EFFECT OF AM FUNGUS *GLOMUS FASCICULATUM* AND CARRIER MATERIALS ON FOUR EXPERIMENTAL PLANTS UNDER GREEN HOUSE CONDITIONS.

INTRODUCTION

The importance of soil as a reservoir of plant nutrients responsible for primary productivity is well known. Soil provides the matrix for the biological processes involved in nutrient cycling. Among the biological processes involved in the rhizoplane, the unique role of symbiotic bacteria and mycorrhizal fungi which ensure fixation and mobilization, and availability of nutrients including phosphorus to plants have been well recognized. (Sampathkumar and Ganeshkumar, 2003). Mycorrhization is the characteristic feature of several agricultural crops (Muthukumar and Udaian, 2002). They play a major role in acquisition of mineral nutrients by acquiring both mobile and immobile elements. (Marschner and Dell, 1994). AM fungal extrametrical hyphae releases polysaccharides, which help in aggregation of soil particles (Srivastava, *et al.*, 1996), and enhance the ability of plants to scope with environmental stresses generally prevalent in degraded wasteland ecosystems (Sylvia and Williams, 1992). This ability to increase mineral uptake favors plant growth in poor soils by increasing the absorptive surface of the associated roots (Lakshman, 1996; Smith and Read, 1997).

It is well established documented that AM fungi forms symbiotic association with diverse group of plant species, however many studies have revealed that AM fungi do show host preference (Bagyaraj *et al.*, 1980; Ramana *et al.*, 1999). Efficient of AM fungi may bring maximum benefits for the crop production. Activity of effective indigenous AM fungi may promote to get maximum benefits for plants provided with the proper culture practices (Bagyaraj, 1992; and Lakshman, 2009).
AM inoculum helps in establishing plantlets in horticultural practices (Evans, 1997; Lu, 1998). However, the infectivity of the commercial mycorrhizal inoculants available in the market has not always been tested in standard nursery practices. To lower the risk of contamination by pathogenic organisms, horticultural crops are usually grown in soilless potting mixes containing different rates of perlite, vermiculate and vermicompost. Soilless media have a lower bulk density; provide better aeration and a higher water-holding capacity than mineral soils (Sylvia, 1992). Some studies suggest that soilless potting mixes are not as favorable as growing media containing soil for the development of mycorrhizal colonization. While these artificial rhizosphere conditions may be advantageous to achieve rapid plant growth in containers, their effects on mycorrhizal colonization are not well studied in fiber yielding plants.

The study has been undertaken to evaluate the growth response of four fiber yielding plants Corchorus capsularis L., Crotalaria juncea L., Gossypium hirsutum L. and Hibiscus cannabinus L. by using carrier materials like Perlite, vermiculate and vermicompost along with AM fungus Glomus fasciculatum.
REVIEW OF LITERATURE


Effect of mycorrhizal inoculation and compost supply on growth and nutrient uptake of young leek plants growth on pear-based substrates has been made by Perner et al., (2006). Ma et al., (2006a) studied the promotion of host plant growth and infection of roots with AM fungus *Gigaspora margarita* by the application of peat. Ma et al., (2006b) studied the stimulatory effect of peat on spore germination and hyphal growth of arbuscular mycorrhizal fungus *Gigaspora margarita*. Nan et al., (2007) studied the effect of peat on mycorrhizal colonization and effectiveness of the arbuscular mycorrhizal
fungus *Gigaspora margarita*. Hameeda *et al.*, (2007) studied the effect of compost or vermicompost on sorghum growth and mycorrhizal colonization. Effect of arbuscular mycorrhizal colonization and two levels of compost supply on nutrient uptake and flowering of pelargonium plants was undertaken by Perner *et al.*, (2007).

Mauritz *et al.*, (2008) studied the performance of AM fungi in peat substrates in greenhouse and field studies. Responses of soilless grown tomato plants to arbuscular mycorrhizal fungal colonization in re-cycling and open systems was made by Dasgan *et al.*, (2008). Mass multiplication of AMF using soilless substrates was carried out by Verma *et al.*, (2008). Uppal *et al.*, (2009) reported the study of the impact of two arbuscular mycorrhizal fungi on *Euphorbia prostrata* production on farm
MATERIALS AND METHODS

Experimental design:

The experiment has five treatments with triplicate per treatment. The seeds were washed under running tap water and then submerged in 70% alcohol for 30 sec. The seeds were then transferred into a beaker containing 40% sodium chloride and 3 drops of tween-20 and stirred for 10 min. The sterilant was decanted and seeds rinsed several times with distilled water. The seeds were sown in earthen pots containing potting mixture with different carrier materials such as vermicompost, vermiculate and perlite in the ratio of 3:1 respectively. The AM fungal inoculum placed just 2 cm below the surface of the potting mixture. The treatments given to each experimental plant are as given below.

1. Control (CN)
2. Mycorrhiza (*Glomus fasciculatum*) inoculated
3. Mycorrhiza (*Glomus fasciculatum*) inoculated + Vermicompost in 3:1 proportion
4. Mycorrhiza (*Glomus fasciculatum*) inoculated + Vermiculate in 3:1 proportion
5. Mycorrhiza (*Glomus fasciculatum*) inoculated + Perlite in 3:1 proportion

The plants were grown in greenhouse under natural photoperiods (23.5°-18° C-day/night, 4000-6000 lux light intensity). Experimental pots were arranged incompletely randomized block design with triplicate per treatment. The experimental pots were kept free of weeds, insects, pets, rodents etc. the pots were watered every alternate day and 10 ml of Hoagland solution without P was given to each seedling at the interval of 15 days.

Analysis of growth parameters:

Plants were harvested after 60, 90 and 120 days after sowing. The plants parameters like shoot and root length, fresh weight of shoot and root, shoot and root dry weight, stem diameter and number of leaves, the per cent root colonization, spore number per 50 g soil, and phosphorus uptake in shoot were recorded. After the harvest,
experimental plants shoot and root was oven dried at 70°C until a constant weight was obtained to determine the dry weight.

**Root colonization**

The per cent root colonization was evaluated microscopically followed by clearing of roots in 10% KOH and staining with 0.05% trypan blue in lactophenol according to method described by Phillips and Hayman (1970). The following formula was used to calculate the root colonization (Giovannetti and Mosse, 1980).

\[
\text{Percent mycorrhizal colonization} = \frac{\text{Number of root segments colonized}}{\text{Total number of root segments examined}} \times 100
\]

**Determination of AM fungal spores**

Spores were separated from the soil by wet sieving and decanting technique (Gerdemann and Nicolson, 1963). 50 g of soil was mixed with water. The mixture was pour through different sieve size (250, 106, 45µm). After several times of sieve washing, the supernatant was collected in petridish and spores counted under binocular-microscope.

**Determination of Fiber content**

Smallholder plots are usually harvested by hand. The plants are cut at 2 to 3 cm above the soil and left on the ground to dry. The cut *Corchorus capsularis* L., *Crotalaria juncea* L., and *Hibiscus cannabinus* L. is laid in swathes to dry for up to four days. This was followed by water retting (the bundled hemp floats in water) and the fiber yield in *Gossypium hirsutum* L. was measured by taking dry weight of fruits.
Phosphorus content:

The phosphorus content in the shoots was determined by the vanado-molybdate phosphoric acid yellow color method outlined by Jackson (1973).

Statistical Analysis

Analysis of variance (ANOVA) was performed on all data and the means were separated using Duncan’s multiple Range Test (DMRT), by the help of SPSS student version-9 software.
RESULTS

In general AMF inoculation caused measurable changes in growth parameters recorded on four fiber yielding plants at 60, 90 and 120 days over the non-mycorrhizal plants. Among the mycorrhizal plants grown in earthen pots containing mixture of growth media and vermicompost have shown remarkable increased growth parameters such as shoot length, root length, fresh weight of shoot and root, dry weight of shoot and root (Fig. 6.1-6.4) over the mycorrhizal plants provided with vermiculate and perlite in the potting mixture and the control plants (Table 6.1-6.4).

All the experimental plants were subjected to analysis of per cent mycorrhizal colonization (PMC). There was increased PMC was recorded in all the experimental plants provided with different carrier materials but, the extent of PMC was varied with each carrier material treatment. The greater values for PMC were recorded in plants grown in potting mixture supplemented with vermicompost (Fig. 6.5 and 6.6) over the plants gown with vermiculate and perlite. The results also reveled that, the very least PMC in mycorrhizal plants not provided any carrier material.

Similarly the rhizospheric soil of all the experimental plants was subjected to measure the density of AM fungal spore per 50g soil for all the treatments. The maximum numbers of AM fungal spore were recorded from the rhizospheric soil of experimental plants grown in potting mixture provided with vermicompost over the remaining two treatments provided with vermiculate and perlite. It was also noticed that the least number of AM fungal spore were reported from the rhizosphere of control plants (Fig. 6.7 and 6.8).

The experimental plants showed greater values for P uptake in shoot irrespective of carrier material treatment over the control plants (Fig. 6.9 and 6.10). Among the plant treated with three different carrier materials, the plants provided with vermicompost has
resulted increased P uptake over the remaining two treatments. But, plants provided with vermiculate and perlite had shown significant values compared to control plants.

The most important parameter of the experimental plants is fiber yield. It was more in plants inoculated with AM fungus and provided with three different carrier materials over the control and plants inoculated with AM fungus without any carrier material in the potting mixture (Table 6.5). It was observed that, greatly increased fiber content in the mycorrhizal plants grown in potting mixture supplemented with vermicompost over the potting mixture with vermiculate and perlite. The minimum value for fiber yield was recorded in control plants when compared to reaming treatments (Fig. 6.11).

The above mentioned results clearly indicated that, the mycorrhizal plants grown in earthen pots containing potting mixture and vermicompost (3:1 v/v) had shown significant results over the reaming treatment and control plants.
Table 6.1: Effect of *Glomus fasciculatum*, perlite, Vermiculate and Vermicompost on the growth of *Corchorus capsularis* L., at various intervals

<table>
<thead>
<tr>
<th>Treatments</th>
<th>SL</th>
<th>FWS</th>
<th>DWS</th>
<th>RL</th>
<th>FWR</th>
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<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
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<td>16.62</td>
<td>25.84</td>
<td>9.83</td>
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Note: SL: Shoot length, FWS: Fresh weight of Shoot, DWS: Dry weight of Shoot, RL: Root Length, FWR: Fresh weight of Root, DWR: Dry weight of Root, STD: Stem Diameter, PC: per cent of mycorrhizal colonization, NFL: Number of Flowers, NFR: Number of fruits, SP: Spore Number, P: Phosphorous. Values represent the mean ± SD. Means followed by the same letter within a column are not significantly P= 0.05 according to DMRT.
**Table 6.2:** Effect of *Glomus fasciculatum*, Perlite, Vermiculate and Vermicompost on the growth *Crotalaria juncea* L., at various intervals.

<table>
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<th>DWS</th>
<th>RL</th>
<th>FWR</th>
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<tr>
<td>Uninoculated</td>
<td>24.73</td>
<td>±0.08e</td>
<td>10.39</td>
<td>±0.07e</td>
<td>5.03</td>
<td>±0.07e</td>
<td>11.52</td>
<td>±0.06e</td>
<td>3.22</td>
<td>±0.12e</td>
<td>1.85</td>
<td>±0.03e</td>
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<td>±0.12d</td>
<td>17.85</td>
<td>±0.04d</td>
<td>7.15</td>
<td>±0.15d</td>
<td>19.62</td>
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<td>23.51</td>
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<td>20.82</td>
<td>±0.12c</td>
<td>31.53</td>
<td>±0.08c</td>
<td>12.85</td>
<td>±0.21c</td>
<td>7.15</td>
<td>±0.03c</td>
</tr>
<tr>
<td>GF+Vermiculate</td>
<td>69.73</td>
<td>±0.12b</td>
<td>39.56</td>
<td>±0.25bc</td>
<td>22.65</td>
<td>±0.1b</td>
<td>35.86</td>
<td>±0.21b</td>
<td>14.61</td>
<td>±0.12b</td>
<td>9.58</td>
<td>±0.06b</td>
</tr>
<tr>
<td>GF+Vermicompost</td>
<td>74.96</td>
<td>±0.13a</td>
<td>48.79</td>
<td>±0.08a</td>
<td>31.49</td>
<td>±0.12a</td>
<td>36.73</td>
<td>±0.05a</td>
<td>20.58</td>
<td>±0.08a</td>
<td>11.63</td>
<td>±0.06a</td>
</tr>
</tbody>
</table>

Note: SL: Shoot length, FWS: Fresh weight of Shoot, DWS: Dry weight of Shoot, RL: Root Length, FWR: Fresh weight of Root, DWR: Dry weight of Root, STD: Stem Diameter, PC: per cent of mycorrhizal colonization, NFL: Number of Flowers, NFR: Number of fruits, SP: Spore Number, P: Phosphorous. Values represent the mean ± SD. Means followed by the same letter within a column are not significantly P= 0.05 according to DMRT.
Table 6.3: Effect of *Glomus fasciculatum*, Perlite, Vermiculate and Vermicompost on the growth of *Gossypium hirsutum* L., at various intervals.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>SL</th>
<th>FWS</th>
<th>DWS</th>
<th>RL</th>
<th>FWR</th>
<th>DWR</th>
<th>STD</th>
<th>PC</th>
<th>NFL</th>
<th>NFR</th>
<th>SP</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>60 Days</strong></td>
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<td></td>
</tr>
<tr>
<td>Uninoculated</td>
<td>27.36</td>
<td>±0.07e</td>
<td>15.75</td>
<td>±0.08e</td>
<td>7.36</td>
<td>±0.05e</td>
<td>10.56</td>
<td>±0.13e</td>
<td>3.56</td>
<td>±0.03e</td>
<td>1.85</td>
<td>±0.14e</td>
</tr>
<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
<td>36.65</td>
<td>±0.04d</td>
<td>17.63</td>
<td>±0.15d</td>
<td>12.36</td>
<td>±0.12de</td>
<td>15.46</td>
<td>±0.05d</td>
<td>8.50</td>
<td>±0.15d</td>
<td>3.75</td>
<td>±0.12d</td>
</tr>
<tr>
<td>GF+Perlite</td>
<td>41.71</td>
<td>±0.11c</td>
<td>20.65</td>
<td>±0.15c</td>
<td>13.63</td>
<td>±0.04c</td>
<td>16.25</td>
<td>±0.22c</td>
<td>10.33</td>
<td>±0.07c</td>
<td>6.33</td>
<td>±0.13c</td>
</tr>
<tr>
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<td>25.83</td>
<td>±0.05bc</td>
<td>14.76</td>
<td>±0.04b</td>
<td>19.63</td>
<td>±0.05b</td>
<td>12.36</td>
<td>±0.05b</td>
<td>8.30</td>
<td>±0.14b</td>
</tr>
<tr>
<td>GF+Vermicompost</td>
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<td>±0.04a</td>
<td>28.74</td>
<td>±0.06a</td>
<td>18.42</td>
<td>±0.14a</td>
<td>22.30</td>
<td>±0.15a</td>
<td>15.86</td>
<td>±0.14a</td>
<td>10.46</td>
<td>±0.08a</td>
</tr>
<tr>
<td><strong>90 Days</strong></td>
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<td></td>
</tr>
<tr>
<td>Uninoculated</td>
<td>36.58</td>
<td>±0.17e</td>
<td>19.63</td>
<td>±0.08e</td>
<td>14.53</td>
<td>±0.14e</td>
<td>17.66</td>
<td>±0.03e</td>
<td>5.66</td>
<td>±0.08e</td>
<td>3.46</td>
<td>±0.03e</td>
</tr>
<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
<td>53.45</td>
<td>±0.11de</td>
<td>28.54</td>
<td>±0.11de</td>
<td>19.56</td>
<td>±0.14d</td>
<td>23.36</td>
<td>±0.12d</td>
<td>9.36</td>
<td>±0.18e</td>
<td>4.46</td>
<td>±0.16d</td>
</tr>
<tr>
<td>GF+Perlite</td>
<td>56.61</td>
<td>±0.31c</td>
<td>29.53</td>
<td>±0.14c</td>
<td>20.56</td>
<td>±0.12c</td>
<td>25.36</td>
<td>±0.12c</td>
<td>10.23</td>
<td>±0.27c</td>
<td>6.63</td>
<td>±0.06c</td>
</tr>
<tr>
<td>GF+Vermiculate</td>
<td>59.53</td>
<td>±0.14b</td>
<td>30.33</td>
<td>±0.14b</td>
<td>22.33</td>
<td>±0.06b</td>
<td>28.53</td>
<td>±0.12b</td>
<td>12.83</td>
<td>±0.10b</td>
<td>7.60</td>
<td>±0.03b</td>
</tr>
<tr>
<td>GF+Vermicompost</td>
<td>63.41</td>
<td>±0.04a</td>
<td>35.64</td>
<td>±0.21a</td>
<td>26.73</td>
<td>±0.12a</td>
<td>31.43</td>
<td>±0.08a</td>
<td>15.53</td>
<td>±0.23a</td>
<td>10.26</td>
<td>±0.08a</td>
</tr>
<tr>
<td><strong>120 Days</strong></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Uninoculated</td>
<td>45.62</td>
<td>±0.07e</td>
<td>22.30</td>
<td>±0.15c</td>
<td>15.65</td>
<td>±0.12e</td>
<td>21.15</td>
<td>±0.23e</td>
<td>7.76</td>
<td>±0.23e</td>
<td>4.56</td>
<td>±0.12e</td>
</tr>
<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
<td>57.70</td>
<td>±0.08d</td>
<td>35.36</td>
<td>±0.18d</td>
<td>26.63</td>
<td>±0.11d</td>
<td>30.53</td>
<td>±0.23d</td>
<td>12.23</td>
<td>±0.29d</td>
<td>6.30</td>
<td>±0.17d</td>
</tr>
<tr>
<td>GF+Perlite</td>
<td>60.67</td>
<td>±0.18c</td>
<td>36.25</td>
<td>±0.06c</td>
<td>28.43</td>
<td>±0.03c</td>
<td>31.42</td>
<td>±0.21c</td>
<td>12.40</td>
<td>±0.15c</td>
<td>7.63</td>
<td>±0.27c</td>
</tr>
<tr>
<td>GF+Vermiculate</td>
<td>65.54</td>
<td>±0.18b</td>
<td>38.23</td>
<td>±0.36b</td>
<td>30.18</td>
<td>±0.12b</td>
<td>31.63</td>
<td>±0.03b</td>
<td>14.63</td>
<td>±0.05b</td>
<td>10.60</td>
<td>±0.04b</td>
</tr>
<tr>
<td>GF+Vermicompost</td>
<td>69.85</td>
<td>±0.06a</td>
<td>40.69</td>
<td>±0.06a</td>
<td>35.76</td>
<td>±0.38a</td>
<td>34.34</td>
<td>±0.11a</td>
<td>18.86</td>
<td>±0.15a</td>
<td>12.63</td>
<td>±0.04a</td>
</tr>
</tbody>
</table>

Note: SL: Shoot length, FWS: Fresh weight of Shoot, DWS: Dry weight of Shoot, RL: Root Length, FWR: Fresh weight of Root, DWR: Dry weight of Root, STD: Stem Diameter, PC: per cent of mycorrhizal colonization, NFL: Number of Flowers, NFR: Number of fruits, SP: Spore Number, P: Phosphorous. Values represent the mean ± SD. Means followed by the same letter within a column are not significantly P= 0.05 according to DMRT.
Table 6.4: Effect of *Glomus fasciculatum*, Perlite, Vermiculate and Vermicompost on the growth of *Hibiscus cannabinus* L., at various intervals.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>SL</th>
<th>FWS</th>
<th>DWS</th>
<th>RL</th>
<th>FWR</th>
<th>DWR</th>
<th>STD</th>
<th>PC</th>
<th>NFL</th>
<th>NFR</th>
<th>SP</th>
<th>P</th>
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<td></td>
<td></td>
</tr>
<tr>
<td>Uninoculated</td>
<td>21.32±0.15e</td>
<td>6.36±0.08e</td>
<td>3.53±0.12e</td>
<td>11.14±0.03e</td>
<td>4.15±0.17e</td>
<td>2.36±0.08e</td>
<td>1.12±0.04e</td>
<td>0.00±0.00e</td>
<td>0.00±0.00e</td>
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<td>0.00±0.00e</td>
<td>0.07±0.00e</td>
</tr>
<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
<td>33.24±0.42d</td>
<td>10.23±0.25e</td>
<td>4.26±0.11d</td>
<td>15.63±0.08d</td>
<td>6.13±0.11d</td>
<td>3.16±0.04d</td>
<td>1.63±0.03d</td>
<td>55.02±0.00d</td>
<td>0.00±0.00d</td>
<td>0.00±1.17d</td>
<td>95.03±0.13d</td>
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</tr>
<tr>
<td>GF+Perlite</td>
<td>40.42±0.15c</td>
<td>13.56±0.02c</td>
<td>5.73±0.03c</td>
<td>16.60±0.08c</td>
<td>6.18±0.14cd</td>
<td>3.82±0.06c</td>
<td>1.83±0.04c</td>
<td>59.65±0.00c</td>
<td>0.00±0.00c</td>
<td>0.00±0.00c</td>
<td>129.35±0.14c</td>
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</tr>
<tr>
<td>GF+Vermiculate</td>
<td>45.63±0.08b</td>
<td>16.34±0.02b</td>
<td>6.46±0.02b</td>
<td>17.72±0.02bc</td>
<td>8.12±0.15b</td>
<td>5.56±0.04b</td>
<td>1.93±0.03b</td>
<td>63.68±0.00c</td>
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<td>0.00±0.00c</td>
<td>153.63±0.17c</td>
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</tr>
<tr>
<td>GF+Vermicompost</td>
<td>49.56±0.06a</td>
<td>20.33±0.02a</td>
<td>8.45±0.11a</td>
<td>18.66±0.13a</td>
<td>10.36±0.06a</td>
<td>6.51±0.08a</td>
<td>2.25±0.05a</td>
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<td>168.05±0.19a</td>
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</tr>
<tr>
<td></td>
<td>90 Days</td>
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</tr>
<tr>
<td>Uninoculated</td>
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<td>9.66±0.03e</td>
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<td>4.73±0.15e</td>
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<td>1.58±0.06e</td>
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<td></td>
</tr>
<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
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<td>13.09±0.12d</td>
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<td>6.36±0.08de</td>
<td>3.95±0.02de</td>
<td>1.95±0.03d</td>
<td>58.56±0.34d</td>
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</tr>
<tr>
<td>GF+Perlite</td>
<td>61.81±0.18c</td>
<td>28.34±0.15c</td>
<td>14.42±0.05c</td>
<td>23.66±0.03c</td>
<td>8.83±0.20c</td>
<td>4.63±0.07c</td>
<td>2.98±0.03c</td>
<td>64.63±0.12c</td>
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<td>0.00±0.00c</td>
<td>152.09±0.16c</td>
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</tr>
<tr>
<td>GF+Vermiculate</td>
<td>65.33±0.05b</td>
<td>30.62±0.14b</td>
<td>16.56±0.15b</td>
<td>24.36±0.16bc</td>
<td>9.63±0.12b</td>
<td>5.22±0.09b</td>
<td>2.52±0.04b</td>
<td>69.32±0.05b</td>
<td>0.00±0.65b</td>
<td>0.00±0.53b</td>
<td>165.63±0.18b</td>
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</tr>
<tr>
<td>GF+Vermicompost</td>
<td>68.63±0.13a</td>
<td>32.20±0.11a</td>
<td>18.32±0.11a</td>
<td>30.65±0.05a</td>
<td>12.22±0.05a</td>
<td>6.01±0.16a</td>
<td>2.86±0.03a</td>
<td>74.43±0.12c</td>
<td>0.00±0.56a</td>
<td>0.00±0.00a</td>
<td>185.65±0.21a</td>
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</tr>
<tr>
<td></td>
<td>120 Days</td>
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</tr>
<tr>
<td>Uninoculated</td>
<td>41.43±0.89e</td>
<td>14.73±0.08e</td>
<td>5.65±0.01e</td>
<td>17.82±0.03e</td>
<td>6.96±0.18e</td>
<td>3.36±0.09e</td>
<td>1.95±0.03e</td>
<td>0.00±0.00e</td>
<td>0.00±0.00e</td>
<td>0.00±0.00e</td>
<td>0.09±0.00e</td>
<td></td>
</tr>
<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
<td>75.33±0.06d</td>
<td>40.53±0.15d</td>
<td>17.73±0.07d</td>
<td>31.33±0.08d</td>
<td>12.15±0.03d</td>
<td>5.18±0.04d</td>
<td>2.98±0.03d</td>
<td>71.56±1.20d</td>
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<td>0.00±0.23d</td>
<td>145.65±0.15d</td>
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<tr>
<td>GF+Perlite</td>
<td>80.43±0.08c</td>
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<td>18.83±0.10cd</td>
<td>34.56±0.12c</td>
<td>13.33±0.27c</td>
<td>6.96±0.04c</td>
<td>2.25±0.03c</td>
<td>75.36±8.20c</td>
<td>0.00±3.76c</td>
<td>0.00±2.85c</td>
<td>166.43±0.17c</td>
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</tr>
<tr>
<td>GF+Vermiculate</td>
<td>86.40±0.05b</td>
<td>50.24±0.08b</td>
<td>22.53±0.12b</td>
<td>38.50±0.11bc</td>
<td>15.46±0.13b</td>
<td>7.52±0.04b</td>
<td>3.22±0.04b</td>
<td>85.23±0.38b</td>
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<td>0.00±2.50b</td>
<td>192.63±0.19c</td>
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</tr>
<tr>
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<td>92.33±0.27a</td>
<td>55.96±0.10a</td>
<td>24.63±0.06a</td>
<td>42.35±0.05a</td>
<td>17.53±0.14a</td>
<td>8.63±0.15a</td>
<td>3.42±0.05a</td>
<td>96.63±0.66a</td>
<td>0.00±0.85a</td>
<td>0.00±2.82a</td>
<td>215.56±0.22a</td>
<td></td>
</tr>
</tbody>
</table>

Note: SL: Shoot length, FWS: Fresh weight of Shoot, DWS: Dry weight of Shoot, RL: Root Length, FWR: Fresh weight of Root, DWR: Dry weight of Root, STD: Stem Diameter, PC: per cent of mycorrhizal colonization, NFL: Number of Flowers, NFR: Number of fruits, SP: Spore Number, P: Phosphorous. Values represent the mean ± SD. Means followed by the same letter within a column are not significantly P= 0.05 according to DMRT.
Table 6.5: Effect of *Glomus fasciculatum* and different microbial treatments on the Fiber yield of *Corchorus capsularis* L., *Crotalaria juncea* L., *Gossypium hirsutum* L., and *Hibiscus cannabinus* L., at different interval plants at different interval (60, 90 and 120).

<table>
<thead>
<tr>
<th>Treatments</th>
<th><em>Corchorus capsularis</em> L.</th>
<th><em>Crotalaria juncea</em> L.</th>
<th><em>Gossypium hirsutum</em> L.</th>
<th><em>Hibiscus cannabinus</em> L.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uninoculated</td>
<td>4.250±0.046e</td>
<td>4.536±0.162e</td>
<td>3.256±0.022e</td>
<td>3.532±0.077e</td>
</tr>
<tr>
<td>AMF (<em>Glomus fasciculatum</em>)</td>
<td>6.886±0.119d</td>
<td>7.833±0.022d</td>
<td>5.210±0.057d</td>
<td>7.503±0.323d</td>
</tr>
<tr>
<td>GF+ perlite</td>
<td>7.341±0.141c</td>
<td>8.134±0.022cd</td>
<td>6.256±0.074c</td>
<td>8.354±0.077c</td>
</tr>
<tr>
<td>GF+ vermiculate</td>
<td>8.170±0.036bc</td>
<td>9.723±0.022b</td>
<td>6.502±0.172b</td>
<td>9.05±0.077b</td>
</tr>
<tr>
<td>GF+ vermicompost</td>
<td>9.52±0.112a</td>
<td>10.734±0.21a</td>
<td>7.013±0.054a</td>
<td>10.12±0.243a</td>
</tr>
</tbody>
</table>

Values represent the mean ± SD. Means followed by the same letter within a column are not significantly P=0.05 according to DMRT.
Fig. 6.1: Effect of AM fungi and different sources of carrier materials on dry weight shoot of plants *Corchorus capsularis* L., and *Crotalaria juncea* L., at different interval.

![Graph of Corchorus capsularis L.](image1)

![Graph of Crotalaria juncea L.](image2)
Fig. 6.2: Effect of AM fungi and different sources of carrier materials on dry weight shoot of plants *Gossypium hirsutum* L., and *Hibiscus cannabinus* L., at different interval.
Fig. 6.3: Effect of AM fungi and different sources of carrier materials on dry weight root of plants *Corchorus capsularis* L., and *Crotalaria juncea* L., at different interval.

**Corchorus capsularis** L.

- Days 120, 90, 60
- Dry weight of root (g)
- Uninoculated, AMF (Glomus fasciculatum), GF+Perlite, GF+Vermiculate, GF+Vermicompost

**Crotalaria juncea** L.

- Days 120, 90, 60
- Dry weight of root (g)
- Uninoculated, AMF (Glomus fasciculatum), GF+Perlite, GF+Vermiculate, GF+Vermicompost
Fig. 6.4: Effect of AM fungi and different sources of carrier materials on dry weight root of plants *Gossypium hirsutum* L., and *Hibiscus cannabinus* L., at different interval.

**Gossypium hirsutum** L.

<table>
<thead>
<tr>
<th>Days</th>
<th>Dry weight of root (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>Uninoculated</td>
</tr>
<tr>
<td></td>
<td>AMF (Glomus fasciculatum)</td>
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<td></td>
<td>GF+Perlite</td>
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<td></td>
<td>GF+Vermiculate</td>
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<td>GF+Vermicompost</td>
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**Hibiscus cannabinus** L.

<table>
<thead>
<tr>
<th>Days</th>
<th>Dry weight of root (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>Uninoculated</td>
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<td></td>
<td>AMF (Glomus fasciculatum)</td>
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<td>GF+Vermiculate</td>
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<td>GF+Vermicompost</td>
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</tbody>
</table>
Fig.6.5: Effect of AM fungi and different sources of carrier materials on Per cent of root colonization of plants *Corchorus capsularis* L., and *Crotalaria juncea* L., at different interval.

**Corchorus capsularis** L.

![Graph showing per cent of root colonization for Corchorus capsularis L.](image1)

- Uninoculated
- AMF (Glomus fasciculatum)
- GF+Perlite
- GF+Vermiculate
- GF+Vermicompost

**Crotalaria juncea** L.

![Graph showing per cent of root colonization for Crotalaria juncea L.](image2)

- Uninoculated
- AMF (Glomus fasciculatum)
- GF+Perlite
- GF+Vermiculate
- GF+Vermicompost
Fig.6.6: Effect of AM fungi and different sources of carrier materials on Per cent of root colonization of plants *Gossypium hirsutum* L., and *Hibiscus cannabinus* L., at different interval.

**Gossypium hirsutum** L.

**Hibiscus cannabinus** L.
Fig. 6.7: Effect of AM fungi and different sources of carrier materials on spore number 50g of soil of plants Corchorus capsularis L., and Crotalaria juncea L., at different interval.
Fig. 6.8: Effect of AM fungi and different sources of carrier materials on percent of root colonization of plants *Gossypium hirsutum* L., and *Hibiscus cannabinus* L., at different interval.
Fig. 6.9: Effect of AM fungi and different sources of carrier materials on P-uptake of plants *Corchorus capsularis* L., and *Crotalaria juncea* L., at different intervals.

![Corchorus capsularis L.](chart1)

![Crotalaria juncea L.](chart2)
Fig. 6.10: Effect of AM fungi and different sources of carrier materials on P uptake of plants *Gossypium hirsutum* L., and *Hibiscus cannabinus* L., at different intervals.
**Fig.6.11:** Effect of different carrier materials on the Fiber yield of *Corchorus capsularis* L., (1), *Crotalaria juncea* L., (2), *Gossypium hirsutum* L., (3) and *Hibiscus cannabinus* L., (4) at different interval plants at different interval (60, 90 and 120).
DISCUSSION

The experimental results clearly indicated that, plants inoculated with AM fungus and potting mixture having carrier materials have showed accountable increased growth and fiber yield. These findings agreed with literature reports of previous studies in soil and soilless systems with different plant species such as Eucalyptus camaldulensis (Missbeahuzzaman and Ingleby, 2005), Gladiolus (Javaid and Riaz, 2008), Piper (Ikiz et al., 2009), Onions (Goussous and Mohammad, 2009) and Vegetable crops (Matsubara et al., 1994). It can be evident that from the previous reports, in soilless substrates lacking mycorrhizal fungi, mycorrhizal inoculation has been found to increased crop uniformity, reduced transplant mortality and increased productivity of different horticultural crops (Vosatka et al., 1999). Similar findings were reported by Jack and Thies, (2006). Uppal et al., (2009) reported that large microbial population in vermicompost might resulted in increase of plant growth due to synergistic effect. The increased plant growth and fiber yield in all the experimental plants depends on the source of material used for the potting mixture preparation, role of microorganisms and nutrient content. Similar reports were made by Atiyeh et al., (2000a) on marigold and Tomato plants grown in the potting mixture amended with vermicompost.

In the present experimental study plants grown in potting mixture provided with perlite have resulted less significant growth and fiber yield over the remaining treatments. This indicated that, the perlite is not substrate for the enhancement of growth but it provides better aeration and doesn’t serve as growth media (Vestiberg et al., 2005). In contrast to this Gour and Adholeya (2000) have reported increased per cent mycorrhizal colonization in the presence of perlite over the potting mixture with only sand and soil. The results of present work are negatively correlated with these findings of Gour and Adholeya (2000), as because, the lesser per cent mycorrhizal colonization has been
recorded in four experimental plants grown with perlite supplementation in the potting mixture.

The percent mycorrhizal colonization was significantly higher in plants grown with vermicompost. The similar results were also observed by Cavender et al. (2003), and they have reported that, there was increased AMF colonization in Sorghum roots grown with the application of vermicompost in the potting mixture. Similar reports were made by Kale et al., (1987). Increased mycorrhizal colonization was due to increased microbial activities, which resulted in translocation of nitrogen source in the form of ammonia during composting and as a nitrate during vermicompost (Atiyeh et al., 2000b).

Mycorrhizal colonization increased when vermicompost was added (Gutierrez-Miceli et al. 2008). Similar reports were recorded by Mba (1983) that more shoot biomass and increased yield of cowpeas in response to vermicompost. The increased growth and yield of peppers in the field confirm our greenhouse experiments on the positive effects of vermicompost and traditional compost on plant growth and yield (Norman et al., 2005).

Vermicompost is often the major component of potting mixture and its specific characteristics exert a significant influence on AM fungi (Linderman and Davis 2003). There are studies showing both negative (Wang et al., 1993; Mauritz Vestberg et al. 2008) and positive (Biermann and Linderman 1983; Graham and Timmer 1984) impacts of peat on AM fungi. AM fungi have shown a negative response to the incorporation of peat in soil (Calvet et al., 1992). The negative impact of peat on mycorrhizal effectiveness may be because of the microbiological properties of peat (Vestberg et al., 2005).

Water retention, nutrient supply, and minor elements in vermicompost-amended soil increases better plant development (Atiyeh, Lee, Edwards, et al., 2002). Additionally, it is possible that AMF with large microbial population in vermicompost might have increased plant growth with synergetic effect. Recent investigations have brought to light
instances where biological activities are markedly enhanced in two or three-member associations of organisms. Synergistic effects of AMF and *Bradyrhizobium japonicum* have a high potential to improve the nutrient supply of soybean, including phosphorous and soil quality (Tilak *et al.*, 1995). It has been reported that microbial biomass and dehydrogenase activities increased in vermicompost amended soil compared to inorganic-fertilized soil, and the size of the microbial biomass was positively correlated with yields of pepper plants (Arancon *et al.*, 2005). It is also reported that humic acids in the vermicompost had positive effect on the growth of maize plants and peppers in laboratory and greenhouse experiments (Atiyeh, *et al.*, 2002).

It can be concluded that from the above discussion, AM fungal inoculation to the potting mixture provided with vermicompost had shown significantly increased growth responses and yield over the potting mixture provided with vermiculate and perlite and the potting mixture not provided any carrier materials therefore, it can be advisable that use of vermicompost along with AM inoculation will boost the growth and fiber yield of the four experimental plants.