Biological Forum – An International Journal **15(8): 316-319(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Changes in Soil behavior under with the use of various Sources of Nutrient and Bio-fertilizer in Chickpea (*Cicer arietinum* L.)

Shani Gulaiya[1], S.B. Agrawal[2], Priya Kochale[1*], Badal Verma[1] and Kamal Kishor Patel[3]
[1]Ph.D. Research Scholar, Department of Agronomy,
College of Agriculture, JNKVV, Jabalpur (Madhya Pradesh), India.
[2]Senior Scientist, AICRP (AF), Department of Forestry, JNKVV, Jabalpur (Madhya Pradesh), India.
[3]Ph.D. Research Scholar, Department of Soil Science and Agriculture Chemistry,
College of Agriculture, JNKVV, Jabalpur (Madhya Pradesh), India.

(Corresponding author: Priya Kochale)*
(Received: 29 May 2023; Revised: 16 June 2023; Accepted: 22 July 2023; Published: 15 August 2023)
(Published by Research Trend)

ABSTRACT: A field experiment was conducted during *rabi* seasons of 2021-22 and 2022-2023 at Research Farm, Department of Agronomy, College of Agriculture, JNKVV, Jabalpur (M.P.). The experiment was laid out in Split Plot Design with 20 treatment combinations were replicated thrice. Twenty treatment combinations consisted of five sources of nutrient (Control, Vermicompost @ 2 t ha $^{-1}$, FYM @ 5 t ha $^{-1}$, NPK (100% RDF) 20: 60: 20 N: P_2O_5:K_2O kg ha^{-1} and Nano DAP (Seed treatment 5 ml kg^{-1} seed and foliar spray 0.4 % at 30 DAS), put under main plot and four bio-fertilizer (Control, *Rhizobium* 10 g kg^{-1}, PSB 10 g kg^{-1} seed and *Rhizobium* + PSB (10 + 10 g kg^{-1} seed) allotted under sub plot. The study on impact of nutrient sources and bio-fertilizers on physico-chemical properties of soil. The results are revealed that application of vermicompost @ 2 t ha^{-1} found significantly improved porosity (reducing BD from 1.35 to 1.31 g cm^{-3}) and water holding capacity 38.20-44.58%, organic carbon 0.59 to 0.65% as well as available status of major nutrients *i.e.*, N, P & K. Whereas, the use of bio-fertilizer in combination with *Rhizobium* and PSB perform to increase the soil physical and chemical properties in respect of BD, WHC & OC as well as N & P status of soil.

Keywords: Chickpea, *Rhizobium*, PSB, vermicompost, FYM, Nano DAP, water holding capacity and soil bulk density.

INTRODUCTION

Grain legumes are an important source of dietary protein for human. Pulses are cheap source of good quality protein and contain nearly twice as compared to cereals. It enhances the nutritional value of cereal dominated diets. Chickpea commonly known as Bengal gram or Gram and it is the third largest food legume globally, having wider adaptability under varied agro-climatic conditions. Among the pulses gram occupies a predominant position and is considered as a "King of pulses". Chickpea is being grown on 149.66 lakh ha area and production is 162.25 lakh tones with productivity of 1252 kg ha^{-1} (FAOSTAT, 2021). Madhya Pradesh ranks first among states in both area and production with the productivity of 1082 kg ha^{-1} (Agricultural statistics at a glance, 2021). Recently, the problem arose in agriculture is the deterioration of soil quality and loss of fertility. It is due to loss of organic matter (OM) and degradation of agro chemicals in agricultural soil. Indiscriminate and continuous use of chemical fertilizers also shown has an effect on soil physical, chemical and biological properties there by affecting the sustainability of crop production, besides causing environmental pollution (Virmani, 1994). Organic manures are traditional sources of nutrients which help in maintaining soil fertility. It also increase the water holding capacity of soil under limited water availability conditions and improve nutrient availability in the soil (Singh *et al.*, 2012). Vermicompost is a good source of macro and micro nutrients. In addition to this it acts as a soil conditioner and increases water-holding capacity of soil (Giusquiani *et al.*, 1995). The application of vermicompost has positive influence on physical and biological properties of the soil.

MATERIAL AND METHODS

A field experiment was conducted consecutive two seasons of 2021-22 and 2022-2023 at Research Farm, Department of Agronomy, College of Agriculture, JNKVV, Jabalpur (M.P.). The soil of Jabalpur region was clay and medium to deep, and black in colour. It expands when moist and contracts when dry. During the summer, the soil develops large cracks on the surface as a result of shrinking and swelling properties of black soil. The soil of experimental fields having clay content 48.54%, silt 28.80% and 21.94% sand. The soil of experiment was neutral in reaction (7.15), normal in EC (0.36), medium in organic carbon (0.59) and medium available nitrogen (281.54 kg ha^{-1}), phosphorus (13.25 kg ha^{-1}) and high in potassium content (282.46 kg ha^{-1}) in initial year of experimentation.

Table 1: Status of soil before the start of experiment.

Texture	Clay (Sand: 21.94%, Silt: 28.80%, and clay: 48.54%)
Soil Bulk density (g cm^{-3})	1.35
Water holding capacity (%)	38.20
Soil pH	7.15
Soil EC (dSm^{-1})	0.36
Organic carbon (%)	0.59
Available N (Kg ha^{-1})	281.54
Available P (Kg ha^{-1})	13.25
Available K(Kg ha^{-1})	282.86

In order to determine the physico-chemical properties of soil of the experimental area, random samples were drawn with the help of soil auger from different locations in each plot to a depth of 15.0 cm, before start and after completion of the experiment during both the years.

In order to determine soil bulk density initial and after harvest of crop soil samples were drawn with the help of core sampler and calculated by using the formula as given below:

$$\text{Bulk Density} = \frac{\text{Weight of soil (Oven dry)}}{\text{Volume of soil}}$$

Volume of soil in inner volume of the core sampler which in given by $\pi r^2 h$, where r is the radius and h is the height of the core.

Water holding capacity was estimated by Keen box method. Keen boxes were used to measure the water retaining capacity.

$$\% \text{ WHC} = \frac{\text{Wet weight of soil} - \text{Dry weight of soil}}{\text{Wet weight of soil}} \times 100$$

Soil chemical properties with respect to pH, EC OC available nitrogen, phosphorus as well as potassium were determined as per the standard methods.

RESULTS AND DISCUSSION

A. Effect of sources of nutrients on soil properties

Data in relation to physico-chemical properties of pre and post harvest soils are presented in Table 2. Results of two year study revealed that the various sources of nutrients had significant effect on soil bulk density, water holding capacity, organic carbon, available nitrogen and phosphorus status of post harvest soils. On the basis of pooled data it is clear that the values of BD significantly reduced over initial and control and recorded 1.31 g cm^{-1} under vermicompost applied @ 2 t ha^{-1}. This treatment proved to be markedly superior over rest of the treatment except FYM @ 5 t ha^{-1}. On the other hand water holding capacity of soil significant increased (44.58%) under vermicompost over control (40.50%) initial (38.20%) values and other treatments except FYM 5 t ha^{-1}. Hence, the addition of organic source either vermicompost or FYM @ 2 t and 5 t ha^{-1} proved superior with respect to improvement in soil porosity (reduction in BD) and water holding capacity of post harvest soils. These findings are in accordance with the findings of Parthasarathi *et al.* (2003); Manivannan *et al.* (2009). As regards to the chemical properties of post harvest soils it indicated that pH and EC of soils were remained unchanged within the period of two years. However, organic carbon and available nitrogen and phosphorus change significantly due to application of sources of nutrients. Addition of vermicompost @ 2 t ha^{-1} or FYM 5 t ha^{-1} bring out significant improvement in organic carbon (%) over initial status, control, RDF as well as Nano DAP. The vermicompost @ 2 t ha^{-1} or FYM 5 t ha^{-1} recorded similar values of 0.65 and 0.63% respectively which were significantly superior over rest of the treatments. As regards to the available nitrogen and phosphorus it was observed that addition vermicompost @ 2 t ha^{-1} recorded to 299.38 kg N ha^{-1} which was significantly superior over the rest of the treatments and initial values. However, other treatments including FYM, RDF and Nano DAP registered their superiority over control and found at par to each other whereas in case of phosphorus availability in post harvest soils recorded significantly at par values of 16.25, 15.16, 14.83 and 15.50 kg ha^{-1} under vermicompost, FYM, 100% RDF and Nano DAP, respectively. However, these values were found to be significantly superior over control and initial status (13.25 kg ha^{-1}). These findings are in accordance with the findings of Shubha *et al.* (2018).

The status of available potassium was found to be changed due to sources of nutrients during both the years and pooled data and it was came into the notice that vermicompost, FYM and 100% NPK proved equally good to each other and significantly superior to control and Nano DAP. The significantly highest content of K in post harvest soil was observed 295.75 kg ha^{-1} under vermicompost @ 2 t ha^{-1} whereas, the lowest under control 277.71 kg ha^{-1}. These results are in accordance with the findings of Celik *et al.* (2004); Rai *et al*. (2015).

B. Effect of bio-fertilizers on soil properties

Bio-fertilizers found to have a significant effect on soil BD, WHC, OC and available nitrogen as well as phosphorus. The soil bulk density did not change significantly during first year of experimentation but in a subsequent years and in pooled data were found to be significant in BD due to inoculation of bio-inoculants on an pooled mean basis, it was observed that significantly lowest values of BD (1.3 g cm^{-3}) and highest WHC of 43.57% were recorded under command inoculation of *Rhizobium* and PSB.

The content of organic carbon available N & P in post harvest soils changed significantly due to inoculation of bio agents in seed. The highest value of OC (0.65%), available N (298.33 kg ha^{-1}) and P (19.47 kg ha^{-1}) were observed under combined use of inoculants and proved markedly superior over individual inoculation of *Rhizobium* and PSB as well as control plots. However, individual inoculation of *Rhizobium* proved superior over control in case of OC%. But, in case of nitrogen both the inoculants (*Rhizobium* and PSB) were found to be significantly superior over control. Whereas, in phosphorus PSB registered its superiority over control and *Rhizobium* proved to combined inoculation. These results are in accordance with the findings of Das and Singh (2014); Nagar *et al.* (2016).

Table 2: Physico-chemical properties of soil as influenced by different nutrient sources and bio-fertilizers.

Treatments	Soil bulk density (g cm^3)			Water holding capacity (%)			pH			EC (dsm^{-1})			Organic Carbon (%)		
	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
Initial values	**1.35**			**38.20**			**7.15**			**0.36**			**0.59**		
Nutrient sources															
Control	1.36	1.35	1.36	39.92	41.08	40.50	7.13	7.11	7.12	0.35	0.35	0.35	0.59	0.61	0.60
Vermicompost	1.33	1.29	1.31	43.58	45.58	44.58	7.12	7.11	7.11	0.35	0.34	0.35	0.64	0.67	0.65
FYM	1.34	1.31	1.32	42.33	44.00	43.17	7.12	7.10	7.11	0.34	0.33	0.33	0.62	0.65	0.63
NPK (RDF)	1.36	1.34	1.35	41.17	42.83	42.00	7.13	7.11	7.12	0.36	0.35	0.35	0.61	0.63	0.62
Nano DAP	1.36	1.34	1.35	40.33	41.75	41.04	7.12	7.11	7.12	0.37	0.36	0.37	0.60	0.62	0.61
SEm±	**0.006**	**0.004**	**0.004**	**0.75**	**0.56**	**0.61**	**0.003**	**0.02**	**0.010**	**0.011**	**0.005**	**0.006**	**0.009**	**0.006**	**0.007**
CD(0.05%)	**NS**	**0.011**	**0.013**	**2.45**	**1.84**	**1.85**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.019**	**0.022**
Bio-fertilizers															
Control	1.35	1.33	1.34	40.00	41.47	40.73	7.13	7.12	7.12	0.35	0.34	0.35	0.58	0.60	0.59
Rhizobium	1.35	1.32	1.34	41.40	42.87	42.13	7.13	7.11	7.12	0.35	0.34	0.35	0.62	0.64	0.63
PSB	1.35	1.32	1.34	41.80	43.40	42.60	7.13	7.11	7.12	0.36	0.35	0.35	0.61	0.63	0.62
Rhizobium + PSB	1.34	1.31	1.32	42.67	44.47	43.57	7.12	7.10	7.11	0.35	0.34	0.35	0.63	0.66	0.64
SEm±	**0.003**	**0.005**	**0.003**	**0.64**	**0.66**	**0.64**	**0.004**	**0.021**	**0.011**	**0.006**	**0.004**	**0.004**	**0.009**	**0.005**	**0.007**
CD(0.05%)	**NS**	**0.015**	**0.010**	**1.85**	**1.90**	**1.94**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**NS**	**0.016**	**0.021**

Table 3: Effect of different nutrient sources and bio-fertilizers on status of nutrients in soil.

Treatments	Nitrogen (kg ha^{-1})			Phosphorus (kg ha^{-1})			Potassium (kg ha^{-1})		
Initial values	**281.54**			**13.25**			**282.46**		
Nutrient sources	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**	**2021-22**	**2022-23**	**Pooled**
Control	275.33	278.00	276.67	11.17	13.33	12.25	276.75	278.67	277.71
Vermicompost	297.33	301.42	299.38	14.92	17.58	16.25	287.92	293.58	290.75
FYM	288.25	294.92	291.08	14.58	15.75	15.16	286.42	290.00	288.21
NPK (RDF)	286.83	291.33	288.08	15.67	14.00	14.83	284.33	288.17	286.25
Nano DAP	280.17	279.25	287.71	14.42	14.74	15.50	281.83	284.58	283.21
SEm ±	**1.39**	**1.25**	**1.29**	**0.42**	**0.58**	**0.47**	**1.58**	**1.31**	**1.44**
CD(0.05%)	**4.54**	**4.07**	**3.87**	**1.38**	**1.90**	**1.41**	**5.16**	**4.29**	**4.32**
Bio-fertilizers									
Control	276.67	279.80	277.83	11.80	13.80	12.80	280.60	281.00	280.50
Rhizobium	293.40	296.53	294.97	12.20	14.40	13.30	282.60	286.20	284.40
PSB	284.67	289.33	287.00	17.60	20.07	18.83	284.07	285.05	284.56
Rhizobium + PSB	296.60	300.07	298.33	18.20	20.73	19.47	285.53	287.13	286.33
SEm ±	**1.39**	**1.10**	0.89	**0.39**	**0.49**	**0.41**	**2.24**	**2.13**	**2.04**
CD(0.05%)	**4.01**	**3.18**	2.50	**1.12**	**1.43**	**1.24**	**NS**	**NS**	**NS**

CONCLUSIONS

Based on the foregoing discussion, it can be concluded that sources of nutrients and bio-fertilizers played an vital role in physico-chemical properties of soil. The soil bulk density and water holding capacity were significantly affected by sources of nutrients and bio-fertilizers. The combined application of enriched vermicompost @ 2 t ha^{-1} along with *Rhizobium* and PSB was recorded superior among all physico-chemical properties and followed by FYM @ 5 t ha^{-1} along with *Rhizobium* and PSB as compared to others nutrient sources.

Acknowledgement. I would like to express my greatly thanks to Professor & Head Agronomy department Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India to provide necessary facilities and required tools to conduct the present study.

Conflict of Interest. None.

REFERENCES

Agricultural statistics at a glance (2021). Directorate of Economics and Statistics. Department of Agriculture and Co-operation, Govt. of India, 62-63.

Celik, I., Ortas, I. and Kilic, S. (2004). Effects of compost, mycorrhiza, manure and fertilizer on some physical properties of a Chromoxerert soil. *Soil & Tillage Research, 78,* 59–67.

Das, I. and Singh, A. P. (2014). Effect of PGPR and organic manures on soil properties of organically cultivated mungbean. *The bio science, 9*(1), 27-29.

FAOSTAT (2021). Statistical Database of the United Nation Food and Agriculture Organization Statistical Division. Rome.

Giusquiani, P. L., Pagliai M., Gigliotti, G., Businelli, D. and Benetti, A. (1995). Urban waste compost: effects on physical, chemical and biochemical soil properties. *Journal of Environmental Quality, 24,* 175-182.

Manivannan, S., Balamurugan, M., Parthasarathi, K., Gunasekaran, G. and Ranganathann, L. S. (2009). Effect of vermicompost on soil fertility and crop productivity beans (*Phaseolus vulgaris*). *Journal of Environmental Biology, 30*(2), 275-281.

Nagar, R. K., Goud, V. V., Kumar, R. and Kumar, R. (2016). Effect of organic manures and crop residue management on physical, chemical and biological properties of soil under pigeonpea based intercropping system. *International Journal of Farm Sciences, 6*(1), 101-113.

Parthasarathi, K., Balamuryan, M. and Ranganathan, L. S. (2003). Influence of vermicompost on the physiochemical and biological properties indifferent type of soil along with yield and quality of pulse crop black gram. *Indian Journal of Agronomy, 48*(1), 45-47.

Rai, S., Rani, P. Kumar, M. Rai, A. K. and Shahi, S. K. (2015). Effect of Integrated use of Vermicompost, FYM, PSB and Azotobacter on Physico-Chemical Properties of Soil under *Alium sativum* Crop. *Environment & Ecology*, *32*(4B), 1797-1803.

Shubha, A. S, Srinivasa, V., Devaraju, Anusha, R. B. and Sharavathi, M. B. (2018). Effect of integrated nutrient management on soil and plant nutrient content in potato (*Solanum tuberosum* L). *International Journal of Chemical Studies*, *6*(5), 879-881.

Singh, G., Sekhon, H. S. and Harpreet, K. (2012). Effect of Farmyard Manure, Vermicompost and Chemical Nutrients on Growth and Yield of Chickpea (*Cicer arietinum* L.). *International Journal of Agricultural Research*, *7*(2), 93.

Virmani, S. M. (1994). The twenty first – Dr. R.V. Tamhane memorial Lecture: UNCEED Agenda 21: The new challenge for soil research, *Journal Indian Society of Soil Science*, *42*, 516-523.

How to cite this article: Shani Gulaiya, S.B. Agrawal, Priya Kochale, Badal Verma and Kamal Kishor Patel (2023). Changes in Soil behavior under with the use of various Sources of Nutrient and Bio-fertilizer in Chickpea (*Cicer arietinum* L.). *Biological Forum – An International Journal*, *15*(8): 316-319.