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Research Article

Host plant resistance in pigeonpea (*Cajanus cajan* (L.) Millsp.) genotypes for root rot disease caused by (*Rhizoctonia bataticola* (Taub.)Butler]

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Abstract
A total of 25 pigeon pea genotypes along with susceptible check CO5 were evaluated for their resistance against root rot in the field under sick plot condition consecutively for three years in the experimental farm, Department of Pulses, Tamil Nadu Agricultural University, Coimbatore. Among these,the genotype *viz*., IPA 8F showed resistant reaction consistently for all the three years with the mean disease incidence of 8.0 per cent. The genotype IPA 15F was found to be moderately resistant which recorded the mean disease incidence of 14.9 per cent.Eighteen genotypes exhibited susceptible reaction and the five genotypes *viz*., BSMR 853, JKM 189,MAL 13 , WRGE 65, ICP 8863 and the variety CO5 used as the susceptible check recorded highly susceptible reaction .The resistance shown by the genotype IPA 8F against root rot was also confirmed in pot culture under artificial inoculation.The root rot disease resistant genotype IPA 8F can be used in crossing programme for developing root rot resistant pigeon pea variety

Key Words
Pigeon pea, genotypes, screening, sick plot, root rot, resistance

INTRODUCTION:

Pigeon pea is one of the important multipurpose grain legume crop which is endowed with several features *viz*., high nutritive value, potential to fix atmospheric nitrogen, capacity to thrive under adverse environmental condition, suitable for intercropping and enhance the net income of small and marginal farmers. India is the largest producer, importer and consumer of pulses, accounting for 25 per cent of global production from 35 per cent of global area under the pulses (Ahlawat*et al*., 2016).Pigeon pea is the second most important pulse crop after chickpea in India. India stands first in pigeon pea cultivation in the world by contributing 74 per cent area and 63 per cent production. In India it is grown in an area of 17.9 m,ha with the production and productivity of 15.7 Mt and 876 Kg/ha respectively. In Tamil Nadu pigeon pea cultivation is spread over an area of 0.69lakh ha with the production of 0.60 lakh tonnes and the productivity of 992 kg/ ha (Anonymous, 2017).

Pigeon pea is affected by many fungal diseases. Among these, soil borne disease infected by *Rhizoctoniabataticola* (sclerotial stage) (*Macrophominaphaseolina* - pycnidial stage) is the most devastating disease inflicting huge economic losses.The pathogen affects both seedlings and mature plants (Gangopadhyay*et al*., 1970; Khare*et al*., 1971).The infected plants show yellowing and drooping of the leaves, brittleness of the tap root and bark shredding symptoms. Due to decay of rootlets, the plant can be easily uprooted. The recent survey conducted in pigeon pea growing tracts of Tamil Nadu indicated the mean incidence of root rot ranged from 13.5 to 14.9 per cent and the highest incidence of 42.0 per cent was recorded in Pallipalayam village of Erode district(Smitha*et al.,* 2015).The pathogen *M.phaseolina* is primarily soil and seed-borne and produces large number of microsclerotia/ pycnidia (Pun *et al*., 1998). It is reported to have high morphological, pathogenic, physiological and genetic

variability (Kaur*et al*., 2012).The pathogen is having wide host range of approximately 500 species in 75 plant families and exhibits heterogeneous host specificity (Mayek-Perez *et al*., 2001;Pande*et al.,*2004).The disease development is favoured by high temperature (30-35^{0}C) coupled with moisture stress (ArnritSandhu*et al*., 1999) and the quantum of inoculum availability(SatishLodha 1998).Rain after the prolonged dry spell predisposes the plant to infection (Reddy *et al.,* 2012). Management of root rot through seed treatment or soil application of chemical fungicide is a difficult task because of hardy nature and prolonged saprophytic survival of the microsclerotia .Use of resistant cultivars in pigeon pea is the best, ecofriendly and economically viable approach for combating the root rot disease in pigeon pea. Keeping this in view the present investigation was carried out to identify resistant sources for root rot in the field under sick plot condition.

MATERIALS AND METHODS

Rhizoctoniabataticola was isolated from the infected pigeon pea showing typical symptoms of root rot. The culture was purified by hyphal tip method (Dhingra and Sinclair, 1985). Pure cultures of the isolates were maintained on PDA slants and used for further studies.

Preparation of sand maize inoculum of ***R. bataticola***

Sand and maize seed powder were mixed at the ratio of 19:1 and the mixture was sterilized at 121ºC at 15 psi for 2 h. The actively growing R. *Bataticola* culture was inoculated into sand maize medium and incubated for 15 days at room temperature (28º ± 2ºC) for multiplication. The sand maize inoculum is further used in the field and pot culture experiment in order to make soil sick.

Screening of pigeon pea genotypes against root rot in the field under sick plot condition

`Experiments were conducted in the root rot sick plot available at experimental farm, Department of Pulses, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore consecutively for three years from 2015-16,2016-17 and 2017- 18 to evaluate the pigeon pea genotypes for their resistance against root rot . Seeds of 25 genotypes received from All India Coordinated Research Programme (AICRP) on Pigeon pea coordinating centres were sown in two rows of 4 meter length during the first week of August in all the three years. For every four rows of test genotype one row of susceptible check CO5 was sown. Three replications were maintained for each genotypes and the crop was maintained by following standard package practices as per the recommendation of the Crop Production Guide TNAU, Coimbatore. Before sowing, root rot infected plant debris and sand maize inoculum of *R.bataticola* were added in the sick plot to enhance the inoculum level (2x10 ^{6}cfu/ g of soil) for effective screening. The observations were recorded on root rot incidence starting from 30 days after sowing to maturity phase at regular intervals. The per cent root rot incidence was calculated using the formula

$$\text{Per cent Disease Incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

The genotypes were categorized for disease reactionas per the score chart described by Lokesha and Benagi (2006)

Rating(Disease incidence %)	Disease Reaction
0	Immune
1- 10	Resistant
11 -25	Moderately Resistant
26 – 50	Susceptible
51- 100	Highly Susceptible

Evaluation of pigeon pea genotypes against root rot in the pot culture under artificially inoculated condition

Based on the performance of genotypes against root rot in the field, nine genotypes were selected for further evaluation in the glass house (pot culture experiment) under the artificial inoculated condition. The potting mixture consisting of red soil + sand + FYM (2:1:1) was sterilized in a autoclave at 121 ºC at 15 psi for 2 hrs for two consecutive days. Earthen pots of 30 cm diameter was filled with sterilized potting mixture and the sand maize inoculum of *R.bataticola* was incorporated @ of 10 % (w/w) and mixed thoroughly .The seeds of pigeon pea genotypes and the susceptible check CO5 were sown @ seven / pot and five replications were maintained for each genotypes and monitored regularly . Moisture stress was given during flowering period to ensure effective infection by the pathogen. Regular observations were recorded on root rot incidence from the initial incidence of disease to maturity stage. The per cent disease incidence worked out and the genotypes were categorised for disease reaction as described above.

RESULTS AND DISCUSSION

The results of the field experiment conducted under sick plot condition revealed that among the 25 genotypes screened for their resistance against root rot none of the genotype showed immune reaction to the disease. The genotype *viz*., IPA 8F recorded resistant reaction consistently for all the three years of evaluation with the mean incidence of 8.0 per cent. The genotype IPA 15F was categorized as moderately resistant as it registered the average incidence of 14.9 per cent. Eighteen genotypes recorded the average disease incidence of more than 30.0 per cent were grouped as susceptible types. Five genotypes *viz.,*BSMR 853, JKM 189,MAL 13, WRGE 65 and ICP 8863 exhibited highly susceptible reaction which registered the mean incidence of more than 50.0 per cent.The variety CO 5 used as the susceptible check was also shown to be highly susceptible with the average disease incidence of as high as 75.8 per cent (**Table 1 and 2.**). Several workers evaluated pigeon pea genotypes for the resistance against root rot and identified resistant sources. Bajpal *et al*. (1999) found that

late maturing varieties showed more resistant to root rot compared to early maturing varieties.Out of 24 genotypes screened by Lokesh and Benagi (2006) two genotypes *viz.,* PT-221 and ICPL-90097 had resistant reaction with the root rot incidence of 5.42 and 9.19 per cent respectively. The six genotypes *viz*., DEPS9, GS-1, ICPL-89049, PhyK-2, TAT-9621 and V-50 recorded moderately resistant reaction with less than 25.0 per cent root rot incidence. The ICRISAT pigeonpea genotypes *viz*., ICPL 8600, ICPL9602, ICPL 97105 and ICPL 91028 were shown to be resistant to root rot (Reddy *et al.,*2012). Biradar *et al*.(2020) evaluated four pigeon pea varieties for their resistance against root rot under field condition and found the lowest root rot incidence of 5.6 and 10.0 per cent in the varieties *viz.,* CRG 811 and CRG 12 respectively . The cultivar *viz*., TS 3R exhibited the root rot incidence of 16.0 per cent and the highest incidence of 36.0 per cent was recorded in Gulyal.

Table 1.Reaction of pigeonpea genotypes against root rot in the field under sick plot condition

S.No	Pigeonpea genotypes	Root Rot incidence (%)*			Mean Incidence (%)
		2015-16	2016-17	2017-18	
1	BDN 2	40.0	12.6	41.2	31.3
2	BRG 1	37.5	34.2	35.9	35.9
3	BRG 2	45.9	45.9	34.5	42.1
4	BRG 3	48.6	36.5	45.3	43.5
5	BRG 4	40.9	41.7	47.8	43.4
6	BSMR 736	44.2	45.0	55.8	48.3
7	BSMR 853	61.9	50.0	50.0	53.9
8	CO 6	29.2	26.3	27.1	27.5
9	CRG 9701	50.9	42.3	48.6	47.3
10	ICP 7119	58.4	54.2	34.9	49.1
11	ICP 2376	52.3	42.6	44.2	46.3
12	ICP 8863	55.8	57.2	63.5	58.3
13	IPA 8F	7.7	7.1	9.2	8.0
14	IPA 15 F	15.5	15.0	14.4	14.9
15	JKM 189	58.9	55.5	60.0	58.1
16	KPL 43	27.4	44.0	49.2	40.2
17	KPL 44	42.1	45.5	40.6	42.7
18	MAL 13	74.3	53.6	39.5	55.8
19	MA6	39.5	40.9	53.6	44.6
20	MAL 43	31.8	31.7	38.7	34.07
21	RVSA 07-31	40.9	50.0	41.7	44.2
22	RVSA 07-29	39.3	37.5	37.3	38.0
23	RVSA 07-10	35.2	29.9	62.2	42.4
24	WRGE 65	43.9	68.5	51.7	54.7
25	WRP -1	47.9	54.2	38.2	46.7
26	CO 5(Susceptible check)	74.2	75.5	77.7	75.8

*Mean of three replications

Table 2.Grouping of pigeonpea genotypes based on their reaction against root rot in the field under sickplot condition

Pigeonpea genotypes	No.of genotypes	Disease incidence (%)	Disease reaction
IPA 8F	1	8.0	Resistant
IPA 15F	1	14.9	Moderately resistant
BDN 2 . BRG 1, BRG 2, BRG 3, BRG 4, BSMR 736, CO6, CRG9701, ICP 7119,ICP2376, KPL 43,KPL 44, MAL 43 ,RVSA 07-31, RVSA 07-29,RVSA 07-10 WRP 1, WRGE 65	18	26 -50.0	Susceptible
BSMR 853, JKM 189,MAL 13 , WRGE 65, ICP 8863	5	More than 50	Highly Susceptible
CO5(Susceptible check)	1	More than 50	Highly Susceptible

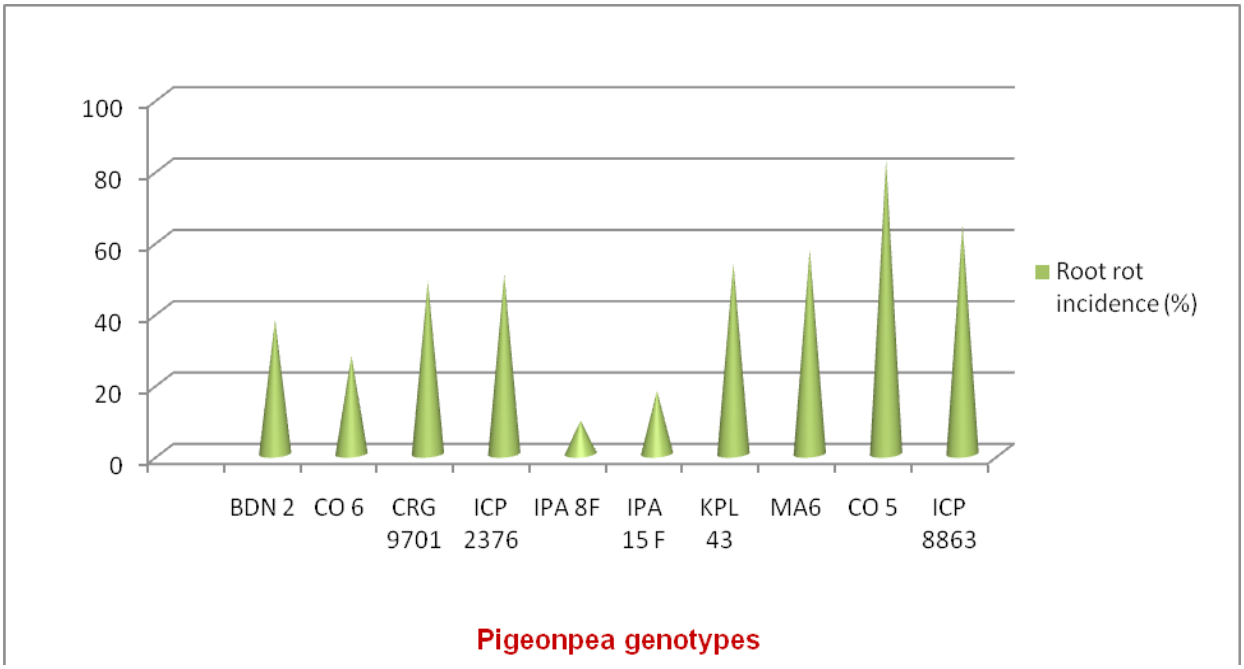

Fig 1 . Reaction of pigeonpea genotypes against root rot in pot culture under artificial inoculation

Based on the performance of genotypes against root rot in the field under sick plot condition for all the three years,nine genotypes were selected and evaluated along with the susceptible check CO5 in the pot culture experiment under artificial inoculation. The reaction of all the genotypes and the susceptible check variety CO5 under artificially inoculated condition showed the same category of disease reaction as in the case of field screening. The root rot resistant reaction exhibited by the genotype IPA 8F in the field was confirmed in the pot culture experiment which recorded the disease incidence of 9.3 per cent under artificial inoculation. The genotype IPA15 F registered moderately resistant and the three genotypes *viz.,*BDN 2,CO6 and CORG 9701 were susceptible to the disease.Four genotypes *viz.*, ICP 2376, ICP 8863,KPL 43 and MA6 were highly susceptible to the disease. The susceptible checkvariety CO5 also showed a highly susceptible reaction with 82.5 per cent disease incidence (**Fig 1**). Ajithkumar *et al*.(2018) screened the 33 pigeon pea genotypes under *in vitro* condition through blotter paper technique and found that eight genotypes *viz.*, ICP-14832, BDN-2008-8, AGL-1666, AGL-1919, AGL-2013, ICP-8793, AGL-1603and GRG-177 were resistant reaction to root rot. Among the 33 pigeon pea genotypes screened under glass house ,11 genotypes *viz.*, GRG-177, GRG-811, TS-3R, ICP-14832, BDN-2008-8, GRG-820, AGL-1666, AGL-1919, AGL-2013, ICP-8793 and AGL-1603 showed resistance to root rot disease (Maruti,*et al*. 2019).

From this investigation it was inferred that the genotype IPA 8F showed resistant reaction against root rot consistently over three years in the field under sick plot condition and it was also confirmed in the pot culture experiment under artificial inoculation. The root rot resistant genotype IPA 8F can be effectively utilized in the breeding programme for developing elite pigeon pea variety with root rot resistance.

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