Screening of traditional chilli cultivars of Kashmir for *Fusarium* wilt resistance

Deepika Pandita, M Ashraf Bhat, Saba Mir, Nayeema Jabeen, Ali Anwar, Khursheed Hussain, Niyaz A Dar, Shahid Qayoom Dar and M Younus Wani

Abstract

Chilli is an important crop grown worldwide for fresh fruits used as vegetable and spice production. The major chilli growing countries are India, China, Korea, Nigeria, U.S.S.R. Mexico, etc. Wilt disease caused by *Fusarium oxysporum* is a major problem in all chilli growing areas of India leading to heavy yield loss. Being a soil-borne pathogen, chemical control is difficult and non-economical. Cultivation of wilt resistant cultivars has proved to be an effective strategy to minimise the loss. *Capsicum* spp. is widely distributed and cultivated in tropical region with 27 species among which *Capsicum annuum* L. is predominately grown across the India and is a major food spices. The production of chilli is devastatingly hindered by the *Fusarium* wilt. A total of 32 local cultivars were collected from the different locations of Kashmir valley including one identified exotic variety and were screened for resistance against *Fusarium* wilt. Out of 32 cultivars six cultivars viz. SKUA-SHC-1, SKUA-SHC-2, SKUA-SHC-14, SKUA-SHC-15, Arka Lohri and SKUA-SHC-29 showed highly resistant reaction against the wilt pathogen *Fusarium oxysporum*.

Keywords: *Capsicum annuum*, *Fusarium oxysporum*, cultivars and resistance

Introduction

*Capsicum* spp., which belongs to the nightshade family Solanaceae is widely distributed and cultivated in tropical regions with 27 species (Costa et al., 2006) [6]. *Capsicum annuum*, *Capsicum frutescense*, *Capsicum chinensis*, *Capsicum pubescence* and *Capsicum baccatum* (Bosland and Votava, 2000) [4] are widely cultivated and among these, *Capsicum annuum* is predominately grown over a large area of 15 lakh ha of the world which gives the total production of 70 lakh tonne per year (NABARD) and is a major food spices. The production of chilli is devastatingly hindered by the *Fusarium* wilt. A total of 32 local cultivars were collected from the different locations of Kashmir valley including one identified exotic variety and were screened for resistance against *Fusarium* wilt. Out of 32 cultivars six cultivars viz. SKUA-SHC-1, SKUA-SHC-2, SKUA-SHC-14, SKUA-SHC-15, Arka Lohri and SKUA-SHC-29 showed highly resistant reaction against the wilt pathogen *Fusarium oxysporum*.

**Deepika Pandita**
Division of Plant Biotechnology, Faculty of Horticulture, Shalimar, Srinagar, Kashmir, India

**M Ashraf Bhat**
Division of Genetics and Plant Breeding, Faculty of Agriculture, Wadura, Srinagar, Kashmir, India

**Saba Mir**
Division of Plant Biotechnology, Faculty of Horticulture, Shalimar, Srinagar, Kashmir, India

**Nayeema Jabeen**
Division of Vegetable Science, Faculty of Horticulture, Shalimar, Srinagar, Kashmir, India

**Ali Anwar**
Division of Plant Pathology, Faculty of Agriculture, Shalimar, Srinagar, Kashmir, India

**Khursheed Hussain**
Division of Vegetable Science, Faculty of Horticulture, Shalimar, Srinagar, Kashmir, India

**Niyaz A Dar**
Division of Plant Biotechnology, Faculty of Horticulture, Shalimar, Srinagar, Kashmir, India

**Shahid Qayoom Dar**
Division of Fruit Science, Faculty of Horticulture, Shalimar, Srinagar, Kashmir, India

**M Younus Wani**
College of Temperate Sericulture, Shalimar, Srinagar, Kashmir, India

Correspondence
Deepika Pandita
Division of Plant Biotechnology, Faculty of Horticulture, Shalimar, Srinagar, Kashmir, India

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Material and Methods

Plant Material

All 32 accessions of *Capsicum annuum* were collected from the farmers’ fields of Kashmir valley. The accession names have been enlisted in the table 1. The accessions were grown under the controlled conditions for further analysis.

<table>
<thead>
<tr>
<th>Genotype</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKUA-SHC-1</td>
<td>Arka Lohit</td>
</tr>
<tr>
<td>SKUA-SHC-2</td>
<td>SKUA-SHC-17</td>
</tr>
<tr>
<td>SKUA-SHC-3</td>
<td>SKUA-SHC-18</td>
</tr>
<tr>
<td>SKUA-SHC-4</td>
<td>SKUA-SHC-19</td>
</tr>
<tr>
<td>SKUA-SHC-5</td>
<td>SKUA-SHC-20</td>
</tr>
<tr>
<td>SKUA-SHC-6</td>
<td>SKUA-SHC-21</td>
</tr>
<tr>
<td>SKUA-SHC-7</td>
<td>SKUA-SHC-22</td>
</tr>
<tr>
<td>SKUA-SHC-8</td>
<td>SKUA-SHC-23</td>
</tr>
<tr>
<td>SKUA-SHC-9</td>
<td>SKUA-SHC-24</td>
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<tr>
<td>SKUA-SHC-10</td>
<td>SKUA-SHC-25</td>
</tr>
<tr>
<td>SKUA-SHC-11</td>
<td>SKUA-SHC-26</td>
</tr>
<tr>
<td>SKUA-SHC-12</td>
<td>SKUA-SHC-27</td>
</tr>
<tr>
<td>SKUA-SHC-13</td>
<td>SKUA-SHC-28</td>
</tr>
<tr>
<td>SKUA-SHC-14</td>
<td>SKUA-SHC-29</td>
</tr>
<tr>
<td>SKUA-SHC-15</td>
<td>SKUA-SHC-30</td>
</tr>
<tr>
<td>SKUA-SHC-16</td>
<td>SKUA-SHC-31</td>
</tr>
</tbody>
</table>

Isolation and inoculation of fungus

An already isolated, identified and purified culture of *Fusarium oxysporum* was provided by Division of Plant Pathology, SKUAST-K, Shalimar. For sub-culturing ready-to-use Potato Dextrose Agar (PDA) medium was used. PDA is a general purpose medium used for cultivation of fungi. The purified culture of *Fusarium oxysporum* was transferred on PDA plate and was placed in an incubator at 22 ± 2°C for 10-15 days. The pure cultures of the pathogen were stored in a refrigerator at 4±1°C for further research work.

Seedlings were inoculated at 35th day after germination. Small (2 mm diameter) blocks of 15 days old culture of the test pathogen grown on PDA served as the inoculum. The tips of the roots (about 5mm in length) were trimmed with the help of a scissor. A suspension of the inoculum was prepared with sterile water and the seedlings were placed in it for about 15-20 minutes and then transplanted in polybags filled with sterilized soil. In control set, seedlings were transplanted without any inoculation. After inoculation the pots were kept in green house. Watering was done regularly to maintain adequate humidity. Distilled water was used for watering the transplanted seedlings.

Screening of genotypes for resistance against *Fusarium wilt*

The screening for disease resistance was done by measuring the disease incidence on a scale of 1 to 5 (table 2), as per mentioned by Marlatt *et al.*, (1996) [12].

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No symptoms</td>
</tr>
<tr>
<td>2</td>
<td>Slight chlorosis, wilting or stunting of plant</td>
</tr>
<tr>
<td>3</td>
<td>Moderate chlorosis, wilting or stunting of plant</td>
</tr>
<tr>
<td>4</td>
<td>Severe chlorosis, wilting or stunting of plant</td>
</tr>
<tr>
<td>5</td>
<td>Dead plant</td>
</tr>
</tbody>
</table>

Result and Discussion

Breeding for biotic and abiotic stresses is a key concept for enhancing the yield in every crop. *Fusarium wilts* (caused by *Fusarium oxysporum*) is a major biotic stress in chilli that adversely affects its overall yield. The information of this disease in the different genetic background of chilli is still in scarce. The traditional cultivars have wide genetic bases and are the morgue of the valuable hidden genes, providing an adaptation to a wide range of stress environments. Therefore, in the present investigation we collected a total of 32 traditionally cultivated genotypes including an promising wilt resistant released variety of IIHR (Bangalore) namely *Arka Lohit*, from the farmers’ fields belonging to the different geographical regions of Kashmir valley, India.

Screening of chilli germplasm for disease incidence.

In this investigation out of 32 a total of six genotypes namely SKUA-SHC-1, SKUA-SHC-2, SKUA-SHC-14, SKUA-SHC-15, *Arka Lohit* and SKUA-SHC-29 showed highly resistant reaction against the wilt pathogen *Fusarium oxysporum*, while the other genotypes showed moderate to nil resistance. These findings are in line with Manu *et al.*, (2014) [11] and Singh *et al.*, (1998) [10].
Conclusion
Based on present findings the resistant genotypes can be further used for selecting and stabilizing suitable genotypes against Fusarium wilt and resistance breeding programme in chilli (Capsicum annuum L). The wilting symptoms in the plants started within a period of one week after inoculation with Fusarium oxysporum. The susceptible genotypes showed typical wilting symptoms such as stunted plant height, yellowing of leaves followed by their drying and blackening of stem. The highly susceptible cultivars can be used as infector rows and the cultivars showing resistant to moderately resistant reaction can be used as donor for resistance in further resistant breeding programmes. However, it would be too much to expect stable resistance against Fusarium diseases because of high variability and dynamic nature of the pathogen. The inheritance of Fusarium wilt resistance in chilli has been of monogenic dominant in nature; hence, heterosis breeding using the resistant source is advocated to boost the yield potential of the crop and to avoid the use of pesticides in reducing the environmental pollution.

References