Effect of incorporation of crop residue on physico-chemical properties and micronutrient status of soil green gram - sunflower sequence

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Abstract
The present investigation was undertaken at Experimental Farm, Annamalai University with eleven treatments and three replications framed under Randomized Block Design in summer season for greengram and split plot design in Rabi season for sunflower. The eleven treatments were T1-C, T2-RDF greengram, T3-incorporation of cotton stalk @ 41 ha⁻¹ + 50% N of RDF, T4-incorporation of cotton stalk @ 41 ha⁻¹ + 100% N of RDF, T5-incorporation of cotton stalk @ 41 ha⁻¹ + 125% N + 100% P through RDF, T6-incorporation of sunflower straw @ 4 t ha⁻¹ + 50% N of RDF, T7-incorporation of sunflower straw @ 4 t ha⁻¹ + 100% N of RDF, T8-incorporation of sunflower straw @ 4 t ha⁻¹ + 125% N + 100% P of RDF, T9-incorporation of farm waste (including grasses) @ 4 t ha⁻¹ + 50% N of RDF, T10-incorporation of farm waste (including grasses) @ 4 t ha⁻¹ + 100% N of RDF, T11-incorporation of farm waste (including grasses) @ 4 t ha⁻¹ + 125% N + 100% P of RDF. The results indicated that various physico-chemical properties of soil such as bulk density, soil reaction, Electrical conductivity were decreased available N, P, K and micronutrient status of soil were increased. It can be stated that incorporation of sunflower straw @ 4 t ha⁻¹ + 125% N + 100% P of RDF to greengram in kharif season and 75% RDF to sunflower in Rabi season indicating thereby 25 percent saving of fertilizers and not only improved the physico-chemical and micronutrient status of soil.

Keywords: Crop residues, farm waste, greengram, micronutrients, physico-chemical properties, sunflower

Introduction
Long terms studies in many cropping systems have clearly indicated that crop residue and green manure with chemical fertilizer resources of nutrients could sustain high productivity and improves soil health. Crop residues, used as dry fodder for animals and very little is returned back to soil by way of direct incorporation, mulching or through composting. In fact returning wastes to land leads to maintenance of soil health. Burning of crop residues results in atmospheric pollution, loss of plant nutrients and organic matter (Rusmussen et al., 1980) [13]. Such crop residues, if managed properly have great potential to be utilized as source of plant nutrients in achieving sustainable crop productivity. Increasing demand of food to feed the ever growing population along with rising cost of chemical fertilizers and depleting soil fertility owing to intensive cropping necessitates judicious use of renewable (organic) and non-renewable (inorganic) sources of input energy. There is urgent need is to test easily available alternative sources of energy such as farmyard manure, rice straw, wheat straw etc. for sustainable crop production and soil health as well (Singh et al., 2000) [14]. Recycling of organic residues is becoming an increasingly important aspect of environmentally sound sustainable agriculture (Bellakki and Badanur, 2000) [2]. Increased removal of micronutrients a consequence of adoption of high yielding varieties and intensive cropping together with a shift toward high analysis NPK fertilizers has caused decline in the level of micronutrients in soil below that required for normal productivity of crops (Dangarwala et al., 1974).

Material and Methods
With a view to study the effect of incorporation of cotton stalk, sunflower straw and farm waste on yield of greengram sunflower sequence and physico-chemical properties and micronutrient status of soil field experiment were conducted at Experimental Farm, Annamalai University.
Physico-chemical characteristics of experimental soil

Depth (142 cm), slope (1-3 %), cSand (31.2 %), slit (16.1 %) clay (51.2 %), texture (Clay), order (Vertisols), sub group (Typic Hapludult), bulk density (0.15 cm - 1.34 Mg m⁻³), free lime (5.7 %), pH (8.0-8.1), EC (0.30~3~S m⁻¹). Organic carbon (4.9 g kg⁻¹), total N (0.044 %), available nitrogen (155.62 kg ha⁻¹), available phosphorus (10.30 kg ha⁻¹), available potassium (155.62 kg ha⁻¹), available sulphur (8.06 kg ha⁻¹), available calcium (C. mol (p+) kg⁻¹) 38, available magnesium (C. mol (p+) kg⁻¹) 6, available zinc (0.6 (ppm) C.L., available iron (4.5 (ppm) C.L., available boron (ppm) (0.52 ppm) (0.18 ppm). Treatment details: T₁ - Control (No manure and fertilizer), T₂ - 100 % RDF, T₃ - Incorporation of cotton stalk @ 41 ha⁻¹ + RDF @ 50% N, T₄ - Incorporation of cotton stalk @ 4 t ha⁻¹ +100 % RDF, T₅ - Incorporation of cotton stalk @ 4 t ha⁻¹ + RDF @ 125% N + 100% P, T₆ - Incorporation of sunflower straw @ 4 t ha⁻¹ + RDF @ 50% N, T₇ - Incorporation of sunflower straw @ 41 ha⁻¹ +100 % RDF, T₈ - Incorporation of sunflower straw @ 4 t ha⁻¹ + RDF @ 125% N + 100% P, T₉ - Incorporation of all farm waste (including grasses) @ 4 t ha⁻¹ + RDF @ 50% N, T₁₀ - Incorporation of all farm waste (including grasses) @ 4 t ha⁻¹ + 100 % RDF, T₁₁ - Incorporation of all farm waste (including grasses) @ 4 t ha⁻¹ + RDF @ 125% N + 100% P. Note: Treatment of decomposition culture was given to all crop residues and incorporated in the field 15 days before sowing of summer greengram.

Size of cotton stalk : 1 to 2 cm
Sunflower straw : 1 to 2 cm
Farm waste : 2 to 3 cm
Composition of organic added (oven dry basis)

<table>
<thead>
<tr>
<th>Source</th>
<th>N %</th>
<th>P %</th>
<th>K %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton stalk</td>
<td>0.45</td>
<td>0.15</td>
<td>0.65</td>
</tr>
<tr>
<td>Sunflower straw</td>
<td>0.95</td>
<td>0.24</td>
<td>0.78</td>
</tr>
<tr>
<td>Farm waste</td>
<td>0.30</td>
<td>0.09</td>
<td>0.47</td>
</tr>
</tbody>
</table>

The surface soil samples from each plot before sowing and after harvesting of greengram and sunflower crop were collected and dried in made, ground and sieved through 2 mm sieve. They were stored in labeled polythene bags for subsequent analysis.

Soil Texture: It was determined by Bouyoucos hydrometer method (Piper, 1966). Soil pH was determined in 1:2.5 soil water suspension with Buckman glass electrode pH meter (Jackson, 1967) [8]. EC was determined with the help of direct leading conductivity meter using soil water suspension of 1:2.5 ratio (Jackson, 1967) [8]. Organic carbon was determined by wet digestion method as described by Walkley and Black (Jackson, 1967) [8]. Total nitrogen was determined by Kjeldahl digestion method. Available nitrogen in soil was quantified by using alkaline permagnate (0.32 % K MnO₄) method as described by Subhiah and Asija (1956) [15]. Available phosphorus (kg ha⁻¹) was extracted by Olsen's reagent and determined by using calorimetric method. Available potassium (kg ha⁻¹) It was extracted with neutral N ammonium acetate and was measured by flame photometer (Jackson, 1967) [8]. Determination of available micronutrients from soil. Zn, Cu, Fe, Mn, were determined in DTPA extract using VARIAN - SPECTRA A.A. Atomic absorption spectrophotometer (Tandon, 1999) [10]. Available sulphur by turbidimetric method (Jackson, 1967 [8], available calcium and magnesium EDTA method (Jackson, 1967 [8], available boron hot water extraction (Tandon, 1999) [16]. Available molybdenum Grigg's reagent (Tandon, 1999) [16]. Analysis of variance was used for statistical analysis (Panse and Sukhatme, 1971) [12]. The critical difference was worked out at 5 percent level of significance.

Results and Discussion

Effect of incorporation of crop residues on soil

The data regarding bulk density, pH, EC (Electrical conductivity) and organic carbon of soil as influenced by various treatments are recorded in Table 1. Data indicate that the maximum bulk density was recorded in treatment T₁ (control) (1.28 Mg m⁻³) without incorporation of crop residue. The minimum bulk density was found in treatment T₈ (1.24 mg⁻³) incorporation of sunflower straw @ 41 ha⁻¹ + RDF @ (125% N +100% P). The data regarding pH of soil was found minimum in treatment T₈ incorporation of sunflower straw @ 4 t ha⁻¹ + RDF @ (125% N + 100% P) and minimum in treatment without incorporation of crop residues T. control. The data related to ECe of soil was found maximum in treatment without incorporation of crop residue treatment T₁ (control). Minimum ECe of soil recorded in treatment T₉ incorporation of sunflower straw @ 4 t ha⁻¹ + RDF @ (125% N + 100% P) minimum in treatment without incorporation of crop residue. Incorporation of crop residues cotton stalk, sunflower straw and farm waste subsequent decomposition added organic matter to soil and thus mass per unit volume of soil reduced resulting in lower bulk density. Decrease in bulk density with the increased organic carbon was reported by Lanjewar et al. (1992) [11] and Das et al. (2001) [4].

Fertility status of nutrients after harvest of greengram

The availability of nutrients in the soil is the most important factor that determines the uptake of the same by the plant. The possible ways to increase the availability of nutrients in the soil are either by an increase in the dose of fertilizer or by increase in the efficiency of added nutrients in the soil or a combination of both. Integrated use of organic and inorganic improved the fertility status of soil. Increase in the availability of nutrient content in soil with incorporation of crop residue was observed. The nutrient content of the soil was variable as per the treatment. Highest available nutrient recorded in the treatment T₈ due to incorporation of sunflower straw @ 41 ha⁻¹ + RDF @ (125% N + 100 % P) over to all treatment over to control. The availability of nutrient increased with incorporation of crop residue was also observed by Shankaran et al. (2002). The lowest available nutrient found in the treatment T₁ (control). The data presented in Table 2 indicate that the incorporation of crop residue increased the available micro nutrient content of soil than the control. The available micro nutrient content in soil after harvest of greengram varied.
A lar observation was.

The status of major and secondary nutrient content in soil was

minimum in treatment T

incorporation of crop residue was found in treatment T

The data regarding the pH and EC of soil was found

in treatment T

incorporation of crop residue and minimum bulk density was

recorded in treatment T

Effect of crop residue and fertilizer doses - The data indicate that the highest bulk density was recorded in treatment T

incorporation of crop residue with fertilizer dose decreased the bulk density of soil recorded in treatment T

incorporation of sunflower straw @ 4 t ha

The data related to pH and EC of soil decreased with incorporation of crop residue with fertilizer doses. Treatment T

sunflower straw @ 4 t ha

recorded minimum pH of soil.

The data further indicate that available organic carbon and fertility status of major and secondary nutrient. Highest content of available major and secondary nutrient in soil was recorded in F2 -100 % RDF which was significantly superior was observed in F1 - 75 %TDF treatment.

Effect of interaction - The interaction effect between crop residue and fertilizer doses was found to be non-significant with regard to physico-chemical properties of soil. Similar results were reported by Lanjewar et al., (1992) [11], Hundekar et al., (1999), Bharambe et al. (2001) [13] and Das et al., (2001) [14].

Conclusion

Effect of crop residue and fertilizer doses on fertility status of soil after harvest of sunflower

Effect of crop residue - Results reveal that the status of available of micronutrient in soil was significantly influenced with application of crop residue. The content of Zinc content in soil was significantly influenced with incorporation of crop residue. Zinc content (0.46 ppm), iron (7.11 ppm), manganese (8.10 ppm), copper (1.11 ppm), boron (0.90 ppm), molybdenum (0.28 ppm), was higher in treatment T

sunflower straw @ 4 t ha

+ RDF @ (125 % N + 100 % P) which was significantly superior over other treatment. The lowest organic carbon and fertility status of major and secondary nutrient content in soil was observed in the treatment T

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+ RDF @ (125 % N + 100 % P) which was significantly superior over other treatment. The lowest available zinc (0.39 ppm), iron (3.47 ppm), manganese (4.16 ppm), copper (0.32 ppm), boron (0.43 ppm), molybdenum (0.16 ppm) was observed in T

treatment (control) without crop residues. The molybdenum content in soil increased with incorporation of crop residue. Simi
treatment was also found in T

Treatment T

incorporation of sunflower straw @ 4 t ha

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treatment (control) without crop residues.
Table 4: Effect of crop residue and fertilizer doses on micronutrients status of soil after harvest of sunflower under various treatments

<table>
<thead>
<tr>
<th>Main factor</th>
<th>B (ppm)</th>
<th>Mo (ppm)</th>
<th>Zn (ppm)</th>
<th>Fe (ppm)</th>
<th>Cu (ppm)</th>
<th>Mn (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>0.43</td>
<td>0.16</td>
<td>0.39</td>
<td>3.47</td>
<td>0.32</td>
<td>4.16</td>
</tr>
<tr>
<td>T2</td>
<td>0.46</td>
<td>0.17</td>
<td>0.39</td>
<td>3.79</td>
<td>0.41</td>
<td>4.28</td>
</tr>
<tr>
<td>T3</td>
<td>0.51</td>
<td>0.18</td>
<td>0.40</td>
<td>4.21</td>
<td>0.47</td>
<td>5.19</td>
</tr>
<tr>
<td>T4</td>
<td>0.62</td>
<td>0.21</td>
<td>0.42</td>
<td>5.57</td>
<td>0.63</td>
<td>6.47</td>
</tr>
<tr>
<td>T5</td>
<td>0.70</td>
<td>0.23</td>
<td>0.44</td>
<td>6.06</td>
<td>0.85</td>
<td>7.35</td>
</tr>
<tr>
<td>T6</td>
<td>0.75</td>
<td>0.24</td>
<td>0.44</td>
<td>6.37</td>
<td>0.90</td>
<td>7.69</td>
</tr>
<tr>
<td>T7</td>
<td>0.78</td>
<td>0.25</td>
<td>0.45</td>
<td>6.77</td>
<td>0.98</td>
<td>7.89</td>
</tr>
<tr>
<td>T8</td>
<td>0.90</td>
<td>0.28</td>
<td>0.46</td>
<td>7.11</td>
<td>1.11</td>
<td>8.10</td>
</tr>
<tr>
<td>T9</td>
<td>0.55</td>
<td>0.19</td>
<td>0.41</td>
<td>4.61</td>
<td>0.53</td>
<td>5.71</td>
</tr>
<tr>
<td>T10</td>
<td>0.59</td>
<td>0.20</td>
<td>0.42</td>
<td>5.18</td>
<td>0.58</td>
<td>6.27</td>
</tr>
<tr>
<td>T11</td>
<td>0.67</td>
<td>0.22</td>
<td>0.43</td>
<td>5.93</td>
<td>0.74</td>
<td>7.16</td>
</tr>
<tr>
<td>SE(m) +</td>
<td>0.01</td>
<td>0.01</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0004</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>0.03</td>
<td>0.04</td>
<td>0.0004</td>
<td>0.0004</td>
<td>0.03</td>
<td>0.004</td>
</tr>
<tr>
<td>Sub factor (Fertilizer doses)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>75 % RDF</td>
<td>0.62</td>
<td>0.21</td>
<td>0.427</td>
<td>5.33</td>
<td>0.683</td>
<td>6.35</td>
</tr>
<tr>
<td>100% RDF</td>
<td>0.64</td>
<td>0.22</td>
<td>0.428</td>
<td>5.41</td>
<td>0.693</td>
<td>6.43</td>
</tr>
<tr>
<td>SE(m) +</td>
<td>0.005</td>
<td>0.005</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0007</td>
<td>0.0003</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>0.01</td>
<td>-</td>
<td>0.0002</td>
<td>0.027</td>
<td>0.013</td>
<td>0.003</td>
</tr>
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<td>Interaction</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SE(m) +</td>
<td>0.01</td>
<td>0.19</td>
<td>0.0004</td>
<td>0.02</td>
<td>0.11</td>
<td>0.003</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Effect of fertilizer doses - Effect of fertilizer dose (F1 - 75% RDF, F2 - 100% RDF) on available zinc content in soil was found to be significant. The highest micronutrient content in soil was recorded in F2 - 100% RDF which was significantly superior (0.46 ppm) over F1-75% RDF treatment.

Effect of interaction - The interaction effect between crop residue and fertilizer doses was found to be non-significant with regard to available micronutrient content in soil. Similar observation recorded by Lai and Mathur (1989) [10], Kher (1993) [11] and Basumatyay et al. (2000) [12].

References