REFERENCE


Bagyaraj, D.J. and Manjunath, A and patil, R.B. 1979. Interaction between vesicular arbuscular mycorrhizae and rhizobium and their effects on soybean in the field. New phytol.82: 141-146.


129


Lakshman, H.C., 1996. VA-mycorrhizal studies in some economically important tree species, Ph.D. thesis Karnataka university Dharwad, India.


Liu, A., Hamel, C., Hamilton, R.I., Ma, B.L. and Smith, D.L 2000. Acquisition of Cu, Zn, Mn and Fe by mycorrhizal maize (*Zea mays* L.) grown in soil at different P and micronutrient levels. Mycorrhiza. 9 (6): 331-336.


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EFFECT OF ARBUSCULAR MYCORRHIZAL (AM) FUNGI AND SALINE WATER WITH AND WITHOUT WATER ADDITIONAL PHOSPHATE ON ELEUSINE CORACANA GAERTN (FINGER MILLET)

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ABSTRACT

Arbuscular Mycorrhizal (AM) fungi (Glomus fasciculatum) was isolated from coastal zones of Karwar. Pot cultured arbuscular mycorrhizal fungi were inoculated with and without additional phosphate levels, to evaluate the growth of finger millet plants under artificial Salinization. There was significant plant growth, per cent root colonization, spore population and P uptake. The results indicated the increased supply of P nutrition for AMF plants growing under saline stress.

Keywords: Arbuscular-mycorrhizal fungi (AMF), E’eusine coracana, Saline soil, Coastal zone.

INTRODUCTION

Eleusine coracana (Finger millet) is the 3rd millet of India. About 75% of the area under the crop lies in south India especially in Karnataka. In India, arid and semi-arid regions where sufficient good quality irrigation water is not available, Finger millets are grown. When the plants become saline tolerant then it reflects a biomass productivity adversely, and the magnitude depends upon the quality of soluble salts that get incorporated through irrigation water. In many important crops salinity increases and plant P concentration decreases (Ross et al., 1985), and these plants may be most beneficial to inoculate with efficient stains of arbuscular Mycorrhizal fungi.

In recent years many experiments have been documented. Many crops; such as tomato (Lycopersion escuentum Mill.), onion (Allium cepa L.), and bell pepper (Capsium annum L.) have increased growth of biomass production, when these plants grown under saline conditions with AM fungal colonization (Ojala et al., 1983; Mass et al., 1986). Most of these studies have been carried out under low soil P conditions. Studies on annual herbaceous perennial plants are very meagre.

The main objective of the present study is to distinguish between enhancement of phosphate nutrition by AMF with and without additional phosphate treatment of finger millet.
This information will help in formulating on annual plants for the best use of saline water with AM fungi to improve plant growth and biomass productivity in sand and semi-arid regions.

MATERIALS AND METHODS

Finger millet grains were grown in pots contained sterilized sand and garden soil in the ratio of (1:1). Uniformly grown 25 days old seedlings were transplanted to experimental pots measuring 25 cm. diameter contained 4 kg of soil (2 kg red Laterite soil mixed with 2 kg pure sand 2.6 ppm of available (NH₄) phosphorus was determined experiments were conducted by using different levels of super phosphate and rock phosphate fertilization. The following treatment were given to all the experimental pots.

1. NM - (Non-mycorrhizal/control); 2. M - (Mycorrhizal); 3. M + Sp₁ (Mycorrhizal inoculum + 2 mg super phosphate/kg soil); 4. M + Sp₂ (Mycorrhizal inoculum + 4 mg superphosphate/kg soil); 5. M + Sp₃ (Mycorrhizal inoculum + 6 mg superphosphate/kg soil); 6. M + Sp₁ (Mycorrhizal inoculum + 2 mg rock phosphorus/kg soil); 7. M + Sp₂ (Mycorrhizal inoculum + 4 mg rockphosphate/kg soil) and 7. M + Sp₃ (Mycorrhizal inoculum + 6 mg rock phosphate/kg soil).

Mycorrhizal mixed inoculum of (25 g/pot) was provided by placing a thin layer of inoculum 2 cm below the seeds at the time of sowing. The mycorrhizal inoculum consists of roots and soil from the pot culture of sudangrass (Sorghym bicolour (L.) moench. Var. Sandanese) which was infected with Glomus fasiculctum. The inoculum contained hyphae, Chlamydospores (146 per pot). The pots were arranged in green house in a randomized block design with four replicates for each treatment. Artificial saline water was given on alternate days. Hoagland solution on minus P of 5 ml/pot was given once in fifteen days. Plants were harvested at two intervals, i. e., 40 and 80 days after sowing. Observation was made on plant height, shoot dry weight, per cent root colonization, spore number per 50 g soil and P uptake in shoots. The dry weight of shoot was taken after constant drying at 70°C in oven for 12 hrs. Phosphorus content of the shoot was determined colorimetrically by vanadomolybedate phosphoris-yellow colour method outlined by Jackson (1973). percentage of mycorrhizal colonization of the roots were determined after clearing in 10 % KOH and stained 0.05 % trypan blue (Phillips and Hayman, 1970). Number of arbuscular mycorrhizal fungal spore were isolated following wet-sieving and decanting technique of (Gerdermann and Nicolson, 1963).

RESULTS AND DISCUSSION

Soils contain low salt concentration may interfere with the growth of many crop plants. This statements applicable to a annual plant like Eleusine coracana (finger millet). When the experimental plants given fresh water with mycorrhizal inoculation showed better growth, biomass production, mycorrhizal colonization and spore population and P uptake,
Compared to the plants given saline water with mycorrhizal inoculation (Table 1). However, the per cent of mycorrhizal colonization and spore number decreased in *Eleusine coracana* plants, which were given saline water with mycorrhizal inoculation. But there was sequential

### Table 1. Plant height, shoot dry weight, per cent root colonization, spore number and P uptake in

*Finger millet* as influenced by *Glomus fasciculatum*, with and without saline water (Treatment for 40 days).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
<th>Shoot dry weight (g)</th>
<th>Per cent AMF root colonization</th>
<th>AMF spore No./50g soil</th>
<th>% P uptake in shoot</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. M.</td>
<td>08.7 ± 3.2</td>
<td>1.4 ± 1.0</td>
<td>----</td>
<td>----</td>
<td>0.05</td>
</tr>
<tr>
<td>M + F-W</td>
<td>22.3 ± 5.3</td>
<td>4.1 ± 3.2</td>
<td>51.2 ± 5.4</td>
<td>168.5 ± 4.3</td>
<td>0.16</td>
</tr>
<tr>
<td>M + W-SW</td>
<td>19.6 ± 4.1</td>
<td>3.9 ± 0.0</td>
<td>49.2 ± 4.0</td>
<td>141.5 ± 4.3</td>
<td>0.16</td>
</tr>
<tr>
<td>L.S.D. (5%)</td>
<td>08.0 ± 2.1</td>
<td>0.2 ± 0.0</td>
<td>11.6 ± 2.0</td>
<td>14.3 ± 0.0</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Increased per cent of mycorrhizal colonization and spore number per 50 g soil was recorded in plants which were treated with saline water with higher level 6 mg Rock Phosphate/kg soil with *Glomus fasciculatum* inoculation. On the other hand the sequential decreased per cent of (AM) fungal colonization and spore number per 50 g soil was recorded, in those plants treated with higher super phosphate (Table 2). *Eleusina coracana* levels of plants treated with super phosphate or rock phosphate level of (2 mg/pot) did not respond significantly with *G. fasciculatum*. The per cent AM fungal colonization in the roots was greater after *G. fasciculatum* inoculation at 80 days harvest. When phosphorus was not given to experimental plants, mycorrhizal inoculated plants grew poorly. But *E. coracana* showed significant increase in plant height, dry matter of shoot, per cent root colonization, spore population and P uptake in shoots. Any change or build up insoluble salt content of soil may influence on crop production in several through changes in the proportions of exchangeable cations. This may be due to, whenever soil have problems of excessive soil moisture then there will be least secondary salanization in the root zone. Plant growth is restricted or entirely prevented even mycorrhizal association...
Table 2: Plant height, shoot dry weight, % AMF Colonization, AMF spore number and P. uptake in shoots in finger millet as influenced by *Glomus fasciculatum*, in fresh water and saline water and without super and rock phosphate. (Treatment for 40 days).

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant height (cm)</th>
<th>Shoot dry weight (g)</th>
<th>Per cent AMF root colonization</th>
<th>AMF spore No./50g soil</th>
<th>% P uptake in shoot</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. M</td>
<td>12.4 ± 5.2</td>
<td>1.8 ± 2.3</td>
<td>---</td>
<td>---</td>
<td>0.10</td>
</tr>
<tr>
<td>M = F-W+Sp1</td>
<td>21.3 ± 5.2</td>
<td>3.8 ± 1.2</td>
<td>46.2 ± 2.2</td>
<td>152.2 ± 5.2</td>
<td>0.19</td>
</tr>
<tr>
<td>M = F-W+Sp2</td>
<td>23.1 ± 1.1</td>
<td>4.0 ± 0.0</td>
<td>44.4 ± 3.1</td>
<td>152.3 ± 2.4</td>
<td>0.22</td>
</tr>
<tr>
<td>M = F-W+Sp3</td>
<td>25.4 ± 1.0</td>
<td>4.6 ± 1.1</td>
<td>43.1 ± 1.1</td>
<td>143.4 ± 1.2</td>
<td>0.24</td>
</tr>
<tr>
<td>M = F-WRP1</td>
<td>32.3 ± 2.4</td>
<td>8.2 ± 4.2</td>
<td>47.4 ± 4.3</td>
<td>179.5 ± 1.1</td>
<td>0.31</td>
</tr>
<tr>
<td>M = F-WRP2</td>
<td>43.2 ± 3.2</td>
<td>11.4 ± 3.1</td>
<td>49.5 ± 5.2</td>
<td>193.3 ± 2.1</td>
<td>0.32</td>
</tr>
<tr>
<td>M = F-WRP3</td>
<td>48.5 ± 4.1</td>
<td>13.2 ± 4.3</td>
<td>51.3 ± 7.1</td>
<td>186.2 ± 0.0</td>
<td>0.32</td>
</tr>
<tr>
<td>M + W-SW+Sp1</td>
<td>27.4 ± 1.1</td>
<td>5.7 ± 5.1</td>
<td>44.4 ± 3.5</td>
<td>48.6 ± 4.6</td>
<td>0.18</td>
</tr>
<tr>
<td>M + W-SW+Sp2</td>
<td>24.6 ± 4.5</td>
<td>4.9 ± 2.2</td>
<td>44.2 ± 2.2</td>
<td>48.7 ± 1.1</td>
<td>0.20</td>
</tr>
<tr>
<td>M + W-SW+Sp3</td>
<td>28.7 ± 7.5</td>
<td>5.8 ± 4.4</td>
<td>40.5 ± 1.0</td>
<td>39.4 ± 2.4</td>
<td>0.24</td>
</tr>
<tr>
<td>M + W-SW+RP1</td>
<td>36.4 ± 6.1</td>
<td>10.5 ± 6.3</td>
<td>45.2 ± 7.2</td>
<td>76.3 ± 3.6</td>
<td>0.34</td>
</tr>
<tr>
<td>M + W-SW+RP2</td>
<td>44.6 ± 4.3</td>
<td>12.7 ± 4.6</td>
<td>48.4 ± 3.4</td>
<td>88.2 ± 4.2</td>
<td>0.35</td>
</tr>
<tr>
<td>M + W-SW+RP3</td>
<td>76.1 ± 5.8</td>
<td>15.8 ± 5.6</td>
<td>67.3 ± 5.1</td>
<td>81.5 ± 5.0</td>
<td>0.38</td>
</tr>
<tr>
<td>L. S. D. (5%)</td>
<td>10.5 ± 0.0</td>
<td>0.5 ± 1.0</td>
<td>9.2 ± 1.0</td>
<td>19.3 ± 0.0</td>
<td>0.04</td>
</tr>
</tbody>
</table>

NM = Non mycorrhizal; M = Mycorrhiza; F-W = Fresh water; W-SW = With Saline water; SP = Super phosphate; RP = Rock phosphate.

(Jackson et al., 1972; Massana Hoffman, 1986). However, in the present study, *E. coracana* plants inoculated with AM fungi *Glomus fasciculatum* which were grown in P deficient soil, with additional rock phosphate (6 mg RP/kg soil) and saline water treatment showed a significant plant growth per cent root colonization, spore number and P content in shoots, compare to non-mycorrhizal plants or plants treated 2 or 4 mg Sp₂ and Sp₃ with mycorrhizal inoculation. These findings are supported to early workers contribution of (Alien and Cunnigham, 1983; Ross et al., 1985). The difference in phosphorus concentration between mycorrhizal inoculated and non-mycorrhizal plants are well marked. Further the increase of P content in shoots is due to added rock-phosphate for the plants at the required level. Considering the plants height and dry weights of shoots the treatments were clearly comparable, and it is suggestive that mycorrhizal (*G. fasciculatum*) was able to extract adequate or near optimum levels of
exist in that fungal respiration presents a carbon drain on the experimental plants (Hirrel and Gerdmann, 1980; Lakshman, 1999).

The main role of the AM fungus *Glomus fasciculatum* in improving growth in finger millet saline soil appeared to be increasing P accumulation and concentration when soil P was low. When sufficient P is added to the saline soil a parasitic relationship may exist in that fungal respiration presents a carbon drain on the experimental plants (Hirrel and Gerdmann, 1980; Lakshman, 1999).

The percentage of AMF colonization, spore number in root system was gradually reduced, when additional super phosphate was given, but, there was significantly increased, spore number and per cent root colonization in plant treated with rock phosphate. Increased height of mycorrhizal plants can be partially be attributed to improve P nutrition. (Gemma and Kosk, 1977; Puppi and Riess, 1987; Bellagrad, 1994). The present investigation brought out clearly that AMF fungi *G. fasciculatum* greatly assisted fold, increased growth of finger millet plants. These plants were grown in Stenilized soil with and without additional phosphate. At the same time it emphasis more number of plot studies are warranted in both laboratory and field, on other annuals/herbaceous plants, which are colonized with arbuscular mycorrhizal fungi of saline treatment with other beneficial microorganisms.

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REFERENCES


