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EVALUATION OF PARENTAL GENOTYPES AND THEIR HYBRIDS AGAINST *FUSARIUM* WILT IN PIGEONPPEA

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ABSTRACT

An investigation was carried out at Agricultural Research Station, Gulbarga to develop and identify the superior hybrids coupled with enhanced resistance to *fusarium* wilt. A total of seventy eight hybrids and their parents were evaluated against *fusarium* wilt in wilt sick plot conditions. Out of 19 parental genotypes screened, seven genotypes showed resistant reaction, seven genotypes showed moderately resistant and remaining five genotypes recorded susceptible reaction to *fusarium* wilt. The parental genotypes TS-3R (6.0),LRG-41 (7.0), Asha (7.1) exhibited less wilt incidence, Out of seventy eight hybrids screened, twelve of them were found to be resistant and forty two hybrids showed moderate resistant reaction and twenty four hybrids showed susceptible reaction to wilt. The cross combinations ICPA-2048-4 x TS-3R (6.2), ICPA-2048-4 x Maruthi (7.1), ICPA-2092 x Asha (8.3) exhibited lower Percent Disease Index(PDI) values. It was interested to note from the present study that hybrids involving parents such as ICPA-2048-4, ICPA-2092, Asha, Maruthi, TS-3R, M-3 (GRG- 2009), LRG-41 and WRP-1 showed resistant and moderately resistant reaction. Hence, these parental genotypes could be utilized in future breeding programme as donor source for development of *fusarium* wilt resistance cultivars of pigeonpea.

INTRODUCTION

Pigeonpea [*Cajanus cajan* (L.) Millsp.] is one of themost widely grown food grain legumes in the semi-aridtropics of the world (Nene and Sheila, 1990).It is drought tolerant and exhibits alarge variation for physiological maturity,cultivated in a total area of 4.92 million ha,globally, with an annual production of 3.65 milliontons (mt) and productivity of around 900 kg/ ha.India has 3.90 mha (H″ 80% of world acreage) witha total production and productivity of 2.89 mt (H″79% of world production) and around 750 kg/harespectively (Muniswamy *et al*. 2014). It finds an important place in the farming systems adopted by small and marginal farmers in a large number of developing countries as it restores the soil fertility by fixing atmospheric nitrogen (Reddy *et al*., 1990). India is the centre of origin and largest producer of pigeonpea in the world sharing approximately 70% of the production and covering 74% of the area (Bohra *et al*. 2012). The yield potential of present day pigeonpea cultivars is not being realized owing to several biotic and abiotic constraints. Pigeonpea suffers from a number of abiotic (e.g. drought, salinity and water-logging) and biotic (e.g. diseases like *Fusarium* wilt, sterility mosaic and pod borer insects) stresses. Among biotic stresses, *Fusarium* wilt (FW) caused by *Fusarium udum* Butler is an important fungal disease prevalent in the pigeonpea growing areas but it is more severe in Indian subcontinent. Wilt symptoms usually appear during flowering and podding stage of the crop. However, symptoms also appear in early developmental stages. In Indian subcontinent the crop loss ranged from 16–47% (Prasad *et al*. 2003) and wilt incidence is believed to have increased significantly over the time (Gwata *et al*. 2006). The main concern, however, is stability in pigeonpea production, which is highly affected by pigeonpea wilt, especially in north-east plains, central and peninsular India. *Fusarium* wilt is an important soil borne disease of pigeonpea which affects seed yields (50-70 %) severely in susceptible varieties. The total production losses due to wilt is approximately 97,000 tonnes per year in India and 5 million in Malawi, Tanzania and Kenya. Annual losses due to wilt and sterility mosaic have been reported to be US $ 113 million (Saxena *et al*., 2002). Since satisfactory control measures for this disease have not been developed so far there by development and adoption of resistant varieties/hybrids is important component of integrated management of disease. Therefore, it is the need to develop and release wilt resistant varieties of pigeonpea through breeding programme in order to stabilize the production for which identification of reliable wilt resistant donors is important and it leads to development and release for resistant genotypes to ensure stability of production. Keeping this in view, present investigations were carried out with an objective to screen diverse pigeonpea parental genotypes and their derived hybrids against *fusarium* wilt resistance.

MATERIALS AND METHODS

The present investigation was carried out with six CGMS lines of which three male sterile lines of *C. cajanifolius* origin *viz.,*ICPA-2098, ICPA-2048-4 and ICPA- 2092 obtained from ICRISAT, Hyderabad and another three CMS lines of *Cajanus scarabaeoides* origin *viz.,*GT- 625A, GT-307A and GT-308A. The CMS lines with thirteen diverse testers *viz.,* Asha, BSMR-736, LRG-41, Maruthi, WRP-1, TS-3R, M-3 (GRG-2009), Laxmi, TAT-9903, PG-12, GC-11-39, ICPL-87 and TS-3 were crossed in a line x tester mating design during *kharif,* 2010-11. The direct 78 F_1 hybrids produced along with their parents were screened against *fusarium udum* under sick plot conditions located in Agricultural Research Station, Gulbarga, University of Agricultural Sciences, Raichur during *Kharif*2011-12.The field experiments were laid out in randomized block design with two replications, each test entry was sown in single line of four-meter length of test hybrid was maintained.After every single row of test hybrid, single row of susceptible checkICP2376 was maintained to increase the sufficient disease inoculums pressure**.** Rowto row spacing of 90 cm and 30 cm between the plants was maintained. The cause of disease incidence was confirmed after splitting the stem of affected plants vertically into two equal halves and observing the typical blackening of xylem vessels in the middle of the stem. Observation on per cent wilt was recorded at flowering stage, pod stage and at physiological maturity stage during the growth period. Per cent disease incidence was calculated on the basis of ratio of total number of emerged plants to number of wilted plants and healthy plants up to harvest and the scored values were converted into *per cent* infection by using the formula.

$$\text{Percent disease index (PDI)} \quad \frac{\text{No. of plants wilted}}{\text{Total no. of plants}} \quad 100$$

The following disease scale was adoptedfor evaluating genotypes against wilt disease as per the criterion followed in All-India Coordinated Research Project on Improvement of pigeonpea for screening the wilt-resistant pigeonpea lines in wilt-sick plot (Anjaneyareddyand Muhammad Saifulla., 2005)

The all 78 eight hybrids and their parents were also evaluated for yield and yield attributing traits in lattice design with two replication during the same season in wilt-free condition. The data on various characters were recorded. The data were subjected to mean performance of parent and their crosses and heterosis as per method given by Kempthorne (1957) and Singh and Narayanan (1997).

RESULTS AND DISCUSSION

The results obtained in the present study were summarized as below.The incidence of disease in sick plot ranged from 0–52.3% among the test parental entries (Table-1). Among the nighteen promising genotypes screened for *fusarium* wilt, almost all the genotypes had wilt incidence of less than ten per cent were categorized them as resistant. The data revealed that among the genotypes screened, seven genotypes have 0-10% of disease incidence in field and seven lines have 10.1-30% plant disease incidence and rest of the test genotypes have showed susceptible to highly susceptible reaction with the disease incidence ranging from 30.1 to 100%.Among the ninghteen promising genotypes screened, seven genotypes showed resistant reaction to *fusarium* wilt *viz.,* TS-3R, Asha, ICPA-2048-4, ICPA-2092, WRP-1, M-3(GRG-2009) and Maruthi C-11. The seven genotypes showed moderately resistant *fusarium* wilt *viz.,* ICPA-2098, GT-307A, BSMR-736, LRG-41, PG-12, GC-11-39 and ICPL-87 while all other genotypes were showed susceptible reaction with the wilt incidence of more than 30 per cent. The genotypes which are exhibited resistant reaction to *fusarium* wilt canbe used in the crop improvement programme to develop stable *fusarium* wilt genotypes and hybrids. The similar studies reported so far were briefed as follows. Patel *et al*. (1988) reported out of sixty one promising lines tested for two years, genotypes GAUT-82-9 and GAUT-82-74 were free from *F. udum* infection. While GAUT-82-23 were completely free from *F. udum* infection. Saifulla and Chikkadevaiah (2001) reported that *fusarium*wilt disease incidence ranged from 0-54.9% in genotypes MDRL 1, 4,5,7,9, 12,14, 18,20 and ICP were free from the disease, whereas, MDRLB recorded maximum disease incidences of 59.90 per cent.

All 78 CGMS hybrids developed using 6 cytoplasmic genetic male sterilelines and 13 diverse restorers were also evaluated for *fusarium* wilt resistance under wilt sick soil conditions. The hybrids were categorized based on disease reaction to *fusarium*wilt were presented in Table 2.In the present study, out of seventy eight hybrids were screened for *fusarium* wilt resistance under wilt sick conditions. Twelve of the hybrids showed resistance reaction to wilt. The hybrids ICPA-2048-4 x TS-3R (6.2%), ICPA-2092 x LRG-41 (6.7%), ICPA-2048-4 x Maruthi (7.1%), ICPA-2092 x Asha (8.3%), ICPA-2092 x PG-12 (8.3%), ICPA-2092 x WRP-1(9.1%), ICPA-2092 x Maruthi (9.5%) recorded superior resistant reaction to the *fusarium* wilt. Whereas, forty two hybrids were showed moderately

Table 1: Categorization of pigeonpea genotypes based on disease reaction

Disease Reaction	Parents
ResistantPDI (0-10%)	ICPA-2048-4 (9.5), ICPA-2092 (7.7), Asha (7.1), LRG-41 (7.0), WRP-1(8.5), TS-3R (6.0), M-3(GRG-2009) (8.9), Maruthi (8.3)
Moderately resistantPDI (10.1-30%)	ICPA-2098 (28.6), GT-307A (18.7), BSMR-736(12.0), LRG-41(17.0), PG-12(20.5), GC-11-39(21.5), ICPL-87(23.1)
SusceptiblePDI (>30.1-100%)	GT-625A(52.3), GT-308A (38.5), LAXMI (35.4), TAT-9903 (31.0)

*Values given at parenthesis are Percent Disease Index (PDI) of respective parents

Table 2: Categorization of pigeonpea hybrids based on disease reaction

Disease Reaction	Hybrids
ResistantPDI (0-10%)	ICPA-2048-4 x Asha (9.5), ICPA-2048-4 x WRP-1(9.5), ICPA-2048-4 x TS-3R (6.2), ICPA-2048-4 x M-3 (GRG-2009) (9.1), ICPA-2048-4 x Maruthi (7.1), ICPA-2092 x Asha (8.3), ICPA-2092 x LRG-41 (6.7), ICPA-2092 x WRP-1 (9.1), ICPA-2092 x TS-3R (10.0), ICPA-2092 x M-3 (GRG-2009) (9.1), ICPA-2092 x PG-12 (8.3), ICPA-2092 x Maruthi (9.5),
Moderately resistantPDI (10.1-30%)	ICPA-2098 x BSMR-736 (16.5), ICPA-2098 x TS-3R (12.5), ICPA-2098 x M-3 (GRG-2009) (25.0), ICPA-2098 x Laxmi (11.1), ICPA- 2098 x PG-12(15.5), ICPA-2098 x GC-11-39 (14.0), ICPA-2048-4 x BSMR-736(28.6), ICPA-2048-4 x LRG-41 (27.8), ICPA-2048-4 x Laxmi (11.1), ICPA-2048-4 x PG-12 (13.5), ICPA-2048-4 x GC-11-39 (25.0), ICPA-2048-4 xTS-3 (26.1), ICPA-2092 x BSMR-736 (22.2), ICPA-2092 x Laxmi (13.6), ICPA-2092 x GC-11-39(21.0), ICPA-2092 x ICPL-87 (18.1), ICPA-2092 x TS-3(20.0), GT-625A x Asha (22.2), GT-625A x WRP-1 (18.9), GT-625A x TS-3R(17.5), GT-625A x M-3 (GRG-2009) (18.3), GT-625A x PG-12(13.0), GT-625A x GC-11-39(15.5), GT-625A x TS-3(11.5), GT-625A x Maruthi(19.5), GT-307A x Asha(27.3), GT-307A x LRG-41(22.5), GT-307A x TS-3R(17.3), GT-307A x M-3 (GRG-2009)(28.6), GT-307A x PG-12(13.8), GT-307A x GC-11-39(16.7), GT-307A x TS-3(25.9), GT- 307A x Maruti(16.5), GT-308A x Asha(15.0), GT-308A x BSMR-736(24.5), GT-308A x TS-3R(20.0), GT-308A x M-3 (GRG-2009)(11.0), GT-308A x PG-12(16.9), GT-308A x GC-11-39(11.3), GT-308A x ICPL-87(14.6), GT-308A x TS-3(17.8), GT-308A x Maruthi(20.0)
SusceptiblePDI (>30.1 -100%)	ICPA-2098 x Asha (80.0), ICPA-2098 x LRG-41(71.4), ICPA-2098 x WRP-1(88.9), ICPA-2098 x TAT-9903(95.0), ICPA-2098 x ICPL-87 (37.5), ICPA-2098 x TS-3(33.3), ICPA-2098 x Maruthi(56.2), ICPA-2048-4 x TAT-9903(33.3), ICPA-2048-4 x PCPL-87 (30.8), ICPA-2092 x TAT-9903(40.0), GT-625 A x BSMR-736 (53.8), GT-625A x LRG-41 (66.7), GT-625A x Laxmi (34.6), GT-625A x TAT-9903(49.5), GT-625A x ICPL-87(30.0), GT-307A x BSMR-736 (33.0), GT-307A x WRP-1 (38.5), GT-307A x Laxmi (31.5), GT-307A x TAT-9903 (44.3), GT-307A x ICPL-87 (60.0), GT-308A x LRG-41 (76.9), GT-308 A x WRP-1 (30.4), GT-308A x Laxmi(37.3), GT-308A x TAT-9903 (52.6)

*Values given at parenthesis are Percent Disease Index (PDI) of respective hybrids

Table 3: Superior hybrids showed resistance to *fusarium* wilt along with their *per s*eperformance and standard heterosis for seed yield and 100 seed weight

Sl. no	Hybrids	PDI	Disease reaction	*Per se*(seed yield(kg)/ha)	% heterosis over standard check Maruthi	
					Seed yield/plant (g/plant)	100 Seed weight (g)
1	ICPA-2048-4 x TS-3R	6.25	Resistant	1414.44	15.27	38.34
2	ICPA-2048-4 x Maruthi	7.11	Resistant	1921.6	43.62	19.72
3	ICPA-2092 x PG-12	8.33	Resistant	1777.78	20.53	26.29
4	ICPA-2048-4 x M-3(GRG-2009)	9.09	Resistant	1872.22	43.62	17.80
5	ICPA-2048-4 x Asha	9.52	Resistant	1648.89	17.02	16.19
6	ICPA-2048-4 x WRP-1	9.52	Resistant	1867.78	22.34	29.52

resistant reaction, while twenty four hybrids were showed susceptible reaction to wilt. The wilt percentage in moderately resistant group ranged from 11.0 per cent(GT-308A x M-3 (GRG-2009) to 28.5 per cent (ICPA-2048-4 x BSMR-736 (28.5%). The highest percentage of wilt reaction was observed in moderate resistant group for the hybrids ICPA-2048-4 x BSMR-736 (28.5%), GT-307A x M-3(GRG-2009) (28.6%), while, low percentage of wilt for moderate resistant group was observed in GT-308A x M-3 (GRG-2009) (11.0%). The highest susceptibility percentage was observed in hybrids ICPA-2098 x TAT-9903 (95.0%), ICPA-2098 x WRP-1 (88.9%), ICPA-2098 x Asha (80.0%) and the lowest susceptibility percentage was observed in hybrid GT-625A x ICPL-87 (30.0%).

The hybrids showed resistant reaction to *fusarium* wilt disease *viz.*, ICPA-2048-4 x TS-3R, ICPA-2048-4 x Maruthi, ICPA-2092 x PG-12, ICPA-2048-4 x M-3(GRG-2009), ICPA-2048-4 x Asha, ICPA-2048-4 x WRP-1 were also exhibited superior *per se* performance for seed yield/ha, significant standard heterosis over commercial check for seed yield/plant and 100 seed weight(Chethana *et al.*2015)(Table 3). These results obtained were in agreement with earlier reports. Chethana *et al*. 2015 also reported hybrids with superior *per se* performance were are also exhibited superior heterosis for seed yield in pigeonpea. It was interesting to note from the present study that hybrids involving parents such as ICPA-2048-4, ICPA-2092, Asha, Maruthi, TS-3R, M-3 (GRG- 2009), LRG-41 and WRP-1 showed resistant and moderately resistant reaction to *fusarium* wilt confirming the resistant reaction of parents. Hence these parents could be utilized in future breeding programme as donor source for development of *fusarium* wilt resistance varieties coupled with high heterotic yield potential.

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