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Pod borer susceptibility reaction in interspesific hybrids of pigeonpea

Lokesh Kumar Gangwar[1], G. C. Bajpai[3], S. A. Kerkhi[1] and S. K. Sachan[2]

[1]Deptt. of Genetics and Plant Breeding, S.V.B. Patel University of Agriculture and Technology, Meerut 250 110
[2]Department of Entomology, S.V.B. Patel University of Agriculture and Technology, Meerut 250 110
[3]Deptt. of Genetics and Plant Breeding, G.B. Pant University of Agriculture and Technology, Pantnagar 263 145

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Abstract

Seventy-two inter-specific plant progenies, derived by crossing wild species *viz., Cajanus cajanifolius*, *C. acutifolius* and *C. scarabaeoides* and cultivated lines *viz.,* UPAS 120, Pant A 134 and ICPL 84023, were screened in the field to isolate sources of resistance to pod borer (*Helicoverpa armigera*). Pest Susceptibility Rating (PSR) and reaction were worked out for pod and seed damage in all F_3 progenies under study. On the basis of pest susceptibility reaction, all 24 F_3 populations derived by utilizing wild species, *C. scarabaeoides* were found highly resistant (HR) for pod and seed damage due to pod borer in protected as well as unprotected condition as compared to cultivated parents. Though moderately susceptibile reaction (MS) was recorded in F_3 population of UPAS 120 x *C. acutifolius.* F_3 progenies of ICPL 84023 x *C. cajanifolius* and UPAS 120 x *C. cajanifolius* were noted highly resistant (HR) for pod as well as seed damage even in unprotected condition. However, two progenies of Pant A134 x *C. cajanifolius* showed the least susceptible reaction (LS) in unprotected condition. In general, all 72 F_3 progenies of nine inter specific hybrids evaluated for their reaction to the infestation of pod borer showed very low level of pod and seed damage as compared to pod and seed damage in cultivated lines of the study.

Key words: Susceptibility reaction, Interspecific hybrids, pod borer, *Cajanus* sp., *Helicoverpa armigera*

Introduction

Pigeonpea [*Cajanus cajan* (L.) Millsp] is grown extensively in the third world countries and occupies an area of about 4.57 million ha producing 3.29 million tonnes of grains globally [1]. India accounts for 72% of the global output with current production of 2.37 million tonnes from an area of 3.52 million ha. However, the yield levels of this crop are not very encouraging. Among the factors responsible for low yield, the damage caused by insect-pest is one of the major factor in pigeonpea. It is attacked by a number of insect-pests that are found feeding on plants from seedling to harvest and no part of the plant is immune to pests [2]. Among several pests, attacking pigeonpea, pod borer (*Helicoverpa armigera* Hubner) is considered as the serious constraint in enhancing production and productivity of pigeonpea [3]. Utilization of host-plant resistance in breeding is the most appropriate option for reducing yield losses due to insect-pests. Among the categories of host-plant resistance, the antibiosis, governed by phenolic compounds (tannin and total phenols), is very important. It reflects adverse effects on insect biology. Wild species of pigeonpea (*Cajanus cajanifolius, C. acutifolius* and *C. scarabaeoides*) have 'antibiosis', a resistance mechanism against *Helicoverpa armigera* [4]. Therefore, wild species of pigeonpea may be used as resistant donors for transfering pod borer resistance in to cultivars through wide hybridization. Identification of donors for pod borer resistance is a pre-requisite for resistance breeing and hence wild species *viz., C. cajanifolius*, *C. acutifolius* and *C. scarabaeoides* were chosen for interspecific hybridization with susceptible cultivars. Results obtaine in the present study are presented here.

Materials and methods

Seventy-two interspecific progenies in F_3 generation derived from the crosses between susceptible cultivars, *viz*., Pant A 134, UPAS 120 and ICPL 84023 and wild species were sown alongwith parents in a randomized complete block design in single rows of 3 m length, spaced 60 x 15 cm, on ridges in two replications each for protected and unprotected field conditions at Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar during *kharif* 2003-04. The

Corresponding author's e-mail: gangwarlk@gmail.com

parents and the progenies were screened against pod borer infestation. In protected set, the crop was sprayed with Endosulfan 0.07@500 g ai per ha. Recommended agronomic practices were followed to raise the crop. Observations on the incidence of pod borer were recorded at the time of harvest. The pods of ten randomly selected plants from each plot in all replications in both conditions were collected to record the number of damaged pods and seeds due to pod borer. The data was converted into per cent damaged pods and seeds. The pest susceptibility rating (PSR) for pod and seed damage was worked out as per the formula given below [5]:

$$\text{Pest susceptibility (\%)} = \frac{\text{\%P.D. in check cultivar} - \text{\% P.D. in test cultivar}}{\text{\%P.D. in check cultivar}} \times 100$$

Where, P.D. = Mean of % pods or seed damaged

Based on above formula the performance of each F_3 progeny on 1-9 scale was assessed as follows:

Pest suscep-tibility (%)	Susceptibility rating	Category
100	1	Highly Resistant (HR)
75 to 99.9	2	Highly Resistant (HR)
50 to 74.9	3	Least Susceptible (LS)
25 to 49.9	4	Least Susceptible (LS)
10 to 24.9	5	Least Susceptible (LS)
–10 to 9.9	6	Moderately Susceptible (MS)
–25 to –9.9	7	Moderately Susceptible (MS)
–50 to –24.9	8	Highly Susceptible (HS)
–50 or less	9	Highly Susceptible (HS)

Results and discussion

Being a rich source of protein, pigeonpea is damaged by a large number of insect-pests mainly pod borer, *Maruca vitruta* and podflies (*Melanagromyza obtusa*). In comparison to checks, insect-pest susceptibility rating was done in all F_3 progenies. Out of 24 F_3 progenies of the cross *C. cajan* (P 134, UPAS 120 and ICPL 84023) x *C. cajanifolius*, 22 progenies were rated as highly resistant in unprotected condition for pod and seed damage, whereras in protected condition 10 and 14 progenies could be rated as highly resistant (Table 1) for pod and seed damage respectively. No F_3 family was observed under the LS and HS categories. In the similar cross, 41.6 to 82.9% damage in pods underprotected condition has been reporte earlier [6]. Such a high damage indicate that *C. cajanifolius* may not provide a very high degree of resistance, although the species has exhibited high resistance in protected as well as unprotected conditions. These observations have been earlier reported [7, 8], however, emphasis has been given on the utilization of *C. cajanifolius* could be used as donor for insect resistance in genetic improvement of *C. cajan.*

Insect-pest susceptibility reaction of the progenies derived from *C. acutifolius* (Table 2) showed that three F_3 progenies in Pant A134 x *C. acutifolius*, one in UPAS120 x *C. acutifolius* and six in ICPL84023 x *C. acutifolius* accounted for highly resitant (HR) reaction for pod damage in protected condition. Only one progeny of UPAS 120 x *C. acutifolius* showed moderately susceptible reaction for pod damage in protected condition. The insect-pest susceptibility rating of seed damage in progenies derived from *C. acutifolius* indicated that all the eight progenies of ICPL84023 x *C. acutifolius* were highly resistant (HR) in unprotected condition, however, only one of the progeny in protected condition turned to be least susceptible (LS). Three progenies showed highly resistant reaction in protected and six in unprotected condition in Pant A134 x *C. acutifolius*. In UPAS120 x *C. acutifolius*, seven progenies showed least susceptible and one moderately susceptible reactions in protected condition, though, out of eight, six progenies were rated highly resistant (HR) for seed damage in unprotected condition. Variable degree of grain damage (5.96% to 32.38%) due to pod borer has been reported [9] earlier.

It is evident from the data presented in Table 1 that all F_3 populations derived from the cross involving *C. scarabaeoides* showed highly resistant (HR) reaction for pod damage under unprotected condition and for seed damage in both protected as well as unprotected conditions. Six F_3 progenies in UPAS120 x *C. scarabaeoides*, seven in Pant A134 x *C. scarabaeoides* and eight in ICPL84023 x *C. scarabaeoides* were marked as highly resistant in protected condition. The results are in accordance with earlier reports [4] that the higher concentration of tannin and phenolic compound are present in wild pigeonpea like *C. scarabaeoides* and *C. cajanifolious* and therefore, the adverse effects on insect biology causes minimum yield losses. All the F_3 progenies showed least susceptible reaction in unprotected condition, as compared to only three F_3 progenies in protected condition. It was

Table 1. Pod borer susceptibility reaction in F_3 progenies derived from interspecific crosses in pigeonpea

Cross	Grade/Category	Number of F_3 progenies			
		Pod damage		Seed damage	
		Protected	Unprotected	Protected	Unprotected
Pant A134/*C. cajanifolius*	HR ≤ 2	3	6	6	8
	LS (3-5)	5	2	2	-
UPAS120/*C. cajanifolius*	HR ≤ 2	2	7	-	6
	LS (3-5)	6	1	8	2
ICPL84023 /*C. cajanifolius*	HR ≤ 2	5	8	8	8
	LS(3-5)	3	-	-	-
Pant A134/*C. acutifolius*	HR ≤ 2	3	6	3	6
	LS(3-5)	5	2	4	2
	MS(6-7)	-	-	1	-
UPAS120/*C. acutifolius*	HR ≤ 2	1	6	0	6
	LS(3-5)	6	2	7	2
	MS(6-7)	1	0	1	0
ICPL84023/*C. acutifolius*	HR ≤ 2	6	8	7	8
	LS(3-5)	2	-	1	-
Pant A134/*C. scarabaeoides*	HR ≤ 2	7	8	8	8
	LS(3-5)	1	-	-	-
UPAS 120/*C. scarabaeoides*	HR ≤ 2	6	8	8	8
	LS(3-5)	2	-	-	-
ICPL84023/*C. scarabaeoides*	HR ≤ 2	8	8	8	8

HR: Highly resistant; LS: Least susceptible; MS: Moderately susceptible
No F_3 progenies in HS category were observed

Table 2. Average damage in pods and seeds of parental lines under protected and unprotected conditions

Parents	Pod damage (in %)		Seed damage (in %)	
	Pro-tected	Uunpro-tected	Pro-tected	Unpro-tected
Pant A134	8,5	22.1	6.5	19.2
UPAS120	9.9	28.4	7.3	23.6
ICPL80423	14.6	36.5	13.1	32.7
Cajanus cajanifolius	1.2	2.6	1.0	2.4
C. acutifolius	2.6	6.9	2.5	5.9
C. scarabaeoides	0.1	0.1	0.1	0.1

interesting to note that all the 24 F_3 progenies of cross *C. cajan* x *C. scarabaeoides*, showed highly resistant reaction (HR) for seed damage in protected as well as unprotected conditions. The differential reaction of pod and seed damage have been reported [10] earlier, which are due to the rate of infestation by insect-pest under varied environment. Some discrepancies in the results were also observed in the present study. Some of the F_3 progenies showed tolerance/resistance under protected condition, but they were rated as susceptible but with low infestation. Exceptionally, there must have been some escapes due to local environment.

The pod and seed damage among the cultivated lines under protected and unprotected conditions is given in Table 2. The pod and seed damage in pigeonpea in the range of 15 to 25% has been earlier reported [10]. Among the wild species, pod damage was least in *C. scarabaeoides* (0.1%) followed by

C. cajanifolius (2.6%) and *C. acutifolius* (6.9%) in unprotected condition.

The infestation of *Helicoverpa armigera* was observed low to moderate in *kharif* season 2003-2004 at Pantnagar. Since all the F_3 progenies from interspecific crosses showed very low level of pod and seed damage as compared to cultivated lines, the results of present screening are encouraging. These results revealed that progenies derived from the cross *C. cajan* x *C. scarabaeoides* in particular could be exploited for pod borer resistance. The F_3 progenies from other 6 crosses were also useful. It is emphasized that the identified F_3 progenies may be used in resistance breeding programmes to evolve pod borer resistant/tolerant varieties of pigeonpea. However, the confirmation of the identified progenies for tolerance to pod borer, field evaluation, screening under artificial conditions is required.

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