Temperature sensitivity and adult plant resistance of some \textit{Lr} genes in \textit{Triticum} species

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Wheat (\textit{Triticum} species) is a major food crop of India, cultivated in more than 27 million hectares with production around 73 million tones. Among the constraints in wheat production, rusts are the most damaging diseases, of which brown (leaf) rust (\textit{Puccinia recondita} Roberge ex Desmaz. f. sp. \textit{tritici} Eriks. & Henn.) is most widespread. Both temperature and growth stage of plants are known to influence expression of resistance (2,4,7). In this investigation effect of temperature on the expression of \textit{Lr} genes in the seedling and adult plant has been presented.

Four pathotypes of \textit{P. recondita} \textit{tritici} viz. 1R5, 125R23-1, 121R63-1 and 21R55 which are most virulent, predominant and belong to different race groups were used in the study. Adult plant evaluation at ear emergence along with seedlings were conducted in polyhouses having temperature 22 + 2 °C. Proper checks, differential sets were maintained and results were confirmed by repeating the experiments. Optimum conditions for inoculation, infection and recording were followed.

Response of recently designated \textit{Lr} genes viz. \textit{Lr39}, \textit{Lr40}, \textit{Lr41}, \textit{Lr42}, \textit{Lr43}, \textit{Lr44} and \textit{Lr45} at two different temperatures to three pathotypes is given in Table 1. \textit{Lr40}, \textit{Lr41} and \textit{Lr44} showed definite influence of temperature on pathotype specific interaction, whereas other \textit{Lr} genes were nearly consistent in their response to brown rust at the two temperatures. Both \textit{Lr40} and \textit{Lr41} showed susceptibility at higher temperature to 125R23-1 whereas \textit{Lr44} to 121R63-1. In these genotypes increase in temperature increased susceptibility. It has been earlier observed in \textit{Lr2a}, \textit{Lr10}, \textit{Lr17} and \textit{Lr18} also that increase in temperature increased susceptibility (6).

**Table 1. Temperature sensitivity of new \textit{Lr} genes to three pathotypes**

<table>
<thead>
<tr>
<th></th>
<th>125R23-1</th>
<th>121R63-1</th>
<th>21R55</th>
</tr>
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<tbody>
<tr>
<td>Infection types</td>
<td>15 °C</td>
<td>20 °C</td>
<td>15 °C</td>
</tr>
<tr>
<td>\textit{Lr39}</td>
<td>0; -; -; -; -</td>
<td>-; -; -; -</td>
<td>-; -; -; -</td>
</tr>
<tr>
<td>\textit{Lr40}</td>
<td>12; 12; 12; 12</td>
<td>12; 12; 12; 12</td>
<td>12; 12; 12; 12</td>
</tr>
<tr>
<td>\textit{Lr41}</td>
<td>0; -; -; -; -</td>
<td>0; -; -; -; -</td>
<td>-; -; -; -; -</td>
</tr>
<tr>
<td>\textit{Lr42}</td>
<td>0; -; -; -; -</td>
<td>0; -; -; -; -</td>
<td>-; -; -; -; -</td>
</tr>
<tr>
<td>\textit{Lr43}</td>
<td>0; -; -; -; -</td>
<td>-; -; -; -; -</td>
<td>-; -; -; -; -</td>
</tr>
<tr>
<td>\textit{Lr44}</td>
<td>12; 12; 12; 12</td>
<td>12; 12; 12; 12</td>
<td>12; 12; 12; 12</td>
</tr>
<tr>
<td>\textit{Lr45}</td>
<td>0; -; -; -; -</td>
<td>0; -; -; -; -</td>
<td>-; -; -; -; -</td>
</tr>
</tbody>
</table>

\(-125R23-1=77-4, \ 121R63-1=77-5, \ 21R55=104-2\)

According to Knott (4) generally with increase in temperature there is a decrease in resistance. Similar observations were recorded by Dyck and Johnson (2) with \textit{Lr18} and Frontana. Luig and Rajaram (5) observed in \textit{Sr6} that between 15 °C - 30 °C using 3 °C intervals resistance began to be ineffective at 18°C and was completely ineffective at 24°C.

Most of these \textit{Lr} genes showed pathotype specific lower infection type resistance to one or other pathotypes at adult plant stage (Table 2). However, \textit{Lr22b} and \textit{Lr34} produced nearly same infection types at both the plant growth stages.

Adult plant resistance of low infection type to all the three pts. Viz. 1R5, 121R63-1 and 21R55 was observed in \textit{Lr21}, \textit{Lr22a}, \textit{Lr35} and \textit{Lr37}. Whereas \textit{Lr12} and \textit{Lr16} produced APR of low infection type to pts. 1R5 and 21R55. \textit{Lr13} and \textit{Lr17} showed similar adult plant resistance to pt.
whereas Lr36 to pt. 121R63-1. Knott (4) observed that several of known genes for rust resistance act only in adult plants but are pathotype specific. Resistance genes Lr12, Lr13, Lr22a, Lr22b, Lr34, Lr35 and Lr37 are known to confer adult plant resistance (6,8,9,10). However, lack of adult plant resistance of Lr22b and Lr34 in present studies can be attributed to pathotypes used, which might not have specificity. Out of these Lr12, having its origin in Chinese Spring or Exchange, Lr13 and Lr34 from Frontana, Frondoso and Fortierra and Lr22b derived from Canthatch, Thatcher, Manitou and Marquis (1) have been extensively used by many wheat programmes (67). This type of resistance can be useful in wheat improvement programme for developing varieties with comparatively more durable resistance.

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REFERENCES