Short communication

Genetics of resistance to ToLCV in tomato (Solanum lycopersicum L.)

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Abstract

Genetics of ToLCV resistance was studied at College of Horticulture, Vellanikkara, Thrissur using the ToLCV resistant genotype IIHR 2195. Pusa Ruby (susceptible to ToLCV) was crossed with IIHR-2195 (resistant to ToLCV) to develop F₁ population during September-December, 2009. The F₁s were raised in the pots filled with sterilised media during Feb-2010. F₁s were selfed to develop F₂. Simultaneously, F₁s were backcrossed to susceptible parent to develop B₁. F₁s were backcrossed to resistant parent to develop B₂. Inheritance of resistance to ToLCV was studied using the parents, F₁, F₂, B₁, and B₂ populations of cross involving susceptible and resistant genotypes. The populations of six generations were screened for ToLCV resistance. The inheritance studies in six generations of cross combination Pusa Ruby x IIHR-2195 clearly revealed that the resistance to ToLCV in IIHR-2195 is controlled by a single dominant gene.

Key words: Tomato leaf curl virus (ToLCV), Pusa Ruby

Tomato leaf curl virus (ToLCV) disease is one of the most serious diseases of tomato in the Indian sub-continent and many other tropical and subtropical Asian countries. This disease is caused by geminivirus transmitted by the whitefly Bemisia tabaci (Gennadius) (Anbinder et al., 2009). Leaf curl disease of tomato was first reported in India by Vasudeva and Samraj (1948). The affected tomato plants exhibit curling, puckering, reduction in leaflet size, severe stunting and reduction in fruit set. However, severely infected young plants almost fail to produce any fruits. The disease is serious in all parts of India. This disease can cause yield losses up to 99-100% (Singh et al., 2008). The disease incidence is correlated with the size of the B. tabaci population. Hence disease incidence is severe in the late dry season/early wet season when the prevailing high temperatures favour rapid growth of white flies. Chemical control measures as well as integrated pest management (IPM) strategies employed for controlling the vector have not been successful in controlling the disease. Under these circumstances breeding for resistant varieties appears to be a promising and eco-friendly approach for controlling the disease.

In the present study, genetics of resistance to ToLCV in the resistant genotype IIHR 2195 was studied in detail. IIHR -2195 was resistant to ToLCV in field screening during peak season, graft transmission studies and vector transmission studies. Pusa Ruby (susceptible to ToLCV) was crossed with IIHR-2195(resistant to ToLCV) to develop F₁ population during September-December, 2009. The F₁s were raised in the pots filled with sterilised media during Feb-2010 (The plants were grown in sterilized media to rescue them from the incidence of bacterial wilt). F₁s were selfed to develop F₂. Simultaneously, F₁s were backcrossed to susceptible parent to develop B₁. F₁s were backcrossed to resistant parent to develop B₂.
To study the genetics of Tomato Leaf Curl Virus (ToLCV) disease resistance, parents, F₁s, F₂s, B₁ and B₂s were raised in pots filled with sterilized medium. No plant protection measures were undertaken. These were screened for ToLCV using a 0-4 scale score chart as suggested by Banerjee and Kaloo, 1987.

0 : Symptoms absent
1 : Very mild curling (Up to 25% leaves)
2 : Curling, puckering of 26-50% leaves
3 : Curling, puckering of 51-75% leaves
4 : Severe curling, puckering of >75% leaves

The plants were classified into 2 categories namely, resistant to virus and susceptible to virus. The gene action of virus resistance was determined by subjecting the F₂ and back cross ratios to chi-square test (Fisher, 1950).

In the F₁, 16 plants out of 20 showed resistance. This points to the dominance of resistance over susceptibility. In the F₂ generation out of the total 200 plants, 146 were resistant while 54 showed susceptibility. This fitted very well into the monogenic mendelian ratio 3:1 (÷2=0.24, ÷p= 0.7-0.5). In the B₁ generation, 17 were resistant and 13 were susceptible which fitted well into the ratio of 1:1 (÷2=0.53, ÷p= 0.5-0.3) while in the B₂, 25 plants were resistant and 5 were susceptible which fitted well into the ratio 1:0 (÷2=0.08, ÷p= 0.95-0.90) (Table-1).

The F₂ segregation ratio was in agreement with the Mendelian genetic ratio of 3:1 (Resistant : Susceptible). The reactions of the test cross B₁ (F₁ back crossed to Pusa Ruby) confirmed this with a genetic ratio of 1:1 (Resistant : Susceptible) and the B₂ (F₁ back crossed to IIHR-2195) generation reaction to ToLCV fits into a genetic ratio of 1:0.

The inheritance studies in six generations of cross combination Pusa Ruby x IIHR-2195 clearly revealed that the resistance to ToLCV in IIHR-2195 is controlled by a single dominant gene. Kasrawi (1989) noted single dominant gene governing the ToLCV resistance in L. pimpinellifolium. The resistance gene to ToLCV in tomato is incompletely dominant (Chomdej et al., 2007). Singh et al. (2008) observed that the gene action for resistance to ToLCV in tomato variety H-24 is single completely dominant gene.

As the gene governing the resistance to ToLCV in IIHR-2195 is single dominant, hybridization followed by selection for yield and desirable horticultural attributes will be required to incorporate ToLCV resistance in commercially superior varieties. As the resistance is governed by single dominant gene, it can be easily incorporated in F₁ hybrids.

### Table 1. Reaction of the parents, F₁, F₂, and backcross generations of the cross Pusa Ruby × IIHR-2195 to ToLCV

<table>
<thead>
<tr>
<th>Parent/Cross</th>
<th>Total plants taken</th>
<th>Resistant genotypes</th>
<th>Susceptible genotypes</th>
<th>Ratio</th>
<th>Expected ratio</th>
<th>÷2</th>
<th>Probability (÷p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pusa Ruby</td>
<td>20</td>
<td>0</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>IIHR-2195</td>
<td>20</td>
<td>20</td>
<td>0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pusa Ruby x IIHR-2195</td>
<td>20</td>
<td>16</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pusa Ruby x IIHR-2195 (F₂)</td>
<td>200</td>
<td>146</td>
<td>54</td>
<td>3:1</td>
<td>3:1</td>
<td>0.24</td>
<td>0.7-0.5</td>
</tr>
<tr>
<td>(Pusa Ruby x IIHR-2195) x Pusa Ruby (B₁)</td>
<td></td>
<td></td>
<td></td>
<td>1:1</td>
<td>1:1</td>
<td>0.53</td>
<td>0.5-0.3</td>
</tr>
<tr>
<td>(Pusa Ruby x IIHR-2195) x IIHR-2195 (B₂)</td>
<td>30</td>
<td>17</td>
<td>13</td>
<td>1:1</td>
<td>1:0</td>
<td>0.08</td>
<td>0.95-0.90</td>
</tr>
</tbody>
</table>

References


