Effect of Biofertilizers, Rhizobium & Phosphate in Combination of Different Level of Ca, Mg & S on the Productivity of Chickpea (Cicer arietinum L.) Cultivar Avrodhi

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Abstract: A field experiment was conducted in Bareilly, Uttar Pradesh, India, during the 2006-07 rabi season to study the effect of biofertilizer (Rhizobium & Phosphate) in combination of different level Ca, Mg & S on the productivity of chickpea (Cicer arietinum) cultivar “Avrodhi”. Experimental units were arranged in split-split plot based on randomized complete blocks with three replication. The treatments consisted of nitrogen, phosphorus and potassium (N: P: K 20:60:30 Kg/ha), calcium/magnesium & sulphur (Ca, Mg & S 38 Kg/ha) and seed inoculation with Rhizobium or Phosphate solubilizing bacteria (PSB), both Rhizobium and PSB, or uninoculated control. The results revealed that application of N: P: K 20:60:30 Kg/ha + Ca, Mg & S 38 Kg/ha + dual inoculation with Bradyrhizobium japonicum and Pseudomonas striata (200 gm/ha) significantly increased the growth characters (Plant height, no of nodules, nodules dry weight & dry matter accumulation) of chickpea. The increase dry matter accumulation gm/plant (16.64). Height of plant cm (45.78), no of nodules/plant (35.18), nodules dry weight Mg/plant (90.47)

Keywords: Cicer arietinum, Rhizobium, productivity

INTRODUCTION

Chickpea (Cicer-arietinum L.) is one of the important grain legume crops of India accounting for about 29.7 percent of the area under pulses & contributes about 41.6 percent of the total pulse production of the country. It is the third most widely grown grain legume in the world tolerating a wide range a climatic condition. Biofertilizers are living micro organisms, which contributes nutrients to plant through microbial activity. These microbial cultures fix atmospheric nitrogen, solubilize both native and applied sparingly soluble phosphate to increase soil fertility.

Leguminous crops have nodules in their root where Rhizobium fix atmospheric nitrogen with the help of nitrogenase enzyme, Number and size of nodules directly affect the amount of nitrogen fixed by Rhizobium. Phosphate solubilizing bacteria (PSB) secrete organic & inorganic acids which convert insoluble phosphate in to soluble forms, which can be used by the plant chickpea requires relatively more phosphorus because of its high energy requirement for protein synthesis. The combined inoculation of Rhizobium and phosphate solubilizing bacteria has increased nodulation, growth parameter in Chickpea. Mineral nutrient, which come from the soil, are dissolved in water an absorbed through a plant’s roots. Micro nutrients are N, P, K, Ca, Mg; S. Nitrogen is a part of all living cells and is a necessary part of all proteins, enzymes and metabolic process involved in the synthesis and transfer of energy. Nitrogen is a part of chlorophyll, the green pigment of the plant that is responsible for photosynthesis.

Like nitrogen (N), phosphorus (P) is an essential part of the process of photosynthesis. Involved in the formation of all oils, sugars, starches etc. potassium (K) helps in the building of protein, photosynthesis, fruit quality and reduction of diseases. Calcium (Ca), an essential part of plant cell wall structure, provides for normal transport and retention of other elements as well as strength is the plant. Magnesium (Mg) is part of the chlorophyll in all green plants and essential for photosynthesis, it also helps activate many plant enzymes needed for growth. Sulfur (S) improves root growth and seed production & essential plant food for production of protein. Sulphur promotes activity and development of enzymes and vitamins.

MATERIAL AND METHOD

The experiment was conducted at the former’s field (Bilwa research form, Bareilly District) in Uttar Pradesh, India during the Rabi season extended 2006-07. The soil P0 was recorded 6.8, Biofertilizer [Bradyrhizobium japonicum & Pseudomonas striata (PSB)] inoculation & macronutrients were applied at the time of land in Basal dose of all plots. Nitrogen, phosphorus, potassium (N: P: K 20:60:30 Kg/ha) & calcium, magnesium/sulphur 38 Kg/ha. The experimental design was randomized complete block with 3 replications and 16 treatments included.

Magnesium + Sulphur + Nitrogen + Phosphorus + Potassium (T_{16}) Rhizobium + PSB + Calcium + Magnesium + sulfur (T_{16}) Rhizobium + PSB + Calcium + Magnesium + Sulphur + Nitrogen + Phosphorus + Potassium.

**Collection of Data**

Data on plant height in cm, dry matter accumulation/plant, no. of nodules/plant, nodules dry weight/plant. Data were taken from randomly selected 3 plants from each plot.

**RESULT**

**Dry matter accumulation**

The results indicated that dry matter accumulation in plant was significantly affected by the treatments. The maximum dry weight of plant was recorded by applying the treatment (T_{16}) (16.64) with dual inoculation (Bradyrhizobium japonicum/Pseudomonas striata) 200 gm/ha + calcium + magnesium + sulphur 38 Kg/ha + N:P:K 20:60:30 Kg/ha, and the lowest rate of treatment (T_1) (13.96) with uninoculated control.

**Nodule dry weight/plant**

As revealed by the data presented in table nodules dry weight/plant increased significantly as compared to control. The number of nodules/plant was affected by treatments so that the highest nodules dry weight/plant (90.47 mg/plant) was recorded by the treatment (T_{16}) with dual inoculation (Bradyrhizobium japonicum/Pseudomonas striata) 200 gm/ha + Calcium + magnesium + sulphur 38 Kg/ha. + N:P:K 20:60:30 Kg/ha and lowest rate nodules dry weight/plant (36.37 mg/plant) was recorded by (T_1) with uninoculated control.

**Height of Plant in cm**

Observation on the effect of basal applications of dual inoculation (Rhizobium + PSB) & Macronutrient on height of plant of Cicer arietinum. The highest height of plant (45.78) was recorded by (T_{16}) with Bradyrhizobium japonicum/Pseudomonas striata 200 gm/ha & 38 kg/ha Ca, Mg & S, N: P: K 20:60:30 kg/ha. The lowest rate (33.40) was shown by Treatment (T_1) with uninoculated control.

**No of nodules / plant**

Data presented in table shows that no of nodules/plant of Cicer arietinum increase significantly in all treatments as compared to control. The number of nodules/plant was affect by treatments, so that the highest number of nodules/plant (35.18) was produced by the treatment (T_{16}) and the lowest rate (20.16) no of nodules/plant was recorded by treatment (T_1) with uninoculated control.

<table>
<thead>
<tr>
<th>Sr. N.</th>
<th>Treatment</th>
<th>Dry matter accumulation gm/plant</th>
<th>Nodules dry weight mg/plant</th>
<th>Height of plant in (cm)</th>
<th>No. of nodules/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Uninoculated</td>
<td>13.96</td>
<td>36.37</td>
<td>33.40</td>
<td>20.16</td>
</tr>
<tr>
<td>2.</td>
<td>Uninoculated N_20_P_60_K_30</td>
<td>14.02</td>
<td>45.02</td>
<td>38.57</td>
<td>23.11</td>
</tr>
<tr>
<td>3.</td>
<td>Rhizobium</td>
<td>15.64</td>
<td>50.67</td>
<td>44.33</td>
<td>27.33</td>
</tr>
<tr>
<td>4.</td>
<td>Rhizobium N_20_P_60_K_30</td>
<td>15.66</td>
<td>62.16</td>
<td>45.67</td>
<td>29.67</td>
</tr>
<tr>
<td>5.</td>
<td>Rhizobium + PSB</td>
<td>15.72</td>
<td>78.28</td>
<td>41.67</td>
<td>30.78</td>
</tr>
<tr>
<td>6.</td>
<td>Rhizobium + PSB N_20_P_60_K_30</td>
<td>15.22</td>
<td>85.54</td>
<td>44.16</td>
<td>32.16</td>
</tr>
<tr>
<td>7.</td>
<td>Rhizobium +PSB+Calcium</td>
<td>14.55</td>
<td>61.49</td>
<td>44.18</td>
<td>28.33</td>
</tr>
<tr>
<td>8.</td>
<td>Rhizobium +PSB+Ca+ N_20_P_60_K_30</td>
<td>15.53</td>
<td>78.50</td>
<td>44.21</td>
<td>30.21</td>
</tr>
<tr>
<td>9.</td>
<td>Rhizobium + PSB + Magnesium</td>
<td>14.38</td>
<td>58.35</td>
<td>44.18</td>
<td>26.33</td>
</tr>
<tr>
<td>10.</td>
<td>Rhizobium +PSB+Mg+N_20_P_60_K_30</td>
<td>15.16</td>
<td>62.16</td>
<td>43.41</td>
<td>29.67</td>
</tr>
<tr>
<td>11.</td>
<td>Rhizobium + PSB + Sulfur</td>
<td>15.96</td>
<td>61.19</td>
<td>44.35</td>
<td>28.10</td>
</tr>
<tr>
<td>12.</td>
<td>Rhizobium +PSB+ S + N_20_P_60_K_30</td>
<td>16.58</td>
<td>80.21</td>
<td>45.00</td>
<td>31.33</td>
</tr>
<tr>
<td>13.</td>
<td>Rhizobium + Ca + Mg + S</td>
<td>16.49</td>
<td>58.78</td>
<td>43.21</td>
<td>26.73</td>
</tr>
<tr>
<td>14.</td>
<td>Rhizobium +Ca+Mg+S+N_20_P_60_K_30</td>
<td>16.52</td>
<td>62.85</td>
<td>45.67</td>
<td>29.66</td>
</tr>
<tr>
<td>15.</td>
<td>Rhizobium+ PSB + Ca + Mg</td>
<td>16.58</td>
<td>85.74</td>
<td>45.28</td>
<td>32.16</td>
</tr>
<tr>
<td>16.</td>
<td>Rhizobium+PSB+Ca+Mg+S+N_20_P_60_K_30</td>
<td>16.64</td>
<td>90.47</td>
<td>45.78</td>
<td>35.18</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Desirable effects of dual inoculation Bradyrhizobium japonicum & Pseudomonas striata on growth parameter and macronutrient by plant have been reported in many experiments. In the present study combined inoculation (Bradyrhizobium japonicum + Pseudomonas striata) & macro nutrient (N,P,K, Ca, mg.S), caused a considerable improvement in growth parameter, of chickpea. The highest plant height (mean) recorded at the treatment (T_{16}) (45.78) with Bradyrhizobium japonicum/Pseudomonas striata & macronutrient (Ca,Mg,S,N,P,K). This is supported by many authors. Chavan et al. (2008) they showed the application of phosphorus (SSP) single super phosphate & PSB inoculation recorded significantly
increase, greater plant height, no of root nodules, dry matter accumulation & nodule dry weight. Kantwa et al. (2002) the application of phosphorus up to 45 kg P₂O₅/ha significantly increase the growth parameters.

The highest dry matter accumulation / plant was recorded at the treatment (T₁₆) (16.64) with Bradyrhizobium japonicum & Pseudomonas striata + macronutrient (N, P, K, Ca, Mg, S). This is supported by many authors. Mondal et al (2005) they showed that the effect of potassium and sulphur on the productivity, nutrient uptake and quality improvement of chickpea. No of nodules / plant (mean) recorded at the treatment (T₁₆) with Bradyrhizobium japonicum / Pseudomonas striata & macro nutrients as basal application was (35.18) highest no of nodules/plant. This is supported by many authors. Tanwar et al (2002) seed inoculation with Rhizobium and PSB either singly or in combination significantly increases dry matter production, no. of nodules/plant, number of pods/plant & no of seeds / pod. The highest nodules dry weight/plant was recorded at the treatment (T₁₆) (90.47 mg/plant) with Bradyrhizobium japonicum & Pseudomonas striata (mean) recorded at the treatment (T₁₆) with Bradyrhizobium japonicum & Pseudomonas striata & macro nutrients as basal application was (35.18) highest no of nodules/plant. This is supported by many authors. Gulati et al. (1989) has reported increased nodules dry weight with the increased inoculants load of Bradyrhizobium japonicum. Chavan et al (2008) they showed the application of phosphorus single super phosphate (SSP) and PSB (Pseudomonas striata) inoculation recorded significantly increase, greater plant height, number of root nodules, dry matter accumulation, nodule dry weight.

According to the results it can be concluded that applying the combined inoculation (Bradyrhizobium japonicum & Pseudomonas striata) of different levels of macronutrient (N, P, K, Ca, Mg, S) used in the experiment as biofertilizers & macronutrient can affect beneficially the growth parameter of chickpea in field condition, further more considering the effective role of Bradyrhizobium japonicum & Pseudomonas striata in crop productivity, the presence of this rhizobium in the combination of microbial biofertilizer will be useful in chickpea production.

REFERENCES


