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Performance of genotypes against pod borers in pigeonpea (*Cajanus cajan* (L.)

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Abstract
Among the twelve germplasm lines the genotypes, WRG 79 and LRG 41 (local check) with 3.3 and 3.5 per cent pod damage respectively due to gram pod borer, *Helicoverpa armigera* were categorized as moderately resistant with pest susceptibility rating (PSR) 4; and the genotypes, RVSA 68 and RVSA 81 with 2.7 and 3.6 per cent pod damage due to spotted pod borer, *Maruca vitrata* respectively were categorized as moderately resistant with PSR 3 and 4, respectively. All the genotypes evaluated were under susceptible category against pod fly, *Melanagromyza obtusa* with PSR ranging from 6 to 9. However, the national check, BSMR 853 has recorded highest yield (771.0 kg/ha), followed by WRG 65 (702.7 kg/ha). Similarly, under preliminary varietal trial, the genotype, ICPL 98008 with 0.9 per cent pod damage due to *Helicoverpa* was moderately resistant with pest susceptibility rating (PSR) of 4. The genotypes, JSA 68 and SKNP 203 with 0.9 and 0.5 per cent pod damage respectively were categorized as resistant with PSR of 2; and the genotypes CORG 990015 and ICPL 98008 with 2.7 and 3.3 per cent pod damage respectively were categorized as moderately resistant with PSR of 3 and 4, respectively against *Maruca*. There was no significant difference among the genotypes against pod damage caused due to pod fly. The genotypes, MAL 29, followed by AKT 222544, ICPL 98008 and SKNP 203 with 813.7, 808.3, 757.0 and 727.7 kg/ha, respectively were highly productive.

Keywords: Genotypes, *Helicoverpa armigera*, *Maruca vitrata*, *Melanagromyza obtusa*, pigeonpea and pod borer

Introduction
Pigeonpea (*Cajanus cajan* (L.) Millsp.) is an important pulse crop grown in Andhra Pradesh, India. A large number of insect pests infest pigeonpea crop at its various growth stages of which gram pod borer (*Helicoverpa armigera*) (Hubner), spotted pod borer (*Maruca vitrata*) (Geyer) and podfly (*Melanagromyza obtusa*) (Malloch) are of great significance and cause considerable yield loss [1]. Under field conditions, large array of insecticides were used for pest control, but over the period of time, indiscriminate and over use of insecticides provoked counterproductive in crop ecosystem on many aspects such as development of insecticidal resistance, residues on produce, resurgence, destruction of natural enemies and above all endangering human habitat. Out of several approaches available for their management, identification and use of resistant varieties is viable and cost effective option as pigeonpea is mostly grown by poor and marginal farmers. A genotype possessing inbuilt resistance to the pest is preferred for its manifold advantages like low input cost, avoidance of pesticide cost besides eliminating residue problems and environmental pollution so that promising genotypes could further be used in breeding programme for development of resistant varieties. Several workers screened different genotypes of pigeonpea for resistance against insect pests [2, 3, 4]. However, information on relative resistance or susceptibility of certain newly developed entries was lacking. Hence, the present studies were conducted.

Materials and Methods
Experiments were conducted in *Kharif* 2011 at Regional Agricultural Research Station, Lam, Guntur with twelve and nine germplasm lines respectively under germplasm evaluation and preliminary yield trail. The local check, LRG 41 was considered as it was the most popular variety grown in Andhra Pradesh, occupying 40% of redgram area. Spacing adopted was 180 x 20 cm in a randomized block design with three replications. The crop was grown under rainfed conditions following all recommended agronomic practices except plant protection measures. The inflorescence damage due to spotted pod borer was recorded on five twigs per plant and

five randomly selected plants per replication at peak flowering stage of the crop. The pods damaged by gram pod borer were identified by the presence of characteristic round large holes on pods. The spotted pod borer infected pods show irregular holes with webbed excreta. Similarly, the podfly infected pods have small holes with gnawed or burrowed shriveled seeds. To assess the degree of infestation by different pod borers, pods from five randomly selected plants per replication were collected at the time of harvest. Based on the number of infested and healthy pods the per cent pod damage due to different insect pests was calculated. In order to group the genotypes, the pest susceptibility (%) was calculated using the formula given by Abbott (1925) [5] and then converted to 1 to 9 pest susceptibility rating (PSR). The per cent pod damage and yield were subjected to RBD analysis using AGRES package [6]

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

Where, P.D = mean of per cent pods damaged.

Pest Susceptibility Rating, Pest Susceptibility (%) and Category

Pest Susceptibility Rating (PSR)	Pest Susceptibility (%)	Category
1	100	Highly resistant
2	75 to 99.9	Resistant
3	50 to 74.9	Moderately Resistant
4	25 to 49.9	Moderately Resistant
5	10 to 24.9	Moderately Susceptible
6	-10 to 9.9	Moderately Susceptible
7	-25 to -9.9	Susceptible
8	-50 to -24.9	Highly Susceptible
9	-50 or less	Highly Susceptible

Results and Discussion

Under germplasm evaluation trial, the genotypes showed vide variation ranging from 3.3% (WRG 79) to 15.3% (RVSA 34) pod damage due to *H. armigera*. Thus, WRG 79 and LRG 41 with 3.3 and 3.5 per cent pod damage respectively were categorized as moderately resistant with pest susceptibility rating (PSR) 4. The results were in conformity with the findings of Singh *et al.* (1993) [7] who reported that medium maturing cultivars had more damage by *H. armigera*. The inflorescence damage due to *M. vitrata* ranges from 8.9 % (RVSA 68) to 19.7% (WRG 65). However, there was no significant difference among the genotypes against pod damage due to *M. vitrata*. The genotypes, RVSA 68 and RVSA 81 with pod damage 2.7 and 3.6 per cent, respectively were categorized as moderately resistant with PSR 3 and 4, respectively; and the genotypes WRG 79, RVSA 34, WRG 65 and Guliyal red with 7.3, 8.7, 9.3 and 10.3% pod damage respectively were categorized as highly susceptible to *M. vitrata* with PSR 8 and 9. Similarly, the genotypes exhibited a great deal of variation ranging from 3.3 (BSMR 853) to 25.3% (Guliyal red) against pod damage due to *M. obtusa* with PSR ranging from 6 to 9. Though low incidence was noticed in LRG 41 and RVSA 34 (3.5 and 4.0%, respectively), none of the genotypes was found resistant (Table 1). None of the genotypes was completely free from infestation by these pests. Further, the pests have better survival on susceptible than resistant genotypes due to antibiosis and antixenosis resistance mechanisms. Dua *et al.* (2005) [8] reported existence of all the four mechanisms of resistance *viz*., non preference, antibiosis, tolerance and avoidance in pigeonpea. These resistance mechanism govern the damage levels by a particular insect and hence the variability. The grain yield was more in the national check, BSMR 853 (771.0 kg/ha), followed by WRG 65 (702.7 kg/ha). The local check, LRG 41 has recorded a grain yield of 640.7 kg/ha.

Under preliminary yield trial, the pod damage due to gram pod borer was low in ICPL 98008 (0.9%), followed by local check, LRG 41 (1.2%), MAL 29 (1.4%) and CORG 990015 (1.7%). The genotype, ICPL 98008 was categorized as moderately resistant with pest susceptibility rating (PSR) of 4 and all others were under susceptible category with PSR ranging from 7 to 9. The results were in agreement with the findings of Sreekanth *et al.* (2014)[9] who reported that BRG 7-1, SKNP 203, JSA 64 and ICPL 98008 with 1.9, 1.7, 1.5 and 2.1% pod damage respectively were moderately resistant to *H. armigera*. The moderate resistance of the genotypes may be due the presence of high trichome density and trichome length on pods; and presence of high phenol and low protein and sugar content. The results were in accordance with Anithakumari *et al.* (2010) [10] who reported that ICPL 98008 was moderately resistant to gram pod borer. The inflorescence damage caused by spotted pod borer, *M. vitrata* was low in ICPL 98008 (3.2%) and high in PTO-3-27 (18.9%). However, the pod damage due to spotted pod borer ranges from 0.5 (SKNP 203) to 12.7% (PTO-3-27) among different genotypes. The genotypes, SKNP 203 and JSA 68 with 0.5 and 0.9% pod damage respectively were categorized as resistant with PSR of 2; and the genotypes, CORG 990015 and ICPL 98008 with 2.7 and 3.3% pod damage, respectively were reported moderately resistant (PSR of 3 and 4, respectively) to spotted pod borer. The results were in agreement with the findings of Sunita Devi *et al.* (2014) [11], who reported that lowest inflorescence damage due to *M. vitrata* was recorded in ICPL 98008(4.8%). Wide variation ranging from 6.2 (AKT 222544) to 16.0% (WRG 91) was noticed against podfly incidence. However, there was no significant difference among the genotypes and all were under susceptible category with PSR ranging from 6 to 9. The results also showed that MAL 29, followed by AKT 222544, ICPL 98008 and SKNP 203 with 813.7, 808.3, 757.0 and 727.7 kg/ha, respectively were highly productive (Table 2). Some genotypes recorded higher grain yield even though they had high infestation. It was in conformity with Chandraka *et al.* (1981) [12] and Patel and Patel(1990) [2].

Table 1: Pest susceptibility rating (PSR) of different pigeonpea genotypes under germplasm evaluation trial

S. No.	Name of the Genotype	Pod damage (%) by *H. armigera*	PSR*	Inflorescence damage (%) by *M. vitrata*	Pod damage (%) by *M. vitrata*	PSR*	Pod damage (%) by *M. obtusa*	PSR*	Yield (kg/ha)
1	WRG 79	3.3 (10.4)	4	18.1 (25.1)	7.3 (15.7)	8	22.7 (28.3)	9	678.3
2	RVSA 81	10.0 (18.4)	9	13.8 (21.7)	3.6 (10.9)	4	14.0 (21.9)	9	497.7
3	SKNP 207	8.0 (16.1)	9	15.7 (23.3)	5.3 (13.3)	6	10.0 (18.4)	9	488.0
4	RVSA 34	15.3 (23.0)	9	17.5 (24.7)	8.7 (17.0)	9	4.0 (11.3)	7	525.0
5	SKNP 224	4.7 (12.4)	6	11.0 (19.3)	4.7 (12.2)	5	13.3 (20.9)	9	493.0
6	RVSA 68	8.0 (16.4)	9	8.9 (17.3)	2.7 (9.3)	3	14.0 (21.8)	9	622.7
7	WRG 65	8.3 (16.7)	9	19.7 (26.4)	9.3 (17.3)	9	6.7 (14.9)	9	702.7
8	WRG 98	10.0 (18.4)	9	17.2 (24.5)	6.7 (14.9)	7	9.3 (17.8)	9	564.3
9	RVSA 64	10.6 (19.0)	9	15.4 (23.0)	6.7 (14.9)	7	8.7 (17.1)	9	602.3
10	Guliyal Red	4.7 (12.4)	6	16.2 (23.6)	10.3 (18.7)	9	25.3 (30.1)	9	612.3
11	LRG 41 (LC)	3.5 (10.7)	4	15.0 (22.8)	5.9 (14.1)	6	3.5 (10.8)	6	640.7
12	BSMR853(NC)	4.7 (12.0)	-	14.8 (22.5)	5.7 (13.8)	-	3.3 (10.4)	-	771.0
	C.D	5.8	-	2.7	NS	-	5.5	-	48.9
	CV (%)	21.4	-	7.1	33.8	-	16.8	-	4.8

* PSR (Pest Susceptibility Rating) based on pod damage;
Figures in ( ) indicate arc sin percentage transformed values; NS: Non Significant; LC: Local check; NC: National Check.

Table 2: Pest susceptibility rating (PSR) of different pigeonpea genotypes under preliminary yield trial

S. No.	Name of the Genotype	Pod damage (%) due to *H. armigera*	PSR*	Inflorescence damage (%) due to *M. vitrata*	Pod damage (%) due to *M. vitrata*	PSR*	Pod damage (%) due to *M. obtusa*	PSR*	Yield (kg/ha)
1	CORG 990015	1.7 (7.4)	8	15.3 (23.0)	2.7 (9.3)	3	11.3 (19.6)	9	623.7
2	MAL 29	1.4 (6.7)	7	13.5 (21.5)	6.0 (14.1)	6	9.3 (17.5)	8	813.7
3	AKT 222544	13.3 (21.4)	9	16.2 (23.7)	6.7 (14.7)	7	6.2 (14.5)	6	808.3
4	PTO – 3- 27	15.8 (23.4)	9	18.9 (25.7)	12.7 (20.8)	9	10.7 (19.0)	9	498.0
5	ICPL 98008	0.9 (5.4)	4	3.2 (10.3)	3.3 (10.4)	4	8.0 (16.1)	7	757.0
6	JSA 68	2.7 (9.3)	9	9.6 (18.0)	0.9 (5.4)	2	10.0 (18.4)	8	522.7
7	SKNP 203	5.3 (12.7)	9	8.6 (17.0)	0.5 (3.9)	2	7.3 (15.7)	6	727.7
8	WRG 91	3.3 (10.4)	9	14.2 (22.0)	10.7 (19.0)	9	16.0 (23.4)	9	573.3
9	LRG 41 (LC)	1.2 (6.4)	-	11.2 (19.6)	5.9 (14.1)	-	6.7 (15.0)	-	608.0
	C.D	8.7	-	4.4	6.3	-	NS	-	61.02
	CV (%)	20.0	-	11.6	29.5	-	18.4	-	5.5

* PSR (Pest Susceptibility Rating) based on pod damage;
Figures in ( ) indicate arc sin percentage transformed values; NS: Non Significant; LC: Local check

Conclusions

From the present studies, it was concluded that among the germplasm lines, WRG 79 and LRG 41 were moderately resistant to *H. armigera;* and RVSA 68 and RVSA 81 were moderately resistant to *M. vitrata*. None of the germplasm lines were found resistant to *M. obtusa*. Similarly, under preliminary yield trial, none of the genotypes were completely free from infestation; and the genotype ICPL 98008 recorded significantly low pod damage both by gram pod borer and spotted pod borer and was categorized as moderately resistant. Further, the genotypes JSA 68 and SKNP 203 were categorized as resistant; and the genotypes CORG 990015 and ICPL 98008 were categorized as moderately resistant to pod damage caused by spotted pod borer.

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