Effect of Growing Media and Fertigation Schedules on Growth and Yield of Cucumber (Cucumis sativus L.) under Polyhouse Condition

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Abstract

An experiment was conducted to study the “Effect of growing media and fertigation schedules on growth and yield of cucumber (Cucumis sativus L.) under polyhouse condition” during kharif season of 2016 at Department of Horticulture, S.K.N. College of Agriculture, Jobner. The growing media: garden soil 18 kg/bag + vermicompost 2 kg/bag + cocopeat 2 cm layer at top shows the increase in all growth characters (chlorophyll and number of days taken to first flower appearance), yield attributes [number of fruits per vine, average fruit weight and fruit yield per 1000 m² (11.89 t)], quality attributes (TSS, ascorbic acid, N, P, K content in fruits). The treatment fertigation schedule at 2 days interval provide higher value for all growth characters (chlorophyll and number of days taken to first flower appearance), yield attributes [of fruits per vine, average fruit weight and fruit yield per 1000 m² (9.75 t)], quality attributes (TSS, ascorbic acid, N, P, K content in fruits).

Keywords
Growing media, Fertigation schedules, Cucumber, Growth, Yield, Polyhouse

Introduction

The cucumber (Cucumis sativus L.) is essentially a warm season crop mainly grown in tropical and subtropical regions where it is cultivated in the field. This crop belonging to family cucurbitaceae is generally known as “cucurbits”. It consist of a wide range of vegetables either used for salad purpose (cucumber) or for cooking (all gourds), pickling (West Indian Gherkin) or as desert fruit (musk melon, water melon) or candiel or preserved (ash gourd). As a group, cucurbits occupy the largest area in India and in other tropical countries. Cucumber (Cucumis sativus L.) is commonly known as khira, dosakagu, sukasa, kakri, vellarikki and kakrikai. Cucumber is one of the oldest cultivated vegetable crops having its origin probably in India. It has been known in history for over 3000 years. From India, it seems to have spread to Asia and Africa and then to Europe. It was ancient Greeks and Romans in about 300 B.C. (Tekale et al., 2014).

A growing medium is a substance through which roots grow and extract water and nutrients. Media for vegetable crops are
composed of soil and different organic matters. The soil is generally used as a basic medium because it is cheapest and easy to procure. Soil can be supplemented with the organic matters by adding vermicompost, farm yard manure, cocopeat etc. to enrich adequate nutrients for the plants. The growing medium also plays an important role in seed germination not only it act as a support, but also a source of key nutrients for plant growth. The composition of the medium influence the quality of the seedling (Wilson et al., 2001). There is a better relationship between the manure and rooting rather than conventional soil mix and less susceptibility of the seedlings to soil borne pest and disease (Akanbi et al., 2002).

The fertigation saves about 25 to 30 per cent of fertilizers coupled with higher productivity and quality (Raman et al., 2000). As the fertilizer is the costly input it is very essential to increase the fertilizer use efficiency by standardizing the fertigation schedule for various crops. Cucumber is one of the most important crop grown in protected condition for achieving higher productivity. However, there is no specific recommendation about scheduling of fertigation. Very meager research work has been carried out on apportioning or scheduling of fertilizers, hence there is scope to increase the productivity of cucumber by adopting suitable fertigation level and schedule. Hence the present research work has carried out to study the effect of fertigation levels and schedules on the growth, yield and quality of cucumber grown under polyhouse condition.

**Materials and Methods**

A field experiment was conducted during ‘Kharif’ season of the year 2016 at Horticulture farm S.K.N. College of Agriculture, Jobner, Jaipur at 75° 28’ longitude and 26° 05’ latitude and altitude of 427 metres above mean sea level. The experiment was laid out in randomized block design with three replications under polyhouse condition. the experiment comprised 18 treatment combinations. 6 combination of growing media [Garden soil (GS) 20 kg per bag (G<sub>0</sub>), Garden soil (GS) 20 kg per bag + Cocopeat 2 cm layer at top (G<sub>1</sub>), GS 15 kg per bag + FYM 5 kg per bag (G<sub>2</sub>), GS 18 kg per bag + Vermicompost 2 kg per bag (G<sub>3</sub>), GS 15 kg per bag + FYM 5 kg per bag + Cocopeat 2 cm layer at top (G<sub>4</sub>), GS 18 kg per bag + Vermicompost 2 kg per bag + Cocopeat 2 cm layer at top (G<sub>5</sub>)] and 3 fertigation schedules [equal amount of fertilizers (19:19:19, 0:0:50, urea, CaNO<sub>3</sub>, MgSO<sub>4</sub> and borex)] were applied at 2 days (S<sub>1</sub>), 4 days (S<sub>2</sub>) and 6 days (S<sub>3</sub>) interval. Garden soil was collected from Horticulture farm by removing surface soil up to a depth of 5cm. The texture of soil was loamy sand (entisol) with pH 8.2, ECe 1.35 dSm<sup>-1</sup>, organic carbon 0.20 %, available nitrogen 135 kg ha<sup>-1</sup>, available phosphorus 16.25 kg.

Leaf sample of cucumber was collected from the field as per standard procedure at flowering for chlorophyll content and fruit sample collected at second and third harvesting for TSS, ascorbic acid, N, P, K content of fruits. TSS was estimated in ° Brix with the help of hand refractometer and ascorbic acid (Vitamin C) content was estimated by the dichlorphenol indophenols dye method, and expressed in mg/100 g. Fruit sample were dried and ground for analysis of N, P, K content of fruits. Nitrogen was estimated by Colorimetric method as suggested by Snell and Snell (1939) using the Spectronic-20 (Model SL-177). Phosphorus was estimated by digesting fruit sample with tri-acid mixture of HNO<sub>3</sub>: H<sub>2</sub>SO<sub>4</sub>: HClO<sub>4</sub> (10:1:4) using Vanadomolybdo Phosphate yellow colour method and the intensity of colour was measured at 470 nm in a spectrophotometer (Jackson, 1973). Potassium
was estimated by digesting leaf sample with tri-acid mixture of HNO₃: H₂SO₄: HClO₄ (10:1:4) and was estimated by flame photometer as per the method as suggested by Bhargava and Raghupathi (1993). Data generated from the experimental plots were analysed using SAS 9.3 version of the statistical package (SAS Institute Inc, 2011). Analysis of variance (ANOVA) was performed using PROCANOVA. Means were separated using Fisher’s least significant difference (LSD) test at a probability level of p ≤ 0.05.

Results and Discussion

The data regarding the effect of growing media and fertigation schedules have been summarized and presented as mean of single year (2016).

Effect of growing media

Significantly higher values for chlorophyll content in leaves and optimum days taken for first flower appearance were recorded under treatment G₅ (soil + vermicompost + cocopeat) over other treatments although, treatment G₄ (soil + FYM + cocopeat) remained statistically at par to it for chlorophyll content (Table 1).

Treatment G₅ (soil + vermicompost + cocopeat) registered significantly higher values for number of fruits per vine, average fruit weight and fruit yield per 1000 m² over rest of treatments and remained at par to G₄ (soil + FYM + cocopeat) for number of fruits per vine (Table 1). Higher values for yield attributes might be due to higher accessibility of chemical fertilizers through fertigation and vermicompost which can induce protein production that causes more meristem cells and cell division and finally led to higher average fruit weight of cucumber and finally yield (Salardini and Mojtahedi, 1988).

Significantly higher values for TSS, ascorbic acid content, nitrogen, phosphorus and potassium content were recorded in treatment G₅ (soil + vermicompost + cocopeat) and minimum with G₀ (soil). Treatment G₅ was found significantly superior over rest of the treatments although, treatment G₅ and G₄ were found statistically at par with each other for TSS, phosphorus and potassium content (Table 1). Increase in ascorbic acid and TSS content of fruit in could be attributed to better growing media which helped in better uptake of NPK nutrients including micronutrients which in turn influence the quality traits in cucumber. The results are in conformity with the findings of Grimstand (1990), Koodzeij and Kostecka (1994) and Asano (1994) in cucumber.

Effect of fertigation schedules

Perusal of data in table 1 reveals that treatment S₁ (fertigation at 2 days interval) was recorded significantly maximum values for chlorophyll content at 45 days and optimum days taken for first flower appearance over rest of the treatments. This might be due to frequent and increased application of fertilizers directly in the vicinity of the root zone increases the availability and uptake of nutrients which leads to increase the cell size and cell elongation resulted in healthy and vigorous plant growth.

These results were in accordance with Lee et al., (2005), Eifediyi and Remison (2009), Sharma et al., (2009) and Jilani et al., (2009). Also, the frequent application at 2 days interval increases the availability of nutrients leads to increases the uptake of N, P and K during growth period which increased protein and protoplasm synthesis for higher rate of mitosis resulted in increase the growth attributes. These results are in agreement with those reported by Al-Jaloud et al., (1999) and Shinde et al., (2010).
Table 1 Effect of growing media and fertigation schedules on growth, yield and quality parameters of cucumber

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Chlorophyll (mg/g)</th>
<th>First flower appearance (days)</th>
<th>No. of fruits per vine</th>
<th>Average fruit weight (g)</th>
<th>Fruit yield per 1000 m² (t)</th>
<th>Ascorbic acid (mg/100g)</th>
<th>TSS (ºBrix)</th>
<th>Nitrogen (mg/100g)</th>
<th>Phosphorus (mg/100g)</th>
<th>Potassium (mg/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growing Media:</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>G₀: GS (20 kg)</td>
<td>0.874</td>
<td>25.19</td>
<td>22.29</td>
<td>147.96</td>
<td>5.31</td>
<td>6.51</td>
<td>3.02</td>
<td>95.20</td>
<td>21.89</td>
<td>138.38</td>
</tr>
<tr>
<td>G₁: GS (20 kg) + CC</td>
<td>0.883</td>
<td>27.52</td>
<td>22.58</td>
<td>153.15</td>
<td>5.57</td>
<td>6.65</td>
<td>3.04</td>
<td>96.22</td>
<td>22.07</td>
<td>138.71</td>
</tr>
<tr>
<td>G₂: GS (15 kg) + FYM (5kg/ bag)</td>
<td>0.885</td>
<td>28.67</td>
<td>37.52</td>
<td>161.12</td>
<td>9.72</td>
<td>6.68</td>
<td>3.05</td>
<td>97.47</td>
<td>22.30</td>
<td>139.80</td>
</tr>
<tr>
<td>G₃: GS (18 kg) + VC (2kg/ bag)</td>
<td>0.891</td>
<td>30.14</td>
<td>37.77</td>
<td>167.4</td>
<td>10.17</td>
<td>6.69</td>
<td>3.07</td>
<td>98.43</td>
<td>22.57</td>
<td>140.19</td>
</tr>
<tr>
<td>G₄: GS (15 kg) + FYM (5kg/bag) + CC</td>
<td>0.896</td>
<td>31.38</td>
<td>38.33</td>
<td>181.69</td>
<td>11.21</td>
<td>6.84</td>
<td>3.09</td>
<td>100.38</td>
<td>22.78</td>
<td>140.57</td>
</tr>
<tr>
<td>G₅: GS (18 kg) + VC (2kg/bag) + CC</td>
<td><strong>0.900</strong></td>
<td>32.64</td>
<td>38.96</td>
<td>189.51</td>
<td>11.89</td>
<td>7.12</td>
<td>3.12</td>
<td>102.26</td>
<td>23.01</td>
<td>141.18</td>
</tr>
<tr>
<td>SEm⁺</td>
<td>0.001</td>
<td><strong>0.19</strong></td>
<td><strong>0.41</strong></td>
<td><strong>1.19</strong></td>
<td><strong>0.10</strong></td>
<td><strong>0.08</strong></td>
<td><strong>0.02</strong></td>
<td><strong>0.63</strong></td>
<td><strong>0.09</strong></td>
<td><strong>0.27</strong></td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>0.004</td>
<td><strong>0.52</strong></td>
<td><strong>1.14</strong></td>
<td><strong>3.34</strong></td>
<td><strong>0.27</strong></td>
<td><strong>0.23</strong></td>
<td><strong>0.05</strong></td>
<td><strong>1.77</strong></td>
<td><strong>0.25</strong></td>
<td><strong>0.77</strong></td>
</tr>
</tbody>
</table>

Fertigation Schedules:

| S₁: at 2 days interval                              | **0.896**          | 32.03                          | 34.78                  | 172.10                   | 9.75                        | 6.96                     | 3.09         | 100.82            | 22.82               | 140.49              |
| S₂: at 4 days interval                              | **0.888**          | 30.05                          | 33.45                  | 170.04                   | 9.27                        | 6.83                     | 3.06         | 97.88             | 22.65               | 140.07              |
| S₃: at 6 days interval                              | **0.881**          | 25.69                          | 30.5                   | 158.28                   | 7.91                        | 6.45                     | 3.04         | 96.29             | 21.85               | 138.86              |
| SEm⁺                                                 | 0.001              | **0.13**                       | **0.29**               | **0.84**                 | **0.07**                    | **0.06**                 | **0.01**     | **0.45**          | **0.06**            | **0.19**            |
| CD (P = 0.05)                                        | 0.003              | **0.37**                       | **0.80**               | **2.36**                 | **0.19**                    | **0.16**                 | **0.03**     | **1.25**          | **0.18**            | **0.54**            |
| Interaction                                          | Sig                | Sig                            | Sig                    | Sig                      | Sig                         | NS                       | NS           | Sig               | Sig                 | NS                  |

GS: Garden soil; FYM: Farm Yard Manure; VC: Vermicompost; CC: Cocopeat 2 cm layer at top
*Optimum no. of days for flower appearance in terminator variety of cucumber is 32-35DAS
Significantly maximum number of fruits per vine, average fruit weight and fruit yield per 1000 m$^2$ were observed in treatment $S_1$ (fertigation at 2 days interval) over $S_2$ (at 4 days) and $S_3$ (at 6 days) (Table 1). The enhanced supply of nutrients through increased fertigation level in the root vicinity of plant maintain optimum nutrient concentration in the root zone throughout the crop growth period, which increases the uptake of moisture and nutrients resulted in increasing all the growth attributes of cucumber which increases the photosynthetic rate and absorbed APAR resulted in more translocation of photosynthates towards reproductive organ (sink) which ultimately increases the yield attributes of cucumber. Janapriya et al., (2010) also reported significantly higher yield and yield attributes under increased fertigation level. Similar results are also reported by Sharma et al., (2009), Dai et al., (2011) and Zhang et al., (2011). The supply of nutrients through fertigation in the required duration has helped in efficient uptake resulting in increased length and girth of the fruits. The results are in conformity with the results of Das et al., (1987), Choudhari and More (2002), Manohar (2002), Peil and Lopez (2002), Rodriguez et al., (2007), Sharma et al., (2009), Shinde et al., (2010).

Treatment $S_1$ (fertigation at 2 days interval) was recorded significantly maximum values for ascorbic acid, TSS, nitrogen, phosphorus and potassium content over rest of fertigation treatments, although it was remained at par to treatment $S_2$ (fertigation at 4 days interval) for values of ascorbic acid, TSS, phosphorus and potassium content. Fertigation is supplying fertilizers along with irrigation is one of the most effective convenient methods of supplying nutrients of water according to the specific requirements of the crop to maintain optimum soil fertility and to increase the quality of the produce (Shingure et al., 1999) might be the probable reason which led improvement in quality attributes of cucumber during experiment.

References


Wilson, S.B., Stoffella, P.J. and Graetz, D.A.


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