Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2020; 9(6): 798-802
Received: 05-09-2020
Accepted: 07-10-2020

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Impact of conventional and biodynamic compost on chemical and biological properties of soil in chickpea

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Abstract

A field experiment was conducted to study the impact of conventional and biodynamic compost on chemical and biological properties of soil in chickpea, during rabi 2017-18 on the field of Agronomy farm section, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. It was low in available nitrogen and phosphorus and medium in organic carbon, high in available potassium and alkaline in reaction. The experiment was laid out in randomized block design with seven treatments and three replications. Treatments consisted of application of compost *viz.*, Control (T_1), BD compost 5 t ha^{-1} (T_2), T_2 + Soil conditioner 500 (T_3), T_2 + Soil conditioner 501 (T_4), T_2 + Soil conditioner 500 + 501 (T_5), FYM 5 t ha^{-1} (T_6) and Vermicompost 2.5 t ha^{-1} (T_7). The results of experiment showed that among chemical properties of soil pH, EC, organic carbon and available NPK significantly influenced by different treatment. The significantly lowest pH, EC and highest organic carbon were found with application of vermicompost 2.5 t ha^{-1}. Similarly, available NPK was found maximum in treatment vermicompost 2.5 t ha^{-1}. The microbial count *viz.*, fungi, bacteria, actinomycetes population in rhizosphere of chickpea was found maximum with application of vermicompost 2.5 t ha^{-1}. However, the minimum microbial population in rhizosphere of chickpea was recorded with the control (T_1).

Keywords: Chickpea, vermicompost, biodynamic, FYM

1. Introduction

Chickpea *(Cicer arietinum* L.) is the major food legume. It belongs to family Fabaceae (Leguminosae), sub family faboideae, genus Cicer and species arietinum. Chickpea (*Cicer arietinum* L.) is known by its different names like Bengal gram in English and Chana in Hindi. It is an importance source of protein in vegetarian diet and become more important to mitigate the problem of protein energy malnutrition (Prasad, 2012). In addition to having high protein content (20 - 22%), chickpea is rich in fiber, minerals (phosphorus, calcium, magnesium, iron and zinc) and □-carotene. Its lipid fraction is rich in unsaturated fatty acids. Chickpea crop meets 80% of its nitrogen (N) requirement from symbiotic nitrogen fixation and can fix up to 140 kg N ha^{-1} from atmosphere. The area under chickpea in India was 9.54 million hectares with production of 9.08 million tones with an average productivity of 951 Kg ha^{-1} in 2016-17 (Anonymous 2017) [1].

The use of organic manure has been the traditional means of maintaining soil fertility. Most of organic compost provides balance sources of nutrients for crops. Compost has a great influence on plant growth like any other commercial fertilizer. These, compost contain in small amount of nutrients, therefore the quantity requirement of these organic sources is more to fulfil the crop needs. Besides, the major nutrients, compost also contain traces of micro-nutrients and also provide food for soil microorganisms. This increases activity of microbes which help to convert unavailable plant nutrient into available and fixing the atmospheric nitrogen (Borey, 2016) [2]. Biodynamic farming is practiced on a commercial scale in many countries and is gaining wider recognition for its contributions to organic farming, food quality, community supported agriculture and qualitative tests for soils and composts from a practical view point biodynamics is proven to be productive and yield nutritious, high quality foods (Steve Diver, 1999) [5].

Organic farming production system aims at promoting and enhancing agro-ecosystem health, biodiversity, biological cycles and soil biological activities. Management of soil organic matter is very important to maintain a productive organic farming system. The application of organic sources *viz.*, FYM, vermicompost, biodynamics and other non-monetary inputs are very well to know to improve the physical, chemical, and biological properties of soil. These organic sources contain balance nutrient and capacity to release fixed nutrient which required by crops.

Keeping this background in view, an attempt was made to study the impact of conventional and biodynamic compost on chemical and biological properties of soil in chickpea.

2. Materials and Methods

A field experiment was carried out at Agronomy farm at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, during rabi 2017-18. The soil of experimental plot was clayey in texture. It was low in available nitrogen and phosphorus and medium in organic carbon, high in available potassium and alkaline in reaction. The experiment was laid out in randomized block design with seven treatments and three replications. The gross plot size was 5.60 m x 6 m. Treatments consisted of application of compost *viz*., Control (T_1), BD compost 5 t ha^{-1} (T_2), T_2 + Soil conditioner 500 (T_3), T_2 + Soil conditioner 501 (T_4), T_2 + Soil conditioner 500 + 501 (T_5), FYM 5 t ha^{-1} (T_6) and Vermicompost 2.5 t ha^{-1} (T_7). Organic manure was applied to all treatments before sowing by broadcasting method. Chickpea variety (JAKI-9218) was sown on 6th November, 2017 and harvested at 22nd February 2018 at a row spacing of 45 cm x 5 cm. Seed of gram treated with S9 culture @ 30 g kg^{-1} and other seed was inoculated with Rhizobium and PSB culture @ 250 g 10 kg^{-1} seed just before sowing. The Organic manure was applied to all treatments before sowing by broadcasting method and other crop management practices were performed as per recommended package of practices.

The observations on growth, yield and yield attributes like number of pods $plant^{-1}$, weight of pods $plant^{-1}$ and seed weight $plant^{-1}$ were taken on five randomly selected plants from each treatment at harvest. After harvest and threshing of crop, seed yield was recorded in net plot wise and converted to grain yield per hectare basis. Data were analyzed by ANOVA at critical difference (CD) p = 0.05 to determine the significance among the treatment means as suggested by Gomez and Gomez (1984).

3. Results and Discussion

3.1 Chemical analysis

3.1.1 pH

pH in soil after harvest of chickpea is presented in Table (1). It is the negative logarithm of hydrogen ion concentration which indicates the acidity or alkalinity of soil. pH of soil was found statistically significant due to application of compost. The higher value of pH was recorded in control (T_1) treatment. Significantly lower pH was recorded with vermicompost 2.5 t ha^{-1} (T_7). The slightly pH was decrease might be due to direct incorporation of organic sources was undergone decomposition and released of organic acid like carbonic acid and add organic matter to the soil. Similar finding was reported by Tharmaraj *et al*. (2010) [6].

Table 1: ph, electrical conductivity (dS m^{-1}) and organic carbon (g kg^{-1}) of soil after harvest as influenced by various treatments

Treatment		pH	EC (dS m^{-1})	OC (g kg^{-1})
T_1	Control	8.25	0.31	4.8
T_2	BD compost 5 t ha^{-1}	8.19	0.30	5.2
T_3	T_2 + soil conditioner 500	8.16	0.29	5.3
T_4	T_2+ soil conditioner 501	8.14	0.27	5.5
T_5	T_2 + soil conditioner 500 + 501	8.11	0.25	5.6
T_6	FYM 5 t ha^{-1}	8.13	0.30	5.4
T_7	Vermicompost 2.5 t ha^{-1}	8.09	0.24	5.7
S.E (m) ±		0.03	0.011	0.010
CD at 5 %		0.10	0.03	0.03
GM		8.15	0.28	5.35
Initial status		8.26	0.32	5.4

3.1.2 Electrical conductivity (dS m^{-1})

The EC in soil after harvest of chickpea is presented in Table (1). EC is a measure of soluble salt concentration in soil. The higher amount of salts in the soil restricts the nutrients uptake and thus affects the plant growth. The lower electrical conductivity (0.24 dSm^{-1}) was recorded with application of vermicompost 2.5 ton ha^{-1} (T_7). The vermicompost will leave some acidic effect which not only nullifies negative effect of salinity but also improve availability and translocation of nutrient in system. Similar finding was reported by Tharmaraj *et al*. (2010) [6].

3.1.3 Organic carbon (g kg^{-1})

The organic carbon content in soil after harvest of chickpea is presented in Table (1) of soil as significantly influenced by application of compost. The highest organic carbon was recorded with application of vermicompost 2.5 t ha^{-1} (5.7 g kg^{-1}) (T_7) as compare to the control (4.8) (T_1). The slightly O.C. was increased as compared to initial due incorporation of organic sources was undergone decomposition and released of organic acid like carbonic acid and add organic matter to the soil. Singh *et al.*, (2014) [4] reported that similar result.

3.2 Available nitrogen, phosphorus, potassium in the soil after harvest

3.2.1 Available nitrogen in the soil after harvest

The data on available nutrient status of soil influenced by various treatment are presented in Table 2. The mean of available N, P and K was found 210.63, 13.86 and 309 kg ha^{-1} respectively in soil after harvest of chickpea crop. The maximum available nitrogen status of soil after harvest of chickpea was significantly increased with the use of organic sources. The available nitrogen in soil varied from 207 to 221.09 kg ha^{-1} indicating that soil was low in available nitrogen. The maximum available nitrogen (221.09 kg ha^{-1}) was observed with application of vermicompost 2.5 t ha^{-1} (T_7) and lower values of available nitrogen found in control. The favorable condition under vermicompost addition might have help in the mineralization of Nitrogen. Addition of organic sources, availability of nutrient increased some extended as a compare to initial due to mineralization of native soil as well as own nutrients contents when added. Similar result was reported by Singh *et al.*, (2014) [4] and Kademani *et al.* (2003).

Table 2: Available nitrogen, phosphorus and potassium as influenced by various treatments

Treatment		Available N (kg ha^{-1})	Available P (kg ha^{-1})	Available K (kg ha^{-1})
T_1	Control	207.00	13.63	306.90
T_2	BD compost 5 t ha^{-1}	214.84	14.80	312.36
T_3	T_2 + soil conditioner 500	213.14	14.57	314.66
T_4	T_2 + soil conditioner 501	216.41	15.60	316.55
T_5	T_2 + soil conditioner 500 + 501	217.68	15.85	317.84
T_6	FYM 5 t ha^{-1}	215.11	14.85	318.31
T_7	Vermicompost 2.5 t ha^{-1}	221.09	17.29	321.04
S.E (m) ±		1.44	0.62	1.32
CD at 5 %		4.44	1.93	4.08
GM		215.04	15.23	315.98
Initial status		210.63	13.86	309.54

3.2.2 Available phosphorus in the soil after harvest
The available phosphorus content of soil varied significantly and it ranged from 13.63 to 17.29 kg ha^{-1} presented in Table 2. Indicating that soil was low in available phosphorus content.

3.2.3 Available potassium in the soil after harvest
The highest available potassium was found with application of vermicompost 2.5 t ha^{-1} (321.04 kg ha^{-1}) (T_7) which was at par with BD compost 5 t ha^{-1} + soil conditioner 500+ 501. (317.84 kg ha^{-1}) (T_5) and lowest value of available potassium was noticed in control (306.90 kg ha^{-1}) (T_1).

3.3 Nutrient content and uptake by chickpea
3.3.1 Nitrogen content in seed and straw (%)
The data presented in Table 3 revealed that, the nitrogen content. The mean N content was 2.77% and 1.54% in seed and straw respectively. There is no significance difference occur in nitrogen content in grain and straw due to application of compost.

Table 3: Nitrogen content and its uptake by chickpea as influenced by various treatments

Treatments		N content (%)		N uptake (kg ha^{-1})		
		Seed	Straw	Seed	Straw	Total
T_1	Control	2.67	1.42	43.61	23.19	66.80
T_2	BD compost 5 t ha^{-1}	2.66	1.46	56.99	31.18	88.17
T_3	T_2 + soil conditioner 500	2.74	1.48	60.41	32.84	93.25
T_4	T_2+ soil conditioner 501	2.80	1.58	65.39	37.08	102.47
T_5	T_2 + soil conditioner 500 + 501	2.81	1.62	68.76	39.49	108.25
T_6	FYM 5 t ha^{-1}	2.75	1.54	57.50	32.37	89.87
T_7	Vermicompost 2.5 t ha^{-1}	2.99	1.65	70.64	39.25	109.89
SE (m) ±		0.13	0.05	3.61	2.65	5.83
CD at 5%		NS	NS	11.13	8.18	17.99
GM		2.77	1.54	60.47	33.63	94.10

3.3.2 Nitrogen uptake (kg ha^{-1})
The data in respect to nitrogen uptake by grain, straw and total uptake is presented in Table 3. Nitrogen uptake by the crop was found to be significantly influenced by various organic sources. Maximum nitrogen uptake was found with treatment vermicompost 2.5 t ha^{-1} T_7 (109.89 kg ha^{-1}) which was at par withT_2 + Soil conditioner 500 + 501 (T_5) (108.25 kg ha^{-1}) and the minimum nitrogen uptake was found in control (T1). The higher uptake of nitrogen might be due reported that microorganisms in the worm casts may fix atmospheric N in quantities that are significant for the earthworm metabolism and as a source of nitrogen for plant growth. The present findings corroborate with that of Jat and Ahlawat (2004) [3] and Singh *et al.* (2014) [4].

3.3.3 Phosphorus content in seed and straw
The data presented in Table 4 revealed that, the values of nitrogen content. The mean phosphorus content in grain and straw was 0.31% and 0.21% respectively. There is no significance difference occur in phosphorus content in grain and straw due to application of compost.

Table 4: Phosphorus content and its uptake by chickpea as influenced by various treatments

Treatment	P content (%)			P uptake (kg ha^{-1})		
	Seed		Straw	Seed	Straw	Total
T_1	Control	0.28	0.17	3.08	2.83	5.90
T_2	BD compost 5 t ha^{-1}	0.29	0.18	4.31	3.92	8.23
T_3	T_2 + soil conditioner 500	0.29	0.20	4.39	4.52	8.91
T_4	T_2+ soil conditioner 501	0.31	0.21	4.89	4.89	9.79
T_5	T_2 + soil conditioner 500 + 501	0.33	0.23	5.66	5.70	11.36
T_6	FYM 5 t ha^{-1}	0.32	0.21	4.93	4.45	9.38
T_7	Vermicompost 2.5 t ha^{-1}	0.34	0.25	6.24	5.83	12.07
S.E (m) ±	0.02		0.018	0.37	0.54	0.54
CD at 5%	NS		NS	1.15	1.68	1.67
GM	0.31		0.21	4.79	4.59	1.67

3.3.4 Phosphorus uptake (kg ha^{-1})
The data in respect to phosphorus uptake by grain, straw and total uptake is presented in Table 4. Phosphorus uptake by the crop was found to be significantly influenced by various organic sources. Maximum phosphorus uptake was found with treatment vermicompost 2.5 ton ha^{-1} (T_7) (12.07 kg ha^{-1}) over rest of treatments and the minimum nitrogen uptake was found in control (5.90 kg ha^{-1}) (T_1). This result might be due the progressively released nutrients by vermicompost into the rhizosphere provide the appropriate conditions for plant uptake and exchangeable P in vermicompost are present in readily available forms for plant uptake. Singh *et al*., (2014) [4] have also reported the similar result for increasing phosphorus uptake.

3.3.5 Potassium content in grain and straw
Potassium uptake in grain, straw and total uptake is presented in Table 5. The mean potassium content in grain and straw was 1.07 % and 1.41% respectively. There is no significance difference occur in potassium content in grain and straw due to application of compost.

Table 5: Potassium content and its uptake by chickpea as influenced by various treatments

Treatment		K content (%)		K uptake (kg ha^{-1})		
		Seed	Straw	Seed	Straw	Total
T_1	Control	1.03	1.31	11.49	21.41	32.90
T_2	BD compost 5 t ha^{-1}	1.05	1.33	15.58	28.48	44.06
T_3	T_2 + soil conditioner 500	1.06	1.37	16.01	30.43	46.44
T_4	T_2+ soil conditioner 501	1.08	1.39	17.13	32.73	49.86
T_5	T_2 + soil conditioner 500 + 501	1.09	1.51	18.85	36.94	55.79
T_6	FYM 5 t ha^{-1}	1.05	1.38	16.02	29.22	45.24
T_7	Vermicompost 2.5 t ha^{-1}	1.14	1.60	21.05	37.80	58.85
S.E (m) ±		0.05	0.07	1.67	3.13	4.13
CD at 5%		NS	NS	5.17	9.96	12.74
GM		1.07	1.41	16.59	31.00	47.59

3.3.6 Potassium uptake (kg ha^{-1})
Phosphorus uptake in grain, straw and total uptake is presented in Table 5. Maximum potassium uptake was found with treatment vermicompost 2.5 ton ha^{-1} (58.85 kg ha^{-1}) (T_7) which was at par with followed by BD compost + soil conditioner 500 + 501 (T_5). The minimum nitrogen uptake was in control (T_1).

3.2 Microbial study
It well known fact that soil harbors a vast of living organisms. Application of organic nutrients sources favorably help in augmentation of beneficial microbial population in soil and their activity such as organic matter decomposition, biological nitrogen fixation and availability of all plant nutrients. Microbial count in rhizosphere of chickpea as influenced by various treatments is presented in Table 6 Count of bacteria, fungi and actinomycetes was found highest with application of vermicompost 2.5 t ha^{-1} (T_7) and lowest microbial population in control (T_1). Vermicompost application increased the biological activity in soil thus which reflects in encourages the microbial population *viz*., bacteria, fungi and actinomycetes.

Table 6: Microbial count (CFU g^{-1} soil) in rhizosphere of chickpea as influenced by various treatments

Treatment		Bacteria 10^7 CFU g^{-1} soil	Fungi 10^4 CFU g^{-1} soil	Actinomycetes 10^6 CFU g^{-1} soil
T_1	Control	26	13	19
T_2	BD compost 5 t ha^{-1}	29	15	22
T_3	T_2 + soil conditioner 500	36	19	24
T_4	T_2 + soil conditioner 501	30	14	20
T_5	T_2 + soil conditioner 500 + 01	37	20	27
T_6	FYM 5 t ha^{-1}	30	16	23
T_7	Vermicompost 2.5 t ha^{-1}	39	23	29
GM		32	17	23

4. Conclusion
In general, the application of vermicompost 2.5 t ha^{-1} shows superior chemical and biological properties of soil. The significantly lowest pH, EC and highest organic carbon were found in vermicompost 2.5 t ha-1. Similarly, available NPK was found maximum in treatment vermicompost 2.5 t ha-$^{-1}$. The microbial count *viz*., fungi, bacteria, actinomycetes population in rhizosphere of chickpea was found maximum with application of vermicompost 2.5 t ha^{-1}. However, the minimum microbial population in rhizosphere of chickpea was recorded with the control (T_1).

References

1. Anonymous. Agricultural Statistics at a Glance. Directorate of Economics and Statistics, Ministry of Agriculture 2017. Govt. of India http://www.dacnet.nic.in/ean
2. Borey PN. Impact of compost on growth and yield of soybean crop on Farmer field. M. Sc. thesis Dr. PDKV Akola: 1 2016.
3. Jat RS, Ahlawat IPS. Direct and residual effect of vermicompost, biofertilizers and phosphorus on soil nutrient dynamics and productivity of chickpea-fodder maize sequence. Journal of Sustainable Agriculture 2006;28(1):41-54.
4. Singh RK, Singh RP, Choudhary SK, Upadhyay PK. Effect of organic sources of nutrients on soil quality, productivity and economics of late sown chickpea and fieldpea. Green Farming 2014;5(5):796-800.
5. Steve Diver. Biodynamic farming and compost preparation 1999. www.attra.ncat.org

6. Tharmaraj K, Ganesh P, Kolanjinathan K, Kumar RS, Anandan A. Influence of vermicompost and vermiwash on physico chemical properties of black gram cultivated soil. International Journal of Recent Scientific Research 2010;3:077-083.