Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2021; 9(2): 1173-1177

Received: 10-01-2021
Accepted: 12-02-2021

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Evaluation of pigeonpea genotypes for their susceptibility to spotted pod borer, *Maruca vitrata* under field conditions

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Abstract
A field experiment was conducted during *Kharif*, 2018 to screen twenty pigeonpea genotypes for their resistance or susceptible to spotted pod borer, *Maruca vitrata*. The results showed that based on per cent pod and seed damage ten genotypes *viz.* RVSA 16-4 (4.67 & 2.14), LRG 467 (5.33 & 2.77), IPA 15-05 (6.67 & 3.77), BDN 711 (6.67 and 3.88), JKM 189 (6.67 and 3.77), GJP 1606 (7.33 and 4.24), TJT 501 (8.00 and 4.27), LRG 463 (8.00 and 4.56), ICPL 87119 (8.00 and 4.57) and RKPV 527-01 (8.00 and 4.4.7) were grouped under the resistant category as they recorded the pest susceptibility rating ranging from 1 to 5; and nine genotypes *viz.*, WRP 1 (13.33 and 7.53), GRG 152 (14.00 and 7.61), PA 440 (14.67 and 8.42), BDN 716 (14.67 and 7.92), LRG 460 (15.33 and 9.94), BDN 2 (17.33 and 9.18), LRG 464 (17.33 and 9.35), LRG 466 (19.33 and 10.05) and ICPL 8863 (22.67 and 13.12) were grouped under the susceptible category as they recorded the pest susceptibility rating ranging from 7 to 9. Maximum seed yield was recorded in RVSA 16-4 (987.33 kg ha^{-1}), followed by LRG 467(958.00), WRP 1(812.33) and RKPV 527-01(793.87), while minimum seed yield was recorded in ICPL 8863 (360.67 kg ha^{-1}). Overall, the genotypes, RVSA 16-4, LRG 467 and RKPV 527-01 with less *M. vitrata* incidence and high grain yield were promising and can be utilisized in further breeding programme.

Keywords: genotypes, *maruca vitrata*, pigeonpea, spotted pod borer

Introduction

Pulses are referred to as poor man's meat since they provide a concentrated source of valuable, digestible and high quality vegetarian protein. They are well known as a cheap source of dietary proteins of food, feed and fodder for animals. Pulses are grown in semi-arid regions under a wide variety of agro climatic conditions. India is the major pulse growing country in the world of which pigeonpea *Cajanus cajan* (L.) ranks second in area and production and contributes about 90% in the world's pulse production. In Andhra Pradesh, it is cultivated in an area of 2.76 lakh hectares with 1.39 lakh tonnes of production and with a productivity of 504 kg/ha [1]. The production of pigeonpea is very low even in the era of green revolution. In recent years, there has been a significant decline in pigeonpea production in India, leading to price increase and reduction in per capita availability. The relatively low crop yields may be attributed to the non-availability of improved cultivars, poor crop husbandry and exposure to several biotic and abiotic stresses in pigeonpea growing regions. Among the various constraints, insect pests are one of the major and important ones affecting the productivity of pigeonpea apart from ecological and biological constraints. It is attacked by more than 300 species of insects of which spotted pod borer, *Maruca vitrata* (Geyer) is the most important pest causing heavy yield loss [2]. It attacks the crop right from the pre-flowering to the pod maturing stage causing heavy yield loss. It webs the floral parts and feeds on them, due to which flower buds fail to open and dropped off from the inflorescence [3]. The yield loss due to *M. vitrata* was estimated to be more than 84% [4]. The annual monitory loss was estimated globally as the US $ 300 million [5].

Farmers depend heavily on the use of synthetic insecticides to combat these insect pests. Extensive use of synthetic insecticides has resulted in disturbances of the environment, pest resurgence, pest resistance to pesticides and lethal effect to non-target organisms in the agro-ecosystem in addition to direct toxicity to users. Therefore, it has now become necessary to search for alternative means of pest control, which can minimize the use of synthetic pesticides. Out of several approaches available for the management, identification and use of resistant varieties are a viable and cost effective option.

Keeping all these in view, the present studies on screening of pigeonpea genotypes against *M. vitrata* were contemplated at Regional Agricultural Research Station, Lam, and Guntur during *Kharif* 2018.

Materials and Methods

A Field experiment was conducted at Regional Agricultural Research Station (RARS), Lam, and Guntur during *Kharif*, 2018. The land was prepared by deep summer ploughing with a tractor drawn cultivator and leveled. Before sowing, the experimental area was prepared by repeated ploughing and harrowing for fine tilth with the onset of pre-monsoon rains. All agronomic practices were adopted as per the recommendation of Acharya N G Ranga Agricultural University in raising the crop during the experimental period. After sufficient amount of rain, twenty genotypes including resistant check (LRG 52) obtained from different All India Coordinator Research Project on Pigeonpea centers across the country were sown to evaluate the resistant/tolerance levels against *M.vitrata* in the field under unprotected conditions in Randomized block design (RBD) with three replications. Each germplasm accession was accommodated in two rows each of 4m length by adopting 1.5 x 0.2 m spacing between rows and plants, respectively with the help of gorru. Gap filling and thinning were done at 15 and 30 days after sowing, respectively to maintain the uniform population. Recommended fertilizer dosage of 20 kg N and 50 kg P_2O_5 ha^{-1} was adopted. Nitrogen was applied in split doses and was phosphorus applied as basal dose one month after sowing. The larval counts of *M. vitrata* were recorded from flowering to pod maturation stage at ten days interval on five randomly tagged plants. To assess the degree of infestation two hundred pods were picked out from each replication at the time of harvest and per cent pod damage was calculated. The pods damaged by spotted pod borer have small holes with scrapped margins and the entrance of holes plugged with larval excreta [6].

$$\text{Per cent pod damage} = \frac{\text{Number of damaged pods}}{\text{Total number of pods}} \times 100$$

At the time of harvest, two hundred pods per replication were collected at random and were split open to count healthy and damaged seeds and the per cent seed damage was calculated [7]. Overall, the data obtained were subjected to RBD analysis using AGRES package [8]

$$\text{Per cent seed damage} = \frac{\text{Number of damaged seeds}}{\text{Total number of seeds}} \times 100$$

To group the genotypes, the pest susceptibility was calculated using the following formula and then converted to 1 to 9 rating scale [9].

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

Where P.D. = mean of per cent pods or seeds damaged

Pest Susceptibility rating	Pest Susceptibility (%)	Remarks
1	100	A rating of scale 1-5 was considered as resistant, 6 was equal to check and from 7-9 as susceptible.
2	75 to 99.9	
3	50 to 74.9	
4	25 to 49.9	
5	10 to 24.9	
6	-10 to 9.9	
7	-25 to -9.9	
8	-50 to -24.9	
9	-50 or less	

Seed yield per plant was calculated for each genotype. Pods collected from each plant were threshed, cleaned, dried and seed weight was measured for all genotypes using a balance. Seed yield per plot was coverted to seed yield kg/ha.

Plate 1: Spotted pod borer, *M. vitrata* and its pod damage on pigeonpea

Results and Discussion

The genotypes showed a great deal of variation in respect to per cent pod and seed damage to *M. vitrata*. However, none of the genotypes were found free form infestation.

Larval population (No)

The observations made on the larval population of *M. vitrata* revealed that there exists a significant difference among genotypes (Table 1**).** The average number of *M. vitrata* larvae per plant ranged from 1.08 (RVSA 16-4) to 9.46 (ICPL 8863) with a mean of 4.40 larvae per plant. These findings were in conformity with Rathod *et al.* [10] who observed 2.47 larvae per plant in ICPL 87119. Sunita Devi *et al.* [11] reported that lowest inflorescence damage due to *M. vitrata* was recorded in ICPL 98008.

Table 1: Pest susceptibility rating for different pigeonpea genotypes based on per cent pod damage by *M. vitrata* during *Kharif*, 2018-2019

S. No.	Name of the genotype	No. of *M vitrata* larvae /plant	Pod damage (%)	Pest susceptibility (%)	Susceptibility rating	Remarks
1	TJT 501	1.69(1.55)*	8.00 (16.34)**	14.25	5	R
2	LRG 463	1.56 (1.49)	8.00 (16.34)	14.25	5	R
3	RKPV 527-01	1.92 (1.63)	8.00 (16.34)	14.25	5	R
4	PA 440	6.60 (2.70)	14.67 (22.50)	-57.23	9	S
5	GJP 1606	2.18 (1.69)	7.33 (15.67)	21.43	5	R
6	JKM 189	1.94 (1.63)	6.67 (14.79)	28.51	4	R
7	WRP 1	7.96 (2.94)	13.33 (21.36)	-42.87	8	S
8	GRG 152	6.94 (2.77)	14.00 (21.93)	-50.05	9	S
9	BDN 711	2.50 (1.78)	6.67 (14.79)	28.51	4	R
10	ICPL 87119	2.40 (1.76)	8.00 (16.34)	14.25	5	R
11	RVSA 16-4	1.08 (1.34)	4.67 (7.32)	49.94	4	R
12	BDN 716	6.21 (2.64)	14.67 (22.50)	-57.23	9	S
13	IPA 15-05	1.54 (1.50)	6.67 (14.79)	28.51	5	R
14	LRG 460	7.52 (2.86)	15.33 (23.03)	-64.30	9	S
15	LRG 466	6.46 (2.68)	19.33 (26.07)	-107.18	9	S
16	LRG 467	1.29 (1.44)	5.33 (7.86)	42.87	4	R
17	BDN 2	7.09 (2.82)	17.33 (24.56)	-85.74	9	S
18	ICPL 8863	9.46 (3.17)	22.67 (28.03)	-142.97	9	S
19	LRG 464	8.06 (2.97)	17.33 (24.56)	-85.74	9	S
20	LRG 52 (RC)	3.52 (2.09)	9.33 (17.62)	-	-	-
Mean		4.40	11.37	-	-	-
F-test		Sig.	Sig.	-	-	-
SEm±		0.46	3.94	-	-	-
CD (p=0.05)		1.33	11.30	-	-	-
CV (%)		12.48	12.23	-	-	-

Pest Susceptibility rating: 1 to 5 –Resistant, 6- Equal to check, 7 to 9 – Susceptible
R ---Resistant S---Susceptible; Sig. – Significant

* Figures in parentheses are square root $\sqrt{(n+1)}$ transformed values
**Figures in parentheses are arc sine transformed values

Pod damage (%)

The results indicated that pod damage due to *M. vitrata* in different pigeonpea genotypes varied significantly and ranged from 4.67 (RVSA 16-4) to 22.67(ICPL 8863) with a mean of 11.37%. Out of 20 genotypes screened for resistance / tolerance to *M. vitrata*, based on per cent pod damage ten genotypes *viz.* RVSA 16-4(4.67), LRG 467(5.33), IPA 15-05(6.67), BDN 711(6.67), JKM 189(6.67), GJP 1606(7.33), TJT 501(8.00), LRG 463(8.00), ICPL 87119(8.00) and RKPV 527-01(8.00) were grouped under the resistant category as they recorded the pest susceptibility rating ranging from 1 to 5; and nine genotypes *viz.*, WRP 1(13.33), GRG 152(14.00), PA 440(14.67), BDN 716(14.67), LRG 460(15.33), BDN 2(17.33), LRG 464(17.33), LRG 466(19.33) and ICPL 8863(22.67) were grouped under the susceptible category as they recorded the pest susceptibility rating ranging from 7 to 9 (Table 1 and Fig 1). Sunitha *et al.* [12] recorded lowest pod damage in ICPL 98003 and ICPL 98008.

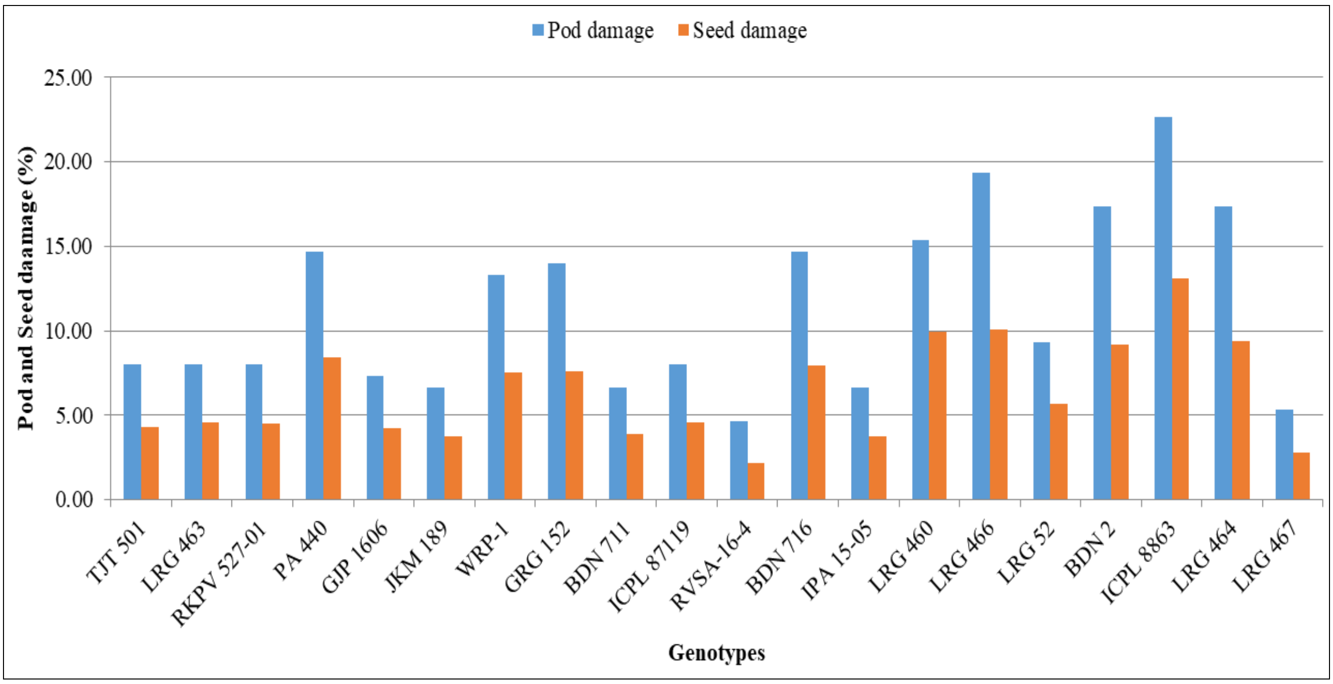

Fig 1: Response of pigeonpea genotypes to per cent pod and seed damage due to *M. vitrata* during *Kharif*, 2018-2019

Seed damage (%)

The seed damage due to *M. vitrata* in different pigeonpea genotypes varied significantly and ranged from 2.14 (RVSA 16-4) to 13.12 (ICPL 8863) with a mean of 6.36%. Out of 20 genotypes screened for resistance/tolerance to *M. vitrata*, based on per cent seed damage ten genotypes *viz.*, RVSA 16-4(2.14), LRG 467(2.77), JKM 189 (3.77), IPA 15-05(3.77), BDN 711(3.88), GJP 1606(4.24), TJT 501(4.27), RKPV 527-01(4.47), LRG 463(4.56) and ICPL 87119 (4.57) were grouped under resistant category as they recorded the pest susceptibility rating ranging from 1 to 5; and nine genotypes *viz.*, WRP 1(7.53), GRG 152(7.61), BDN 716(7.92), PA 440(8.42), BDN 2(9.18), LRG 464(9.35), LRG 460(9.94), LRG 466(10.05) and ICPL 8863(13.12) and were grouped under susceptible category as they recorded the pest susceptibility rating ranging from 7 to 9 (Table 2). Sreekanth *et al.* [13] reported that genotypes, SKNP 224, WRG 79 and SKNP 207 were categorized as moderately resistant with pest susceptibility rating (PSR) 4.

The observations also revealed that the genotypes with a high rate of pod damage show high degree of seed infestation. The number of days taken for 50% flowering ranged from 121(RVSA 16-4) to 101(ICPL 8863) days with a mean of 110 days. Whereas, the number of days taken for maturity ranged from 181 (RVSA 16-4) to 161(ICPL 8863) days with a mean of 169 days. The results obtained on seed yield of different genotypes showed distinct variation with a mean yield of 674 kg ha^{-1}. Maximum (987 kg ha^{-1}) and minimum (361 kg ha^{-1}) seed yield were recorded in RVSA 16-4 and ICPL 8863 respectively (Table 3). The results were in agreement with the findings of Sreekanth *et al.* [14] who reported that a seed yield of 760 kg/ha with WRP 1.

Table 2: Pest susceptibility rating for different pigeonpea genotypes based on per cent seed damage by *M. vitrata* during *Kharif*, 2018-2019

S. No.	Name of the genotype	Seed damage (%)	Pest susceptibility (%)	Susceptibility rating	Remarks
1	TJT 501	4.27 (11.88)	24.82	5	R
2	LRG 463	4.56 (12.07)	19.71	5	R
3	RKPV 527-01	4.47 (11.94)	21.30	5	R
4	PA 440	8.42 (16.65)	-48.23	8	S
5	GJP 1606	4.24 (11.70)	25.35	4	R
6	JKM 189	3.77 (11.15)	33.62	4	R
7	WRP 1	7.53 (15.86)	-32.57	8	S
8	GRG 152	7.61 (15.87)	-33.97	8	S
9	BDN 711	3.88 (11.18)	31.69	4	R
10	ICPL 87119	4.57 (12.26)	19.54	5	R
11	RVSA 16-4	2.14 (4.89)	62.32	3	R
12	BDN 716	7.92 (16.24)	-39.43	8	S
13	IPA 15-05	3.77 (10.95)	33.62	4	R
14	LRG 460	9.94 (18.22)	-75.00	9	S
15	LRG 466	10.05 (18.47)	-76.93	9	S
16	LRG 467	2.77 (5.59)	51.23	3	R
17	BDN 2	9.18 (17.53)	-61.61	9	S
18	ICPL 8863	13.12 (21.22)	-130.98	9	S
19	LRG 464	9.35 (17.61)	-64.61	9	S
20	LRG 52 (RC)	5.68 (13.75)	-	-	-
Mean		6.36	-	-	-
F-test		Sig.	-	-	-
SEm±		2.93	-	-	-
CD (p=0.05)		8.41	-	-	-
CV (%)		12.33	-	-	-

Pest Susceptibility rating:
1 to 5 –Resistant, 6- Equal to check, 7 to 9 – Susceptible
R ---Resistant. S---Susceptible; Sig. – Significant
Figures in parentheses are arc sine transformed values

Table 3: Yield particulars of different pigeonpea genotypes during *Kharif*, 2018-2019

S. No.	Name of the genotype	Days to 50% flowering	Days to maturity	Seed yield (kg ha^{-1})
1	TJT 501	105	165	677
2	LRG 463	111	171	520
3	RKPV 527-01	105	165	794
4	PA 440	103	163	662
5	GJP 1606	108	168	762
6	JKM 189	112	172	731
7	WRP 1	105	165	812
8	GRG 152	106	166	498
9	BDN 711	107	167	679
10	ICPL 87119	115	175	658
11	RVSA 16-4	121	181	987
12	BDN 716	107	167	746
13	IPA 15-05	104	164	553
14	LRG 460	111	171	511
15	LRG 466	109	169	667

16	LRG 467	111	171	958
17	BDN 2	108	168	726
18	ICPL 8863	101	161	361
19	LRG 464	117	177	621
20	LRG 52 (RC)	119	179	560
Mean		110	169	674
F-test		NS	NS	Sig.
SEm±		4.63	4.63	64
CD (p=0.05)		13.26	13.26	182
CV (%)		7.34	4.74	16.34

Sig. – Significant
NS –Non significant

Conclusion
The experimental results conclude that the genotypes, RVSA 16-4, LRG 467 and RKPV 527-01 were found to record less *M. vitrata* incidence with high grain yield.

Acknowledgement
The authors are highly thankful to Acharya N.G. Ranga Agricultural University and Associate Director of Research, RARS, Lam, and Guntur for providing necessary facilities to carry out the work.

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