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Effect of different resource conservation practices on soil chemical properties under soybean cultivation

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Abstract
The present investigation was conducted at Research Farm of Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The field experiment consisting of nine treatments with three replications in the Randomized Block Design. The treatments comprised of T_1 (100% RDF), T_2 (Dhaincha 25% N +Compensation of RDF), T_3 (Cotton Stalk 25% N +Compensation of RDF), T_4 (Wheat Straw 25% N +Compensation of RDF), T_5 (Bio mulch 25% N + Compensation of RDF), T_6 (Neemcake 25% N + Compensation of RDF), T_7 (100% N-FYM +Compensation of P-Phosphocompost), T_8 (50% N-FYM +Compensation of P-Phosphocompost +Urea), T_9 (50% N - leuceana loppings +Compensation of P – Phosphocompost +Urea). The results of the present study indicated that, application of 100% N - FYM + Compensation of P- Phosphocompost was significantly superior over all the other treatments.

Keywords: Resource Conservation, Soil, Physico, Chemical, Properties

Introduction
Resource conservation technologies is gaining acceptance in many parts of the world as an alternative to both conventional agriculture and organic agriculture. Conservation agriculture is based on the principles of rebuilding soil, optimizes the crop production input, including labor, and optimizing the profit. Conservation Agriculture has emerged as a new way forward to achieve the goals of sustainable agriculture.

In recent years conservation agriculture concept has come in vogue, as a means of reducing time, labours and machine operation as well as conserving moisture and reducing soil erosion and nutrient loss. Conservation agriculture is more appropriate strategy for rainfed production system. Conservation agriculture is generic term encompassing many different soil management practices. It is generally defined as “Conservation agriculture is minimal disturbance of the soil by tillage (zero tillage), balanced application of chemical inputs (only as required for improved soil quality and healthy crop and animal production), and careful management of residues and wastes” (Dumanski *et al.*2006) [6].

The term 'Conservation Agriculture' refers to the system of raising crops without tilling the soil while retaining crop residues on the soil surface. Land preparation through precision land leveling and bed furrow configuration for planting crops further enables improved resource management.

The key features which characterize conservation agriculture include: a) Minimum soil disturbance by adopting no-tillage and minimum traffic for agricultural operations, b) Leave and manage the crop residues on the soil surface, and c) Adopt spatial and temporal crop sequencing/crop rotation to derive maximum benefits from inputs and minimize adverse environmental impacts (Sangar, 2004) [18]. The conservation Technology Information Centre in India, USA has defined conservation tillage as tillage and planting system in which at least 30% of the soil surface is covered by plant residue after planting to reduce erosion by water.

Organic manures ameliorate this problem as organic matters helps in increasing adsorptive power of soil for cations and anions particularly phosphorus and nitrates. These absorbed nutrient ions are released slowly for the benefit of crop during entire growth period (Naguib, 2011) [14]. It helps to improve the soil chemical properties (Tiwari *et al.*, 1998) [23]. Organic manures also improve the organic carbon status, available primary and secondary nutrients (Pratibha, *et al.*2011) [16].

The enhancement in available micronutrients viz., Fe, Mn, Zn and Cu due to the addition of organic substances may be ascribed to the presence of appreciable quantity of Fe, Mn, Zn and Cu in the organics and residual effect of FYM added to this treatment while cultivation of soybean which enhances the micronutrients due to their ability to form stable water soluble complexes preventing the reaction with soil constituent and also increasing the micronutrients content through releasing from the native sources Ghosh *et al.* (2001) [6] and Katkar (2002) [9].

The systematic study of soil chemical properties of soil under different resource conservation technologies is necessary to create an evidence for evaluating the impact of these management measures on soil quality. The primary factor having influence on soil health is organic matter fractions, which are under constant threat of depletion due to inadequate replenishment under rainfed farming system. The organic matter build up in tropical soil is not feasible, but its maintenance at a desirable level is essential. Use of organics, crop residues, green manures, agricultural wastes, biofertilizers as the components of conservation agriculture improve soil health by changing rhizosphere environment.

Materials and Methods

The experiment was conducted during 2012-14 at Research Farm of Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola. The experiment was consisting of nine (9) treatment viz., T_1 (100% RDF), T_2 (Dhaincha 25% N +Compensation of RDF), T_3 (Cotton Stalk 25% N +Compensation of RDF), T_4 (Wheat Straw 25% N +Compensation of RDF), T_5 (Bio mulch 25% N + Compensation of RDF), T_6 (Neemcake 25% N + Compensation of RDF), T_7 (100% N-FYM +Compensation of P-Phosphocompost), T_8 (50% N-FYM +Compensation of P-Phosphocompost +Urea), T_9 (50% N - leuceana loppings +Compensation of P – Phosphocompost +Urea). These treatments were evaluated in Randomized Block Design having three replications. Available N, P, K, S, Fe, Mn, Zn and Cu content in soil at 15 cm depth from each plot after soybean harvest was estimated separately. These parameters were measured separately in soils like pH and Electrical conductivity (Jackson, 1973) [7], Organic Carbon (Walkley and Black's, 1934) [24], Nitrogen (Subbiah and Asija, 1956) [21], Phosphorus (Olsen *et al.,* 1954) [15], Potassium (Jackson, 1973) [7], Sulphur (Chensin and Yien, 1950) [2], micronutrients viz., Iron (Fe), Magnesium (Mn), Copper (Cu), and Zinc (Zn), were determined by using atomic absorption spectrophotometer (Lindsay and Norvell, 1978) [11] by their standard methods.

Results and Discussion

The chemical properties of soil were assessed for pH, EC, OC, N, P, K, S, Fe, Mn, Cu, and Zn contents (Table.1). All the treated soil samples were alkaline in reaction. Soil pH is most important chemical characteristics of soil that influences all properties of soil and also important factors for nutrient availability to the plants. The pH of soil range varied from 8.31 to 8.35 under soybean crop cultivation, which could be attributed to the buffering effect caused due to organic matter and secondly due to pH the high buffering capacity of the clayey soil. Masto *et al* (2007) [12] and Sujata *et al* (2007) [22] studied the effect of various levels of FYM and NPK fertilizers alone and in combination for 15 years on black soils and found that the long term use of FYM and fertilizers caused slight decrease in pH due to FYM. Leaving crop residues on the soil surface reduced the soil pH due to organics (crop residue or plant parts) contain large amount of organic nitrogen such as proteins and amino acids, which mineralizes to nitrate in soil producing protons during nitrification and hence acidifying the soils according to Kumar *et al*. (2008) [10] and Rao and Janawade (2009) [17].

Table 1: Effect of different resource conservation practices on soil chemical properties under soybean cultivation

T. No.	pH (1:2.5)		EC (dSm^{-1})		OC($g\ kg^{-1}$)		Avai. N ($kg\ ha^{-1}$)		Avai. P ($kg\ ha^{-1}$)		Avai. K ($kg\ ha^{-1}$)		Avai. S ($mg\ kg^{-1}$)	
	Initial	At harvest	Initial	At harvest	Initial	At harvest	Initial	At harvest	Initial	At harvest	Initial	At harvest	Initial	At harvest
T1	8.32	8.31	0.16	0.16	5.83	5.83	203.00	202.40	11.46	11.64	330.10	345.20	10.13	11.44
T2	8.36	8.35	0.18	0.17	5.83	5.85	193.08	200.40	11.38	11.47	328.30	341.20	9.77	11.23
T3	8.30	8.31	0.18	0.18	5.79	5.80	199.00	201.90	11.36	11.48	325.70	338.30	9.78	11.13
T4	8.31	8.31	0.17	0.16	5.78	5.79	190.20	192.40	11.36	11.42	323.20	336.90	9.79	11.08
T5	8.34	8.33	0.16	0.15	5.79	5.81	191.30	201.87	11.36	11.43	322.10	335.20	9.82	11.27
T6	8.34	8.33	0.18	0.17	5.80	5.81	194.10	203.49	11.38	11.50	326.70	340.50	9.51	11.19
T7	8.32	8.31	0.18	0.16	6.01	6.08	208.80	218.30	11.63	12.70	345.30	356.00	9.96	11.39
T8	8.33	8.32	0.18	0.17	6.00	6.05	198.80	216.40	11.41	11.53	340.10	349.30	9.92	11.33
T9	8.34	8.33	0.17	0.16	5.82	5.93	195.03	202.60	11.37	11.47	320.30	331.50	9.67	11.21
SE(m)±	0.047	0.047	-	0.006	-	0.03	-	2.63	-	0.25	-	4.23	-	0.11
CD at 5%	-	-	-	-	-	0.11	-	7.89	-	0.75	-	12.68	-	0.34

Note-T_1= 100% RDF, T_2= Dhaincha 25% N +Compensation of RDF, T_3= Cotton Stalk 25% N +Compensation of RDF, T_4= Wheat Straw 25% N +Compensation of RDF, T_5= Bio mulch 25% N + Compensation of RDF, T_6= Neemcake 25% N + Compensation of RDF, T_7= 100% N-FYM +Compensation of P-Phosphocompost, T_8= 50% N-FYM +Compensation of P-Phosphocompost +Urea, T_9= 50% N - leuceana loppings +Compensation of P – Phosphocompost +Urea.

EC was also observed that, the differences of electrical conductivity among the different treatments were non-significant, electrical conductivity varied from 0.15 to 0.18 dsm^{-1} under soybean cultivation. The application of organic materials also increases the release of salts into soil solution as result of mineral dissolution due to increase in partial pressure of carbon dioxide and organic acids which leads to very slight increase in electrical conductivity Choudhary *et al.* (2011) [3]. Lowering the electrical conductivity under all resource conservation treatments is attributed to the increased permeability and consequently the leaching of salts (Srikanth *et.al*. 2000) [20].

Soil organic carbon dynamics is of paramount importance for sustaining long term soil quality and productivity under intensive cropping. Organic matter is an indication of organic carbon fraction of soil formed due to microbial decomposition of organic residues. The effect of different resource conservation practices under soybean varied from 5.79 to 6.08 g $kg^{-1}$and result was found to be significant. The higher organic carbon content of soil (6.08 g kg^{-1}) was observed with the application of RDF (based on soil test) i.e 100% N - FYM + compensation of P - Phosphocompost (T_7) followed by other treatment combinations. The organic carbon in the soil under soybean crop increased as compared to other cereals which may be due to legume crop like soybean which adds more crop residues than other crops. The organic carbon content of soil increased slightly due to cultivation of leguminous crop (90.41%) as compared to soil under cereal (0.38%) and fallow (0.36%) (Sharma *et al.* 1986) [19].

The soil available nitrogen varied from 192.40 to 218.30 kg ha^{-1} after harvested of soybean crop. The data showed significant difference in all treatments. It was observed that gain of nitrogen after harvest of soybean crop in all treatments over initial value. The maximum available nitrogen (218.30 kg ha^{-1}) was observed in treatment (T_7) and (216.40 kg ha^{-1}) in treatment (T_8). There was significant increase in available nitrogen due to addition of FYM and Phosphocompost (T_7) over use of other treatments. The regular application of FYM is highly essential to maintain the sustainability of soil in respect of available nutrients. It was observed that considerable improvement in available N status was observed in all the treatments which involve combined application of crop residues and inorganic fertilizer over initial status. Organic matter helps in increasing adsorptive power of soil for cations and anions which released slowly particularly nutrients Katkar *et al.* (2005) [8] and Babhulkar *et al.* (2000) [1].

The highest amount of available phosphorus and potassium in soil recorded in treatment T7 (100% N-FYM+Compensation of P-Phosphocompost) 12.70 and 356.00 $Kgha^{-1}$ respectively, which was significantly superior over all the other treatments. The increase in available phosphorus status under all INM treatments might be due to residual effect of organics applied as well as inclusion of legume crop in the cropping system, as legume absorb more soil phosphorus from subsurface and a part of which is left in the surface layer and part of which is left in subsurface soil with roots.. The results are in conformity with Mohanthy *et al.* (2007) [13]. The increase in availability of potassium can be attributed to direct addition of potassium through fertilizers and FYM to the available pool of soil and also the interaction of organic matter added through FYM with clay reduce potassium fixation and releases potassium in soil solution. Considerable increase in soil available potassium was also reported by Kumar *et al.* (2008) [10]. In case of available sulphur was recorded maximum in treatment T1 (100% RDF) 11.44 mg kg^{-1}, Which was significant superior with followed by rest of all treatments. The increase in available sulphur under Phosphocompost and FYM application might be due to solubilisation of the nutrients from native sources during the process of decomposition. Similar results were also noted by Ganeshmurthy (2006) [5], while recorded minimum available nitrogen, phosphorus and sulphur in treatment T4 (Wheat Straw 25% N +Compensation of RDF) 192.40 (Kg ha^{-1}), 11.42 (Kg ha^{-1}), 11.08 (mg kg^{-1}) except available potassium because it was recorded minimum in treatment T9 (50% N - leuceana loppings +Compensation of P – Phosphocompost +Urea) 331.50 (Kg ha^{-1}).

The experimental sites showed significant improvement in fertility level of soils with respect to micronutrients viz., Fe, Mn, Zn and Cu as recorded after harvest of soybean crop (Table-2). The highest amount of available iron, manganese, zinc and copper in soil recorded in treatment T7 (100% N-FYM+Compensation of P-Phosphocompost) 10.27, 10.08, 0.67 and 3.30 mg kg^{-1} respectively. Which was significant superior with followed by rest of all treatments while minimum in treatment T1 (100% RDF) 9.60, 9.03, 0.58 and 2.90 mg kg^{-1} respectively). This increase in available micronutrients viz., Fe, Mn, Zn and Cu may be due to addition of organic manures which enhances the microbial activity and consequently releases complex organic substances would have prevented copper from precipitation, fixation, oxidation and leaching (Ghosh *et al.* 2001 and Katkar 2002) [6, 9]. The improvement in micronutrients status in soils might be due to application of resource conservation practices on soils. The DTPA (Diethylene triamine pentaacetic acid) extractable micronutrients consisting of Fe Mn, Zn, and Cu after harvest were found to be slightly higher than initial values.

Table 2: Effect of different resource conservation practices on soil micro nutrients status under soybean cultivation

T. No.	Avai. Fe (mg kg^{-1})		Avai. Mn (mg kg^{-1})		Avai. Zn (mg kg^{-1})		Avai. Cu (mg kg^{-1})	
	Initial	At harvest	Initial	At harvest	Initial	At harvest	Initial	At harvest
T_1	9.60	9.60	8.99	9.03	0.57	0.58	2.85	2.90
T_2	9.77	9.80	9.83	9.85	0.59	0.62	3.00	3.08
T_3	9.75	9.79	9.21	9.22	0.57	0.59	2.95	2.97
T_4	9.75	9.78	9.17	9.25	0.56	0.58	2.91	2.95
T_5	9.76	9.80	9.19	9.46	0.57	0.60	2.95	3.05
T_6	10.13	10.19	9.14	9.18	0.61	0.62	2.97	2.99
T_7	10.24	10.27	10.00	10.08	0.64	0.67	3.22	3.30
T_8	10.23	10.25	9.96	10.05	0.62	0.65	3.16	3.22
T_9	10.22	10.24	9.87	9.94	0.61	0.64	3.13	3.15
SE(m)±	-	0.011	-	0.007	-	0.01	-	0.01
CD at 5%	-	0.033	-	0.022	-	0.03	-	0.03

Conclusion

The results from the sites under study where application of farm yard manure and phosphocompost, along with chemical fertilizers is useful for improving the chemical properties of soil resulting into enhancement in soil quality under soybean crop cultivation.

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