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

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Abstract
The present investigation was conducted at Research Farm of Department of Soil Science and Agricultural Chemistry, Dr. Panjab Rao Deshmukh Krishi Vidyapeeth, Akola. The field experiment consisting of nine treatments with three replications in the Randomized Block Design. The treatments comprised of recommended dose only through chemical fertilizers, 25% N through Sesbania aculeata (Dhaincha), cotton stalk, wheat straw, Biomulch and neemcake with remaining dose through chemical fertilizers, 100% N - FYM + compensation of P - Phosphocompost, 50% N - FYM + compensation of P - Phosphocompost + Urea and 50% N – leucaena loppings + compensation of P - Phosphocompost + Urea. The results of the present study indicated that, application of 100% N - FYM + Compensation of P-Phosphocompost significantly.

Keywords: Resource, conservation, soil, physico, chemical, properties, cotton, cultivation

Introduction
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) [2].

The conservation Technology Information Centre in India, USA has defined conservation tillage as a no 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. 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 (Ghuman and Sur 2006) [6] bed furrow configuration for planting crops further enables improved resource management.

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.

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 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 constant threat of depletion due to inadequate replenishment under rainfed farming system.

The organic matter in c...
In recent years conservation agriculture concept has come in vogue, as a means of reducing time, labour and machine operation as well as conserving moisture and reducing soil erosion and nutrient loss. Conservation agriculture is a 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) [5].

Materials and Methods

The experiment was conducted at Research Farm of Department of Soil Science and Agricultural Chemistry, Dr. Panjab Rao Deshmukh Krishi Vidyapeeth, Akola. The experiment was consisting of nine (9) treatment viz., T1 (100% RDF), T2 (Dhaincha 25% N + Compensation of RDF), T3 (Cotton stalk 25% N + Compensation of RDF), T4 (Wheat straw 25% N + Compensation of RDF), T5 (Bio mulch 25% N + Compensation of RDF), T6 (Neemcake 25% N + Compensation of RDF), T7 (100% N - FYM + Compensation of P - Phosphocompost), T8 (50% N - FYM + Compensation of P - Phosphocompost + Urea), T9 (50% N - leucaena lopings + Compensation of P – Phosphocompost + Urea). These treatments were evaluated in Randomized Block Design having three replications. Soil samples collected from sites from each plot at a depth of 0-15 cm before sowing of cotton crop and after harvest of cotton crop. After preparing soil samples, several parameters were measured separately from soil samples like pH and Electrical conductivity (Jackson, 1973) [8], Organic Carbon (Walkley and Black’s, 1934), Nitrogen (Subbiah and Asija, 1956) [23], Phosphorus (Olsen et al., 1954), Potassium, Calcium, Magnesium and Sodium (Jackson, 1973) [8], Sulphate (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) [14] by their standard methods.

Soil pH is most important chemical characteristics of soil that influences all (physical, chemical and biological) properties of soil and also important factors for nutrient availability to the plants. The pH of soil ranged from 8.29 to 8.34 under cotton, 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. There was no significant variation among treatment due to addition of amendments. However, Ismail et al. (1998) [7] observed a significant reduction in pH value of Vertisol with application of FYM @ 30 Mg ha⁻¹ over control within one year. Masto et al. (2007) [15] and Sujata et al. (2007) [24] 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. Similar observations were also reported earlier by Katkar et al. (2006) [10], Kumar et al. (2008) [13] and Rao and Janawade (2009) [19] who has reported that soil pH and electrical conductivity reduced slightly with the application of FYM, crop residue and green manure.

Electrical conductivity was also observed that, the differences of EC among the different treatments were non significant, electrical conductivity varied from 0.14 to 0.17 dSm⁻¹ under cotton 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) [4]. Lowering the electrical conductivity under all resource conservation treatments is attributed to the increased permeability and consequently the leaching of salts (Srikantan et al. 2000) [2]. The effect of different resource conservation practices on organic carbon content under cotton cultivation varied from 5.79 to 6.20 g kg⁻¹ and result was found to be significant. The higher organic carbon content of soil (6.20 g kg⁻¹) was observed with the application of RDF (based on soil test) i.e 100% N - FYM + compensation of P - Phosphocompost (T7) followed by other treatment combinations. The organic carbon in the soil under cotton 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) [21]. 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 soil available nitrogen varied from 209.20 to 225.90 kg ha⁻¹ after cotton cultivation. The data showed significant difference in all treatments. It was observed that gain of nitrogen after harvest of cotton crop in all treatments over initial. The maximum available nitrogen (225.90 kg ha⁻¹) was observed in treatment (T7) and (224.10 kg ha⁻¹) in treatment (T5). There was significant increase in available nitrogen due to addition of FYM and Phosphocompost (T7) over use of other treatments. The regular application of FYM is highly essential to maintain the sustainability of soil in respect of available nitrogen. It was observed that considerable improvement in available nitrogen 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) [11] and Babulakar et al. (2000) [1]. Effect of different resource conservation practices on available phosphorous after harvest of cotton was significantly influenced by various treatments. It varied from 14.92 to 16.80 kg ha⁻¹ after harvest of cotton. The highest available phosphorous (16.80 kg ha⁻¹) was observed in RDF (based on soil test) i.e. 100% N - FYM + compensation of P - Phosphocompost (T7) which was significantly superior over all the other treatments. Significant increase in available phosphorous by addition of chemical fertilizer with organic manures as compared to only chemical fertilizers was also reported by Kanwar and Paliyal, (2002) [9] and Chitale et al. (2003) [3]. The decomposition of leaf litter is useful for slight reduction in pH which favours availability of phosphorous in these soils. The appreciable build up in available phosphorous may also be due to influence of organic matter in increasing the labile phosphorous in soil through complexing of cations like Ca²⁺ which is mainly responsible for fixation in swell shrink soils. The conjunctive use of organics with chemical fertilizers is beneficial for improving available P which is also evidenced by the reduced calcium carbonate content of the soil there by reducing phosphorous fixations. Similar results were reported by Kharche et al. (2011) [12].

The highest amount of available potassium in soil recorded in
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Table 1:

<table>
<thead>
<tr>
<th>T. No.</th>
<th>pH (1:2.5)</th>
<th>EC (dS/m)</th>
<th>O.C(g kg⁻¹)</th>
<th>Avai. N (kg ha⁻¹)</th>
<th>Avai. P (kg ha⁻¹)</th>
<th>Avai. K (kg ha⁻¹)</th>
<th>Avai. S (mg kg⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Initial</td>
<td>Cotton</td>
<td>Initial</td>
<td>Cotton</td>
<td>Initial</td>
<td>Cotton</td>
<td>Initial</td>
</tr>
<tr>
<td>T1</td>
<td>8.32</td>
<td>8.30</td>
<td>0.16</td>
<td>0.16</td>
<td>5.83</td>
<td>5.84</td>
<td>203.00</td>
</tr>
<tr>
<td>T2</td>
<td>8.36</td>
<td>8.34</td>
<td>0.18</td>
<td>0.16</td>
<td>5.83</td>
<td>5.86</td>
<td>193.08</td>
</tr>
<tr>
<td>T3</td>
<td>8.30</td>
<td>8.31</td>
<td>0.18</td>
<td>0.17</td>
<td>5.79</td>
<td>5.82</td>
<td>199.00</td>
</tr>
<tr>
<td>T4</td>
<td>8.31</td>
<td>8.31</td>
<td>0.17</td>
<td>0.16</td>
<td>5.78</td>
<td>5.79</td>
<td>190.20</td>
</tr>
<tr>
<td>T5</td>
<td>8.34</td>
<td>8.32</td>
<td>0.16</td>
<td>0.14</td>
<td>5.79</td>
<td>5.81</td>
<td>191.30</td>
</tr>
<tr>
<td>T6</td>
<td>8.34</td>
<td>8.33</td>
<td>0.18</td>
<td>0.17</td>
<td>5.80</td>
<td>5.82</td>
<td>194.10</td>
</tr>
<tr>
<td>T7</td>
<td>8.32</td>
<td>8.29</td>
<td>0.18</td>
<td>0.16</td>
<td>6.01</td>
<td>6.20</td>
<td>208.80</td>
</tr>
<tr>
<td>T8</td>
<td>8.33</td>
<td>8.32</td>
<td>0.18</td>
<td>0.17</td>
<td>6.00</td>
<td>6.14</td>
<td>198.80</td>
</tr>
<tr>
<td>T9</td>
<td>8.34</td>
<td>8.33</td>
<td>0.17</td>
<td>0.16</td>
<td>5.82</td>
<td>6.09</td>
<td>195.03</td>
</tr>
<tr>
<td>SE(m)±</td>
<td>0.047</td>
<td>0.033</td>
<td>-</td>
<td>-</td>
<td>0.04</td>
<td>-</td>
<td>2.70</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.12</td>
<td>-</td>
<td>8.11</td>
</tr>
</tbody>
</table>

The highest amount of available iron, manganese, zinc and copper in soil recorded in treatment T7 (100% N-FYM+Compensation of P-Phosphocompost) 10.33, 10.14, 0.69 and 3.33 mg kg⁻¹ respectively. Which was significant superior with followed by rest of all treatments, while minimum in treatment T1 (100% RDF) 9.62, 9.05, 0.58 and 2.92 mg kg⁻¹ respectively.

Conclusion

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

References

7. Kanwar, Kamla, Paliyal SS. Influence of phosphorus management and organic manuring on uptake and yield

“The statement about the least available P concentration was significant superior” corrected to “the least available P concentration was significant superior.”