Evaluation of mini core accessions of pigeonpea (Cajanus cajan (L.) Millsp.) against sterility mosaic disease and fusarium wilt*

Pigeonpea (Cajanus cajan (L.) Millsp.) is a grain legume belonging to the Cajaninae sub tribe of the economically important leguminous tribe Phaseoleae. The Cajanus comprises of 32 species, of which most of them are found in India and Australia although one is native to West Africa. Pigeonpea has a diploid genome comprising of 11 pairs of chromosomes (2n=22). India is the world’s largest pigeonpea producer (2.65 MT) and currently global annual production of pigeonpea is 4.24 MT from an area of 4.92 million ha with the productivity of 898 kg ha\(^{-1}\) (http://faostat.fao.org/). Its abundance in protein makes it an ideal supplement to traditional cereal-banana or tuber-based diets of resource poor farmers that are generally protein deficient. The minicore collection set comprises of 1 per cent of whole and 10 per cent of the core collection with presence of lot diversity among the germplasm lines. Pigeonpea mini core collection set was evaluated in multi-location trials by Upadhyaya et al. (2010) in International Crop Research Institute for Semi-Arid Tropics (ICRISAT) and reported several accessions with early maturity, greater harvest index, shelling percentage and high grain yield.

Because of biotic and abiotic factors, pigeonpea crop has low productivity of 898 kg ha\(^{-1}\) compared to its potential of 2000 kg ha\(^{-1}\) in India. Fusarium Wilt (FW) is the most destructive disease caused by the soil pathogen, Fusarium udum Butler and causes an annual loss of US $71 million. Similarly, Sterility Mosaic Disease (SMD) is also one of major biotic constraints caused by pigeonpea sterility mosaic virus (PPSMV) and spreads via vector Aceria cajani, a mite (Jones et al., 2004). It is considered to be “green plague” because affected plant never produce flowers and plant remains green in its reproductive stage. More than 90 per cent of the crop would be lost if it occurs at the early stage of the crop growth (Bhaskaran and Muthiah, 2005) with an estimated yield loss of US $76 million. The present study aims to identify the pigeonpea accessions resistant to FW and SMD by adopting leaf stapling and wilt sick plot techniques, respectively. The genotypes resistant to the diseases will be utilized for the hybridization programme. Among 146 mini core collection set developed by Upadhyaya et al. (2006) in ICRISAT 135 accessions were used for conducting experiment for the resistance evaluation of SMD and FW. This material was screened for SMD using ‘Leaf stapling technique’ developed by Nene et al. (1981) in the Botanical garden of the Department of Genetics and Plant Breeding, UAS, Dharwad. ICP-8863 (Maruti) was grown as susceptible check around the plot and also intermittently in the experimental plot. Screening of genotypic reaction to FW was done at National wilt sick plot, Agricultural Research Station, Gulbarga. The experiment was conducted in the wilt infested

Table 1. Disease reaction of 135 pigeonpea accessions to sterility mosaic disease (SMD)

<table>
<thead>
<tr>
<th>Disease reaction</th>
<th>Disease grade</th>
<th>Number of accessions</th>
<th>Accession list</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistant (0 per cent)</td>
<td>1</td>
<td>92</td>
<td>ICP772, ICP939, ICP995, ICP1071, ICP1126, ICP1156, ICP1273, ICP1279, ICP2577, ICP2698, ICP2746, ICP3451, ICP3576, ICP4029, ICP4167, ICP4307, ICP4726, ICP4575, ICP4715, ICP6128, ICP6370, ICP6668, ICP6739, ICP6845, ICP6859, ICP7076, ICP7148, ICP7223, ICP6049, ICP7803, ICP7869, ICP8012, ICP8255, ICP8266, ICP8602, ICP8793, ICP8860, ICP8949, ICP9045, ICP9336, ICP9655, ICP10094, ICP10228, ICP11321, ICP11477, ICP11477, ICP1150, ICP11910, ICP11946, ICP12105, ICP12410, ICP12654, ICP13011, ICP13139, ICP13191, ICP13244, ICP13270, ICP13304, ICP13359, ICP13431, ICP13577, ICP13579, ICP13633, ICP13662, ICP13884, ICP14116, ICP14120, ICP14147, ICP14155, ICP14545, ICP14569, ICP14638, ICP14701, ICP14722, ICP14801, ICP14819, ICP14832, ICP14903, ICP14976, ICP15049, ICP15068, ICP15107, ICP15116, ICP15185, ICP12142, ICP16264 and ICP163</td>
</tr>
<tr>
<td>Moderately resistant (0 – 10 per cent)</td>
<td>3</td>
<td>16</td>
<td>ICP7, ICP348, ICP655, ICP3046, ICP3049, ICP6992, ICP7057, ICP7366, ICP8840, ICP9414, ICP9750, ICP10654, ICP12596, ICP13167, ICP14444 and I4471</td>
</tr>
<tr>
<td>Moderately susceptible (10 – 20 per cent)</td>
<td>5</td>
<td>10</td>
<td>ICP7314, ICP8384, ICP8757, ICP9691, ICP10503, ICP11320, ICP11477, ICP12298, ICP13571 and ICP14368</td>
</tr>
<tr>
<td>Susceptible (20 – 50 per cent)</td>
<td>7</td>
<td>11</td>
<td>ICP6123, ICP6815, ICP8921, ICP11690, ICP12515, ICP12680, ICP14094, ICP14229, ICP14900, ICP15382 and ICP8863 (CHECK)</td>
</tr>
<tr>
<td>Highly susceptible (More than 50 per cent)</td>
<td>9</td>
<td>6</td>
<td>ICP7260, ICP4392, ICP10397, ICP11946, ICP15403 and ICP13575</td>
</tr>
</tbody>
</table>

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possible to screen only 90 accessions (with ICP 2376 as a susceptible check) due to heavy rains causing waterlogged condition in the experimental plot leading to death of F. udum pathogen. The wilt incidence was recorded from 0 to 100 per cent. Among the minicore collection set, 39 accessions recorded resistant reaction towards FW with less than 1 per cent disease incidence. Twenty six accessions recorded susceptible disease reaction with disease incidence ranging from 21 to 50 per cent and 23 accessions recorded highly susceptible disease reaction (>51% wilt disease incidence). However, two accessions viz., ICP10094 and ICP11321 showed moderately susceptible disease reaction, with a disease incidence of 11 to 20 per cent (Table 2).

During investigation, the per cent disease incidence in 135 accessions ranged from 0 to 100 per cent for both the diseases. Disease load noticed was very less in SMD. Resistant lines to one or both the disease should be very useful to introgress the disease resistance was studied using well known cultivars or popular varieties. In the present study conducted by Barhate et al. (2000) 19 entries selected entries found resistant for both the diseases were evaluated in regular yield trials to know their yield performance along with high yielding checks. Earlier works on pigeonpea varieties through classical breeding (Saxena et al., 2010). Twenty four pigeonpea accessions (ICP1071, ICP2577, ICP3451, ICP3576, ICP4575, ICP6859, ICP7057, ICP7366, ICP8266, ICP8602, ICP8840, ICP8860, ICP8863, ICP8949, ICP9750, ICP11230, ICP11281, ICP11543, ICP11690, ICP11823, ICP12515, ICP12680, ICP13167, ICP13304, ICP13577, ICP13633, ICP13662, ICP14444, ICP14509, ICP14545, ICP14638, ICP14701, ICP14722, ICP14832, ICP14976, ICP15049 and ICP15382

plots using ICP-2376 variety as a susceptible check to increase the disease incidence and also for scoring. Regular monitoring was done to assess the status of the SMD and FW. The per cent disease incidence was calculated using the following formula.

Per cent disease incidence = \( \frac{\text{Number of plants infected in a row}}{\text{Total number of plants in a row}} \times 100 \)

Disease rating was done based on 1-9 scale as per Nene et al. (1981) for FW and Mayee and Dater (1986) for SMD. The reduced size of mini core collections has provided ample opportunities to the breeders for their efficient and economic multi-environment evaluation, which has lead to the identification of several new sources of variation for different traits for utilization in crop improvement programs.

The leaf stapling method assists to transfer PPSMV, where mite (A. cajani) is a vector helping in transmission of virus. The technique had shown to facilitate inoculation at primary leaf stage and also rapidly express disease symptoms. The per cent disease incidence for SMD among 135 accessions ranged from 0 to 100 per cent. The six highly susceptible accessions showed more than 51 per cent SMD with a grade of ‘9’ and 92 accessions recorded less than 1 per cent disease and were found resistant to SMD (Table 1). Sixteen accessions recorded moderately resistant reaction for the SMD with a disease incidence of 1 to 10 per cent while, 10 of the pigeonpea accessions showed moderately susceptible reaction with a disease incidence ranging from 11 to 20 per cent followed by 11 accessions with 21 to 50 per cent disease incidence. Reddy et al. (1993), also observed large variation in disease incidence and symptom expression. In another study conducted by Barhate et al. (2000) 19 entries showed resistance against SMD.

Out of 135 pigeonpea accessions evaluated for FW, it was possible to screen only 90 accessions (with ICP 2376 as a susceptible check) due to heavy rains causing waterlogged condition in the experimental plot leading to death of F. udum pathogen. The wilt incidence was recorded from 0 to 100 per cent. Among the minicore collection set, 39 accessions recorded resistant reaction towards FW with less than 1 per cent disease incidence. Twenty six accessions recorded susceptible disease reaction with disease incidence ranging from 21 to 50 per cent and 23 accessions recorded highly susceptible disease reaction (>51% wilt disease incidence). However, two accessions viz., ICP10094 and ICP11321 showed moderately susceptible disease reaction, with a disease incidence of 11 to 20 per cent (Table 2).

During investigation, the per cent disease incidence in 135 accessions ranged from 0 to 100 per cent for both the diseases. Disease load noticed was very less in SMD. Resistant lines to one or both the disease should be very useful to introgress the resistance to FW and/or SMD while developing superior pigeonpea varieties through classical breeding (Saxena et al., 2010). Twenty four pigeonpea accessions (ICP1071, ICP2577, ICP3451, ICP3576, ICP4575, ICP6859, ICP8266, ICP8602, ICP8840, ICP8860, ICP8949, ICP11230, ICP11281, ICP11543, ICP11690, ICP11823, ICP12515, ICP12680, ICP13167, ICP13304, ICP13577, ICP13633, ICP13662, ICP14444, ICP14509, ICP14545, ICP14638, ICP14701, ICP14722, ICP14832, ICP14976, ICP15049 and ICP15382.
References


http://faostat.fao.org/