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Influence of organic manures on soil Physico-chemical properties under chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted during rabi season of 2016-2017 to find out influence of organic manures on soil Physico-chemical properties under chickpea (*Cicer arietinum* L.) at Instructional Farm, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur (Rajasthan). Results indicated that available nitrogen, phosphorus, potassium were observed significantly maximum under application of vermicompost 2 t ha^{-1} compared to other organic manure treatments while bulk density, particle density, pH, EC were non-significant due to organic manure treatment and liquid organic manure treatment. Among liquid organic manures, application of Panchagvya 3 per cent remained on par with vermiwash 10 per cent and cow urine also recorded significantly available nitrogen, phosphorus, potassium as compared to control, respectively. Organic manures application and liquid organic manure spray did not influence significantly the available micronutrients (Cu, Zn, Fe and Mn) in soil.

Keywords: Chickpea, organic manure, liquid organic manures, nutrients

Introduction
The development of organic agriculture is receiving a lot of attention throughout the world. Consumer demand for organically grown, increased dramatically over the past decade, because of the perceived advantages to the environment and human health. Pulse crops play an important role in Indian agriculture and India is the largest producer and consumer of pulses in the world. Pulses contain high percentage of quality protein nearly three times as much as cereals (Upadhayay *et al.* 1999) [10]. Pulses are known to improve the physical characteristics of soil through tap root system which opens the soil into deeper layers and their ability to use atmospheric nitrogen through biological nitrogen fixation which is economically sound and environmentally acceptable. In addition, they also provide nutritious fodder and feed for livestock. Pulses are drought tolerant and prevent soil erosion due to their deep root and good ground covers, because of these good characters, pulses are called as “Marvel of Nature”. Pulses account for 35.2 per cent of the world area and 30 per cent of world’s production. In India pulses are grown over an area of 25.26 m. ha with a production of 16.47 mt and a productivity of 652 kg ha^{-1} (Directorate of Economics and Statistics, 2016) [5]. Important chickpea growing states in India are Madhya Pradesh, Maharashtra, Rajasthan, Andhra Pradesh, Uttar Pradesh and Karnataka. In Rajasthan it occupies an area of 9.4 lakh hectares with production of 9 lakh tonnes and average productivity of 852 kg ha^{-1}(Directorate of Economics and Statistics, 2016) [6].

The excessive utilization of chemical fertilizers have not only caused the exhaustion of soil of its reserved nutrients but also resulted in soil health problem. The high cost of inorganic fertilizers makes it uneconomical and out of reach to poor farmers and it is also undesirable due to its hazardous environmental effects. Moreover the imbalance and continuous use of chemical fertilizers has adverse effect on soil physical, chemical and biological properties there by affecting the sustainability of crop production, besides causing environmental pollution (Virmani, 1994) [12]. Therefore, it is essential to investigate the use of locally sourced organic materials which are environment friendly, cheap and probably an effective way of improving and sustaining the productivity of soils. Manures are the organic material derive from animal, human and plant residues which contain plant nutrients in complex organic form. Application of organic sources of the nutrient may work as the 'driving force' in sustainable crop production while improving soil health and fertility (Singh and Singh, 2012) [9].

Organic manure act not only as a source of organic matter and nutrients, but also increase size, biodiversity and activity of the microbial population in soil, influence structure, nutrients get turnover and many other changes related to physical, chemical and biological parameters of the soil (Albiach *et al*., 2000) [1]. The experiments so far carried in the country had clearly indicated that there is need for application of different sources of organics including compost, vermicompost, FYM, liquid organic manures for sustainable crop production, maintenance of soil health and conservation of natural resources. Vermicompost is an aerobically degraded organic matter which improves Physico-chemical properties of the soil and enhances the microbial, crop growth and yield (Vasanthi and Kumaraswamy, 1999) [11]. Application of organic manures mainly compost, vermicompost and FYM produced higher yield apart from improving soil health.

Further, the liquid organic manures meet the nutrient requirement of crops with greater nutrient use efficiency and also correct the deficiency as and when noticed under organic production system. The edaphic environment under organic production system will be more congenial for good crop growth and application of organics regularly maintains it at optimum level. Earlier studies have shown that legume crop productivity can be enhanced and sustained under organic production system. The study of physico-chemical properties is very essential because all agricultural productions depend upon the physico-chemical parameters of the soil used for it. So taking the above facts under consideration the study was done to investigate the influence of organic manure on physico-chemical properties of soil and to see their comparative impact on the chickpea.

Material and Method

The experimental conducted at 24º35' N latitude and 74º42' E longitude and 579.5 meters above mean sea level. This region falls under agro-climatic zone IV a (Sub- humid Southern Plain and Aravalli Hills) of Rajasthan, India. The experiment was laid out in randomized block design (Factorial) comprised of four treatments of organic manure practices (control, FYM 5 t ha^{-1}, comopost 3 t ha^{-1}, vermicompost 2 t ha^{-1}) and four treatment of liquid manure spray (control, panchagavya 3 per cent, cowurine 10 per cent, vermiwash 10 per cent) with three replication. The soil was clay loam in texture, the pH of the soil was slightly alkaline (8.10), and it was medium in organic carbon (0.67%), low in available nitrogen content (280 kg ha^{-1}), medium in available phosphorus (18.90 kg ha^{-1}) and medium in available potassium (347 kg ha^{-1}). Organic manures were applied 30 days before sowing of crop. Liquid organic manures panchagavya 3 per cent, vermiwash 10 per cent, cow urine 10 per cent were applied as per the treatments at 50 per cent flowering. Ideal weather conditions prevailed during experimental period and crop growth was normal. Organic carbon (%) in soil was determined by rapid titration method, bulk density (Mg m^{-3}) and particle density (Mg m^{-3}) by pycnometer method, pH determined by glass electrode and EC (dS m^{-1}) by conductivity meter. Estimation of available nitrogen concentration (kg ha^{-1}) in soil was done by alkaline permanganate method, available phosphorus (kg ha^{-1}) was determined by 0.5 M NaHCO3 (pH 8.5) and available potassium (kg ha^{-1}) concentration was determined by "Flame photometer". DTPA extractable Zn (mg kg^{-1}), Fe (mg kg^{-1}), Mn (mg kg^{-1}) and Cu (mg kg^{-1}) in soil was determined by Lindsay and Norvell method. Statistical analysis of the data was carried out by adopting the procedure of Gomez and Gomez (1984).

Result and Discussion

Effect on Physico-chemical property of soil

Among different source of organic manure application of compost 3 t ha^{-1} had recorded significantly higher organic carbon content (0.74 per cent) as compared to control (0.66 per cent). There is no any significant effect of liquid organic manures on organic carbon content in soil. Organic manures, liquid organic manures and their interaction had no significant effect on change of soil pH, bulk density and partical density. Organic matter is the major component that stimulates the formation and stabilization of granular and crumb type of soil aggregates (Brady, 1996) [3]. As organic residue decompose organic acids, sugars, mucilaginous substances, and other viscous microbial by-products are evolved. Higher organic matter addition could increase organic carbon content of the soil which resulted in an increased water holding capacity of the soil. The humus can absorb water two to six times its own weight. Soil organic matter is responsible to a great extent, directly or indirectly for making the physical environment of the soil suitable for the growth of crops. It exerted this benefit largely through its effect on improving soil aggregation and porosity, which in turn influenced soil structure, water infiltration, moisture conservation, drainage, aeration, temperature, and microbial activities.

Effect on available nutrient in soil

Organic matter addition significantly enhanced the nutrient availability of the soil. Data present in Table 1 indicate that application of vermicompost 2 t ha^{-1} recorded significantly higher available nitrogen content (263.19 kg ha^{-1}) in soil after harvest of chickpea as compared to control but at par with compost 3 t ha^{-1} and FYM 5 t ha^{-1}. Vermicompost 2 t ha^{-1} remained at par with compost 3 t ha^{-1} recorded significantly higher phosphorus content (16.02 kg ha^{-1}) and potassium content (349.96 kg ha^{-1}) in soil as compared to control and FYM 5 t ha^{-1}.

Among the liquid organic manure spray, application of panchagavya 3 per cent recorded significantly higher nitrogen content (269.50 kg ha^{-1}), phosphorus content (15.51 kg ha^{-1}) and potassium content (349.96 kg ha^{-1}) in soil after harvest of chickpea as compared to control (239.98 kg ha^{-1}) but at par with vermiwash 10 per cent and cow urine 10 per cent treatment. Organic manures application and liquid organic manure spray did not influence significantly the available micronutrients (Cu, Zn, Fe and Mn) in soil. Application of vermicompost 2 t ha^{-1} had recorded significantly higher seed yield (1916 kg ha^{-1}) as compared to other treatments. The application of compost 3 t ha^{-1} (1736 kg ha^{-1}) was at par with FYM 5 t ha^{-1} (1636 kg ha^{-1}). Among liquid organic spray panchagavya 3 per cent had recorded significantly higher seed yield (1888 kg ha^{-1}) than control and cow urine 10 per cent but it was at par with vermiwash 10 per cent (1783 kg ha^{-1}).

The bulky organic manures reduce bulk density due to increase in the porosity of the soil due to addition of organic matter. Patidar and Mali (2004) [8] indicated the benefits of organics on soil physical, chemical and biological properties. Nutrients contained in organic manure are released slowly and are stored for a longer time in the soil, thereby ensuring a longer residual effect and persistence of nutrient availability.

The general decreasing C: N ratio observed in organic treatment helped for higher release of nutrients. Higher soil available N, P_2O_5 and K_2O might be due to higher soil microbial activity and higher root activity in the rhizosphere and improved soil physical and chemical properties. The increase of nitrogen content in the vermicompost is reported to be due to the addition of Muco-proteins secreted from the body wall of the earthworms (Lee, 1985) [7]. Furthermore, Blair *et al.,* (1997) [2] revealed that increase in the nitrogen content by the earthworm might be due to the reduction in the microbial immobilization. Vermicompost with higher amount of active humic fraction having high CEC had thus resulted in improvement in physic-chemical properties. Vermicompost had a higher urease activity than soils and other compost materials (Bremner & Mulvaney 1978) [4]. The process of aminization, ammonification, and oxidative de aminisation brought about by microbially mediated enzyme systems are active in vermicompost and other organic amendments, thus contributing more of soluble N. The high microbial activity and enhanced mineralization of soil P coupled with high phosphatase activity are the reasons for high Bray extractable P. K+ ions from edge, wedge, or inter layer sites within clay minerals, could possibly be replaced by NH4+ ions of similar ionic radius, so the concentration of which was increased in the presence of vermicompost.

Table 1: Effect of different organic manures on Physico-chemical properties of soil after harvest of chickpea

Treatment	Organic carbon (%)	Bulk density (Mg m^{-3})	Particle density (Mg m^{-3})	pH	EC (ds m^{-1})	N (kg ha^{-1})	P (kg ha^{-1})	K (kg ha^{-1})	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)	Yield (kg ha^{-1})
Source of organic manure													
Control	0.66	1.32	2.62	7.62	0.56	238.53	13.21	332.40	0.54	1.51	1.63	1.02	1310
FYM 5 t ha^{-1}	0.73	1.29	2.59	7.57	0.542	262.54	14.98	341.66	0.55	1.53	1.67	1.07	1636
Compost 3 t ha^{-1}	0.74	1.29	2.6	7.59	0.542	261.48	15.86	343.88	0.55	1.48	1.63	1.08	1736
Vermicompost 2t ha^{-1}	0.74	1.29	2.55	7.59	0.544	263.19	16.02	349.96	0.55	1.48	1.66	1.07	1916
S.Em±	0.004	0.022	0.036	0.05	0.005	5.28	0.24	2.30	0.01	0.02	0.01	0.02	54
CD (P=0.05)	0.012	NS	NS	NS	NS	15.26	0.68	6.65	NS	NS	NS	NS	156
Liquid organic manures spray													
Control	0.71	1.31	2.63	7.61	0.547	239.98	13.71	335.50	0.54	1.49	1.63	1.02	1371
Panchagavya 3 per cent	0.72	1.3	2.57	7.59	0.546	269.50	15.51	347.72	0.54	1.50	1.64	1.07	1888
Cow Urine 10 per cent	0.71	1.3	2.59	7.59	0.547	256.90	15.49	342.43	0.56	1.49	1.67	1.08	1556
Vermiwash 10 per cent	0.72	1.28	2.58	7.59	0.548	259.36	15.37	342.25	0.56	1.52	1.65	1.07	1783
S.Em±	0.004	0.022	0.036	0.05	0.005	5.28	0.24	2.30	0.01	0.02	0.01	0.02	54
CD (P=0.05)	NS	NS	NS	NS	NS	15.26	0.68	6.65	NS	NS	NS	NS	156

Conclusion

On the basis of above finding, this may concluded that application of vermicompost 2 t ha^{-1}, compost 3 t ha^{-1} and FYM 5 t ha^{-1} being at par with each other recorded significantly higher available nitrogen and organic carbon content. Vermicompost 2 t ha^{-1} remained at par with compost 3 t ha^{-1} recorded significantly higher phosphorus content and potassium content in soil as compared to control and FYM 5 t ha^{-1}. Panchagavya 3 per cent at par with vermiwash 10 per cent and cow urine 10 per cent treatment recorded significantly higher nitrogen content, phosphorus content and potassium content in soil after harvest of chickpea as compared to control. However, Organic manures application and liquid organic manure spray could not bring any significant increase in the soil pH, bulk density and partical density, available micronutrients (Cu, Zn, Fe and Mn) in soil over control. As per data, the above result based on one year trial, which need to be validation through further experimentation to formulate a concrete recommendation.

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