Influence of organic, inorganic and bio-fertilizers on growth, flowering, yield and quality attributes of bitter gourd (Momordica charantia L.) var. green long

Deepanjali Masih, VM Prasad, Vijay Bahadur and Netra Pal Yadav

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Abstract
The present investigation entitled “Influence of organic, inorganic and bio-fertilizers on growth, flowering, yield and quality attributes of bitter gourd (Momordica charantia L) var. Green Long” was carried out during the year 2019-2020 in the Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences Prayagraj in the months of Feb 2019 to May 2019. The experiment was laid out in Randomized Block Design (RBD) with 11th treatments combinations with control. The results revealed that T10 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha was found suitable for application in winter season bitter gourd cultivation for better flowering, growth, fruit yield and quality viz., The maximum average vine length (cm) at 30, 60, 90 DAS were recorded 124.65cm, 243.77cm, 368.61cm respectively, number of branches per plant at 30, 60, 90 DAS were recorded 69.52gm, total...
The fruit contains 2.1g of protein, 4.2g of carbohydrates, 1.8mg of iron, 20mg of calcium, 55mg of phosphorus, 210 IU of vitamin A and 88mg of vitamin C per 100gm of edible portion (Aykroyd, 1963). The fruits, young shoots and flowers are used for flavouring, the leaves as green and the pulpy aril as a sweet. The fruit of bitter gourd is having a lot of medicinal properties and said to have cooling effect, prevents constipation and checks jaundice and indigestion. The bitter principle in bitter gourd is due to ‘momordicine’, an alkaloid which is different from ‘cucurbitacins’ present in other genera of cucurbits. Momordicine is the nomordicosides–glycosides of tetracyclic triterpenoids with cucurbite skeleton (Chandravadana & Subhash Chandra, 1990) [7]. It is considered for having medicinal properties and with a compound named ‘Charantin’ present in the bitter gourd, is useful to reduce blood sugar of diabetic patients. The fruit of bitter gourd fruit is similar in nutritional value compared to other cucurbits, with the notable exceptions that it is much higher in folate and vitamin C. parts used: fruit, seeds, seed oil, leaves; uses: antidiabetic, anti-infective, antipyretic, antihelminthic, laxative, possible antifungal, androgenic, antiviral, antimarial actions; possibly useful for infertility; precautions: pregnancy, lactation, children, patients taking hypoglycemic medications; may cause uterine bleeding or contractions, hepatotoxicity; seeds are toxic to children.

Plant nutrition is one of the most important factors that increase plant production. Nitrogen (N) is one of the most important nutrients affecting the growth, development, and yield and fruit quality of plants. Integrated nutrient sources are increased the nutrient use efficiently and soil fertility thus enhance the productivity of tomato. Organic manures not only balance the nutrient supply but improve the physical and chemical properties of soil. Vermicomposting known to increase protein synthesis in plant, have definite influence on plant growth and yield. Bio fertilizers, which are eco-friendly and more economics, can play an important role in reducing the dependence on chemical fertilizers.

Farm yard Manure is prepared basically using cow dung, cow urine, waste straw and other dairy wastes. FYM is rich in nutrients a small portion of N is directly available to the plants while a larger portion is made available as and when the FYM decomposes. When cow dung and urine are mixed, a balanced nutrition is made available to the plants. Availability of Potassium and Phosphorus from FYM is similar to that from inorganic sources Application of FYM improves soil fertility.

Vermicompost has been shown to be richer in many nutrients than compost produced by other composting methods. It has also outperformed a commercial plant medium with nutrients added, but levels of magnesium required adjustment, as did pH. Increases in the total nitrogen content in vermicompost, an increase in available nitrogen and phosphorus in the soil. Enhances germination, plant growth and crop yield, Improves root growth and structure, Enriches soil with micro-organisms. Azotobacter is the important and well-known nitrogen fixing aerobic bacterium. It is used as a biofertilizer for all non-leguminous plants especially Rice, Cotton, and Vegetables etc. Azotobacter cells are not present on the rhizosphere plant but are abundant in the rhizosphere region. The lack of organic matter in the soil is a limiting factor for the proliferation of Azotobacter in the soil.

Materials and Methods

The present investigation entitled “Influence of organic, inorganic and bio-fertilizers on growth, flowering, yield and quality attributes of bitter gourd (Momordica charantia L.) var. Green Long” was carried out during the year 2019-2020 in the Department of Horticulture, Sam Higginbottom University of Agriculture Technology & Sciences Prayagraj in the months of Feb 2019 to May 2019. The experiment was conducted on Bitter gourd (Momordica charantia L) var. Green Long. The experiment was laid out in randomized block design with 12 treatments replicated three. The treatments involved were T0. Control, T1. 100% RDF (90:60:60), T2. 75% RDF + FYM@20 tonnes/ha, T3. 75% RDF + Vermicompost@10 tonnes/ha, T4. 75% RDF + Azotobacter, T5. 50% RDF + Vermicompost@10 tonnes/ha, T6. 50% RDF + FYM@20 tonnes/ha, T7. 50% RDF + Azotobacter, T8. 25% RDF + FYM@20 tonnes/ha + Azotobacter, T9. 25% RDF + Vermicompost@10 tonnes/ha + Azotobacter, T10. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha, T11. 50 % RDF + FYM@20 tonnes/ha + Azotobacter.

Results and Discussion

Growth parameters

The data revealed that the combination of different Organic and inorganic fertilizers and bio fertilizers affected growth parameter like Vine length, Number of branches per plant and number of leaves per plant of bittergourd as shown in (Table 1). Significant difference in the Vine length, Number of branches per plant and Number of leaves per plant was recorded due to application of different combinations of organic, inorganic fertilizers and bio-fertilizers. The treatment T10 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha recorded the maximum Vine length (368.61 cm), followed by T9 (363.68cm) and the maximum number of leaves per plant T10 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (288.76), followed by T11. 50 % RDF + FYM@20 tonnes/ha + Azotobacter (284.39) and the maximum number of branches per plant was T10 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (14.56), followed by T11- 50 % RDF + FYM@20 tonnes/ha + Azotobacter (13.62) which differed significantly from each other as well from other treatments. Where in RDF: Recommended Dose of fertilizers, Bio-fertilizer: Azotobacter. The plot size was 2 m x 1 m and spacing followed was 50cm x 1 m. the land was brought to a fine tilth by through ploughing and tillage. The organic manures were applied one week before sowing, for proper decomposition, full dose of nitrogen, phosphorus and potassium Bio-fertilizers Azotobacter, as per treatment were applied just before the sowing. All cultural practices were followed regularly during crop growth and observations were recorded on growth characters i.e., Vine length, number of leaves per plant, number of branches per plant were recorded from time to time. It was noticed that number of branches per plant, number of leaves per plant increased with increasing Vine length successively with the increasing levels of organic inorganic fertilizer and bio-fertilizer. Combination of organic inorganic fertilizer and bio-fertilizer also recorded maximum Vine length, number of branches and number of leaves also which helped the plants in better photosynthesis to attain vigor. The findings of the present investigation are in conformity with the reports of as reported Aranc (2015) [21], Prabha et al., (2007) [17], Prasad et al., (2009) [18], Narkhede et al., (2011) [16], Thriveni et al., (2015) [21] in bittergourd.
Fertilizer affected various flowering attributes of bitter gourd (Momordica charantia L.) var. green long. Due to application of different organic, inorganic and biofertilizers, the treatment T<sub>1</sub> (50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha) recorded the maximum number of female flower appearance in T<sub>1</sub> (Control) might be due to non-availability of nutrients. Similar findings were reported by Sree nivas et al., (2000) [20], Mulani et al., (2007) [15], Priyanka et al., (2009) [19], Kameswari et al., (2010) [8], Baset et al., (2011) [3], Mukesh et al., (2012) [12] in bittergourd.

Flowering parameters
The data revealed that the combination of different organic, inorganic and biofertilizers affected flowering parameters as shown in (Table 1). The minimum days to first female flower appearance was observed in T<sub>10</sub> (50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha) (33.17 days) Followed by T<sub>11</sub> - 50% RDF + FYM@20 tonnes/ha + Azotobacter (31.87 days) and the minimum days to first male flower appearance was observed in T<sub>1</sub> (51.18 days) and the maximum number of female flower appearance in T<sub>1</sub> (Control) might be due to non-availability of nutrients. Similar findings were reported by Sree nivas et al., (2000) [20], Mulani et al., (2007) [15], Priyanka et al., (2009) [19], Kameswari et al., (2010) [8], Baset et al., (2011) [3], Mukesh et al., (2012) [12] in bittergourd.

Yield parameters
The data revealed that the combination of different Organic and inorganic fertilizers and bio fertilizers affected Yield parameter like Days to first fruit picking, Number of fruits per plant, average fruit length, average fruit width, average fruit weight, fruit yield per plant, fruit yield t/ha of bittergourd as shown in (Table 2). Significant difference in the Days to first fruit picking, Number of fruits per plant, average fruit length, average fruit width, average fruit weight, fruit yield per plant, fruit yield t/ha was recorded due to application of different combinations of organic, inorganic fertilizers and bio-fertilizers. The treatment T<sub>10</sub> (50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha) recorded the Minimum days to first fruit picking (45.88 days), followed by T<sub>11</sub> (51.18 days) and the maximum number of fruits per plant T<sub>10</sub> (50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha) (42.20). Followed by T<sub>1</sub> 75% RDF + Azotobacter (38.14) and the maximum average fruit length was T<sub>10</sub> 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (25.47cm), followed by T<sub>11</sub> 50% RDF + FYM@20 tonnes/ha.
+ Azotobacter (22.67 cm), the Average fruit width was observed in T10 (17.24 cm), followed by T6. 25% RDF + Vermicompost@10 tonnes + Azotobacter (16.05 cm) respectively, the Average fruit length was observed in T10. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (69.52 cm), followed by T11. 50% RDF + FYM@20 tonnes/ha + Azotobacter (63.48 cm), fruit yield per plant was observed in T10. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (2.93 kg), followed by T4. 75% RDF + Azotobacter (230.2 kg), and fruit yield (t ha-1) was observed in T10. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (52.81 t ha-1) followed by T8. 25% RDF + Vermicompost@10 tonnes + Azotobacter (42.69 t ha-1). which indicated significantly from each other as well from other treatments. Where in RDF: Recommended Dose of fertilizers, Bio-fertilizer: Azotobacter. It was noticed that Days to first fruit picking, Number of fruits per plant, average fruit length, average fruit width, average fruit weight, fruit yield per plant, fruit yield t/ha increased with increasing plant growth successively with the increasing levels of organic inorganic fertilizer and bio-fertilizer. Combination of organic inorganic fertilizer and bio-fertilizer also recorded maximum Days to first fruit picking, Number of fruits per plant, average fruit length, average fruit width, average fruit weight, fruit yield per plant, fruit yield t/ha also which helped the plants in better photosynthesis to attain vigor. The findings of the present investigation are in conformity with the reports of as reported by Sreenivas et al., (2000) [20], Bindiya et al., (2006) [4], Mulani et al., (2007) [13], Karuppaiah and Balasankari (2008) [9], Kameswari et al., (2010) [8] in bitter gourd.

**Table 2: Influence of organic, inorganic and bio-fertilizers on growth, flowering, yield and quality attributes of bitter gourd (Momordica charantia L.) var. green long**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Days to first fruit picking</th>
<th>Number of fruit per plant</th>
<th>Average fruit length</th>
<th>Average fruit width</th>
<th>Average fruit weight</th>
<th>Fruit yield per plant</th>
<th>Fruit yield (t/ha)</th>
<th>Total soluble solid</th>
<th>Ascorbic acid (mg 100g-1)</th>
<th>Shelf life (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T0 control</td>
<td>67.99</td>
<td>22.76</td>
<td>11.54</td>
<td>6.45</td>
<td>43.25</td>
<td>0.983</td>
<td>17.70</td>
<td>3.16</td>
<td>75.62</td>
<td>5.57</td>
</tr>
<tr>
<td>T1 100% RDF (90:60:60)</td>
<td>53.55</td>
<td>30.51</td>
<td>16.07</td>
<td>9.07</td>
<td>52.45</td>
<td>1.601</td>
<td>28.81</td>
<td>4.16</td>
<td>78.52</td>
<td>7.52</td>
</tr>
<tr>
<td>T2 75% RDF + FYM@20 tonnes/ha</td>
<td>53.73</td>
<td>33.37</td>
<td>18.51</td>
<td>10.07</td>
<td>53.75</td>
<td>1.792</td>
<td>32.26</td>
<td>4.31</td>
<td>81.52</td>
<td>7.19</td>
</tr>
<tr>
<td>T3 75% RDF + VC@10 tonnes/ha</td>
<td>60.12</td>
<td>35.87</td>
<td>15.51</td>
<td>12.75</td>
<td>59.14</td>
<td>2.122</td>
<td>38.19</td>
<td>4.15</td>
<td>80.15</td>
<td>7.16</td>
</tr>
<tr>
<td>T4 75% RDF + Azotobacter</td>
<td>57.55</td>
<td>38.14</td>
<td>15.77</td>
<td>14.54</td>
<td>60.41</td>
<td>2.302</td>
<td>41.44</td>
<td>4.67</td>
<td>77.45</td>
<td>7.96</td>
</tr>
<tr>
<td>T5 50% RDF + VC@10 tonnes/ha</td>
<td>61.54</td>
<td>34.17</td>
<td>17.81</td>
<td>13.40</td>
<td>60.18</td>
<td>2.059</td>
<td>37.07</td>
<td>4.72</td>
<td>76.52</td>
<td>7.32</td>
</tr>
<tr>
<td>T6 50% RDF + FYM@20 tonnes/ha</td>
<td>61.22</td>
<td>34.21</td>
<td>17.07</td>
<td>13.42</td>
<td>60.89</td>
<td>2.085</td>
<td>37.54</td>
<td>4.20</td>
<td>81.52</td>
<td>7.73</td>
</tr>
<tr>
<td>T7 50% RDF + Azotobacter</td>
<td>58.96</td>
<td>36.51</td>
<td>18.27</td>
<td>13.23</td>
<td>62.98</td>
<td>2.300</td>
<td>41.40</td>
<td>4.33</td>
<td>81.52</td>
<td>7.66</td>
</tr>
<tr>
<td>T8 25% RDF + FYM@20 tonnes + Azotobacter</td>
<td>60.33</td>
<td>30.51</td>
<td>18.37</td>
<td>13.92</td>
<td>60.75</td>
<td>1.854</td>
<td>33.38</td>
<td>4.19</td>
<td>80.45</td>
<td>7.20</td>
</tr>
<tr>
<td>T9 25% RDF + VC@10 tonnes + Azotobacter</td>
<td>55.85</td>
<td>37.51</td>
<td>18.38</td>
<td>16.05</td>
<td>63.18</td>
<td>2.371</td>
<td>42.69</td>
<td>4.26</td>
<td>79.54</td>
<td>7.56</td>
</tr>
<tr>
<td>T10 50% RDF + FYM@20 tonnes + VC@10 tonnes/ha</td>
<td>45.88</td>
<td>42.20</td>
<td>25.47</td>
<td>17.24</td>
<td>69.52</td>
<td>2.934</td>
<td>52.81</td>
<td>4.81</td>
<td>84.52</td>
<td>8.74</td>
</tr>
<tr>
<td>T11 50% RDF + FYM@20 tonnes + Azotobacter</td>
<td>51.18</td>
<td>32.44</td>
<td>22.67</td>
<td>14.92</td>
<td>63.48</td>
<td>2.056</td>
<td>37.00</td>
<td>4.26</td>
<td>81.45</td>
<td>8.10</td>
</tr>
<tr>
<td>F-test</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>C. D. at 0.5%</td>
<td>5.59</td>
<td>3.26</td>
<td>2.15</td>
<td>1.60</td>
<td>4.460</td>
<td>0.250</td>
<td>5.00</td>
<td>0.73</td>
<td>2.45</td>
<td>0.660</td>
</tr>
</tbody>
</table>

**Quality parameters**

The data revealed that the combination of different organic, inorganic and bio-fertilizer affected various Quality parameters as shown in (Table 2.). Quality parameter like Total soluble solid was observed in T10. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (4.81) followed by T3. 50% RDF + Vermicompost@10 tonnes/ha (4.72) respectively the maximum Ascorbic acid was observed in T10. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (84.52 mg 100g-1), followed by T8. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (81.52 mg 100g-1) and maximum shelf life was observed in T10. 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha (8.74 days), followed by T11. 50% RDF + FYM@20 tonnes/ha + Azotobacter (8.10 days). Treatment T8 might be due to luxuriant vegetative growth and better translocation of nutrients to the aerial parts. Maximum value of Total soluble solid, Ascorbic acid and shelf life in days of fruit T0 (Control) might be due to non-availability of nutrients. Similar findings were reported by Karuthamani et al., (1995) [10], Nair and Nair (2006) [15], Bindiya et al., (2006) [4], Karuppaiah and Balasankari (2008) [9] in bitter gourd.

**Conclusion**

It is concluded from the investigation that the treatment T10 50% RDF + FYM@20 tonnes/ha + Vermicompost@10 tonnes/ha was found suitable for application in winter season bitter gourd cultivation for better flowering, growth, fruit yield and quality viz., vine length (cm), number of branches per plant, number of leaves per plant, days to first female flower emergence, days to first male flower emergence, node. No, to which 1st male flower appear, node. No, to which 1st male flower appear, node. No, to which 1st female flower appear, days to first fruit picking, number of fruit per plant, length of fruit (cm), width of fruit (cm), average fruit weight (g), total yield per plant (kg), fruit yield (t ha-1), total soluble
solids, ascorbic acid and Shelf life days. The highest yield benefit cost ratio (4.38) were obtained in treatment T; 50%RDF + Azotobacter under Prayagraj agro climatic condition.

As the study was undertaken only for one season, it needs further confirmation by conducting more trials.

References