Agronomic Traits of Mungbean and Subsequent Rice Crop as Affected by Seed Inoculation and Different Fertilizer Level

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Abstract: Effect of seed inoculation and different fertilizer levels on the yield and yield components of mungbean and subsequent rice crop was studied. Results showed that seed inoculation and different fertilizer levels significantly affected yield and yield components of mungbean and rice crops. Treatment T4 exhibited superior performance for exploiting maximum potential of mungbean (954.8 kg ha⁻¹ grains), which was 50% more than that of control. Whereas T5 gave maximum residual effect (4075 kg ha⁻¹ paddy yield), however statistically it was at par with T3, T6, T7, and T8. In conclusion, T4 proved better for getting maximum mungbean yield while T7 produced highest paddy yield.

Key words: Inoculation, NPK fertilizer, mungbean, rice, residual effect, yield, yield components

Introduction
Mungbean (Vigna radiata L.) and rice (Oryza sativa L.) are important crops of Pakistan. Former is popular for its nutritive value and digestibility. It is short duration, drought tolerant and suits well in our crop rotation program. In Pakistan annually 202.7 thousand hectares are put under its cultivation and 94.8 thousand tons of yields are achieved with an average of 468 kg ha⁻¹. Latter is the second largest staple food crop in Pakistan and is also a major export item. Rice is grown on 251.5 thousand hectares with an estimated production of 51.56 thousand tons, with an average of 2050 kg ha⁻¹ (Anonymous, 2001). The average yield of both the crops is too low. A tangible approach to solve this problem may be the use of fertilizers along with beneficial microbes in agriculture. Singh et al. (1993) reported that grain yield of mungbean was increased by the application of 20 kg N ha⁻¹ and 40 kg P₂O₅ ha⁻¹, whereas K₂O application has no significant effect. Bahlu et al. (1995) concluded that seed yield of Vigna mungo was increased by seed inoculation, seed yield was also increased when N was applied @ 20 kg ha⁻¹. Patra and Bhattacharyya (1997) observed that highest nodule number and seeds yield were obtained by treating the mungbean seeds with rhizobium and applied urea @ 25 kg ha⁻¹. Ali et al. (1998) reported that rice biomass was maximum for azolla (30 kg N + azolla, 7.2%) followed by bacterial treatment (30 kg N + bacteria, 7.0%) and minimum was with 60 kg N ha⁻¹ (-2.3%). Provorov et al. (1998) observed in field trials that inoculation of mungbean seeds with Bradyrhizobium increased the herbage mass by 6%, seed mass by 3.6%, mass of 1000-seeds by 0.8%, nitrogen content in seeds by 8.9%, starch content in seeds by 5.5% and number of nodules by 2.54%.

Ahmad (2000) found that PGPR increased paddy yield of two rice cultivars over control. Numbers of tiller hill⁻¹ were significantly affected by all the PGPR inoculants. Straw yield was increased by all bacterial cultures in both cultivars. Kashem et al. (2000) observed that brady rhizobium inoculation and NPK fertilization increased the grain and straw yields of mungbean significantly and obtained the highest grain yield by the treatment 0-30-20 NPK kg ha⁻¹ + inoculum. Shivens et al. (2000) observed that seed inoculation + 20 kg P₂O₅ ha⁻¹ to mungbean gave high growth, seed yield and dry matter accumulation. Van et al. (2000) reported that the inoculation had a significant effect on shoot weight (33%), root weight (57%) and tiller hill⁻¹ (13%) and grain yield (22%) over uninoculated control. Ashraf (2001) found that in mungbean number of pod plant⁻¹, no. of seeds pod⁻¹ and 1000 grain weight were affected significantly by the application of 50 kg P₂O₅ with varying level of N from 20 to 50 kg ha⁻¹ in addition to seed inoculation. It was therefore, felt that there was an urgent need to determine the effect of seed inoculation and appropriate level of NPK for getting higher seed production of mungbean and subsequent rice crop under Farooqabad (Sheikhpura) conditions.

Materials and Methods
The present studies were carried out at the Agronomic Research Station Farooqabad, District Sheikhpura for two consecutive years (1999, 2000). Experiments were laid out in randomized complete block design with three
replications. After harvest of wheat, mungbean variety NM-92 was sown during the 1st fortnight of May and harvested during 2nd week of July. The mungbean seeds were inoculated with *Rhizobium phaseoli* just before drilling. The whole quantity of fertilizers was side dressed just after sowing. All other agronomic practices for mungbean crop were kept uniform for all the treatments. Subsequently after the harvest of mungbean crop, a fine rice variety Basmati-385 was transplanted during the 2nd week of July in the same plots and harvested during 2nd week of November keeping all other management practices uniform. The following treatments were used:

\[ \begin{align*}
T_1 &= \text{No seed inoculation + No fertilizer (control)} \\
T_2 &= \text{Seed inoculation alone + No fertilizer} \\
T_3 &= \text{Seed inoculation + 20-50-0 NPK kg ha}^{-1} \\
T_4 &= \text{Seed inoculation + 30-50-0 NPK kg ha}^{-1} \\
T_5 &= \text{Seed inoculation + 40-50-0 NPK kg ha}^{-1} \\
T_6 &= \text{Seed inoculation + 50-50-0 NPK kg ha}^{-1} \\
T_7 &= \text{Seed inoculation + 50-50-25 NPK kg ha}^{-1}.
\end{align*} \]

Observations regarding various agronomic characteristics of both the crops were recorded by using standard procedure. Data collected and analyzed statistically by using the analysis of variance technique and Duncan's new multiple range tests at 5% probability was applied to compare the treatment means (Steel and Torrie, 1984).

**Results and Discussion**

**Mungbean**

**Number of pod plant**\(^{-1}\): Number of pod plant\(^{-1}\) was significantly (\(P<0.05\)) affected by seed inoculation and fertilizer application. \(T_1\) (seed inoculation + 50-50-25 kg NPK ha\(^{-1}\)) gave maximum number of pods plant\(^{-1}\) (26.07) but was statistically at par with \(T_2\) (25.03). While \(T_1\) (no seed inoculation + no fertilizer) produced minimum number of pods plant\(^{-1}\) (13.92) (Table 1). Results are in line with those obtained by Ashraf (2001).

**Number of grain pod**\(^{-1}\): Seed inoculation and fertilizer application exhibited a positive effect towards number of grain pod\(^{-1}\) (Table 1). Maximum number of grain pod\(^{-1}\) was noted in plot treated with \(T_6\), which was statistically at par with \(T_5\) and \(T_7\). Whereas minimum number of grains pod\(^{-1}\) were received in case of \(T_1\). Ashraf (2001) also reported similar results.

**1000-grains weight (g)**: Seed inoculation and NPK application significantly affected 1000-grains weight. Maximum 1000-grains weight was recorded in plots having \(T_6\) (42.22 g) with minimum in case of plot applied \(T_1\) (37.06). The heavier seed could be because of favorable soil environment and better fertilizer supply, which finally improve the grain weight. Provorov et al. (1998) also reported almost similar results.

**Biological yield (kg ha\(^{-1}\))**: Seed inoculation +50-50-0 kg NPK ha\(^{-1}\) \(T_6\) produced highest biomass (4668 kg ha\(^{-1}\)), which was (36%) higher than that of control. Provorov et al. (1998) and Kasheem et al. (2000) are in agreement with these results.

**Grain yield (kg ha\(^{-1}\))**: Final grain yield is a function of cumulative effect of various yield parameters. Data reflects that seed inoculation and fertilizer application has a significant effect on grain yield hectare\(^{-1}\). Maximum grain yield (954.8 kg ha\(^{-1}\)) was noted in plots applied with \(T_6\), while the \(T_1\) produced only 635.5 kg ha\(^{-1}\) grains. This increase in yield is due to the better N supply and growth promoting effect of inoculation. These results are in conformity with those of reported by Bahlil et al. (1995), Patra and Bhattacharyya (1997), Kasheem et al. (2000) and Ashraf (2001).

**Rice**

**Number of tiller hill**\(^{-1}\): Seed inoculation and fertilizer application affected number of tiller hill\(^{-1}\) significantly (Table 2). \(T_6\) produced maximum number of tiller hill\(^{-1}\), nevertheless it was statistically at par with \(T_1\), \(T_5\), \(T_7\) and \(T_8\). Whereas \(T_1\) and \(T_2\) produced minimum number of tiller hill\(^{-1}\). The results are similar with those obtained by Ahmed (2000), who found that numbers of tiller hill\(^{-1}\) were significantly affected by all the PGPR inoculants and Van et al. (2000), who stated that 13% increase in number of tillers per hill than un inoculated control.

**Number of grain panicle**\(^{-1}\): The data (Table 2) revealed that different treatments significantly affected number of grain panicle\(^{-1}\). \(T_1\) produced maximum number of grain panicle\(^{-1}\) (75.17), while \(T_5\) produced minimum number of grain panicle\(^{-1}\) (65.67). Van et al. (2000) reported 13-22% increase in grains per panicle in rice by inoculation.

**Biological yield (kg ha\(^{-1}\))**: Data (Table 2) indicated that seed inoculation and fertilizer had a concreto effect towards biological yield. \(T_6\) produced maximum biomass (17460 kg ha\(^{-1}\)), however statistically it was at par with \(T_1\), \(T_5\), \(T_7\) and \(T_8\). The results are in conformity with the results got by Ali et al. (1998).

**Straw yield (kg ha\(^{-1}\))**: Maximum straw yield was obtained from plot treated with \(T_4\) (13390 kg ha\(^{-1}\)), however
Table 1: Various agronomic characteristics of mungbean as affected by seed inoculation and different fertilizer levels

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of pod plant⁻¹</th>
<th>Number of grain pod⁻¹</th>
<th>1000-grains weight (g)</th>
<th>Biological yield (kg ha⁻¹)</th>
<th>Grain yield (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>13.92d</td>
<td>7.907d</td>
<td>37.06f</td>
<td>3411e</td>
<td>635.5e</td>
</tr>
<tr>
<td>T₂</td>
<td>15.41cd</td>
<td>7.873d</td>
<td>38.84e</td>
<td>3877d</td>
<td>787.8d</td>
</tr>
<tr>
<td>T₃</td>
<td>17.10c</td>
<td>9.057c</td>
<td>39.92d</td>
<td>3961d</td>
<td>798.7cd</td>
</tr>
<tr>
<td>T₄</td>
<td>21.69b</td>
<td>9.903b</td>
<td>40.66c</td>
<td>4163c</td>
<td>844.0be</td>
</tr>
<tr>
<td>T₅</td>
<td>22.69b</td>
<td>10.92a</td>
<td>40.09d</td>
<td>4220c</td>
<td>798.7cd</td>
</tr>
<tr>
<td>T₆</td>
<td>25.03b</td>
<td>11.33a</td>
<td>42.22a</td>
<td>4682a</td>
<td>954.8a</td>
</tr>
<tr>
<td>T₇</td>
<td>26.07a</td>
<td>11.02a</td>
<td>41.28b</td>
<td>4391b</td>
<td>871.7b</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>1.963</td>
<td>0.5626</td>
<td>0.5569</td>
<td>151.7</td>
<td>51.54</td>
</tr>
</tbody>
</table>

Table 2: Various agronomic characteristics of rice as affected by seed inoculation and different fertilizer levels

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of tiller hill⁻¹</th>
<th>Number of grain panicle⁻¹</th>
<th>Biological yield (kg ha⁻¹)</th>
<th>Straw yield (kg ha⁻¹)</th>
<th>Paddy yield (kg ha⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁</td>
<td>9.583b</td>
<td>68.17b</td>
<td>14640b</td>
<td>11120b</td>
<td>3516b</td>
</tr>
<tr>
<td>T₂</td>
<td>9.567b</td>
<td>65.67b</td>
<td>14340b</td>
<td>10970b</td>
<td>3368b</td>
</tr>
<tr>
<td>T₃</td>
<td>12.53a</td>
<td>74.67a</td>
<td>17110a</td>
<td>13110a</td>
<td>4000a</td>
</tr>
<tr>
<td>T₄</td>
<td>12.70a</td>
<td>75.17a</td>
<td>17460a</td>
<td>13390a</td>
<td>4047a</td>
</tr>
<tr>
<td>T₅</td>
<td>12.60a</td>
<td>69.17b</td>
<td>15560ab</td>
<td>11910b</td>
<td>3645ab</td>
</tr>
<tr>
<td>T₆</td>
<td>12.83a</td>
<td>66.33b</td>
<td>15570ab</td>
<td>11850b</td>
<td>3718ab</td>
</tr>
<tr>
<td>T₇</td>
<td>11.82a</td>
<td>64.83b</td>
<td>17360a</td>
<td>13280a</td>
<td>4075a</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>1.323</td>
<td>4.236</td>
<td>2266</td>
<td>1115</td>
<td>424.7</td>
</tr>
</tbody>
</table>

Means followed by different letters differ significantly at 5% level of probability.

Statistically it was at par with T₂ and T₃, T₄ produced the minimum straw yield (10970 kg ha⁻¹) (Table 2). Results are in line with those maintained by Ahmed (2000) who reported that straw yield of rice was increased by all bacterial cultures.

**Paddy yield (kg ha⁻¹):** T₄ (Seed inoculation: 50-50-25 NPK kg ha⁻¹) produced maximum paddy yield kg ha⁻¹ (4075); nevertheless, statistically it was at par with T₃, T₆, T₇, and T₅. This yield of T₄ was about 16% higher than that of control. This increase in yield is due to the residual effect of P₂O₅ and K and growth promoting effect of inoculation. Results rare in agreement with those obtained by Ali et al. (1998), Ahmed (2000) and Van et al. (2000).

In conclusion, T₄ (Seed inoculation: 50-50-0 kg NPK ha⁻¹) exhibited superior performance for exploiting maximum potential of mungbean, while T₄ has better residual effect on rice crop as it produced 16% more paddy yield over control. Alone inoculation is not sufficient for getting higher yield of both crops and mungbean can be successfully grown between wheat and rice crop.

**References**


