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RESEARCH ARTICLE

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Screening of Cowpea Genotypes for Field Resistance to the Spotted Pod Borer (*Maruca vitrata*)

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ABSTRACT

Background: Cowpea [*Vigna unguiculata* (L.) Walp.] is an important legume crop known for its nutritional value. However, the cultivation of this crop is greatly hampered by a destructive pest, a spotted pod borer (*Maruca vitrata* Fab.). Keeping the caustic nature of the pest in view, the present study was undertaken.

Methods: Field evaluation of thirty cowpea genotypes was carried out by raising cowpea plants in an open field. Observations on the *M. vitrata* incidence were recorded at three days' intervals starting from the development of the first buds to the end of flowering. Based on the level of infestation of buds, flowers and pods, the cowpea genotypes were categorised into four groups *viz*., resistant, moderately resistant, susceptible and highly susceptible.

Results: Results of the study revealed a significant variation between the genotypes in terms of total damage (0.21 to 48.46%). Genotype IC 2918 recorded remarkably low damaged (0.12%) and was on par with Palakkadan thandan payar, Hridya, EC 300039, EC 101216, EC 98668, IC 39945, IC 52110, IC 39922 and IC 39916. The genotype Bhagyalaxmi recorded the highest damage (48.46%) followed by the variety Lola (30.04%). Flower buds were more susceptible to *M. vitrata* and suffered severe damage as compared to flowers and pods. Conversely, genotypes EC 98668 and IC 39922 were free from bud damage. Genotypes EC 300039, EC 98668, IC 52110, IC 39945, IC 2918 and IC 39922 recorded no flower damage and Palakkadan thandan payar, IC 39945, IC 2918 and IC 39947 recorded no pod damage.

Key words: Cowpea, *Maruca vitrata*, Naturally available resistance, Screening, Spotted pod borer.

INTRODUCTION

Cowpea, [*Vigna unguiculata* (L.) Walp.] is an important pulse crop with great nutritional potential. This crop is cultivated in the semi-arid tropics of Asia, Africa and other parts of the world. It is food not only for humans but also dishes up as feed for animals. Nevertheless, the economic production of cowpea is unable to achieve its fullest potential due to damage caused by insect pests. Of this, a notorious pest, a spotted pod borer, *Maruca vitrata* (Fab.) (Lepidoptera: Crambidae) is a major pest of cowpea. This pest was first reported by Dietz (1914) on beans in Indonesia. The caterpillar of this moth is polyphagous that causes damage to almost all kinds of legumes over a wide range of environmental conditions in all areas where legumes are cultivated as a major crop (Srinivasan *et al.,* 2021). This pest gains the attention of several researchers around the globe because damage by this pest almost always crosses the economic threshold level (Rathwa *et al*., 2018).

The larvae of *M. vitrata* are more abundant and cause severe damage to crop than any other pests (Karel, 1985). The pod damage due to this pest ranges from 13 to 31 per cent, the seed damage around 16 per cent and the total yield loss ranges between 33 to 53 per cent (Singh and Allen, 1980). Based on the estimate, the annual yield losses caused by *M. vitrata* have been around 30 million dollars in India (Saxena *et al*., 2002). In Kerala, 8 to 40 per cent of pod damage has been reported (Anithakumari, 1992). The high humidity and low temperatures prevailing during September and October are highly favourable for pest build-up. To overcome the *M. vitrata* damage in cowpea several control measures were adopted in the recent past in different parts of the world (Challa *et al*., 2016). Among these, the use of host plant resistance is an important component of integrated pest management. In such scenario, the use of complete or partial resistance or/and tolerant sources against many insect pests are available in different cultivars and helpful in reducing crop damage (Singh, 1978; van Emden, 1989). Therefore, screening of commercial and local cultivars is suggested as a prerequisite to find out tolerant or resistant sources against the different insects. Saxena and Khan (1991) reported that sources of resistance should be looked for in traditional varieties or unimproved germplasm of the particular crop. Singh (1999) opined that

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finding out and using a source of resistance from wild relatives for transferring the resistance genes to cultivated types may have a limited scope because of the retention of wild characters in the segregating generations. Keeping these facts in view, a screening trial has been taken up to find out naturally available resistance in thirty genotypes of cowpea.

MATERIALS AND METHODS

Description of genotypes used for the study

Thirty genotypes of cowpea comprising 20 genotypes from the National Bureau of Plant Genetic Resources (ICAR-NBPGR) Regional Station, Jodhpur, Rajasthan, six cultivars released from Kerala Agricultural University (KAU), Thrissur, one genotype each from the University of Agricultural Sciences (UAS), Bengaluru, Vegetable and Fruits Promotion Council Keralam (VFPCK), Thiruvananthapuram, ICAR-Indian Institute of Vegetable Research (IIVR), Varanasi as well as ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru were evaluated for resistance to spotted pod borer (Table 1). These genotypes constituted the treatments in the field experiment. Three yard-long bean genotypes were used in the study (Geethika, Vellayani Jyothika and Lola) and the rest were grain-type cowpea.

Field screening of cowpea genotypes for resistance to spotted pod borer (*Maruca vitrata* Fab.)

Field evaluation of thirty cowpea genotypes was carried out by raising cowpea plants on an open field at a spacing of 30 × 15 cm, 45 × 15 cm and 2 × 2 m for the bush, semi-trailing and trailing types, respectively during *Kharif*, 2018 at Vellyanikara, KAU, Thrissur. Two weeks before planting, the variety Bhagyalaxmi was sown along the border around the plot to serve as a multiplication site for the test insect, *M. vitrata*. Observations on the spotted pod borer incidence were recorded at three days' intervals starting from the development of the first buds up to the end of flowering. Ten plants were selected randomly from each genotype as replicate and pod borer infestation to buds, flowers and pods were recorded. The per cent damage was calculated based on the number of infested buds, flowers and pods to the total number of buds, flowers and pods, respectively. Flower buds, flowers and pods once counted were marked to avoid

Table 1: Details of the cowpea genotypes evaluated.

Treatments	Genotypes	Source
T_1	Geethika	KAU, Thrissur
T_2	Vellayani Jyothika	KAU, Thrissur
T_3	Lola	KAU, Thrissur
T_4	Hridya	KAU, Thrissur
T_5	Palakkadan thandan payar	VFPCK, Thiruvananthapuram
T_6	Kanakamony	KAU, Thrissur
T_7	Mysore Local	IIHR, Bengaluru
T_8	Kashikanchan	IIVR, Varanasi
T_9	EC 300039	ICAR - NBPGR, RS, Jodhpur
T_{10}	EC 98668	ICAR - NBPGR, RS, Jodhpur
T_{11}	EC 101216	ICAR - NBPGR, RS, Jodhpur
T_{12}	IC 52110	ICAR - NBPGR, RS, Jodhpur
T_{13}	IC 39945	ICAR - NBPGR, RS, Jodhpur
T_{14}	IC 2918	ICAR - NBPGR, RS, Jodhpur
T_{15}	IC 39922	ICAR - NBPGR, RS, Jodhpur
T_{16}	IC 52118	ICAR - NBPGR, RS, Jodhpur
T_{17}	IC 39916	ICAR - NBPGR, RS, Jodhpur
T_{18}	IC 2196	ICAR - NBPGR, RS, Jodhpur
T_{19}	IC 20645	ICAR - NBPGR, RS, Jodhpur
T_{20}	IC 26048	ICAR - NBPGR, RS, Jodhpur
T_{21}	IC 52107 A	ICAR - NBPGR, RS, Jodhpur
T_{22}	IC 39947	ICAR - NBPGR, RS, Jodhpur
T_{23}	IC 39921	ICAR - NBPGR, RS, Jodhpur
T_{24}	IC 26029	ICAR - NBPGR, RS, Jodhpur
T_{25}	IC 20720	ICAR - NBPGR, RS, Jodhpur
T_{26}	IC 39870	ICAR - NBPGR, RS, Jodhpur
T_{27}	IC 52105	ICAR - NBPGR, RS, Jodhpur
T_{28}	IC 9883	ICAR - NBPGR, RS, Jodhpur
T_{29}	TVX - 944	UAS, Bengaluru
T_{30}	Bhagyalaxmi	KAU, Thrissur

recounting. Based on the level of infestation of buds, flowers and pods, the cowpea genotypes were categorised into four groups *viz*., resistant (0 to 5% damage), moderately resistant (5 to 10% damage), susceptible (10 to 15%) and highly susceptible (>15% damage).

$$\text{Total damage (\%)} = \frac{\Sigma\ (\text{Number of damaged buds, flowers and pods per plant})}{\Sigma\ (\text{Total number of buds, Flowers and pods per plant})} \times 100$$

Statistical analysis

Data on the damage parameters, per cent bud, flower and pod damage were analysed using One-way ANOVA to test the significance of difference among genotypes using Web Agri. Stat Package 2.0, an online-based tool (https://ccari.icar.gov.in/waspnew.html). Principal component analysis for clustering was performed using Minitab 18.

RESULTS AND DISCUSSION

Thirty cowpea genotypes were evaluated for their reaction to the infestation of spotted pod borer, *M. vitrata*. There was significant variation observed between the genotypes with respect to bud, flower, pod and overall damage (Table 2). Based on overall damage caused by spotted pod borer, all genotypes were categorised as resistant, moderately resistant, susceptible and highly susceptible (Table 3 and Fig 1). Ten genotypes recorded the overall damage remarkably below 5 per cent with the damage ranging between 0.12 to 4.78 per cent. Among these ten genotypes, the lowest damage was recorded by genotype IC 2918 (0.12%) and was found on par with Palakkadan thandan payar, Hridya, EC 300039, EC 101216, EC 98668, IC 39945, IC 52110, IC 39922 and IC 39916. These genotypes were categorised as resistant genotypes. Three genotypes *viz*., IC 39947, IC 52107 A and IC 20645 recorded total damage

Table 2: Extent of damage and scenario of morphological characters related to resistance.

Genotypes	Mean no. of damage bud	Mean no. of damage flower	Mean no. of damage pod	Total damage %
Geethika	6.02±0.46	3.46±0.01	2.45±0.23	13.78±0.36
Vellayani Jyothika	6.40±0.40	3.64±0.65	7.50±0.19	18.11±0.69
Lola	8.28±0.71	10.86±1.18	7.96±0.94	30.04±1.99
Hridya	0.84±0.02	0.86±0.05	0.99±0.04	4.02±0.35
Palakkadan thandan payar	0.91±0.08	1.16±0.06	0.00±0.00	4.02±0.56
Kanakamony	5.62±0.78	2.28±0.17	2.77±0.32	15.24±0.92
Mysore Local	4.68±0.13	2.19±0.04	1.89±0.33	13.95±0.06
Kashikanchan	6.92±0.12	5.35±0.53	4.57±0.09	28.74±0.76
EC 300039	0.97±0.03	0.00±0.00	1.34±0.45	4.78±0.79
EC 98668	0.00±0.00	0.00±0.00	0.20±0.20	0.21±0.29
EC 101216	0.56±0.56	0.79±0.79	0.75±0.25	2.61±1.97
IC 52110	0.64±0.03	0.00±0.00	1.67±0.56	3.23±0.92
IC 39945	0.35±0.35	0.00±0.00	0.00±0.00	0.52±0.51
IC 2918	0.10±0.42	0.00±0.00	0.00±0.00	0.12±0.71
IC 39922	0.00±0.00	0.00±0.00	0.38±0.38	0.75±0.75
IC 52118	6.82±0.87	4.12±1.99	1.53±0.20	14.81±3.73
IC 39916	1.86±0.48	0.00±0.00	0.76±0.25	3.83±0.57
IC 2196	6.00±0.80	5.32±0.39	5.06±0.30	19.94±2.21
IC 20645	1.96±1.02	1.22±0.03	1.39±0.46	9.43±3.5
IC 26048	2.87±0.01	2.06±0.73	1.25±0.42	13.08±2.33
IC 52107 A	2.63±0.18	1.63±0.75	1.22±0.07	7.78±0.19
IC 39947	1.35±0.42	2.28±0.06	0.00±0.00	6.88±0.89
IC 39921	2.53±0.03	3.57±0.04	1.71±0.05	14.86±0.57
IC 26029	3.04±0.20	5.38±0.12	6.88±0.26	23.57±2.05
IC 20720	6.28±0.14	6.14±0.04	1.64±0.04	27.5±0.09
IC 39870	4.66±0.28	5.03±0.13	3.79±0.13	21.33±0.64
IC 52105	2.69±0.01	5.31±0.31	5.52±0.20	25.84±0.01
IC 9883	4.49±0.41	4.46±0.61	2.97±0.43	25.09±1.47
TVX - 944	2.09±0.62	1.04±1.04	2.58±0.02	18.07±4.77
Bhagyalaxmi	13.85±0.35	11.03±1.71	9.49±0.39	48.46±4.73
CD ($P\leq0.05$)	1.265	1.876	0.902	5.934

* Figures indicate means±standard error.

of 6.68, 7.78 and 9.43 per cent and were categorised as moderately resistant genotypes.

Total five genotypes recorded overall damage in the range of 10 to 15 per cent and were categorised as susceptible. The remaining 12 genotypes recorded total damage more than 15 per cent and were categorised as highly susceptible. The highest damage caused by *M. vitrata* to the grain type bushy variety Bhagyalaxmi (48.46%), followed by the vegetable type trailing variety Lola (30.04%). It was also observed that the vegetable type *viz*., Vellayani Jyothika, Lola and Kashikanchan suffered comparatively more damage by *M. vitrata* than the grain type genotypes. This may be due to the succulent nature of the pods in vegetable cowpea than grain-type genotypes. These findings are in accordance with the earlier report of Beegum and Subramanian (2017).

Variation was also observed in infestation levels at different reproductive stages of the genotype. The variety Bhagyalaxmi recorded the highest level of infestation at all three stages *viz*., bud (13.85%), flower (11.03%) and pod (9.49%) followed by Lola. The buds of Genotypes EC 98668 and IC 39922 were free from *M. vitrata* damage. The genotypes EC 300039, EC 98668, IC 52110, IC 39945, IC 2918 and IC 39922 were found to be tolerant at the flowering stage and no flower damage was recorded. The genotype Palakkadan thandan payar, IC 39945, IC 2918 and IC 39947 also recorded no pod damage.

Overall, the buds of most of the genotypes suffered more damage than the flowers and pods. This can be explicated by the following reasons. The adult female of the *M. vitrata* prefers the flower bud as an oviposition site (Jackai, 1980; Sharma *et al*., 1999, Wang *et al*., 2014) and after hatching from eggs, the neonate larva directly feeds on the bud as ready food sources that result in a higher infestation to bud. Sharma *et al.* (1999) and Fousséni *et al.* (2013) reported that the first instar larvae of *M. vitrata* show a strong feeding affinity towards bud and flower than the pods. Besides, Smith (1979) reported that the pod infestation indicates the intensity of the larval migration on the pods when the pest population is high. The intensity of larval migration is largely depending on the age and density of *M. vitrata* larvae found on the different parts of the host plant (Jackai, 1981). Therefore, high densities of larvae on flower buds force the larvae to migrate on pods from buds and which results in high pod damage due to feeding and cause secondary infestation. Moreover, in field situations, usually, older instar larvae are found infesting pods compared to early instar larvae (Oghiakhe *et al*., 1995). While early instars prefer to feed on flower buds and cause damage to flowers and buds. Hence, the screening of germplasm is necessary at bud, flower and pod stages to search out resistant/tolerant genotypes of cowpea which could be utilized in breeding programmes to develop resistant or tolerant varieties against notorious pests like *M. vitrata*.

Table 3: Classification of cowpea genotypes based on the extent of damage by spotted pod borer.

Susceptibility rating	The extent of total damage %	Genotypes
Resistant	0-5%	Hridya, Palakkadan thandan payar, EC 300039, EC 98668, EC 101216, IC 52110, IC 39945, IC 2918, IC 39922 and IC 39916
Moderately resistant	5-10%	IC 20645, IC 52107 A and IC 39947
Susceptible	10-15%	Geethika, Mysore Local, IC 52118, IC 26048 and IC 39921
Highly susceptible	<15%	Bhagyalaxmi, Vellayani Jyothika, Lola Kanakamony, Kashikanchan, IC 2196, IC 26029, IC 20720, IC 39870 IC 52105, IC 9883 and TVX - 944

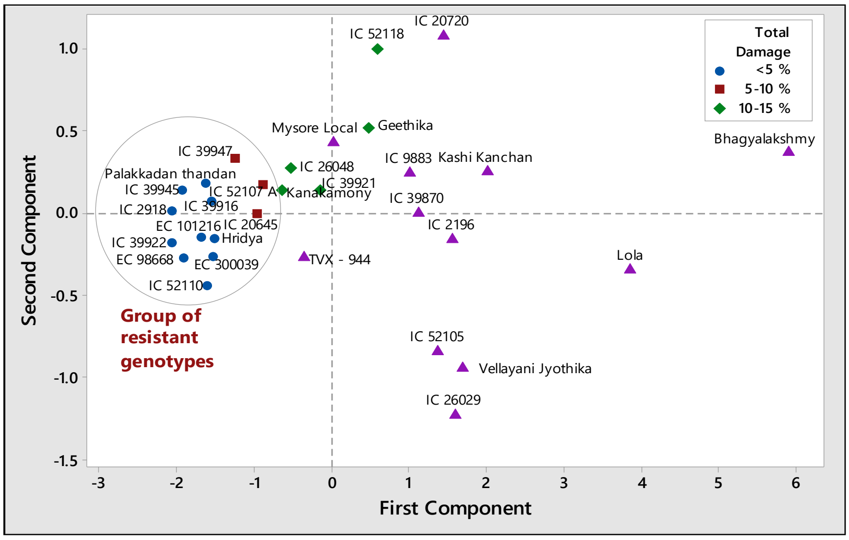

Fig 1: Clustering of genotypes in two principal components.

CONCLUSION

In the present study, EC 300039, EC 98668, IC 52110, IC 39945, IC 2918 and IC 39922 recorded no flower damage and Palakkadan thandan payar, IC 39945, IC 2918 and IC 39947 recorded no pod damage by *M. vitrata*. These genotypes recorded a remarkably low level of damage and could serve as valuable sources of resistance in the breeding programme against *M. vitrata*.

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Conflict of interest: None.

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