RESPONSE OF LEUCAENA LEUCOCEPHALA TO INOCULATION WITH RHIZOBIA FROM TROPICAL LEGUMES

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Abstract

Rhizobia isolated from root nodules of Albizia lebbeck, Arachis hypogaea, Clitoria ternatea, Leucaena leucocephala, Medicago sativa, Pithecellobium dulce, Sesbania sesban and Vigna unguiculata were tested for their ability to produce root nodules on Leucaena leucocephala. Amount of fixed N₂ was measured. Except Arachis hypogaea isolates from all leguminous plants produced nodules on Leucaena leucocephala. Isolates from V. unguiculata, A. lebbeck and P. dulce were most effective in nitrogen fixation and induced substantial increase in dry weight and nitrogen contents of the host plant.

Introduction

Rhizobia from Leucaena leucocephala have been used frequently in cross inoculation experiments (Trinick, 1965a, 1965b, 1968, 1980). Trinick (1968) reported the specificity of Leucaena - Rhizobium symbiosis and the fast growing nature of the microsymbiont which could effectively nodulate on Vigna species. The present report discusses the symbiotic performance of rhizobia obtained from root nodules of Albizia lebbeck, Arachis hypogaea, Clitoria ternatea, Leucaena leucocephala, Medicago sativa, Pithecellobium dulce, Sesbania sesban and Vigna unguiculata cultures of Rhizobia were isolated on Yeast Mannitol Agar medium following Somasegarn & Hoben (1985) technique and their growth rate recorded.

Material and Methods

Using nodules of Albizia lebbeck, Arachis hypogaea, Clitoria ternatea, Leucaena leucocephala, Medicago sativa, Pithecellobium dulce, Sesbania sesban and Vigna unguiculata cultures of Rhizobia were isolated on Yeast Mannitol Agar medium following Somasegarn & Hoben (1985) technique and their growth rate recorded.

Leucaena plants were grown in modified Leonard jar assemblies, 4 plant in a jar (Anon., 1987). Plants were kept in growth chamber at 25-28°C with 16 h illumination and watered with nitrogen free nutrient solution (Hoagland & Arnon, 1950). Plants were inoculated using a cell suspension of rhizobial strains prepared in 10% sucrose solution @ 10 ml/plant. There were 3 replicates of each treatment. Uninoculated plants were kept as control. Plants were harvested after six weeks. Nodule number, nodule size, plant dry weight and total nitrogen contents were determined by microkjeldahl method (Bergerson, 1980).

Result and Discussion

Rhizobia from M. sativa, L. leucocephala and S. sesban formed relatively large colonies of 2mm diameter as compared to Bradyrhizobia from A. lebbeck, A. hypogaea,
Table 1. Nodulation response of *Leucaena leucocephala* to rhizobium strains isolated from tropical legumes.

<table>
<thead>
<tr>
<th>Host of Rhizobium isolate</th>
<th>Nodulation Status</th>
<th>Nodule size (mm)</th>
<th>Nodule Shape</th>
<th>Nodule No. per plant</th>
<th>Total dry weight per plant (mg)</th>
<th>N-contents per plant (mg)</th>
<th>N₂ contents (mg/100 mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>144.9</td>
<td>0.173</td>
<td>0.120</td>
</tr>
<tr>
<td>Nitrate control</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>187.1</td>
<td>0.224</td>
<td>0.120</td>
</tr>
<tr>
<td><em>Albizia lebbeck</em></td>
<td>+</td>
<td>1.4</td>
<td>Spherical elongated</td>
<td>13.87</td>
<td>260.5</td>
<td>1.224</td>
<td>0.470</td>
</tr>
<tr>
<td><em>Arachis hypogaea</em></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>63.3</td>
<td>0.079</td>
<td>0.125</td>
</tr>
<tr>
<td><em>Clitoria ternatea</em></td>
<td>+</td>
<td>1.2</td>
<td>Spherical elongated bilobed branched</td>
<td>5.83</td>
<td>73.1</td>
<td>0.109</td>
<td>0.150</td>
</tr>
<tr>
<td><em>Leucaena leucocephala</em></td>
<td>+</td>
<td>1.5</td>
<td>Elongated, beaded spherical, branched</td>
<td>6.14</td>
<td>201.2</td>
<td>0.342</td>
<td>0.170</td>
</tr>
<tr>
<td><em>Medicago sativa</em></td>
<td>+</td>
<td>1.5</td>
<td>Elongated, beaded spherical branched</td>
<td>12.90</td>
<td>246.6</td>
<td>0.468</td>
<td>0.190</td>
</tr>
<tr>
<td><em>Pithecellobium dulce</em></td>
<td>+</td>
<td>1.4</td>
<td>Elongated branched spherical</td>
<td>12.40</td>
<td>254.4</td>
<td>1.195</td>
<td>0.470</td>
</tr>
<tr>
<td><em>Sesbania sesban</em></td>
<td>+</td>
<td>1.0</td>
<td>Elongated, beaded spherical</td>
<td>5.66</td>
<td>130.0</td>
<td>0.182</td>
<td>0.140</td>
</tr>
<tr>
<td><em>Vigna unguiculata</em></td>
<td>+</td>
<td>1.9</td>
<td>Elongated, oblate beaded</td>
<td>29.16</td>
<td>262.6</td>
<td>2.520</td>
<td>0.96</td>
</tr>
</tbody>
</table>

- = No nodulation
+ = Nodulation present
C. ternatea P. dulce and V. unguiculata which produced 1mm diameter colonies after 48 h at 28-30°C.

Nodules were produced on L. leucocephala in response to inoculation with rhizobia isolated from nodules of A. lebbeck, C. ternatea, L. leucocephala, M. sativa, P. dulce, S. sesban and V. unguiculata except A. hypogaea (Table 1).

Of the 99 strains of Rhizobium tested representing all the 7 recognized cross inoculation groups, 94 strains failed to nodulate on Leucaena (Trinick, 1968, 1980). Nodules were produced only by fast growing rhizobia isolated from tropical legumes like Acacia farnesiana, Mimosa invasa, M. pudica, Sesbania grandiflora and Lablab purpureus (Trinick, 1980). R. meliloti, R. trifolii, R. leguminosarum, R. phaseoli and slow-growing cowpea type rhizobia which represent the typical rhizobial type found associated with tropical legumes did not produce nodules on Leucaena (Trinick, 1980). Majority of the strains tested belonged to cow pea group with the exception of Medicago sativa (Dadarwal et al., 1987). Rhizobium isolates from Albizia stipulata, Arachis hypogaea, Cli- toria ternatea and Vigna sinensis did not produce nodules on Leucaena but formed ineffective nodules with Sesbania grandiflora (Trinick, 1968). In the present study however nodules were formed on Leucaena when isolates from A. lebbeck, C. ternatea, L. leucocephala, M. sativa, P. dulce, S. sesban and V. unguiculata were used. It would therefore suggest that Leucaena can be nodulated by the use of a wider range of slow growing Bradyrhizobium as well as fast growing Rhizobium. These results corroborate Tan & Broughton (1982) that Leucaena rhizobia possess characteristics of both fast and slow-growing rhizobia and may be regarded as representatives of the organisms intermediate between the fast and slow-growing rhizobial groups.

An increase in the nitrogen concentration was recorded in 7 out of 8 trials. Isolates from V. unguiculata A. lebbeck and P. dulce induced substantial increase in the dry weight and nitrogen contents in respective host plants as compared to Leucaena isolate since total dry weight of V. unguiculata, A. lebbeck and P. dulce recorded were 262.6, 260.5 and 254.4 mg and their nitrogen contents 2.52, 1.22 and 1.19 mg, respectively (Table 2). An increase in the nitrogen content of V. unguiculata as a response to cross infection with wild legumes has also been reported by Srivastava & Tewari (1982). Cross infection of agriculturally important legumes with isolates from wild legumes may therefore prove a useful means of increasing total nitrogen contents within these plants.

References


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