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Screening of pigeonpea (*Cajanus cajan*) mini-core germplasm sub-set for tolerance to wilt and pod borers

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Pigeonpea [*Cajanus cajan* (L.) Millspaugh] is an important pulse crop grown predominantly in semi-arid conditions of India with a production of 4.25 metric tonnes from an area of 4.43 million ha (Obala *et al*. 2020). Although pigeonpea growing area has considerably increased, the productivity remained stagnant due to biotic stresses including pod borer complex and Fursarium wilt (Pande *et al.* 2013, Murali-Baskaran *et al*. 2019,Yadav *et al*. 2019). Host plant resistance is one of the eco-friendly strategies to manage biotic stresses in pigeonpea (Singh *et al.* 2015, Kavitha and Vijayaraghavan 2017). The ICRISAT, Telangana, India screened 15,000 accessions of pigeonpea under field condition and identified several genotypes with moderate to low level pod borer damage (Sharma *et al*. 2016). Although, several new sources of resistance have been reported against pigeonpea Fusarium wilt (Pawar *et al*. 2015), but it is a continuous process of identification of potential resistance sources as location and pathogenic variability affects the status of germplasm against the particular host-pathogen combination. In the present study, mini-core sub-subset of pigeonpea was screened under field conditions to identify the resistance/tolerance sources against biotic stresses.

A total of 146 mini-core sub-set pigeonpea accessions and 4 control entries procured from the ICRISAT, Hyderabad, Telangana were screened against legume pod borer [*Helicoverpa armigera* (Hubner)], spotted pod borer [*Maruca vitrata* (Fabricius 1787)], pod fly (*Melanagromyza obtusa* Malloch) and wilt disease [*Fusarium udum* (Fusaud)] during *kharif* 2018–19 at the research field of ICAR-National Institute of Biotic Stress Management, Raipur, Chhattisgarh. The germplasm were sown in augmented design in paired rows of 4 m length with spacing of 1 m × 0.5 m. Control entries were sown on either side of every 10 germplasm accessions. All entries were maintained by following agronomic practices and free from plant protection measures.

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The spotted pod borer damage was recorded during vegetative and pod maturation stages. Number of leaf/flower bud webbings and number of spotted pod borer larvae/webbing in a randomly selected five plants for each germplasm were recorded during vegetative/flowering stage of crop (50 to 60 days old) and expressed in terms of number of leaf or flower bud webbings/plant and number of larvae/plant. The infestation of pod borers (legume pod borer and spotted pod borer) at reproductive stage was recorded on 100 matured pods collected randomly from each germplasm at the time of maturity and the ratio of healthy pods to bored pods was computed and expressed as per-cent bored pods. Based on the data, the pest susceptibility percent (PSP) and pest susceptibility index (PSI) were calculated for each accessions and controls. Based on PSI, resistance levels of pigeonpea accessions were categorized (Kavitha and Vijayaraghavan 2017). Reaction of pigeonpea accessions to pod fly was recorded at pod maturation stage on randomly collected 100 pods in each germplasm. The per cent shriveled seeds were estimated by calculating the ratio of total number of seeds to shriveled seeds. Based on the data, the PSP and PSI were computed and categorized. Number of wilt infected plants was recorded at flowering and podding stages. Percent disease incidence (PDI) was calculated (number of wilted plants/total number of plants × 100). Based on the PDI, accessions were categorized for their reaction to wilt according to rating scale (Sharma *et al*. 2016).

During rainy (*kharif*) season 2018, low damages to leaflets and flowers (0.6-2.4 leaf/flower webbings/plant; 0.2-0.6 larvae/plant) was observed in 6 accessions, while 20 accessions received low leaf/flower bud damage during *kharif* 2019 at vegetative/flowering stage of the crop. In controls, the incidence of spotted pod borer was 4.5 leaf/flower webbings/plant and 2.6 larvae/plant over two seasons. Three accessions (ICP 11321, 12515, 15185) were moderately resistant to *H. armigera* and *M. vitrata* with PSI of 3 and 4 while 19 lines were reported to be moderately susceptible with PSI of 5 and 6 during *kharif* 2018. The susceptible reaction was observed in 14 accessions with PSI

of 7 while 66 accessions were highly susceptible with PSI of 8 and 9. During *kharif* 2019, 27 accessions were found to be moderately resistant to *H. armigera* and *M. vitrata*. Forty-nine accessions were moderately susceptible while 12 accessions were designated as susceptible. The remaining three accessions were highly susceptible.

Since the mini-core sub-set of pigeonpea accessions was developed for traits other than pod borer complex (Upadhyaya *et al*. 2006), the information on their reactions are unknown and not matching with earlier findings (Naresh *et al*. 1993, Reddy *et al*. 1995, Kooner and Cheema 2006, Singh *et al*. 2015, Kavitha and Vijayaraghavan 2017, Gupta *et al*. 2018, Sreekanth *et al*. 2019). No pigeonpea accession was found to be moderately resistant to *H. armigera* and *M. vitrata* consistently during two season screenings. This was due to that 40 to 60 accessions could not establish due to high rainfall- and soil moisture-induced wilt at the reproductive stage of *kharif* 2018 crop and vegetative stage of *kharif* 2019 crop. Based on the per cent shriveled seeds, 18 accessions were categorized as moderately resistant to pod fly with PSI of 3 and 4 during *kharif* 2018 while 16 accessions were designated as moderately susceptible with PSI of 6. Respectively, 26 and 44 accessions were categorized as susceptible (PSI 7) and highly susceptible (PSI 8 and 9). During *kharif* 2019, 28 accessions were moderately resistant to pod fly while 37 accessions were designated as moderately susceptible. The susceptible reaction in eight accessions was recorded. In contrast, 14 accessions showed highly susceptible reaction to pod fly with PSI of 8 and 9. Interestingly, three lines, ICP7314, ICP7426 and ICP14819 were found to be moderately resistant to pod fly for two seasons during *kharif* 2018 and 2019 (Fig 1). Moreover, the line, ICP 7426 was found to be moderately resistant to pod fly and moderately susceptible to *H. armigera* and *M. vitrata*. These three lines can be promoted to next stage of breeding after testing through artificial screening.

There was difference in number of resistant and moderately resistant accessions against wilt in 2018–19, though the incidence of wilt was very good in both the years as susceptible accessions (>40.1% PDI) were 84

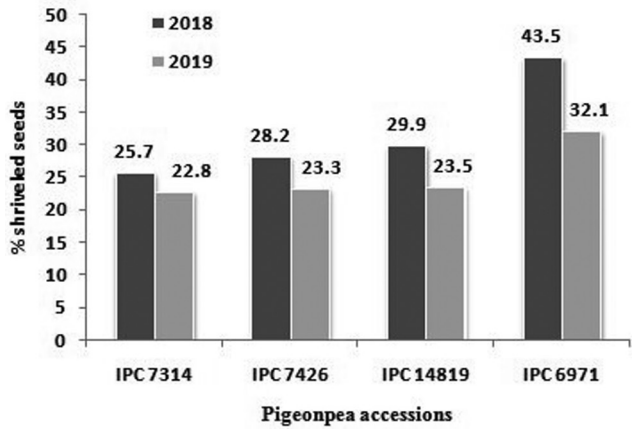

Fig 1 Per cent shriveled seeds caused by pod fly in pigeonpea accessions during *kharif* 2018–19.

Table 1 Per cent disease incidence (PDI) of resistant/moderately resistant accessions to Fusarium wilt during 2018–19

Accession		Percent disease incidence	
		2018	2019
ICP 1126		17.86	12.5
ICP7076		9.38	12.5
ICP8921		16.00	12.5
ICP8949		12.50	10.00
ICP 9045		0.00	0.00
ICP9414		6.67	0.00
ICP9750		4.17	0.00
ICP10094		11.54	11.11
ICP12515		11.43	14.29
ICP12596		18.75	10.00
ICP14801		16.67	9.09
ICP14900		10.00	10.00
ICP14903		3.85	0.00
ICP16264		9.52	12.50
Control	ICP 6971	57.14-73.68	41.67-75.00
Control	ICP 7221	50.00-58.33	50.00-66.67
Control	ICP 8863	6.25-9.09	7.69-8.33
Control	ICP 11543	29.41-50.00	25.0-37.50

and 78, respectively out of 146 accessions screened. In 2018, 8 accessions were found to be resistant (<10% PDI) whereas 23 resistant accessions in 2019. However, based on the two years screening data and consistent reaction, 5 accessions, viz. ICP 9045, ICP9414, ICP9750, ICP14900 and ICP14903 were found to be resistant and 9 other accessions, viz. ICP1126, ICP7076, ICP8921, ICP8949, ICP10094, ICP12515, ICP12596, ICP14801 and ICP16264 were moderately resistant to Fusarium wilt (Table 1). Among these accessions, ICP9045 was free from the disease in both the years. Out of 4 control entries, ICP8863 was found to be resistant which was also reported to be resistant to Fusarium wilt by Sharma *et al*. (2012). Sharma *et al*. (2016) screened these 146 mini-core germplasm against Fusarium wilt, out of which six accessions namely, ICP6739, ICP8860, ICP11015, ICP13304, ICP14638 and ICP14819 were found resistant. In the present study, ICP11015 and ICP13304 were found to be susceptible; however, remaining four accessions gave inconsistent reaction ranged from susceptible to moderately resistant. This may be due to location, pathogen variation or environmental effect.

SUMMARY

Biotic stresses are the major production constraints of pigeonpea crop including legume pod borer, spotted pod borer and pod fly and Fusarium wilt which cause significant yield losses. A mini-core sub-set of pigeonpea consisting of 146 accessions along with 4 control entries were screened against pod borer complex and wilt under field conditions in 2018 and 2019 at the research farm of ICAR-

National Institute of Biotic Stress Management, Raipur, Chhattisgarh. Three accessions, viz. ICP7314, ICP7426 and ICP14819 were found to be moderately resistant to pod fly. Additionally, ICP 7426 was moderately susceptible to both the Lepidoptera pod borers. Five accessions, ICP9045, ICP9414, ICP9750, ICP14900 and ICP14903 were resistant to Fusarium wilt and 9 more accessions were moderately resistant. The identified accessions can be utilized in crop improvement which may provide resistance and/or tolerance against pod borers and wilt disease.

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