Effect of organic manures on growth and yield of summer cowpea 
[Vigna unguiculata (L.) Walp] under middle Gujarat conditions

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ABSTRACT
An experiment was carried out on loamy sand soil of Bidi tobacco Research Station Farm, AAU, Anand to evaluate the effect of organic manures (farmyard manure, vermi-compost, poultry manure, neem cake and castor cake) on growth and green pod yield of cowpea during summer season of 2013-14 in randomized block design with four replications. Application of recommended dose of fertilizer 20-40-0 NPK kg ha⁻¹ recorded significantly higher green pod, stover yield and yield contributing characters viz., number of green pods plant⁻¹, number of seeds pod⁻¹ over different organic sources; However, application of 2 t ha⁻¹ vermicompost was at par with RDF. The plant population per meter row length at 25 DAS and at final picking and number of branches plant⁻¹ and plant height at 30 DAS showed no significant difference between different treatments, but at 60 DAS and at final picking significantly higher plant height was observed due to use of RDF 20-40-0 NPK kg ha⁻¹.

Key words: Cowpea, Castor cake, Farmyard manure, Neem cake, Poultry manure, Stover vermicompost.

India is the largest producer of pulses and accounts for about 25 per cent of the global share. In India, pulse crops are grown over an area of 26.28 million ha with an annual production of 18.09 million tonnes and productivity of 689 kg ha⁻¹. In Gujarat, it is cultivated in 2.09 lakh hectares with an annual production of 1.14 lakh metric tonnes leading to average productivity of 546 kg ha⁻¹ (Anonymous, 2011). Being an inseparable ingredient in the diet of the vast majority of vegetarian population and mainstay of sustainable crop production, pulses continue to be an important component of the rain fed agriculture, since time immemorial.

Among the pulse crops, cowpea is more cosmopolite and grown in most of the regions of India which showed very encouraging results and promises to have a far-reaching significant in achieving a breakthrough in the pulse production. Cowpea is cultivated throughout India for its long green pods as vegetables, and pulses, as green manure, as well as green fodder. Cowpea seeds contain 54.5% carbohydrates, 24.1% protein and 0.1% fat. Moreover, it is a rich source of phosphorus, calcium and iron (Anonymous, 2007). The protein in cowpea seed is rich in amino acids, viz, lysine and tryptophan as compared to cereal grains. However, it is deficient in methionine and cysteine as compared to cereals.

Modern agriculture based on chemicals is not sustainable because of many problems such as loss of soil productivity from excessive erosion and associated plant nutrient losses, surface and ground water pollution from pesticides, fertilizers and sediments imposing shortages of non-renewable resources and low farm income from high production costs. As a result, there is increasing awareness of the need for alternative agricultural systems. Although, chemical fertilizers are playing a crucial role to meet the nutrient requirement of the crop, persistent nutrient depletion is posing a greater threat to sustainable agriculture. Therefore, there is an urgent need to reduce the usage of chemical fertilizers and inturn increase the usage of organics. Use of organic manures alone or in combination with chemical fertilizers, helps in improving the physico-chemical properties of the soil and improves the efficient utilization of applied fertilizers resulted in higher seed yield and quality.

Organic manures viz., FYM, vermicompost, poultry manure and oilcakes help in the improvement of soil structure, aeration and water holding capacity of soil. Further, it stimulates the activity of microorganisms that makes the plant to get the macro and micro-nutrients through enhanced biological processes, increase nutrient solubility, alter soil salinity, sodicity and pH. (Alabadan et al., 2009). Though, they contain relatively low concentrations of nutrients and handling them is labour intensive, there has been large increase in their use over inorganic fertilizers as nutrient source (Kannan et al., 2005). Therefore, the soil must be ‘fed’ in a way that the beneficial soil organisms necessary for recycling nutrients and producing humus are not inhibited. The long term manurial studies conducted at many places have revealed the superiority of integrated nutrient supply

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system in sustaining crop productivity in comparison to chemical fertilizer alone (Gaur, 1991). Hence, the present study was carried out to study the effect of various types of organic manures on growth and yield of cowpea during summer season.

A field experiment was conducted at Bidi Tobacco Research Station, Anand Agricultural University, Anand during summer season of the year 2013 - 2014, Gujarat, India. The experiment was conducted in randomised block design with four replication, consisting of nine treatments [T<sub>1</sub>- Control, T<sub>2</sub>- RDF(20-40-0 NPK kg ha<sup>-1</sup>), T<sub>3</sub>- FYM (2.5 t ha<sup>-1</sup>), T<sub>4</sub>- Vermicompost (1 t ha<sup>-1</sup>), T<sub>5</sub>- Vermicompost (2 t ha<sup>-1</sup>), T<sub>6</sub>- Poultry manure (1 t ha<sup>-1</sup>), T<sub>7</sub>- Poultry manure (2 t ha<sup>-1</sup>), T<sub>8</sub>- Castor cake (500 kg ha<sup>-1</sup>) & T<sub>9</sub>- Neem cake (500 kg ha<sup>-1</sup>)]. Yellow mosaic virus resistant cowpea variety “Anand Vegetable Cowpea” (AVC-1) was used as a test crop. Soil of experimental area was loamy sand in texture, low in available nitrogen (120.3 kg ha<sup>-1</sup>), phosphorus (45.7 kg ha<sup>-1</sup>) and medium in available potassium (165.9 kg ha<sup>-1</sup>). Different growth (plant population, plant height, LAI), yield (green pod and stover yield) and yield contributing characters (number of branches plant<sup>-1</sup>), total number of green pods plant<sup>-1</sup>, length of pod, number of seeds pod<sup>-1</sup>, dry weight of root nodules plant<sup>-1</sup>) of cowpea were studied during the field investigation. Data on different aspects of cowpea crop were subjected to statistical analysis as per the procedure of Randomized Block Design. Significance of difference between means for different factors was tested through ‘F’ test and least significant differences were calculated whenever variance ratio was found significant at five percent level for treatment effect (Panse and Sukhatme, 1967).

Different organic manure treatments had significant influence on the growth attributes of cowpea such as plant height, leaf area index and dry weight of the root nodules plant<sup>-1</sup> (Table-1). Different treatments failed to exert their significant influence on plant stand recorded at 25 DAS and at final picking. Plant height recorded at 30 DAS was not affected significantly due to different organic manure treatments while significantly higher plant height recorded at 60 DAS (59.37 cm) and at harvest (62.00 cm) of the crop was observed with the application of treatment RDF (20-40-0 kg NPK ha<sup>-1</sup>) compared to treatment (Control), which might be due to availability of nutrients from inorganic sources and favourable conditions created in uptake of plant nutrients by the crop. The plant growth is the function of photosynthetic activity of the plants and translocation of photosynthates within the plant which ultimately depend on their capacity to utilize available nutrients. Initial boost of nitrogen which might have helped in higher chlorophyll formation and ultimately higher photosynthesis resulted in more plant height. Nitrogen is also known to contribute for cell elongation. Another probable reason might be due to an application of available phosphorus under treatment RDF, which might help in root elongation and better nutrients as well as water extraction from soil. Phosphorus is also known to encourage cell division and hence contributed to taller plants. The application of vermicompost @ 2 ton ha<sup>-1</sup> recorded statistically at par values of plant height at various stages of observation. An observed improvement in overall vegetative growth of the crop with an application of NPK in this investigation is in conformity with those of Rajkhowa et al. (2002), Ramesh et al. (2006) and (Tanwar et al., 2010).

Leaf area index is a measure of photosynthetic machinery. Application of RDF (20-40-0 NPK kg ha<sup>-1</sup>) and vermicompost @ 2 ton ha<sup>-1</sup>, significantly increased the LAI (3.97 and 3.92) at 60 DAS (Table-1). Which might be due to the greater supply of nitrogen by this treatment which in turn increased leaf size, thereby resulting in maximization of LAI, light interception and high dry matter production. These results are in conformity with results obtained by Chandramohan and Chandagaragi (2007). However, different treatments do not exert significant influence on number of branches plant<sup>-1</sup>. Application of different levels of organic manure resulted in significantly higher dry weight of nodules

### Table 1: Effect of organic manures on growth parameters of cowpea

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Plant height</th>
<th>Plant population</th>
<th>LAI</th>
<th>Number of branches plant&lt;sup&gt;-1&lt;/sup&gt;</th>
<th>Dry weight of root nodules plant&lt;sup&gt;-1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25DAS</td>
<td>60DAS Final Picking</td>
<td>30DAS</td>
<td>60DAS</td>
<td></td>
</tr>
<tr>
<td>T&lt;sub&gt;1&lt;/sub&gt;-Control</td>
<td>20.60</td>
<td>44.77</td>
<td>49.25</td>
<td>10.53</td>
<td>1.47</td>
</tr>
<tr>
<td>T&lt;sub&gt;2&lt;/sub&gt;-RDF(20-40-0 NPK kg ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>27.67</td>
<td>59.37</td>
<td>62.00</td>
<td>14.37</td>
<td>2.26</td>
</tr>
<tr>
<td>T&lt;sub&gt;3&lt;/sub&gt;-FYM (2.5 t ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>23.30</td>
<td>54.22</td>
<td>58.00</td>
<td>12.47</td>
<td>1.87</td>
</tr>
<tr>
<td>T&lt;sub&gt;4&lt;/sub&gt;-Vermicompost (1 t ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>23.00</td>
<td>55.67</td>
<td>57.87</td>
<td>11.27</td>
<td>1.86</td>
</tr>
<tr>
<td>T&lt;sub&gt;5&lt;/sub&gt;-Vermicompost (2 t ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>26.25</td>
<td>59.25</td>
<td>60.75</td>
<td>12.92</td>
<td>2.07</td>
</tr>
<tr>
<td>T&lt;sub&gt;6&lt;/sub&gt;-Poultry manure (1 t ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>22.90</td>
<td>53.40</td>
<td>56.20</td>
<td>11.62</td>
<td>1.86</td>
</tr>
<tr>
<td>T&lt;sub&gt;7&lt;/sub&gt;-Poultry manure (2 t ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>26.25</td>
<td>59.00</td>
<td>59.97</td>
<td>13.00</td>
<td>2.05</td>
</tr>
<tr>
<td>T&lt;sub&gt;8&lt;/sub&gt;-Neem cake (500 kg ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>26.00</td>
<td>57.67</td>
<td>59.65</td>
<td>11.35</td>
<td>1.96</td>
</tr>
<tr>
<td>T&lt;sub&gt;9&lt;/sub&gt;-Castor cake (500 kg ha&lt;sup&gt;-1&lt;/sup&gt;)</td>
<td>25.15</td>
<td>58.62</td>
<td>59.92</td>
<td>12.15</td>
<td>1.87</td>
</tr>
<tr>
<td>S. Em ±</td>
<td>1.46</td>
<td>3.05</td>
<td>2.35</td>
<td>0.75</td>
<td>0.14</td>
</tr>
<tr>
<td>C.D. at 5%</td>
<td>NS</td>
<td>8.90</td>
<td>6.88</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Leaf area index is a measure of photosynthetic machinery. Application of RDF (20-40-0 NPK kg ha<sup>-1</sup>) and vermicompost @ 2 ton ha<sup>-1</sup>, significantly increased the LAI (3.97 and 3.92) at 60 DAS (Table-1). Which might be due to the greater supply of nitrogen by this treatment which in turn increased leaf size, thereby resulting in maximization of LAI, light interception and high dry matter production. These results are in conformity with results obtained by Chandramohan and Chandagaragi (2007). However, different treatments do not exert significant influence on number of branches plant<sup>-1</sup>. Application of different levels of organic manure resulted in significantly higher dry weight of nodules
plant\(^1\) over recommended dose of fertilizer. Significantly higher dry weight of root nodule plant\(^1\) (99.37 mg) was achieved with an application of vermicompost @ 2 t ha\(^{-1}\). However, the differences amongst organic manures remained were not reached to the level of significance. Higher dry weight of root nodule with organic manure application was might be due to favourable effect of organic manures in improving the overall physical, chemical and biological properties of the soil and enhancing symbiosis with nodule bacteria thereby increasing activity of *Rhizobium* in the roots. Similar results were reported by Goud *et al.* (2010) and Sangakkara (1997). Yield and yield attributes of cowpea were also influenced significantly due to various manures and RDF treatments (Table-2). Application of RDF (20-40-0 NPK kg ha\(^{-1}\)) recorded significantly higher number of pods plant\(^{-1}\) (79.60), and number of seeds pod\(^{-1}\) (13.45). More number of pods, the highest green pod yield and stover yield might be mainly due to more survival of flower under high supply of photosynthates with the application of RDF (20-40-0 NPK kg ha\(^{-1}\)) as compared to other organic sources. Among various manures and their levels application of vermicompost @ 2 ton ha\(^{-1}\) was found superior over rest treatments and at par with RDF. In RDF and vermicompost treatments greater root extension under phosphorus application might have helped in greater uptake of nutrients which ultimately improved the yield attributing characters. Furthermore, higher photosynthates produced under treatment, RDF (20-40-0 NPK kg ha\(^{-1}\)) and vermicompost @ 2 ton ha\(^{-1}\) due to better nitrogen and phosphorus availability, better translocation within plants and favourable sink source ratio of photosynthates. Similar results were also reported due to application of 20 kg nitrogen ha\(^{-1}\) and 40 kg phosphorous ha\(^{-1}\) by Shukla and Dixit (1996), Rajkhowa *et al.* (2007), Chandramohan and Chandragiri (2007), Maheshbabu *et al.* (2008) and Singh *et al.* (2008), however, that pod length was non-significant under the influence of different treatments. The highest green pod yield (6738 kg ha\(^{-1}\), 6265 kg ha\(^{-1}\), and 5877 kg ha\(^{-1}\)) and stover yield (6860 kg ha\(^{-1}\), 6748 kg ha\(^{-1}\) and 6202 kg ha\(^{-1}\)) were recorded under the application of RDF (20-40-0 kg NPK ha\(^{-1}\)). Vermicompost 2 t ha\(^{-1}\) and FYM 2.5 t ha\(^{-1}\), respectively.

**CONCLUSIONS**

To achieve higher yield of summer cowpea variety AVC-1 application of RDF (20-40-0 kg NPK ha\(^{-1}\)) or Vermicompost 2 t ha\(^{-1}\) or FYM 2.5 t ha\(^{-1}\) was found equally effective under middle Gujarat conditions.

**REFERENCES**


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