by V-ditcher. Layout plan of *rabi* chickpea with random allocation of all treatments. The application of fertilizers, biocompost and banana psedostem enriched sap (1% spray) were done as per treatments. The nitrogen was applied through urea and phosphorus was applied through single superphosphate. The desired quantity of bio compost was worked out as per treatments and uniformly spread and mixed in particular plots before sowing. The biometric observations were recorded on five randomly selected plants from the net plot. These plants were labelled with proper notations and used for recording the observations.

Results and Discussion

From the data (Table 1), it could be seen that the plant height of chickpea increased with advancing crop age during both the years. Different treatments exert their significant effect on plant height during individual years. At 60 DAS significantly higher plant height (37.92 and 38.00 cm) was observed with treatment (T_7) application of 75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS during both the years, respectively. However, treatments T_5 (50% RDF + Bio compost 2.5 t/ha + Bananapseudostem enriched sap (1% spray) at 30 DAS and 45 DAS), T_6 (75% RDF + Bio compost 2.5 t/ha) and T_8 (100% RDF) were found at par during the year 2019-20 and 2020-21. Moreover, at harvest significantly the higher plant height was recorded with treatment T_7 during both the years. However, treatments T_6 and T_8 were found statistically at par during the both the years. The higher plant height observed in treatment T_7 might be due to combine use of organic manure and inorganic fertilizers improve the availability of nutrients. Thus, greater availability of nutrients from an early stage was reflected in improved growth of crop. At 60 DAS, number of branches per plant (10.00 and 10.33) were observed significantly higher with treatment (T_7) application of 75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS during individual years. Treatments T_5 (50% RDF + Bio compost 2.5 t/ha + Bananapseudostem enriched sap (1% spray) at 30 DAS and 45 DAS), T_6 (75% RDF + Bio compost 2.5 t/ha) and T_8 (100% RDF) were found statistically at par with treatment T_7 during first year of study. Same trends were observed during second year except treatment T_5. At harvest, significantly higher number of branches (13.53 and 13.73) per plant was seen under (T_7) during both the years. Treatments T_6 and T_8 were remain at par with treatment T_7 during first year of study, where in case of second year of experimentation, treatments T_5, T_6 and T_8 remained significantly at par with treatment T_7. Dry matter accumulation per plant at 60 DAS and at harvest were found significantly higher in both the years with application of 75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS (T_7) which was found statistically at par with application of 75% RDF + Bio compost 2.5 t/ha (T_6) during both the years. Increasing dry matter accumulation observed in treatment T_7 probably due to improvement in soil conditions and availability of nutrients during growth and development stages under this treatment. Application of 75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS (T_7) resulted in higher number of pods per plant (68.20 and 66.47) in both the years which was found statistically at par with treatments T_6 during first year. More number of seeds per pod was observed under T_7 and less seeds per pod observed in treatment T_1 during individual years as well as pooled data. Numerically higher seed index of chickpea (21.25 and 21.00) was observed under the treatment T_7 during both the year. The lower value of plant height, number of branches per plant, dry matter accumulation, number of pods per plant, number of seeds per pod and seed index of chickpea observed under the treatment control (T_1) during the both the years. The data on seed yield and stover yield of *rabi* chickpea as influenced by different INM treatments are presented in Table 2. It can be seen that seed yield and stover yield were significantly influenced by various INM treatments. In first year of experimentation, application of 75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS (T_7) registered the significantly higher yield and stover yield remained statistically at par with treatments 75% RDF + Bio compost 2.5 t/ha (T_6) in during first and second year. The increased availability of nutrients due to combined application of organics and inorganic resulted in better absorption, translocation and assimilation of nutrients. Better partitioning of photosynthates between source and sink led to greater assimilation of dry matter in the reproductive or fruiting parts which resulted on improvement of yield attributing characters and ultimately yield. The results support to the findings of Singh *et al*. (2012) [9], Patil *et al*. (2012) [8], Singhal *et al*. (2015), Mansuri *et al*. (2016) [5], Yadav *et al*. (2017) [11], Kumar *et al*. (2018) [4], Patel (2020) [6] and Sodavadiya (2021) in chickpea crop.

Table 1: Periodical plant height, number of branches per plant and dry matter accumulation of chickpea as influenced by different INM treatments.

Treatments	Plant height (cm)				Number of branches per plant				Dry matter accumulation (g/plant)			
	60 DAS		At harvest		60 DAS		At harvest		60 DAS		At harvest	
	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2
T_1: Control	27.37	27.33	40.58	39.33	5.73	6.00	8.07	8.07	8.84	7.87	25.36	24.50
T_2: Bio compost 2.5 t/ha	30.80	31.22	42.87	41.80	7.00	7.73	9.73	9.47	9.09	9.62	26.64	26.30
T_3: Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS	31.33	33.40	44.83	43.08	8.07	7.67	10.40	10.33	9.50	9.99	28.32	28.67
T_4: 50% RDF + Bio compost 2.5 t/ha	31.83	32.33	43.53	43.67	8.40	8.80	10.47	10.00	10.19	9.83	29.82	29.47

T_5: 50% RDF + Bio compost 2.5 t/ha + Bananapseudostem enriched sap (1% spray) at 30 DA Sand 45 DAS	33.50	33.32	45.27	44.00	8.67	8.80	10.80	11.60	10.88	10.13	31.53	30.82
T_6: 75% RDF + Bio compost 2.5 t/ha	36.00	34.99	49.00	48.33	8.87	10.00	12.13	13.00	11.18	10.94	35.64	32.25
T_7: 75% RDF + Bio compost 2.5 t/ha + Bananapseudostem enriched sap (1% spray) at 30 DAS and 45 DAS	37.92	38.00	50.47	50.16	10.00	10.33	13.53	13.73	12.42	12.54	37.67	36.18
T_8: 100% RDF (20-40-00, N-P_2O_5-K_2Okg/ha)	33.90	32.92	49.42	47.17	8.53	9.47	11.80	12.73	10.39	10.33	33.00	30.74
SEm±	1.54	1.81	1.62	1.83	0.51	0.47	0.58	0.70	0.49	0.54	1.38	1.35
CD(P = 0.05)	4.66	5.48	4.90	5.56	1.55	1.43	1.75	2.14	1.47	1.63	4.17	4.09
CV (%)	8.11	9.50	6.12	7.10	10.84	9.52	9.17	10.97	8.16	9.18	7.68	7.82

Table 2: Number of pods per plant, number of seeds per pod seed index, seed yield and stover yield of chickpea as influenced by different INM treatments.

Treatments	No. of pods per plant		No. of seeds per pod		Seed index (%)		Seed yield (kg/ha)		Stover yield (kg/ha)	
	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2	Y-1	Y-2
T_1: Control	42.27	40.73	1.07	1.07	19.67	19.33	1457	1414	2851	2748
T_2: Bio compost 2.5 t/ha	51.87	47.47	1.13	1.07	20.24	19.67	1515	1560	2846	3001
T_3: Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS	53.33	49.80	1.20	1.20	20.31	20.00	1586	1592	3013	2883
T_4: 50% RDF + Bio compost 2.5 t/ha	54.00	52.87	1.27	1.20	20.27	20.52	1738	1683	3240	3041
T_5: 50% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS	57.20	55.07	1.27	1.27	20.37	20.22	1897	1796	3409	3291
T_6: 75% RDF + Bio compost 2.5 t/ha	61.60	58.13	1.33	1.33	21.12	20.79	2101	2068	3668	3717
T_7: 75% RDF + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS	68.20	66.47	1.33	1.33	21.25	21.00	2370	2383	4139	4201
T_8: 100% RDF (20-40-00, N-P_2O_5-K_2Okg/ha)	55.57	56.67	1.33	1.27	21.10	19.91	1977	1991	3536	3618
SEm±	2.69	2.52	0.06	0.06	0.37	0.58	116	107	265	248
CD (P = 0.05)	8.17	7.66	NS	NS	NS	NS	352	325	805	751
CV (%)	8.41	8.19	8.63	8.41	3.11	4.95	10.97	10.26	13.77	12.95

Conclusion

On the basis of two years experimentation, It can be concluded that, *rabi* chickpea crop should be fertilized with 75% RDF (15-30-00 N-P_2O_5-K_2O kg/ha) + Bio compost 2.5 t/ha + Banana pseudostem enriched sap (1% spray) at 30 DAS and 45 DAS for getting favourable growth and yield.

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