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Screening of pigeonpea genotypes against *Maruca vitrata* (Geyer)

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ABSTRACT

Six promising short duration pigeonpea genotypes were screened for their reaction against *Maruca vitrata* (Geyer) under field, greenhouse and laboratory conditions. Field and greenhouse experiments showed significantly lower pod damage by *Maruca* in ICPL 98003 and ICPL 98008 as compared to the susceptible genotype ICPL 88034. In addition, greenhouse and laboratory studies showed less consumption of food and reduced larval and pupal weights of *M. vitrata* when reared on resistant genotypes like ICPL 98003 and ICPL 98008.

Key words: *Maruca vitrata*, Resistance, Screening

Pigeonpea, [*Cajanus cajan* (L) Millsp] is an important grain legume in India and is grown in 3.5 million ha with an annual production of 2.4 million tonnes (FAO, 2005). Among the major insect pests, gram pod borer *Helicoverpa armigera* (Hubner), spotted pod borer *Maruca vitrata* and redgram pod fly *Melanogromyza obtusa* are of prime importance. In pigeonpea, losses due to *M. vitrata* have been estimated at US$ 30 million annually (ICRISAT 1992). This pest is controlled primarily through use of chemical insecticides (Booker 1965, Dina 1979, 1988). However, dependence on only chemicals may lead to problems such as development of resistance, outbreak of secondary pests and pesticide residues in agricultural produce. Use of insect resistant genotypes is an important and compatible component of IPM modules which is an effective, cheap, and environmentally safe. However, screening of cultivars under field conditions is often difficult due to lack of uniform infestation or low levels of infestation. This problem can be avoided through artificial infestation of the test plants under greenhouse conditions. As no serious attempts have been made in the past to screen pigeonpea varieties for resistance to *M. vitrata* under uniform infestation, the present study was carried out to screen some of the short duration pigeonpea genotypes under field, greenhouse and laboratory conditions against *M. vitrata*.

MATERIALS AND METHODS

Screening of six promising pigeonpea genotypes ICPL 98001, ICPL 98002, ICPL 98003, ICPL 98008, ICPL 98012 and ICPL 88034 against *Maruca vitrata* (Geyer) was conducted under field, greenhouse and laboratory conditions at International Crops Research Institute for the Semi Arid Tropics (ICRISAT), Patancheru.

Screening under field conditions: Six pigeonpea genotypes were sown in red soil in four replications during *kharif* season from June to October 2005 at ICRISAT, Patancheru. Each cultivar was sown in two rows of 3 m length with a row to row spacing of 60 cm and plant to plant spacing of 10 cm. Recommended agronomic practices were followed to raise the crop except plant protection measures. Observations on *Maruca* infestation were recorded during peak pod infestation when some of the lines were completely damaged by *Maruca*. The pod damage was recorded on ten plants from each replication. From each plant, five peduncles were randomly selected for pod damage and the data were expressed in per cent pod damage and given in a scale of 1-5 as suggested by Jackai (1982).

Greenhouse and laboratory studies: The technique of mass rearing of the test insect was done on artificial diet developed by Ochieng *et al.* (1981) under laboratory conditions. Under greenhouse conditions, cage technique developed by Sharma (in press) was used to screen pigeonpea genotypes by subjecting them to uniform insect pressure at 50% flowering stage of the crop. The six pigeonpea genotypes were planted in separate pots at the rate of one plant per pot with four replications of each treatment. Each replication was infested with 10 first instar larvae at 50% flowering stage and covered with a muslin cloth. Observations on larval weight gain, larval mortality, number of healthy and damaged pods, per cent pod damage and grain yield were recorded 15 days after larval inoculation.

Under laboratory studies, flowers of each of the six genotypes were collected from unsprayed field, weighed and kept in plastic cups separately. Ten first instar larvae of M. *vitrata* were released on flowers kept in separate cups. Each treatment was replicated four times. Flowers in the cup were changed daily with freshly weighed flowers till the larval period was completed. Observations were taken on mass of food consumed by the larvae, mass of frass excreted, larval weight gain, growth rate (%) and weight of pupae and pupation (%).

RESULTS AND DISCUSSION

Among the six genotypes, ICPL 88034 recorded significantly higher pod damage (68%) as compared to ICPL 98002 (51%) and ICPL 98001 (49%) which were at par with each other. The pod damage recorded in ICPL 98012 was 24.50%. The lowest pod damage was recorded in ICPL 98003

(5.80%) and ICPL 98008 (6.77%). Based on the pod damage, the genotypes were given the resistance rating 1-5. In the present study, ICPL 98003 and ICPL 98008 which recorded resistance rating of 0.25 and 0.35 were categorized as highly and moderately resistant genotypes. ICPL 98012 recorded 1.24 damage score. The genotypes ICPL 98001 and ICPL 98002 recording the damage score of 2.40 and 2.55 were grouped under intermediate type and the susceptible genotype ICPL 88034 recorded 3.45 damage score. In the present study, none of the genotypes were highly susceptible to the pest attack (Table 1).

Table 1. Field screening of six short duration pigeonpea genotypes against spotted pod borer *Maruca vitrata* during *kharif* season 2004–2005

Genotype	Pod damage (%)	Damage score	Resistance rating*
ICPL 98001	49.25 (44.56)	2.40	Intermediate
ICPL 98002	51.00 (45.57)	2.55	Intermediate
ICPL 98003	5.80 (13.91)	0.25	Highly resistant
ICPL 98008	6.77 (14.73)	0.35	Highly resistant
ICPL 98012	24.50 (29.61)	1.24	Moderately resistant
ICPL 88034	68.00 (56.71)	3.45	Susceptible
CV	2.10		
SE	11.0		
CD (0.05)	5.648		

*% Pod damage, Values in parentheses are arc sine percentage values

Under greenhouse conditions, the maximum number of pods were recorded in ICPL 88034 (23.00) and ICPL 98002 (20.00) which were at par with each other. Significantly lower pods were recorded in ICPL 98008 (12.0) and ICPL 98003 (14.75). The number of pods recorded in ICPL 98001 and ICPL 98012 were 16.00 and 15.00, respectively (Table 2). The larvae fed on ICPL 88034 gained maximum weight (70.20 mg) whereas it was lowest on ICPL 98012 (27.62 mg). The larval weight gain recorded in ICPL 98002 (62.27 mg) and ICPL 98001 (60.08 mg) was at par with each other. The larval weight gain in ICPL 98003 and ICPL 98008 was 30.77mg and 31.95 mg, respectively. The larval mortality observed on test genotypes ranged from 20 to 25% and no significant difference was observed between the treatments. The grain yield/plant varied from 1.52 g in ICPL 88034 to 3.37 g in ICPL 98003. The grain yield obtained from ICPL 98012 (2.42 g), ICPL 98008 (2.30 g) and ICPL 98002 (2.05 g) were at par with each other. The grain yield obtained from ICPL 98001 was 1.85 g/plant. The results revealed that the genotype ICPL 88034 recorded significantly highest pod damage resulting in lower yield (1.52 g/ plant) and highest larval weight (70.20 mg). The genotypes ICPL 98003 and ICPL 98008 recorded significantly low pod damage and less larval weight and higher yield than other genotypes. Thus, the greenhouse screening confirmed the results obtained from the field.

Table 2. Relative susceptibility of pigeonpea genotypes to spotted pod borer *Maruca vitrata* at the flowering stage (10 larvae/plant) under greenhouse conditions

Genotype	Pod damage (%)	Larval weight (mg)	Larval mortality (%)	Grain yield (g/plant)
ICPL 98001	28.36 (32.12)	60.08	(26.19) 20.00	1.85
ICPL 98002	32.47 (34.72)	62.27	(27.69) 2250	2.05
ICPL 98003	17.40 (24.51)	30.77	(29.36) 25.00	3.37
ICPL 98008	21.74 (27.65)	31.95	(29.36) 25.00	2.30
ICPL 98012	31.65 (34.17)	27.62	(29.36) 25.00	2.42
ICPL 88034	32.42 (34.69)	70.20	(29.36) 25.00	1.52
CV	9.96	4.64	0.29	0.12
SE	10.59	1.10	5.98	0.11
CD (0.05)	4.63	3.30	12.57	0.37

M. vitrata larvae prefer hidden and shaded places for feeding. In the present study, the highly resistant pigeonpea genotypes *viz.*, ICPL 98003 and ICPL 98008 hold the pods above the foliage and also the time required to complete flowering and pod maturity in the above genotypes was comparatively short. These factors might have resulted in less preference of the genotypes for feeding and less weight gain by the larvae. The results are in conformity with the findings of Singh (1978) and Oghiakhe *et al.* (1991) who showed significantly greater damage of pod borer in cowpea with pods held within the canopy.

The results of feeding first instar larvae of *M. vitrata* on flowers under laboratory conditions (Table 3) showed highest

Table 3. Growth and development of *Maruca vitrata* larva reared on flowers of six pigeonpea genotypes under laboratory conditions

Genotype	Mass of food consumed by larva (%)	Mass of faeces excreted by larva (%)	Increase in mass (%)	Growth rate (%)	Pupation (%)	Pupal weight (mg)
ICPL 98001	(53.93) 65.30	(23.75) 16.20	(47.58) 54.50	254.72	69.25	41.10
ICPL 98002	(40. 24) 1.70	(22.36) 15.10	(42.00) 46.30	270.05	70.25	34.80
ICPL 98003	(40.96) 43.00	(28.68) 23.30	(32.32) 31.10	112.45	49.75	11.30
ICPL 98008	(37.94) 38.00	(23.98) 16.80	(35.00) 33.00	136.79	45.50	20.00
ICPL 98012	(56.63) 69.30	(28.20) 22.50	(34.84) 32.70	116.38	41.75	31.50
ICPL 88034	(61.66) 77.00	(31.87) 28.00	(53.63) 64.80	276.47	73.0	48.30
CV	0.106	0.114	0.164	0.104	2.76	0.12
SE	3.66	2.15	4.75	14.33	0.009	2.30
CD (0.05)	7.70	4.52	9.98	30.12	8.22	6.84

food consumption on ICPL 88034 (77%) followed by ICPL 98003 (69.30%) and ICPL 98002 (65.30%) which were at par with each other. The lowest food consumption was recorded with ICPL 98008 (38%) followed by ICPL 98001 (41.70%) and ICPL 98012 (43%). Mass of faeces excreted by the larvae was highest when fed on ICPL 88034 (28%) followed by ICPL 98003 (23.30%) and ICPL 98012 (22.50%). Lowest mass of excreta was recorded with ICPL 98002 (15.10%) followed by ICPL 98001 (16.20%) and ICPL 98008 (16.80%) which were at par with each other. The highest larval weight was recorded on ICPL 88034 (66.80%) followed by ICPL 98001 (56.70%), ICPL98002 (48.30%), ICPL 98008 (35%) and ICPL 98012 (34.70%). Lowest larval mass was recorded with ICPL 98003 (33.30%). The increase in larval weight was highest on ICPL 88034 (64.80%) followed by ICPL 98001 (54.50%) and ICPL 98002 (46.30%). Lowest larval weight gain was observed on ICPL 98003 (31.30%) followed by ICPL 98012 (32.70%) and ICPL 98008 (33%). Larva reared on ICPL 88034 recorded highest growth rate (276.47 %) followed by ICPL 98002 (270.05%) and ICPL 98001 (254.72%). Significantly lower growth rate was recorded on ICPL 98003 (112.45%) followed by ICPL 98012 (116.38%) and ICPL 98008 (136.79%). Similarly, the highest pupation was recorded on ICPL 88034 (73%) followed by ICPL 98002 (70.25%) and ICPL 98001 (69.25%), whereas lowest pupation was recorded on ICPL 98003 (41.75%) followed by ICPL 98008 (45.50%) and ICPL 98012 (49.75%).

Maruca reared on ICPL 88034 recorded highest pupal mass (48.30 mg) followed by ICPL 98001 (41.10 mg), ICPL 98002 (34.80 mg) and ICPL 98012 (31.50 mg). Lowest pupal mass was recorded on ICPL 98003 (11.30 mg) and ICPL 98008 (20 mg). Sharma *et al.* (1999) observed significant differences in the consumption and utilization of flowers by the 3rd instar larvae of *M. vitrata*. He found that the larvae reared on ICPL 84023 had lower larval and pupal mass than those reared on ICPL 90036-M1-2. He further stated that fecundity was low when the larvae were reared on the pods of *Maruca* resistant cultivar MPG 537-M1-M5. Jackai (1991) reported that *M. vitrata* larvae surviving on pods of resistant cowpea variety TVNu 72 were smaller, produced smaller pupa and lower percentage pupation compared with other test varieties.

Thus, the results of the present study indicated that pigeonpea genoypes, ICPL 98003 and ICPL 98008 showed resistance against *Maruca vitrata* and may be utilized in breeding programme for incorporation of resistance in high yielding background.

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