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Variatel Reaction of Wheat to VAM Infection

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Abstract: Six commercial wheat vars. grown in micro plots showed VAM infection in their roots after 10 days of sowing the seeds. After lag phase VAM infection in all the 6 vars. progressed exponentially in a sigmoid fashion with increasing age of plants and then attaining a plateau state at a certain stage of growth which differed significantly variety wise (p<0.001). Of the six wheat vars., Blue Silver was found highly susceptible to the VAM fungi and showed highest VAM infection (80.3 ± 6.8 %) in its roots, whereas it was found least in Sonalika (65.2 ± 3.7 %). Histological study of VAM infected roots showed that the arbuscular structure appeared earlier than the vesicular structure. This information would be of great significance in boosting up the yield of wheat by growing and inoculating the var. Blue Silver on preferential basis in wheat fields of Sindh, Pakistan.

Key words: VAM infection, varietal reaction, wheat

Introduction
Vesicular arbuscular mycorrhiza (VAM) is one of the effective soil micro-organisms, that forms a symbiotic association with the roots of a wide range of vascular plants (Sieverding, 1981). In symbiotic association the absorptive area of host roots, and the mobilization of available Phosphorus along with various other minerals is greatly enhanced which consequently increase the plant yield many folds (Harley, 1989). The intensity of VAM infection in roots of commercial indigenous wheat vars. of Sindh, Pakistan has not so far been studied empirically. This research work was carried out to determine the extent of VAM infection in roots of 6 commercial wheat vars. of Sindh at various growth stages, to find out the VAM susceptible vars. for cultivation and to overcome the limitation of the practical utilization of the VAM technology in our country.

Materials and Methods
The six indigenous commercial wheat vars. viz. Blue silver, Pak-70, Paxon, Sindh-83, Sonalika and ZA-77 were cultivated during wheat season (1994/95) in the experimental micro plots each of 120 cm², containing sandy clay loam soil (true density 2.66 g/cc, pore space 43 % and pH level 7.2). The plots were established in blocks at Karachi University Campus by randomized complete block design method. In each plot surface disinfected seeds of the 6 wheat vars. were sown in 3 straight rows of 85 cm length @ 5 seeds of each var./row, maintained at a distance of 10 cm, whereas the distance between each row was kept 30 cm. Each var. was replicated 3 times. The seeds were allowed to germinate and grow up to the harvesting stage by irrigating them with tap water. The lateral and fine feeder roots of wheat vars. (site of VAM infection) were collected (Kormanick & McGravy, 1982) at 10 days interval by stratified sampling method (Zar, 1984). The wheat root tissues were processed by the method of Koske & Gemma (1988) to determine the VAM infection in cortical tissues. The assessment of VAM infection percentage in roots of 6 wheat vars. was carried out separately by slide length method (Giovannetti & Mosse, 1980).

Results
When the data on VAM infection percentage of the six wheat vars. were subjected to Analysis of Variance-ANOVA (Table 1) it showed that the VAM infection percentage in roots of 6 wheat vars. growing in different blocks was significantly different. The 6 wheat vars. at various growth stages also differed significantly in respect of VAM infection percentage. A non-significant interaction was found between wheat varietal and growth stages.

Discussion
VAM fungi are found naturally in all terrestrial ecosystem and infect roots of wide range of vascular plants. Its pattern of root infection in different plants of different species and genera has been studied by many scientists. Smith & Smith (1981) obtained sigmoid curves against VAM infection percentage verses time in roots of Trifolium subterraneum and Allium cepa which support the present findings. The sigmoid form of the curve against VAM infection and time has also been illustrated by Land & Shonbeck (1991) in...
Table 1. Analysis of variance on VAM infection percentage in the roots of 6 wheat vars.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Sum of squares</th>
<th>DF</th>
<th>Mean squares</th>
<th>F</th>
<th>Probability Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blocks</td>
<td>8104.02</td>
<td>17</td>
<td>471.01</td>
<td>14.15</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>Varieties</td>
<td>8794.51</td>
<td>6</td>
<td>1466.08</td>
<td>33.09</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Growth stages</td>
<td>12859.76</td>
<td>13</td>
<td>9899.06</td>
<td>243.89</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Interaction</td>
<td>2580.42</td>
<td>85</td>
<td>30.86</td>
<td>0.88</td>
<td>NS</td>
</tr>
<tr>
<td>Error</td>
<td>6726.64</td>
<td>195</td>
<td>44.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>15228.24</td>
<td>237</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NS = Non significant

Figs. 1 A - F: VAM infection percentage in roots of 6 wheat vars. At various growth stages. The alphabets on x-axis represent the days after sowing seeds at an interval of 10 days and the vertical bars on each graphic line represent the standard deviation of the mean value LSD_0.05 (WHEAT VARS.) = 2.74, LSD_0.05 (days after sowing) = 4.18

different plants which corroborate our results. Many workers (Sutton, 1978; Sair, 1977; Moos, 1981; Harley & Smith, 1983) have described the existence of lag phase in VAM infection as found in present work in Sonalika (Fig. 1 D).

Our results showed that after attaining the plateau, there was no further increase in VAM infection up to harvesting stage, which is similar to the findings of Sieverding (1981). Our results clearly indicate that the 6 commercial wheat vars., which were grown in ecologically similar area showed their own varietal reaction against VAM infection. The difference in VAM infection percentage in 6 different wheat vars. can also be due to the difference in wheat varieties within a species having different infection levels as pointed out by Crush (1978). According to Hall (1981) there are more than 100 different VAM species in soil, each differs in the extent to which it infect the particular plant species/vars. However, the root system of a growing plant is usually infected by more than one VAM species which can not be identified perfectly in the root tissues. Since the identification of VAM fungi in the infected roots is very controversial due to lack of comprehensive works. Present results are further supported by Sieverding (1981), who pointed out that different
Figs. 2 A to F: The pattern of appearance and number of vesicles and arbuscules in the root cortical tissues of wheat at various growth stages. The alphabets on x-axis represent the days after sowing seeds at an interval of 10 days and the vertical bars on each graphic line represent the standard deviation of the mean value.

Plate 1: The microphotograph showing asceptate hyphae and intracellular dichotomously branched arbuscules in the root cortical tissues of wheat var. Blue silver.

Plate 2: The microphotograph showing asceptate hyphae, intercellular and intracellular vesicles in the root cortical tissues of wheat var. Blue silver.
mycorrhizal (mycorrhizal) plants differ in rate of VAM formation in their roots due to the variation in susceptibility towards the VAM fungi.

On the basis of result it has been inferred that the six wheat var. showed a clear varietal reactions against VAM infection. Of the six var., Blue Silver showed maximum susceptibility to the VAM infection as compared to the rest of the 6 var. whereas Sonalika was found least susceptible towards the VAM fungi. This information would be of great significance in boosting up the yield of wheat by growing and inoculating the var. Blue Silver on preferential basis in wheat fields of Sindh, Pakistan.

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