Morphological and bio-chemical factors associated with resistance to *Maruca vitrata* (*testulalis*) (Geyer) in cowpea

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**ABSTRACT**

Legume pod borer, *Maruca vitrata* (Geyer) is one of the major constraints in increasing the production and productivity of grain legumes in the tropics. Keeping in view of the importance of this pest, present studies were carried out with the association of different morpho-chemical traits with resistance/susceptibility to *M. vitrata* at the Pulses Research Station, SDAU, S.K. Nagar. Some of the characters like flower colour, pod angle, protein, flavonoid, tannin and phenols were found to be associated with *M. vitrata* attack on cowpea genotypes. The pod damage by *M. vitrata* on different cowpea genotypes in the field ranged from 10.22 to 19.98%. High phenol content in pods (428.63mg/100g) and (326.33mg/100g) found responsible for the resistance of GC 5 and GC 0815, respectively and high flavonoid concentration in pods (484.08mg/100g) and (458.81mg/100g) in GC 5 and GC 0815 respectively were responsible for resistance. Based on these results, GC 5 and GC 0815 were categorized as moderately resistant. This paper discusses the physico-chemical traits associated with resistance to *M. vitrata* in cowpea variety/genotypes.

**Key words:** Host plant resistance, *Maruca vitrata*, Physico-chemical traits, Resistance mechanisms.

**INTRODUCTION**

The legume pod borer, *Maruca vitrata* (Geyer) is a serious pest of grain legumes in the tropics and sub-tropics because of its extensive host range, destructiveness, and distribution and its ability to infest the young growing plant tips, flower buds, flowers, pods and seeds. The destructiveness at critical stages of growth viz, flowering and seed development constitutes a significant constraint to the productivity of grain legumes. During recent years the damage caused by *M. vitrata* has been aggravated (Sharma *et al.*, 1999). Infestation starts in the terminal shoots, but later spreads to the reproductive parts (Jackai, 1981). Eggs are normally deposited on floral buds and flowers, although oviposition on leaves, leaf axils, terminal shoots, and pods. Infestation is highest in flowers > flower buds > terminal shoots > pods. Karel (1985) also observed more larvae (52.3%) on flowers than on pods (37.8%), and leaves (9.9%). Losses in grain yield have been estimated to range from 20 to 60% (Singh and Allen, 1980). In Bangladesh, pod borer damage in cowpea was 54.4% during harvest, but yield loss was estimated to be < 20% (Ohno and Alam, 1989). A threshold of 40% larval infestation in flowers has been established (Ogunwolu, 1990).

Insect pests are often affected by physico-chemical features of the host plants. Type of cultivars possess fewer flowers per cluster than determinant type and hence a disproportionately lower number of pod borer larvae per unit area of reproductive shoots. The studies conducted by Sharma (1998) showed significant differences in oviposition preference of *M. vitrata* under multi-choice conditions. These studies also suggested less suitability of some of the genotypes for growth and development of pod borer under field conditions. Thus there is a need for understanding the factors responsible for the resistance. Hence the present studies were undertaken to determine the role of morphological and/or biochemical traits of cowpea genotypes associated with resistance to *M. vitrata*.

**MATERIALS AND METHODS**

**Evaluation of cowpea genotypes/variety for resistance to *M. vitrata* under field condition:** The test genotypes were planted at the Pulses Research Station, SDAU, S. K. Nagar during the *kharif* season 2015 under AICRP on Arid legume project. Each cultivar was sown in five rows of each 4 m length with a row spacing of 45 cm and 10 cm plant to plant within the row. Each treatment is replicated thrice following randomized block design. Recommended agronomic practices were followed to raise the crop, with a basal application of 20:40:0 kg NPK/ha respectively at the time of sowing. Observations on *M. vitrata* damage were recorded on ten randomly selected plants in each replicate. From each plant five peduncles were again randomly selected and the pods on the peduncles were examined for *M. vitrata* damage at the peak infestation when some of the genotypes were completely damaged. Genotypes showing > 60% damage were categorized as susceptible and those showing <10%
damage as resistant (Bindra and Jokhmola 1967; and Sahoo et al. 2002).

**Morphological characters:** Data on certain morphological characters of test genotypes such as flower colour, pod colour, pod wall thickness, pod length and pod angle were recorded following factors in order to study the relationship of these traits with resistance/susceptibility to *M. vitrata*.

To determine the factors attributing resistance against *M. vitrata*, observations on plant morphological characters recorded on randomly selected plants in the following manner.

- **Flower colour:** Flower colour was noted by visual observations.
- **Pod colour:** Pod colour was noted by visual observations.
- **Seed colour:** Seed colour was noted by visual observations.
- **Pod wall thickness:** Thickness of pod wall measured with vernier calipers in mm.
- **Pod length:** Pod length measured with measuring scale from randomly selected ten pods from each tagged plants and recorded in cm.
- **Pod angle:** Pod angle was measured with protractor as per standard procedure.

**Biochemical factors:** Pods of cowpea variety/genotypes were collected at immature stage. These pods were freeze dried in a life lyophilizer, powdered in a grinder and analyzed for the total soluble sugars, protein, flavonoid, tannin and phenols following standard procedures. Total phenol content in pods of cowpea was estimated as per the method developed by Malik et al., (1980) and data was expressed as mg/g phenols of dry pods of cowpea. Total protein content in test materials was estimated using micro-kjeldahl method (Tandon, 1992) of nitrogen content estimation which then multiplied by the factor 6.25 for obtaining the protein content. Flavonoid content in test material was estimated by aluminum chloride colorimetric method given by Chang et al., (2002) and data were expressed in mg/g flavonoid of dry pods of cowpea. In cowpea tannin determination was carried out by Folin-Denis method Schanderl, (1970) and data was expressed in mg/g tannin of dry pods of cowpea.

Flavonoid content in test materials was found significantly different in pods across the genotypes. The genotype GC 5 recorded highest flavonoid content (484.08 mg/100gm) followed by GC 0815 (458.81 mg/100gm). Lowest flavonoid content was recorded in GC 3 (335.80 mg/100g). Highest tannin content was recorded in pods of GC 0815 (4.03g/100g) while lowest was recorded in RC 101 (2.11g/100g). In the present study higher concentration of phenols found in GC 5 (4.28mg/100g) followed by GC 0703 (4.04mg/100g) which might have made the genotypes less nutritionally suitable for *Maruca* development resulting in less pod damage. Macfoy and Dabrowski (1983) reported higher concentration of phenols in the stems of *Maruca* resistant cowpea variety TVu 946 than in susceptible varieties. Low phenol content was

### RESULTS AND DISCUSSION

Seven cowpea genotypes/variety tested for their reaction to the infestation of spotted pod borer, *M. vitrata* showed a significant variation in pod damage. The morphological characters associated with resistance are pod angle, flower colour and pod wall thickness. Pod angle and pod damage were positively correlated in cowpea cultivars. Pods with wide angles were damaged on one side, and rarely on both sides. Erect and profuse flowering contributed to the resistance against *Maruca*. Similar results were observed by Singh (1978) who reported that resistance is due to long peduncles, pods held over the plant canopy and at a wider angle than the normal in pigeon pea. Present finding were also supported by Halder and Srinivasan (2011) they reported that resistance is due to morphological characters in cowpea. Among the seven genotypes (Table 1), Pusa phalguni recorded significantly highest pod damage (19.98%) followed by GC 3 (18.10%) and GC0706 (15.76 %) which were at par with each other. The lowest pod damage was recorded on GC 0815 (10.22 %) followed by GC 5(10. 27). Based on the pod damage under field conditions these genotypes were categorized as moderately resistant.

The observations on biochemical constituents (Table 2) viz., sugars, phenols, flavonoid, tannin and proteins were found significantly different in pods across the genotypes. The genotype GC 5 recorded highest flavonoid content (484.08 mg/100gm) followed by GC 0815 (458.81 mg/100gm). Lowest flavonoid content was recorded in GC 3 (335.80 mg/100g). Highest tannin content was recorded in pods of GC 0815 (3.54g/100g) while lowest was recorded in RC 101 (2.11g/100g). In the present study higher concentration of phenols found in GC 5 (428.63mg/100g) followed by GC 0703 (404.80mg/100g) which might have made the genotypes less nutritionally suitable for *Maruca* development resulting in less pod damage. Macfoy and Dabrowski (1983) reported higher concentration of phenols in the stems of *Maruca* resistant cowpea variety TVu 946 than in susceptible varieties. Low phenol content was

### Statistical analysis:

Data on morphological and biochemical parameters of test genotypes were analyzed using ANOVA and these parameters used with per cent pod damage.

### Table 1: Different morphological characters of cowpea genotypes and pod borer damage

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Flower colour</th>
<th>Pod colour</th>
<th>Pod wall thickness (mm)</th>
<th>Pod Length (cm)</th>
<th>Pod angle</th>
<th>Pod borer damage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC-3</td>
<td>Purpal violet</td>
<td>Green</td>
<td>0.66</td>
<td>12.90</td>
<td>59.56</td>
<td>24.93*(18.10)</td>
</tr>
<tr>
<td>GC-5</td>
<td>Purpal violet</td>
<td>Green</td>
<td>0.57</td>
<td>10.41</td>
<td>62.10</td>
<td>18.65(10.27)</td>
</tr>
<tr>
<td>Pusa phalguni</td>
<td>Purpal violet</td>
<td>Green</td>
<td>0.64</td>
<td>11.56</td>
<td>55.0</td>
<td>26.52(19.98)</td>
</tr>
<tr>
<td>RC-101</td>
<td>Whitish yellow</td>
<td>Light green</td>
<td>0.63</td>
<td>10.01</td>
<td>55.63</td>
<td>22.41(14.27)</td>
</tr>
<tr>
<td>GC-0815</td>
<td>Yellowish white</td>
<td>Light green</td>
<td>0.84</td>
<td>11.91</td>
<td>64.83</td>
<td>18.60(10.22)</td>
</tr>
<tr>
<td>GC-0703</td>
<td>Yellowish white</td>
<td>Light green</td>
<td>0.62</td>
<td>11.57</td>
<td>52.23</td>
<td>20.45(12.26)</td>
</tr>
<tr>
<td>GC-0706</td>
<td>Yellowish white</td>
<td>Green</td>
<td>0.69</td>
<td>10.63</td>
<td>60.66</td>
<td>23.27(15.76)</td>
</tr>
<tr>
<td>S.Em±</td>
<td>-</td>
<td>-</td>
<td>0.029</td>
<td>0.454</td>
<td>2.27</td>
<td>1.61</td>
</tr>
<tr>
<td>CD at 5%</td>
<td>0.090</td>
<td></td>
<td>1.410</td>
<td>6.87</td>
<td>5.01</td>
<td>1.61</td>
</tr>
<tr>
<td>CV %</td>
<td>7.53</td>
<td></td>
<td>6.97</td>
<td>9.69</td>
<td>12.61</td>
<td>1.61</td>
</tr>
</tbody>
</table>

*arc sin transformed values, figures in parenthesis are retransformed values
recorded in Pusa phalguni (287.04 mg/100gm) followed by GC 3 (295.63 mg/100gm). Similar results were observed by Halder et al. (2006) who reported that phenols were highest (21.03 mg/g) in resistant cultivar LGG 497 than the susceptible cultivar LGG 450 (20.0 mg/g) in mung bean. Anantharaju and Muthaiah (2008) identified that biochemical basis of resistance may be due to low amount of total free amino acid, crude protein content and high amount of total phenols in the pigeonpea genotypes against spotted pod borer.

**REFERENCES**


