Effect of Rhizobium Strains on Growth of Two Sesbania species
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Abstract
The objective of this study was to evaluate the effectiveness of Rhizobium strains on Sesbania (S. aculeata and S. grandifolia) growth. In this two-factor factorial pot experiment, inocula of ten Rhizobium strains were applied on two Sesbania species. The effect of inocula, Sesbania species and their interaction on growth parameters was statistically significant. Sesbania treatments with different inocula showed higher growth than uninoculated plants (control) and the treatment with N addition. In S. grandifolia, the mixture of strains responded better in all parameters, however in S. aculeata, no specific Rhizobium strain showed extraordinary performance. Rhizobium inoculation exhibited 3-fold increase in S. grandifolia and 4-fold in S. aculeata shoot dry matter, nodule dry matter and nitrogen contents.

Key words: Effect, Rhizobium strains, Growth, Sesbania

Introduction
Soil health is critical for producing high quality and sustainable crop production. Leguminous plants proved excellent tool for this purpose by improving soil fertility through regenerative means. Leguminous plants in association with Rhizobium can fix significant amount of atmospheric nitrogen from air which contributes to the soil nitrogen pool (Jefing et al., 1992). On a global level, annual contribution of biological nitrogen fixation has been estimated about 172 million tons. Legumes contribute about 25% (35 m tons) of biologically fixed nitrogen, which is slightly less than that supplied to agro-ecosystems through chemical fertilizers (Azam, 2001; Lshizuka, 1992). Sesbania being rich in nitrogen fixing bacteria is extensively cultivated in Pakistan (Fazal, 1994). In symbiosis with Rhizobium, it can fix up to 542 kg N ha⁻¹ (FAO, 1984). Its inoculation with superior rhizobial strains is essentially required to increase the yield of legumes through nitrogen fixation (Athar, 1998).

Results and Discussions

Growth Parameters
The inoculation of rhizobial strains significantly improved growth of both Sesbania species. The effect of inoculation in term of shoot and root dry weights and plant height was non-significant between the two species.
Table 1: Effect of *Rhizobial* strains on growth of *Sesbania* species

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Shoot dry wt. (g)</th>
<th>Root dry wt. (g)</th>
<th>Plant height (cm)</th>
<th>Nodule dry wt. (mg)</th>
<th>Shoot N (mg)</th>
<th>ARA (m mole hr(^{-1}) g(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Sesbania</em> grandifolia</td>
<td><em>Sesbania</em> aculeata</td>
<td><em>Sesbania</em> grandifolia</td>
<td><em>Sesbania</em> aculeata</td>
<td><em>Sesbania</em> grandifolia</td>
<td><em>Sesbania</em> aculeata</td>
</tr>
<tr>
<td>T(_0) (No Inoculation)</td>
<td>0.09 e</td>
<td>0.05 ab</td>
<td>0.022 b</td>
<td>0.025 ab</td>
<td>8.6 e</td>
<td>8.3 b</td>
</tr>
<tr>
<td>T(_1) (Sa-1)</td>
<td>0.27 abc</td>
<td>0.14 a</td>
<td>0.050 ab</td>
<td>0.030 ab</td>
<td>18.3 a</td>
<td>13.1 a</td>
</tr>
<tr>
<td>T(_2) (Sa-2)</td>
<td>0.20 b-e</td>
<td>0.23 ab</td>
<td>0.059 ab</td>
<td>0.063 ab</td>
<td>17.5 ab</td>
<td>14.4 a</td>
</tr>
<tr>
<td>T(_3) (Sa-3)</td>
<td>0.17 b-e</td>
<td>0.15 a</td>
<td>0.030 ab</td>
<td>0.044 ab</td>
<td>10.1 e</td>
<td>15.1 a</td>
</tr>
<tr>
<td>T(_4) (Sa-4)</td>
<td>0.11 dc</td>
<td>0.27 a</td>
<td>0.040 ab</td>
<td>0.040 ab</td>
<td>11.8 de</td>
<td>16.8 a</td>
</tr>
<tr>
<td>T(_5) (Sa-5)</td>
<td>0.28 ab</td>
<td>0.24 a</td>
<td>0.024 b</td>
<td>0.090 a</td>
<td>10.1 e</td>
<td>13.0 a</td>
</tr>
<tr>
<td>T(_6) (Sa-6)</td>
<td>0.17 b-e</td>
<td>0.24 a</td>
<td>0.036 ab</td>
<td>0.044 ab</td>
<td>12.6 cde</td>
<td>15.3 a</td>
</tr>
<tr>
<td>T(_7) (Sa-7)</td>
<td>0.26 a-d</td>
<td>0.16 ab</td>
<td>0.085 a</td>
<td>0.034 ab</td>
<td>16.2 a-d</td>
<td>146 a</td>
</tr>
<tr>
<td>T(_8) (Sg-1)</td>
<td>0.13 cde</td>
<td>0.16 ab</td>
<td>0.030 ab</td>
<td>0.024 b</td>
<td>13.4 b-e</td>
<td>13.8 a</td>
</tr>
<tr>
<td>T(_9) (Sg-2)</td>
<td>0.10 e</td>
<td>0.23 a</td>
<td>0.036 ab</td>
<td>0.045 ab</td>
<td>12.4 cde</td>
<td>16.3 a</td>
</tr>
<tr>
<td>T(_{10}) (Sg-3)</td>
<td>0.17 b-e</td>
<td>0.18 ab</td>
<td>0.035 ab</td>
<td>0.053 ab</td>
<td>16.2 a-d</td>
<td>14.3 a</td>
</tr>
<tr>
<td>T(_{11}) (Sa-1+ Sa2 + Sg-1 + Sg-2)</td>
<td>0.38 a</td>
<td>0.21 a</td>
<td>0.087 a</td>
<td>0.044 ab</td>
<td>17.2 a-c</td>
<td>15.8 a</td>
</tr>
<tr>
<td>T(_{12}) (S)</td>
<td>0.14 b-e</td>
<td>0.17 ab</td>
<td>0.033ab</td>
<td>0.044 ab</td>
<td>10.2 e</td>
<td>14.0 a</td>
</tr>
</tbody>
</table>
Mixture of strains performed better than individual strain treatments in S. grandifolia. Upto four times higher shoot dry weight was recorded in inoculated treatment of T11 (mixture of strains) S. grandifolia plants. In Sesbania aculeata, mixture of strains and T9 (Sg-2 strain inoculation) performed better and produced 4-5 times more shoot dry matter than control. No specific host affinity was observed regarding species-strain specificity.

Mix culture response by S. grandifolia and S. aculeata was in accordance with Podder (1994), who found the mixed inoculation of Rhizobium in lentil was superior to a single strain for all the plant characteristics measured. However, it contradicts results of Nambiar et al. (1984) who reported that single Rhizobium culture performed better than mixed Rhizobium culture. Application of N also didn’t cause significant difference as compared to control treatment. Root dry weight ranged from 0.02 g plant\(^{-1}\) (T3) to 0.09 (T11) in S. grandifolia while it ranged from 0.02 (T3) to 0.09 (T3) g plant\(^{-1}\) in S. aculeate.

Similar results were also seen regarding plant height which confirms the previous results that the treatment where mixture of strains is used performs better than the control and the treatment where single strain inoculation was done.

**Symbiotic Traits**

The parameters which were studied were nodule dry weight (mg plant\(^{-1}\)) and acetylene reduction assay (ARA, m mole hour\(^{-1}\) g\(^{-1}\)). In S. grandifolia, nodules dry weight ranged from 9.7 to 38.00 mg and minimum was in treatment where S. aculeata native inoculation was applied while maximum was recorded for mixture of strains (T11). In S. aculeata, it ranged from 12.4 to 24.7 mg in various treatments, which were statistically non-significant due to large variation among replications. In S. grandifolia maximum ARA was in treatment where mixture of strain was applied, while in S. aculeata single strain inoculation showed maximum ARA (m mol h\(^{-1}\) g\(^{-1}\)).

**Plant Nitrogen Contents**

In Sesbania grandifolia maximum shoot N contents were found in T11 (mixture of strains) which were five-fold when compared with control. This again confirms the previous results. However, in Sesbania aculeata maximum shoot nitrogen contents were observed in T4 (a strain native to S. aculeata).

In conclusion, the results showed that Rhizobium inoculation enhanced the yield traits of Sesbania species. Both the two Sesbania species differed non-significantly regarding all the parameters. However, both performed differently to the inoculum application. Sesbania grandifolia responded better to the mixture of different rhizobial strain inoculum while S. aculeata responded better to inoculation of individual strains. All the treatments performed better than the control treatments. It is also obvious that a plant species can respond to the same extent to inoculums which is not native to that when compared to a plant species with a native inoculums.

**References**


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