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Influence of organic composts on soil physical and chemical properties under soybean crop in vertisols

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Abstract
A field experiment consisting of eight treatment and three replication was carried at research farm of department of Soil Science and Agricultural Chemistry during kharif 2016 to study the influence of organic composts like phospho and Nitro-phospho compost on soil physical and chemical properties. The study showed decrease in Bulk Density and increase in available water holding capacity by combined use of organics and inorganics. In case of chemical properties like soil reaction, electrical conductivity and calcium carbonate content organics treatment showed better results. Hence combined use of organics along with inorganics is recommended to maintain soil health.

Keywords: organic composts, soil physical, chemical properties, soybean crop

Introduction
Healthy soils are essential for the integrity of terrestrial ecosystems to remain intact or to recover from disturbances, such as drought, climate change, pest infestation, pollution, and human exploitation including agriculture (Ellert *et al*. 1997) [3]. Deterioration of soil, and thereby soil health, is of concern for human, animal, and plant health because air, groundwater, and surface water consumed by humans, can be adversely affected by mismanaged and contaminated soil (Singer and Ewing 2000) [12].

Soybean is a nutrient rich crop. Soybean oil contains no cholesterol and has one of the lowest levels of saturated fat among vegetable oils. Soybean has great potential as an exceptionally nutritive and very rich food. It can supply the much needed protein of superior quality and all the amino acids particularly glycine, tryptophane and lysine.

In Akola district the Area under Soybean Cultivation during *Kharif* 2016 is 2.331 Lac Hectare as compared to 2.223 Lac hectares during *Kharif* 2015. The yield during *Kharif* 2016 was 700 Kg per hectare as compared to 1100 Kg per hectare during *Kharif* 2015. Resulting into a production of 1.632 Lac MT during *Kharif* 2016 as compared to 2.445 Lac MT during *Kharif* 2015. (Anonymous, 2016) [1].

Vidarbha region in Maharashtra comprises 11 districts Livelihood of around 65% rural population of this region is dependent on agriculture and allied activities. However, agriculture in this region is comparatively less productive than the State and National averages. Now a day, there is urgent need to search for an alternative to intensive chemical based production system. Increased use of pesticides also resulted into buildup pesticides resistance in insect, toxicity of pesticides to natural predators and parasites of pest affecting natural ecosystem. Use of organic manures saves the environment and it includes use of phospho-compost, sulpho-compost, vermicompost, green manure etc. which is essential elements to maintain the soil fertility and ensure balanced nutrient content in soil.

The fertility status of soil is very important under cultivation of soybean crop, as it was observed that organic sources such as FYM, vermicompost, phospho-compost etc. improve the fertility status of soil. Hence to improve fertility status and to fulfill nutrient demand of crop, it is necessary to evaluate and study influence of organic sources. Because organic sources are very much important in increasing the microbial activity in the soil, improving soil health as well as the productivity of soybean and also help to increase the nutrient content of soil.

Vertisols contain appreciable amount of P, they lack water soluble form of phosphorus, to be supplied to crops in required quantity mainly due to its insoluble nature and fixation. The immobilization of phosphorus ultimately warrants for P application in amounts high enough to

compensate for crop removal and fixation by soils. It has been found that the crop removal of added P in Vertisols seldom exceeds 20 per cent (Kanwar *et al*.1982) [6]. Most of the Indian soils are deficient in Phosphorus. Also, yearly removal of P is more than its addition through P fertilizers during continuous and intensive cropping.

Phospho-compost or N-enriched phospho-compost technology has, thus, been developed using phosphate solubilizing microorganisms, namely, *Aspergillus awamori*, *Pseudomonas straita* and *Bacillus megaterium*, phosphate rock, pyrite and bio-solids to increase the manurial value as compared to ordinary FYM.

Nitrophospho-sulpho compost is prepared using crop residues, urea, gypsum, rock phosphate. The nitrophospho-sulpho compost will be prepared by decomposing crop residues viz, wheat straw and shredded cotton stalk with rock phosphate, urea and gypsum.

Materials and methods

The present investigation was undertaken at Research Farm of Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola during Kharif season of 2016-17.

The nitrogen, phosphorus, potassium applied in the form of Urea, Diammonium phosphate, Muriate of potash respectively and also in combination with organic manures i.e Phospho-Compost and Nitrophospho-Sulpho compost.

Table 1: Treatment Details of an experiment

Sl. no.	Treatment details
T_1	Control
T_2	100%Recommended Dose of Mineral Fertilizers(RDF) [30:75:30 NPK]
T_3	50% P through PC +Remaining RDF through mineral Fertilizers
T_4	25% P through PC+ Remaining RDF through mineral Fertilizers
T_5	50% P through NPS +Remaining RDF through mineral Fertilizers
T_6	25% P through NPS +Remaining RDF through mineral Fertilizers
T_7	100% P through PC
T_8	100% P through NPS

RDF- Recommended Dose of Fertilizer.
PC - Phospho Compost
NPS – Nitro-phospho - Sulpho compost

Table 2: Nutrient content of Phosphocompost and nitro phospho-sulpho compost on oven dry basis (2016)

Organics	N	P	K	S	C:N
Phosphocompost	0.80	1.65	0.68	0.39	20.44
Nitro phospho Sulpho compost	1.85	1.76	0.92	1.58	19.30

The hydrogen ion activity expressed as pH was measured with pH meter using 1:2.5 soil water suspensions (Jackson, 1967) [5]. The clear supernatant extract obtained from suspension used for pH was taken for EC measurements (Jackson, 1967) [5]. Bulk Density was determined by clod coating method (Jackson, 1967) [5]. Available Water content was determined by using Pressure plate and membrane apparatus method (Klute, 1986) [7]. Calcium carbonate was determined by acid neutralization Method. (Piper 1966) [10].

The data was subjected to Analysis of Variance (ANOVA) in Randomized Block Design with 8 treatments and 3 replications as per standard statistical method and standard error was used to calculate Critical Difference to know the significant different among treatments and mean were separated by using F test [Panse and Sukhatme, 1985] [9].

Results and Discussion

Effect on physical properties of soil

Effect on Bulk Density

The data pertaining to bulk density is presented in Table 8. The bulk density as influenced by the various treatments ranged from 1.44 to 1.48 mg m^{-3}.The highest bulk density i.e.1.48 mg m^{-3} is recorded by the treatment control (T1) and application of 100% RDF(T2).

There were numerically lower values of bulk density were noticed by the treatment where application of 100% organic manure in the form of 100% Phospho-compost (T7) and 100% Nitrophospho-sulpho compost (T8).However, statistically there were no significant changes were observed in all the treatments.

Numerical reduction in bulk density by the application of organic manures may be due to more air spaces in the soil. Similar result was recorded by Selvi (2003) [11].

Effect on Available Water Content (AWC)

The data pertaining to Available Water Content as influenced by the different treatments is presented in Table 8. The Available Water Content ranged from 18.16 to 18.73%.the highest Available Water Content was recorded in the treatment where50% P through PC + Remaining dose through fertilizer (T3) i.e.18.73%.all other treatment reported numerical higher values of Available Water Content particularly where the organic manure applied in different combinations.

However, statistically no significant effects were reported in all the treatments. The lowest Available Water Content was reported in control and 100% RDF treatment (T1 and T2).similar result was observed by Surekha (2004).

Table 3: Effect of different treatments on BD and AWC of soil

	Treatments	BD (Mg m^{-3})	AWC (%)
T_1	Control	1.48	18.16
T_2	100% RDF	1.48	18.16
T_3	50% P through PC + Remaining through fertilizer	1.46	18.73
T_4	25 % P through PC + Remaining through fertilizer	1.47	18.43
T_5	50 % P through NPS + Remaining through fertilizer	1.46	18.50
T_6	25 % P through NPS + Remaining through fertilizer	1.47	18.35
T_7	100 % P through PC	1.44	18.53
T_8	100 % P through NPS	1.44	18.53
	SE(m)±	0.033	1.417
	CD at 5 %	NS	NS

Effect on chemical properties of soil

Effect of enriched composts on soil pH, electrical conductivity and Calcium Carbonate Content

Organic manures after their addition to soil undergo decomposition by the action of soil microorganisms. During such biological degradation, organic acids are formed which held to lower down the soil pH and EC. Similarly, the chemical fertilizers like nitrogenous, which are acidic in nature lower the pH and EC. Addition of organics like composts and FYM add the carbon source to soil hence increases the organic carbon levels

Effect on soil pH

The pH of experimental soil as influenced by the various treatments is shown in table 2 which ranged from 8.17 to 8.36. The lowest pH i.e 8.17 and 8.21 was observed with treatment which received 100% dose through organic manure i.e Nitrophospho-sulpho compost and and 25 % P through PC and NPS (T_8, T_4 andT_6) respectively. Numerically increased pH were recorded with 50% P through PC and 100% RDF. However, there were no significant changes noted in pH of soil after harvest of crop.

The slight change in pH with the application of organic sources such as Phospho- compost and Nitrophospho-sulpho compost were noted. The similar findings are inconformity with the results obtained by More and Hangarge (2003) [8].

Effect on Electrical Conductivity (EC)

The effect of various treatments on Electrical Conductivity of soil is presented in Table 2. The Electrical Conductivity varied from lowest to highest values i.e 0.28 to 0.30 dSm^{-1}. The lowest Electrical Conductivity was 0.28 dSm^{-1} observed with application of 100% P through NPS and in treatment with 50% P through PC, 25% P through NPS with remaining RDF through chemical fertilizers. There were no significant changes noted in all treatment after harvest of crop. Similarly applicaton of 50% compost showed lowest EC compared to other treatments observed by Halemani *et al.* (2004) [4].

Effect on Free Calcium Carbonate Content

The Free Calcium Carbonate Content as affected by different treatment under experimentation reported in Table 2. The Free Calcium Carbonate content after harvest of crop ranged from 8.41 to 8.59%.The lowest Calcium Carbonate content was observed in the treatments which receive 100% P through NPS (T8) followed by 100% P through PC (T7). The significant increase in calcium carbonate content was recorded in the treatment of 100% RDF over all the treatment. The significant decrease in Free Calcium Carbonate Content in the treatment of application 100% organic manures. Similar result was observed by Bellakki and Badanur (1997) he observed that incorporation of organic materials in Vertisol significantly lower be $CaCO_3$content than their combined application with fertilizer or application of fertilizer alone.

Table 3: Effect of different treatments on pH, electrical conductivity and free calcium carbonate content of soil after harvest of soybean.

	Treatments	pH (1:2.5)	EC (dSm^{-1})	Calcium carbonate (%)
T_1	Control	8.29	0.30	8.48
T_2	100% RDF	8.35	0.30	8.59
T_3	50% P through PC + Remaining P through chemical fertilizer	8.36	0.28	8.49
T_4	25 % P through PC + Remaining P through chemical fertilizer	8.21	0.30	8.45
T_5	50 % P through NPS + Remaining P through chemical fertilizer	8.24	0.30	8.46
T_6	25 % P through NPS + Remaining P through chemical fertilizer	8.21	0.28	8.44
T_7	100 % P through PC	8.22	0.29	8.42
T_8	100 % P through NPS	8.17	0.28	8.41
	SE(m)±	0.05	0.007	0.059
	CD at 5 %	NS	NS	0.179

Conclusion

The present studies showed the decrease in bulk density which is desirable by addition of organics in the form of organics like composts which increased the water holding capacity. In case of chemical properties like pH, EC and $CaCO_3$ content improvement was seen in organics and inorganics combined plots. Hence combined judicious use of organics and inorganics helps to increase overall soil health and helps to maintain soil sustainability.

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