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Phenotyping of Pigeonpea Genotypes Against *Phytophthora cajani* an Incitant of Phytophthora Blight Disease

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Abstract

The use of resistant cultivars is considered to be the best way of controlling the disease. The present investigation was carried to identify pigeonpea genotypes with resistance to *Phytophthora* blight (PB) caused by *Phytophthora cajani*. Artificial screening of 19 pigeonpea genotypes was carried out using stem inoculation method. None of them showed resistance reaction. Nine genotypes showed moderate resistance reaction with less than 20 per cent disease incidence. Phenotyping of 57 pigeonpea entries comprising varieties, hybrids and wild species for resistance to PB under natural disease pressure. Among the genotypes, incidence of disease ranged from 0 to 100 per cent., 38 genotypes showed resistance reaction with an incidence of less than 10 per cent and six genotypes showed moderate resistance reaction**.** The resistant / moderately resistant genotypes identified can be utilized for breeding programme as donors.

Keywords : Phytophthora blight, Pigeonpea, Phenotyping, Resistance source, Screening

In India, pigeonpea is the second most important pulse crop after chickpea. It is cultivated over 5.34 million ha, accounting 4.87 million tonnes of grain (Indiastat, 2017). India alone contributes 72 per cent of the area and two thirds portion of the global pigeonpea production. *Phytophthora* blight (PB) of pigeonpea caused by *Phytophtohra cajani* is an economically important disease particularly in the area where intermittent rainfall followed by warm and humid weather persists. The varieties grown by farmers are no longer resistant to *Phytophthora* blight (PB). Pande *et al*. (2011) observed the occurrence of PB across all cropping system, soil type and cultivars in the Deccan Plateau of India. The most effective way to control *Phytophthora* blight is identification and development of resistant cultivars. Hence, the present study was undertaken to identify the genotypes of pigeonpea with resistance to *Phytophthora* blight.

Material and Methods

Pathogen

The isolation of pathogen was done by tissue segment method (Rangaswamy, 1958) using V8 juice agar media (Himedia, Mumbai, India) amended with PARP antibiotics (pimarcin 400 µL; ampicillin 250 mg; rifampicin 1000 µL; and pentachloronitrobenzine 5 mlL–1 media). Pathogen was identified by cultural and morphological characteristics as described by Erwin and Ribeiro (1996). The fungus was subcultured and maintained on tomato extract agar. Virulence of the pathogen was maintained by transferring the pathogen through susceptible host after every 60 days.

Phenotyping of Pigeonpea Accessories for Resistance to *Phytophthora* Blight under Artificial Inoculation.

Nineteen pigeonpea genotypes were screened at RL-17 field of ICRISAT, Patancheru for resistance to *Phytophthora* blight as described by Nene *et al*. (1981). The pigeonpea genotypes were planted in rows at spacing of 30 cm. Susceptible cultivar ICP 7119 was planted after every two rows. The collar region of 30 days old plants were inoculated with pathogen. The field was flooded immediately after inoculation and further irrigated twice a week, as and when dry weather was noticed. Typical blight symptoms appeared in about 10 days. Plants which did not show

symptoms were re-inoculated after one month. Percentage of blight affected seedlings was calculated based on number of infected plants to total number of plants (Chauhan *et al.,* 2002). Based on disease incidence the pigeonpea accessions categorized into as resistant (0-10 per cent), moderately resistant (11-20 %), moderately susceptible (21-50 %), susceptible (51-80 %) and highly susceptible (81-100 %).

Phenotyping of Pigeonpea Accessions for Resistance to *Phytophthora* Blight under Natural Epiphytic Conditions

A total of 57 pigeonpea entries comprising varieties and hybrids were sown at ICRISAT in demonstration plot during the survey at 25 days after sowing we noticed the incidence of *Phytophthora* blight and then we have recorded the incidence of *Phytophthora* blight at 30, 60, 90 and 130 days after sowing in the demonstration plot. The per cent disease incidence (PDI) was calculated based on total number of plants present and number of plants showing typical PB symptoms in each entry.

Results and Discussion

Sources of resistance to *Phytophthora* blight were mentioned by various researchers *viz.,* Sharma *et al*. (1995). The crop was found susceptible to *Phytophthora cajani* under natural epiphytotic conditions in major pigeonpea growing areas of Deccan Plateau of India (Sharma *et al.,* 2006). This could be due to frequent evolution of new pathotypes and coexistence of more than one pathotype at one location. In this context, 19 pigeonpea genotypes were screened using stem inoculation method. In addition the reaction of improved Pigeonpea breeding lines in a hot spot area for *Phytophthora* blight at research farm of ICRISAT, Patancheru was also studied.

Screening of Pigeonpea Genotypes against *P. cajani*

Nineteen Pigeonpea genotypes were screened in research farm (RL-17) of ICRISAT, Patancheru, using stem inoculation method and the results are presented in Table 1. Among all the genotypes screened ICP 9174 showed the lowest disease incidence (12.2 %), followed by ICP 8863 (14.3 %). Highest incidence was recorded by genotype ICPL 161 (52.5 %). Based on disease reaction, the genotypes were grouped as resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible. Among the 19 Pigeonpea genotypes (Table 2), nine genotypes (ICP 9174, ICP 8863, JA-4, ICP 11302, ICP 11290, BDN 2, Bahar, KPBR 80 2 1, ICP 2376) showed moderately resistant reaction, eight genotypes (ICPL 288, ICP 4135, ICP 87119, ICP 580, ICP 113, ICP 11304, UPAS 120, ICP 339) showed moderately susceptible reaction and two genotypes (ICPL 161 and ICP 7119) showed susceptible reaction. None of the genotypes showed resistant reaction.

Table 1

Reaction of pigeonpea entries against *Phytophthora cajani* under artificial inoculation

Genotypes	PDI	Reaction
ICP 9174	12.2	MR
ICP 8863	14.3	MR
KPBR 80 2 1	15.6	MR
JA-4	16.3	MR
ICP 87119	16.6	MR
Bahar	16.8	MR
ICP 11302	19.1	MR
BDN 2	19.7	MR
ICP 2376	19.7	MR
ICPL 288	21.0	MS
ICP 4135	25.5	MS
ICP 580	26.7	MS
ICP 11290	27.8	MS
ICP 113	28.7	MS
UPAS 120	35.0	MS
ICP 11304	36.3	MS
ICP 339	36.3	MS
ICP 7119	52.3	S
ICPL 161	52.5	S

TABLE 2

Classification of pigeonpea genotypes based on disease reaction against *Phytophthora cajani*

Disease reaction	Scale	Breeding lines/ germplasm	Number
Resistant	0-10	Nil	0
Moderately resistant	10.1-20	ICP 9174, ICP 8863, KPBR 80-2-1, JA-4, ICP 87119, Bahar, ICP 11302, BDN 2 and ICP 2376	9
Moderately susceptible	20.1-50	ICPL 288, ICP 4135, ICP 580, ICP 11290, ICP 113, UPAS 120, ICP 11304 and ICP 339	8
Susceptible	50.1-80	ICP 7119 and ICPL 161	2
Highly susceptible	80.1-100	Nil	0

Reaction of Pigeonpea Genotypes to *Phytophthora* Blight under Natural Disease Incidence

Reaction of 57 pigeonpea genotypes was assessed at research farm (BP - 14A) of ICRISAT, Patancheru under natural environmental condition. The disease incidence ranged from 0.0 to 100 per cent (Table 3). Among the 57 genotypes, 38 (ICPL 20338 DT, ICPL 20326 NDT, MN 1, MN 5, MN 8, ICPL 87051, 88034, 96053, 6058, 96061, 98008, 92016, 87154, 84023, ICPA 2209, 2043, 2047, 2048, 2092, 2199, ICPH 2363, 2671, 2740, 3461, 3933, 3762, 3477, 3492, 4503, ICP 5028, Maruti, Asha, Lakshmi, Abhaya, Sarita, Durga, Jagriti, Prasada) showed resistant reaction, six genotypes (ICPA 2039, 2089, ICPH 2438, 2364, ICPL 20340 DT, ICPL 85030) showed moderately resistant reaction and 10 genotypes (ICPH 2433, 2751, ICPL 20325 NDT, ICPL 87091, 88039, 97250, 99004,UPAS 120, Pragati, *Cajanus cajanifolius*) showed moderately susceptible reaction. The genotypes ICPL 20092, Kamika and *Cajanus scarabeiodes* showed highly susceptible reaction (Table 4). Preliminary investigations suggest that phenolic constituents of

TABLE 3

Severity of *Phytophthora* blight on pigeonpea genotypes under natural ecosystems

Genotype	PDI at different days after sowing				Disease reaction
	30	60	90	130	
ICPA 2039	0.7	15.11	18.4	17.8	MR
ICPA 2089	1.1	9.7	15.0	16.0	MR
ICPH 2438	0.0	12.8	13.5	14.3	MR
ICPH 2363	1.0	2.5	4.5	4.5	R
ICPH 2364	3.6	8.1	13.9	16.5	MR
ICPH 2433	7.6	29.3	37.6	40.0	MS
ICPL 20338 DT	0.0	4.7	4.7	4.7	R
ICPL 20340 DT	0.0	11.6	12.6	14.5	MR
ICPL 20325 NDT	3.2	26.8	31.6	32.9	MS
ICPL 20326 NDT	0.0	4.6	4.6	4.6	R
MN 1	0.0	1.7	1.8	1.8	R
MN 5	0.0	0.0	0.0	0.0	R
MN 8	2.9	2.9	2.9	2.9	R
Sarita	0.0	0.0	0.0	0.0	R
Pragati	0.0	22.0	22.0	26.1	MS
Durga	0.0	2.0	2.0	2.0	R
Jagriti	0.0	4.0	4.0	4.0	R
ICPL 87091	0.0	15.8	17.7	23.8	MS
ICPL 88039	12.6	13.5	25.6	26.9	MS
ICPL 88034	0.0	2.0	2.0	3.1	R
ICPL 98008	1.9	1.9	1.9	1.9	R
Prasada	0.0	0.0	0.0	0.0	R
ICPL 92016	0.0	0.0	0.0	0.0	R
ICPL 87154	0.0	0.0	0.0	0.0	R
ICPL 85030	0.0	8.3	8.3	10.6	MR
ICPL 84023	0.0	7.0	7.0	7.5	R
ICPA 2209	0.0	1.8	1.8	1.8	R
ICPA 2043	0.0	0.0	0.0	0.0	R
ICPA 2047	0.0	0.0	0.0	0.0	R
ICPA 2048	0.0	0.0	0.0	0.0	R
ICPA 2092	0.0	0.0	0.0	0.0	R
ICPA 2199	0.0	0.0	0.0	0.0	R
ICPH 2671	2.6	3.0	4.8	5.3	R

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Genotype	PDI at different days after sowing				Disease reaction
	30	60	90	130	
ICPH 2740	0.0	0.0	0.0	0.0	R
ICPH 2751	0.0	18.3	18.3	23.9	MS
ICPH 3461	0.0	0.0	0.0	0.0	R
ICPH 3933	0.0	0.0	0.0	0.0	R
ICPH 3762	0.0	0.0	0.0	0.0	R
ICPH 3477	0.0	0.0	0.0	0.0	R
ICPH 3492	0.0	0.0	0.0	0.0	R
ICPH 4503	0.0	0.0	0.0	0.0	R
Maruti	0.0	0.0	0.0	0.0	R
Asha	0.0	0.0	0.0	0.0	R
Lakshmi	1.7	1.7	1.7	1.7	R
Abhaya	0.0	0.0	0.0	0.0	R
ICP 5028	3.6	3.6	3.6	5.4	R
ICPL 96058	0.0	1.7	1.7	1.7	R
ICPL 96061	0.0	1.9	1.9	1.9	R
ICPL 96053	2.3	2.3	4.5	4.5	R
ICPL 87051	2.4	4.9	7.3	7.3	R
ICPL 97250	0.0	29.8	29.8	39.7	MS
ICPL 99004	0.0	18.3	18.3	25.0	MS
Kamika	25.0	59.4	83.7	100.0	HS
ICPL 20092	11.2	44.8	74.8	100.0	HS
Cajanus cajanifolius	6.0	21.2	33.6	43.4	MS
UPAS 120	13.2	19.8	32.9	33.0	MS
Cajanus scarabeiodes	21.7	38.6	64.6	82.1	HS

leaves and stems increased after inoculation in resistant varieties while, they decreased in the *Phytophthora* blight susceptible variety of pigeonpea (Pal and Grewal, 1975). It appears that there may be stimulation of host defense reaction due to infection in the resistant variety while such mechanism may be absent in the susceptible one. Resistance identified so far needs to be reconfirmed under epidemiologically sound disease development environment and with the emergence of new pathotypes of *P. cajani*.

TABLE 4

Classification of pigeonpea genotypes based on reaction against *Phytophthora* blight disease

Disease reaction	Scale	Breeding lines/ germplasm	Number
Resistant	0-10	MN-5, Sarita, Prasada, ICPL 92016, ICPL 87154, ICPA 2043, ICPA 2047, ICPA 2048, ICPA 2092, ICPA 2199, ICPH 2740, ICPH 3461, ICPH 3933, ICPH 3762, ICPH 3477, ICPH 3492, ICPH 4503, Maruti, Asha, Abhaya, Lakshmi, ICPL 96058, MN 1, ICPA 2209, ICPL 98008, ICPL 96061, Durga, MN 8, ICPL 88034, Jagriti, ICPH 2363, ICPL 96053, ICPL 20326 NDT, ICPL 20338 DT, ICPH 2671, ICP 5028, ICPL 87051 and ICPL 84023	38
Moderately resistant	10.1-20	ICPL 85030, ICPH 2438, ICPL 20340 DT, ICPA 2089, ICPH 2364 and ICPA 2039	6
Moderately susceptible	20.1-50	ICPL 87091, ICPH 2751, ICPL 99004, Pragati, ICPL 88039, ICPL 20325 DT, UPAS 120, ICPL 97250, ICPH 2433 and *Cajanuscaj anifolius*	10
Susceptible	50.1-80	Nil	0
Highly susceptible	80.1-100	*Cajanusscarabeiodes,* Kamika and ICPL 20092	3

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