



Screening of Pigeonpea (*Cajanus cajan* L.) Genotypes against Pod Borer Complex under Field Conditions in Eastern Plateau and Hill Region of India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The pod borer complex, including *Helicoverpa armigera*, *Melanagromyza obtusa*, and *Exelastis atomosa* are one of the major problems of pigeonpea cultivation in the eastern plateau and hill region (EPHR) of India. Field screening of fourteen medium-duration pigeonpea genotypes for their response to key pod borer complex was assessed during *Kharif* 2023-24 and 2024-25 in a randomized block design at the research farm of Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India. The total pod damage caused by the pod borer complex varied from 9.27% in Ormanjhi-local to 21.70% in BAUPP 22-12. Per cent grain damage exhibited a comparable pattern, ranging between 5.70% and 13.90%, and showed a significant correlation with pod damage. Across both years, Ormanjhi-local consistently showed the lowest pod damage from 3.20 to 4.60 percent and showed the lowest pest susceptibility rating, ranging from 55.21% to 63.08% in both years. Ormanjhi-local proved to be the most promising genotype for resistance against major pod borer complex, exhibiting the lowest levels of pod and grain damage. The suggested genotype can further be utilized for pod borer-resistant breeding programmes.

Keywords: Grain damage; pod borer complex; susceptibility; susceptibility rating.

1. INTRODUCTION

Pulses, often called the "poor man's meat," are a cost-effective source of high-quality vegetarian protein, contributing significantly to food security and sustainable agriculture. Their ability to fix nitrogen and thrive in marginal soils makes them ideal for semi-arid regions. India, the leading producer of pulses, accounts for nearly 90% of global pigeonpea production. Pigeonpea (*Cajanus cajan* L.) ranks second in terms of overall output and planted area. The world's largest producer of pigeonpea is India, with an area of 46 lakh hectares, producing approximately 38 lakh tons, and has a productivity of 837 kg/ha. It is grown on 2.27 lakh hectares in Jharkhand, yielding roughly 2.47 lakh tons with a productivity of 1088 kg/ha (Anonymous, 2023).

However, the productivity of pigeonpea is often hampered by a range of insect pests, which pose a major threat throughout the crop's phenological stages. Among the most destructive are *Helicoverpa armigera* (Hübner, 1809) (pod borer), *Melanagromyza obtusa* (Malloch) (pigeonpea pod fly), and *Exelastis atomosa* (Wals.) (flower webber), causing substantial yield losses annually (Srivastava and Joshi, 2011). *Helicoverpa armigera* is the most important pest in the semi-arid tropics (Sharma et al., 2008) and causes significant losses in grain yield (Kumari et al. 2006). *Maruca testulalis* is a significant insect pest of early pigeonpea. In India, crop losses from this pest can reach 100% (Saxena et al., 2002). In the untreated control, the percentage of pod damage caused by *E. atomosa* was 11.40% (Nithish et al. 2017). Due to the voracious feeding habits of *H. armigera*, *M. vitrata*, and *M.*

obtusa, as well as their tendency to develop resistance to synthetic pesticides, the majority of studies have concentrated on managing these species (Volp et al., 2025).

Host Plant Resistance (HPR) is an eco-friendly and cost-effective viable management strategy against such insect pests and is also recommended as a component of integrated pest management. The identified resistance sources can be used directly or indirectly in breeding programmes for solving problems related to the development of pod borer complex resistance in pigeonpea. Hence, in the present study, medium duration pigeonpea genotypes were screened in field conditions to find out the sources of resistance against pod borer complex.

2. MATERIALS AND METHODS

The field experiments were conducted at the Research Farm of Birsa Agricultural University (BAU), Kanke, Ranchi (23°17' N latitude and 85°19' E longitude, elevation 625 m above mean sea level) during *Kharif* 2023-24 and 2024-25. Fourteen genotypes, namely BDN 716, BAUPP 23-1, Rajiv Lochan, BAUPP 20-37, ICP 8863, BAUPP 20-40, BA-1, JKM 189, BAUPP 22-2, Ormanjhi-Local, BAUPP 22-3, BAUPP 22-12, ICPL 87119, and BAUPP 22-1, were collected from the Department of Genetics and Plant Breeding of BAU, Ranchi, Jharkhand, India. Pigeonpea seeds were seeded in good soil conditions, and all agronomical packages of practices (except the application of pesticides) were followed with a spacing and plot size of 75 cm x 20 cm and 12 m² respectively to raise the crops in the Randomized Block Design (RBD).

Table 1. Rating scale for Pest susceptibility according to Lateef & Sachan (1990)

Pest Susceptibility Rating	Pest Susceptibility (%)	Remarks
1	100	A rating of scale 1-5 was considered as resistant, 6 moderately resistant, 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	

The plots were kept free from the application of any insecticides and fungicides during the study period. Five plants from each plot were chosen at random from each of the three replications. Data for pod damage and grain damage were taken at peak infestation (fully grown pods) and harvesting, respectively. To assess the degree of infestation caused by pod borer complex, pods were picked out from each replication at the time of harvest, and per cent of pod and grain damage was calculated.

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

2.1 Genotype Grouping According to Pest Susceptibility

To categorize the genotypes based on their pest susceptibility, the percentage of pest damage was first calculated using a specific formula, and the results were subsequently converted into a 1 to 9 rating scale, following the method outlined by Abbott (1925).

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

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

3. RESULTS AND DISCUSSION

3.1 Pod and Grain Damage by pod Borer Complex of Pigeonpea Genotypes

The field screening of 14 pigeonpea genotypes against the major pod borer complex, *H. armigera*, *M. testulalis*, and *E. atomosa* revealed significant differences in pod and grain damage among the genotypes in both tested years ($p < 0.001$) (Tables 2 & 3). This indicates the presence of genotypic variation in resistance to insect pest damage and productivity potential.

Among all the genotypes during 2023-24, Ormanjhi-Local recorded the lowest overall pod borer complex damage (11.37%) and grain damage (6.42%), followed by Rajiv Lochan (14.58% pod damage, 7.48% grain damage), suggesting their relatively higher resistance to insect pests. Ormanjhi-Local also showed the lowest infestation from individual pests, especially *H. armigera* (4.60%) and *E. atomosa* (2.14%). Similarly, during 2024-25, Ormanjhi-Local exhibited the lowest levels of pod borer complex damage (9.27%) and grain damage (5.70%), followed by Rajiv Lochan with low pod borer damage (12.37%) and moderate grain damage (6.77%). Medium maturity genotype CG ARHAR-2 reported by Patel et al. (2024) showed the lowest total pod percent damage of 19.00% in the line of the present study genotypes.

Lepidopteran pod borers caused a large variation in the percentage of pod damage, ranging from 4.33 percent in genotype IVT-520 to 11.67 percent in genotype IVT-502. IVT-510 also had the largest grain damage from pod borers (4.90%), whereas IVT-520 had the lowest grain damage (1.07%) reported by Singh et al. (2016). In contrast, BAUPP 22-12 exhibited the highest pod borer complex damage (24.53%) and grain damage (14.51%) during 2023-24, indicating high susceptibility to pest infestation. It was followed closely by BA-1 (22.00% and 13.18%, respectively) and JKM 189 (20.93% and 12.64%, respectively). Notably, these genotypes showed higher infestation levels across all three insect species, particularly *H. armigera*, which remained the dominant pest across genotypes. A high level of susceptibility in these genotypes requires more intensive pest management interventions if considered for cultivation. Chakravarty et al. (2016) observed that PUSA-2012-1 recorded lowest pod damage of 18.61% followed by PA 409 (21.25%). In line of present study, Akkanna (2020) reported damage variation among genotypes by pod borer, *H. armigera*,

Table 2. Per cent pod and grain damage by pod borer complex on Pigeonpea genotypes during Kharif 2023-24

S. No.	Genotypes	Per cent pod damage			Pod borer complex	Per cent damage of grains by pod borer complex
		<i>H. armigera</i>	<i>M. testulalis</i>	<i>E. atomosa</i>		
1.	BDN 716	7.20 (2.68) ^{k *}	5.86 (2.42) ^{ij}	2.44 (1.56) ^{kl}	15.51(3.94) ^{jk}	10.48 (3.24) ^{ij}
2.	BAU PP 23-1	9.27 (3.04) ^{de}	7.10 (2.66) ^d	3.61 (1.90) ^{fg}	19.97 (4.47) ^{cd}	11.75 (3.43) ^{fg}
3.	Rajiv Lochan	6.33 (2.52)	5.71 (2.39) ^{cd}	2.53 (1.59) ^{jk}	14.58 (3.82) ^k	7.48 (2.74) ^k
4.	BAUPP 20-37	8.20 (2.86) ^{hi}	6.48 (2.55) ^{ef}	3.36 (1.83) ^{hi}	18.04 (4.25) ^{gh}	11.66 (3.41) ^{gh}
5.	ICP 8863	9.00 (3.00) ^{ef}	7.15 (2.67) ^{cd}	4.26 (2.06) ^a	20.41 (4.52) ^{bc}	11.89 (3.45) ^{ef}
6.	BAUPP 20-40	8.73 (2.96) ^{gh}	6.25 (2.50) ^{gh}	3.93 (1.98) ^{bc}	18.91 (4.35) ^{fg}	12.91 (3.59) ^{ab}
7.	BA-1	10.27 (3.20) ^{ab}	7.63 (2.76) ^{ef}	4.09 (2.02) ^{ab}	22.00 (4.69) ^a	13.18 (3.63) ^a
8.	JKM 189	9.93 (3.15) ^{bc}	7.20 (2.68) ^{bc}	3.80 (1.95) ^{de}	20.93 (4.58) ^{ab}	12.64 (3.55) ^{bc}
9.	BAUPP 22-2	9.60 (3.10) ^{cd}	6.48 (2.54) ^{fg}	3.71 (1.93) ^{ef}	19.79 (4.45) ^{cd}	12.16 (3.49) ^{cd}
10.	Ormanjhi-Local	4.60 (2.14)	4.63 (2.15)	2.14 (1.46) ^l	11.37 (3.37) ^l	6.42 (2.53) ^l
11.	BAUPP 22-3	7.60 (2.76) ^{jk}	5.62 (2.37) ^k	3.12 (1.77) ^{ij}	16.34 (4.04) ^{ij}	9.83 (3.13) ^j
12.	BAUPP 22-12	10.53 (3.25) ^a	8.03 (2.83) ^a	5.97 (2.44)	24.53 (5.95)	14.51 (3.81)
13.	ICPL 87119	7.80 (2.79) ^{ij}	5.96 (2.44) ^{hi}	3.40 (1.84) ^{gh}	17.17 (4.14) ^{hi}	11.29 (3.36) ^{hi}
14.	BAUPP 22-1	9.00 (3.00) ^{fg}	6.86 (2.62) ^e	3.84 (1.96) ^{cd}	19.70 (4.44) ^{de}	12.09 (3.48) ^{de}
	SE(m)	0.30	0.20	0.21	0.49	0.39
	F cal	29.52	19.39	19.55	44.97	29.71
	<i>P</i>	<0.001	<0.001	<0.001	<0.001	<0.001

*Values in parentheses are the square root of mean values

Table 3. Per cent pod and grain damage by pod borer complex on Pigeonpea genotypes during Kharif 2024-25

S. No.	Genotypes	Per cent pod damage			Pod borer complex	Per cent damage of grains by pod borer complex
		<i>H. armigera</i>	<i>M. testulalis</i>	<i>E. atomosa</i>		
1.	BDN 716	6.00 (2.45) ^{*k}	5.43 (2.33) ^{jk}	2.37 (1.54) ^l	13.80 (3.71) ^{jk}	9.70 (3.11) ^{ij}
2.	BAU PP 23-1	8.27 (2.88) ^{de}	6.80 (2.61) ^{cd}	3.57 (1.89) ^{gh}	18.60 (4.31) ^{cd}	11.03 (3.32) ^{fg}
3.	Rajiv Lochan	4.80 (2.19) ^l	5.17 (2.27) ^l	2.40 (1.55) ^{kl}	12.37 (3.52) ^k	6.77 (2.60) ^k
4.	BAUPP 20-37	7.23 (2.69) ^{hi}	6.17 (2.48) ^{fg}	3.33 (1.83) ^{ij}	16.70 (4.09) ^{gh}	10.80 (3.29) ^{gh}
5.	ICP 8863	7.77 (2.79) ^{fg}	6.77 (2.60) ^{de}	4.23 (2.06) ^{ab}	18.73 (4.33) ^{bc}	11.27 (3.36) ^{ef}
6.	BAUPP 20-40	7.63 (2.76) ^{gh}	5.83 (2.42) ^{hi}	3.90 (1.97) ^{cd}	17.37 (4.17) ^{fg}	12.17 (3.49) ^{ab}
7.	BA-1	9.27 (3.04) ^{ab}	7.30 (2.70) ^{ab}	4.07 (2.02) ^{bc}	20.06 (4.48) ^a	12.37 (3.52) ^a
8.	JKM 189	8.97 (2.99) ^{bc}	6.90 (2.63) ^{bc}	3.73 (1.93) ^{ef}	19.63 (4.43) ^{ab}	11.97 (3.46) ^{bc}
9.	BAUPP 22-2	8.60 (2.93) ^{cd}	6.13 (2.48) ^{gh}	3.67 (1.91) ^{fg}	18.43 (4.29) ^{de}	11.47 (3.39) ^{cd}
10.	Ormanjhi-Local	3.20 (1.79)	4.07 (2.02)	2.03 (1.43)	9.27 (3.04) ^l	5.70 (2.39) ^l
11.	BAUPP 22-3	6.53 (2.56) ^{jk}	5.23 (2.29) ^{kl}	3.07 (1.75) ^{jk}	14.77 (3.84) ^{ij}	9.13 (3.02) ^j
12.	BAUPP 22-12	9.53 (3.09) ^a	7.77 (2.79) ^a	4.40 (2.10) ^a	21.70 (4.66)	13.90 (3.73)
13.	ICPL 87119	6.83 (2.61) ^{ij}	5.60 (2.37) ^{ij}	3.37 (1.83) ^{hi}	15.80 (3.97) ^{hi}	10.67 (3.27) ^{hi}
14.	BAUPP 22-1	7.97 (2.82) ^{ef}	6.50 (2.55) ^{ef}	3.83 (1.96) ^{de}	18.27 (4.27) ^{ef}	11.37 (3.37) ^{de}
	SE(m)	0.33	0.21	0.26	0.57	0.39
	F cal	26.47	20.52	7.67	33.85	31.35
	<i>P</i>	<0.001	<0.001	<0.001	<0.001	<0.001

*Values in parentheses are the square root of mean values

Table 4. Pest resistance/susceptibility for different pigeonpea genotypes based on per cent pod damage by *H. armigera* during Kharif, 2023-24 and 2024-25

S. No.	Resistant categories	Genotypes/Varieties	Number of genotypes/variety
1.	Resistant	BDN 716, Rajiv lochan, BAUPP 20-37, ICP 8863, BAUPP 20-40, Ormanjhi local, BAUPP 22-3, ICPL 87119, BAUPP 22-1	9
2.	Moderately resistant	BAUPP 23-1, BA-1, JKM 189, BAUPP 22-2	4
3.	Susceptible	BAUPP 22-12	1

where the least per cent of pod damage by the *H. armigera* were observed in the entry BRG 2 (20.39%). Similarly, larval population and pod damage by *E. atomosa* were least in BRG 2 (18.96%). Rathod et al. (2014) reported that the highest pod damage was recorded on variety ICPL-87119 (36.56%).

In pest susceptibility rating, genotypes such as BDN 716, Rajiv Lochan, BAUPP 20-37, ICP 8863, BAUPP 20-40, Ormanjhi local, BAUPP 22-3, ICPL 87119, and BAUPP 22-1 were categorised as resistant genotypes (Table 4). Genotype BAUPP 22-12 was categorised as susceptible to pod borer complex. Genotypes such as BAUPP 23-1, BA-1, JKM 189, and BAUPP 22-2 were recorded as moderately susceptible. Four years observations of data on host plant resistance in mango showed different levels of resistance against insect pest infestation in field conditions (Choudhary and Das, 2020). Similar finding also shows among the genotypes screened against *H. armigera* for resistance/tolerance, based on per cent pod damage and seed damage, eight genotypes viz., RKPV 527-01, GJP 1606, JKM 189, BDN 711, ICPL 87119, RVSA 16-4, IPA 15-05, LRG 467 were grouped under the resistant category as they recorded the pest susceptibility rating ranging from 1 to 5 (Divyasree et al. 2019).

4. CONCLUSION

In conclusion, Ormanjhi-Local was found most resistant genotype against the pod borer complex in field conditions based on two years of observations. Other genotypes, such as BDN 716, Rajiv Lochan, BAUPP 20-37, ICP 8863, BAUPP 20-40, BAUPP 22-3, ICPL 87119, and BAUPP 22-1, were also categorized as resistant genotypes based on pest susceptibility rating. The observed genotypes can further be utilized for pod borer-resistant breeding programmes for sustainable farming after further validation under multilocation trials in the eastern plateau and hill region conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author (s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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