Screening of yard long bean genotypes for resistance to legume pod borer, *Maruca vitrata* F.

Robiah Noor Ahmed¹, Md. Azizul Haque², Kazi Shahanara Ahmed³, Mohammad Mahir Uddin² and Mohammed Abul Monjur Khan²

¹Department of Agricultural Extension (DAE), Natore, Rajshahi  
²Department of Entomology, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

**Abstract**

The research work on the evaluation of yard long bean genotypes for resistance to legume pod borer, *Maruca vitrata* F. was carried out in two consecutive seasons viz., kharif 2015 and rabi 2015-16 in randomized complete block design (RCBD) in the field of the Department of Entomology, Bangladesh Agricultural University (BAU). The biochemical constituents present in legume pod borer, *Maruca vitrata* F. was carried out in two consecutive seasons viz., kharif 2015 and rabi 2015-16 in randomized complete block design (RCBD) in the field of the Department of Entomology, Bangladesh Agricultural University (BAU), Mymensingh. Nine genotypes of yard long bean were evaluated and reacted distinctly to *M. vitrata* with significantly different levels of infestation to flowers, pods and yield. The genotype Long Red Mollika was categorized as moderately resistant to legume pod borer in both kharif and rabi seasons. Genotype YL 305 was found susceptible in both the seasons. The plant attributes, both vegetative and reproductive, of yard long bean did not show any significant correlation in favour of resistance to *M. vitrata*. Yard long bean genotypes also did not show resistive reaction to *M. vitrata* in respect of sugar and phenol but particularly protein showed antibiosis against *M. vitrata*.

**Introduction**

Legumes are important sources of low-fat dietary protein, fiber, and micronutrients in the human diet (Messina, 1999) and therefore, considered as the 'meat of the poor' (Heiser, 1990). In the farming system, legumes are planted in crop rotations to improve soil fertility by fixing atmospheric nitrogen, to control soil erosion, to break pest cycles, and to produce livestock fodder (Leikam et al., 2007). Amongst food legume, yard long bean (*Vigna unguiculata* sub sp. *sesquipedalis*) is one of the most popular vegetables in Bangladesh. It has potentiality for export of both fresh and frozen and can be grown all the year round (Rashid, 1999). It is extensively grown in kharif season when there is a shortage of vegetables supply in the market in Bangladesh.

There are many constrain including insect pests as vital one for the production of yard long bean. Among insect pests legume pod borer (LPB), *Maruca vitrata* (Fab.) is one of the major constraints to the production and productivity of grain legumes including yard long bean. Legume pod borer (LPB), *M. vitrata* Fabricius (Lepidoptera: Pyralidae), is also considered the most serious pest of yard long bean, mungbean, and soybean in Southeast Asia (Sharma 1998; Ulrichs et al., 2001; Soeun 2001). *M. vitrata* is a genetically complex species (Margam et al., 2011; Periasamy et al., 2015) due to an extensive host range, high damage potential and cosmopolitan distribution (Taylor, 1967; Sharma et al., 1999; Margam et al., 2011). The geographic range of *M. vitrata* extends from northern Australia and East Asia through sub-Saharan Africa (Ke et al., 1985; Sharma, 1998) to the Americas (Munroe, 1995). The larvae web the leaves and inflorescence, feed inside the flowers, flower buds, and pods. Typical infestations by *M. vitrata* can cause yield reductions of 20 to 80% (Atachi et al., 2007). In the Philippines and Indonesia, pod damage in yard long bean was estimated about 80% and 25%, respectively (Ulrichs and Mewis, 2004; Hammig et al., 2008). Yield losses of about 40% from *M. vitrata* damage have been reported in yard long bean and cowpea in Thailand (Phompajai and Jamjanya, 2000; Yule and Srinivasan, 2013). In Bangladesh, pod borer damage has been estimated to be 54.4% during harvest in cowpea, (Ohno and Alam, 1989).

Several plant characters have been postulated to offer resistance to the pod borers (Tayo, 1988, Oghiakhe et al., 1991a, 1991b, 1992). However data on the role of plant characters that provide resistance to *M. vitrata* are inconclusive. The biochemical constituents present in quantities and proportion to each other in host plants have been reported to exert profound influence on the growth, survival and reproduction of insects in various ways (Painter, 1958; Panda and Khush, 1995). The secondary plant substances present in yard long bean which affect the plant suitability to other insects are also
likely to affect the growth and development of *M. vitrata*. Sharma (1998) reviewed and concluded that significant progress in developing resistant varieties in cowpea and pigeon pea has been made in Africa. Although it is a highly nutritious vegetable, until now no commercial variety of yard long bean with high yield and better pod quality has been released in Bangladesh and no proper research thrust has been given for the improvement of this vegetable. Better knowledge on genetic diversity or genetic similarity could help to get long term selection gain in plants (Chowdhury et al., 2002). For all these reasons, now it is essential to find out the resistant genotype(s) of yard long bean against legume pod borer, *M. vitrata* F.

**Materials and Methods**

The research was conducted at the field of Department of Entomology and laboratory of the Department of Biochemistry and Molecular Biology, Professor Mohammad Hossain Central Laboratory, Bangladesh Agricultural University, Mymensingh and Bangladesh Institute of Nuclear Agriculture (BINA). Nine promising yard long bean genotypes were selected to find out the varietal resistance against the legume pod borer. The list of genotypes with their source of collection is shown in Table 1.

**Table 1. List of yard long bean genotypes with their source**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Genotypes</th>
<th>Place/source of collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Green Mollika</td>
<td>Mollika Seed Company</td>
</tr>
<tr>
<td>02</td>
<td>Long Red Mollika</td>
<td>Mollika Seed Company</td>
</tr>
<tr>
<td>03</td>
<td>Sabuj Sanket</td>
<td>ACI Limited</td>
</tr>
<tr>
<td>04</td>
<td>YL 305</td>
<td>ACI Limited</td>
</tr>
<tr>
<td>05</td>
<td>Shornolata</td>
<td>United Seed Company</td>
</tr>
<tr>
<td>06</td>
<td>Toki</td>
<td>Lal Teer Seed Industry Limited</td>
</tr>
<tr>
<td>07</td>
<td>SB Quick Long</td>
<td>SB Crop Care Industries Limited</td>
</tr>
<tr>
<td>08</td>
<td>BARI Borboti 1</td>
<td>Bangladesh Agricultural Research Institute (BARI)</td>
</tr>
<tr>
<td>09</td>
<td>Kegarnatki</td>
<td>Bangladesh Agricultural Development Corporation (BADC)</td>
</tr>
</tbody>
</table>

The experiment was conducted in two consecutive seasons viz., kharif 2015 and rabi 2015-16. The seeds were sown on May 17, 2015 and October 22, 2015. The experiment was laid out in a randomized complete block design with three replicates. The distance of plot to plot and replicate to replicate was 1.0m and 2.0m, respectively. Each plot measuring 2.65m x 1.2m had 20 plants. Intercultural operations were done as and when needed. No insecticides were applied. Two kinds of data like morphological and bio chemical parameters of yard long bean were investigated for their resistance.

**Morphological observations of yard long bean genotypes**

Data on the morphological characters of tested genotypes, namely number of leaves per plant, leaf area, number of branches per plant, plant height (cm), days to first flowering and harvesting, pod length (cm), pod girth (cm), number of pods (fresh and infested) per plant, pod wall thickness (mm), number of seeds per pod, 100 seeds weight (g), surface area of seed (mm²) and pod yield (g) per plant were observed and recorded from twenty plants from each plot and correlated with incidence of *M. vitrata*.

**Percent flower infestation**

The intensity of flower infestation was recorded from 10 rachis selected randomly per plot starting from flower initiation to the end of the study at 7 days intervals. The number of healthy flowers and infested flowers were counted and the percent flower infestation for each genotype was calculated by using the following formula:

\[
\% \text{ Flower infestation} = \frac{\text{Number of infested flower}}{\text{Total number of flower}} \times 100
\]

**Percent pod infestation**

Observations on pod infestation were recorded during each harvesting time at four days intervals. The pod damage was recorded from twenty plants from each replication. Each pod was examined for *M. vitrata* injury. The number and weight of healthy pods and infested pods were counted and the percent pod infestation for each treatment was calculated and expressed as percentage.

\[
\% \text{ Pod infestation} = \frac{\text{Number of infested pod}}{\text{Total number of pod}} \times 100
\]

Based on the per cent pod damage, the damage score for each genotype was calculated and was given the resistance rating 1–5 as suggested by Jackai (1982).

**Table 2. Pod damage (%) score resistance rating**

<table>
<thead>
<tr>
<th>Pod damage (%)</th>
<th>Score</th>
<th>Resistance rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>1</td>
<td>Highly resistant</td>
</tr>
<tr>
<td>21-40</td>
<td>2</td>
<td>Moderately resistant</td>
</tr>
<tr>
<td>41-60</td>
<td>3</td>
<td>Intermediate</td>
</tr>
<tr>
<td>61-80</td>
<td>4</td>
<td>Susceptible</td>
</tr>
<tr>
<td>81-100</td>
<td>5</td>
<td>Highly susceptible</td>
</tr>
</tbody>
</table>

**Biochemical observations of yard long bean genotypes**

Flowers of yard long bean genotypes were collected at 50% flowering stage and pods collected at immature stage. Those flowers and pods were freeze dried in a life lyophilizer at -80°C for 72 hours, powdered with the help of a grinder and analyzed for the total sugar, protein and phenol.

**Results and Discussion**

The results obtained from the field studies revealed that none of the genotypes of yard long bean was found to be completely resistant to *M. vitrata* (Table 3). However, the lowest flower and pod damage and the highest yield were obtained in Long Red Mollika and the highest flower and pod damage and the lowest yield were found in YL 305. In both kharif and rabi seasons the lowest flower (25.45 & 20.00%) and pod damage (37.04 & 29.39%) were obtained in Long Red Mollika and the highest flower (46.85 & 40.00%) and pod damage
(70.44 & 61.22%) were found in YL 305 (Table 3). In both seasons the highest pod yield was found from Long Red Mollika (11.93 ton per hectare in kharif and 10.43 ton per hectare in rabi) and the lowest pod yield was recorded from YL 305 (7.14 ton per hectare in kharif and 6.20 ton per hectare in rabi) (Table 4). Based on the percent pod damage the genotypes were given the resistance rating 1 to 5 as suggested by Jackai (1982). Based on the damage score, in kharif season, the genotype Long Red Mollika was categorized as moderately resistant. The genotypes Green Mollika, Sabuj Sanket, Shornolata, SB Quick Long, BARI Borboti 1, Toki and Kegarnatki were grouped under intermediate type. The susceptible genotype was YL 305. In the rabi season, the percentage of infested flower and pod of all genotypes decreased. The genotypes Long Red Mollika, BARI Borboti 1 and Shornolata were categorized as moderately resistant. Green Mollika, Sabuj Sanket, SB Quick Long, Toki and Kegarnatki were grouped under intermediate type and the susceptible genotype was YL 305.

The intensity of flower and pod damage by M. vitrata was found to be higher in the kharif, 2015 than in the rabi 2015–16. The higher temperature, relative humidity and rainfall in kharif, 2015 season compared to the rabi 2015–16 season influenced the flower and pod damage by this insect. It was observed that the population abundance of M. vitrata increased when temperature, relative humidity and rainfall increased and again the population abundance decreased when temperature, relative humidity and rainfall decreased. Similar results were reported by Sahoo and Bahera (2001) and Reddy et al. (2001) who observed the positive correlation between population of M. vitrata and minimum, maximum and average of temperature and relative humidity on pigeon pea in India.

The plant attributes both vegetative and reproductive, of yard long bean did not show any significant correlation in favour of resistance to M. vitrata. However, biochemical factor might exhibit resistance to M. vitrata. Biochemical factors are likely to affect the growth and development of M. vitrata. There is influence on nutritional value in different genotypes for the growth and development of larvae. Low sugar, less protein and high phenol content has been found to offer resistance to pigeon pea because it influences the feeding habit of M. vitrata (Maxwell and Jennings, 1980). In present study it was found that protein content in pods and flowers were significantly higher (29.46 and 22.46%) in susceptible YL 305 compared to moderately resistant Long Red Mollika (21.00 and 15.17%) (Table 5). Sunitha et al. (2008) also observed similar trend that protein content in pods was significantly higher (25.5%) in susceptible ICPL 88034 compared to resistant ICPL 98003 (16.5%) against the M. vitrata in short duration pigeonpea cultivars. Phenol and sugar compounds in the flower and green pods of the yard long bean are not found to contribute resistance against the insect M. vitrata (Table 5). This confirms the report of Oghiakhe et al. (1993) who could not find any significant correlation between the sugar and phenolic concentration in pods of wild and cultivated Vigna species and damage by M. vitrata. However, phenol is known to play important defensive roles against some other cowpea pests (Baker et al., 1989).

Yard long bean genotypes did not show resistant reaction to M. vitrata in respect of sugar and phenol but particularly protein showed antibiosis against M. vitrata.

Among the genotypes of yard long bean, Long Red Mollika in spite of its some susceptibility performed much better in respect of flower and pod damage and yield. It was found as a moderately resistant/tolerant and the others were susceptible to intermediate to M. vitrata. Hence, the genotype Long Red Mollika may be recommended for cultivation.

### Table 3. Percent infestation of legume pod bore, M. vitrata to flowers and pods of yard long bean obtaining in different genotypes in two seasons (kharif, 2015 and rabi, 2015–16)

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Infested flower (%)</th>
<th>Infested pod (%)</th>
<th>Score 1–5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Mollika</td>
<td>32.36 bd</td>
<td>24.99 (29.93) b</td>
<td>51.00 bc</td>
</tr>
<tr>
<td>Sabuj Sanket</td>
<td>34.20 bd</td>
<td>26.65 (31.06) ab</td>
<td>58.96 ab</td>
</tr>
<tr>
<td>Shornolata</td>
<td>30.69 bd</td>
<td>23.51 (28.99) b</td>
<td>43.02 bc</td>
</tr>
<tr>
<td>Kagornatki</td>
<td>35.97 bc</td>
<td>28.38 (32.11) ab</td>
<td>53.39 ac</td>
</tr>
<tr>
<td>SB Quick Long</td>
<td>38.17 ab</td>
<td>28.40 (32.19) ab</td>
<td>54.62 ac</td>
</tr>
<tr>
<td>Long Red Mollika</td>
<td>25.45 d</td>
<td>20.00 (26.49) b</td>
<td>37.04 c</td>
</tr>
<tr>
<td>BARI Borboti 01</td>
<td>28.48 cd</td>
<td>21.31 (27.44) b</td>
<td>43.04 bc</td>
</tr>
<tr>
<td>Toki</td>
<td>38.46 ab</td>
<td>30.01 (33.19) ab</td>
<td>55.93 ab</td>
</tr>
<tr>
<td>YL 305</td>
<td>46.85 a</td>
<td>40.00 (39.16) a</td>
<td>70.44 a</td>
</tr>
<tr>
<td>Level of significance</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>CV (%)</td>
<td>10.60</td>
<td>10.28</td>
<td>12.97</td>
</tr>
</tbody>
</table>

Figures in the parentheses are the arcsin transformed mean values for infested flowers of Rabi (2015–16)

Means in a column having same letter(s) are not significantly different by DMRT
Table 4. Percentage of Pod infestation (by weight) and yield of different yard long bean genotypes in two seasons (kharif, 2015 and rabi, 2015–16)

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>% Pod infestation (by weight)</th>
<th>Yield (T/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Mollika</td>
<td>49.92 bc</td>
<td>42.28 ab</td>
</tr>
<tr>
<td>Sabuj Sanket</td>
<td>57.29 ab</td>
<td>48.17 ab</td>
</tr>
<tr>
<td>Shornolata</td>
<td>44.38 bc</td>
<td>37.50 b</td>
</tr>
<tr>
<td>Kagornatki</td>
<td>54.47 ab</td>
<td>42.65 ab</td>
</tr>
<tr>
<td>SB Quick Long</td>
<td>54.52 ab</td>
<td>40.57 b</td>
</tr>
<tr>
<td>Long Red Mollika</td>
<td>36.85 c</td>
<td>29.33 b</td>
</tr>
<tr>
<td>BARI Borboti 01</td>
<td>42.21 bc</td>
<td>36.84 b</td>
</tr>
<tr>
<td>Toki</td>
<td>56.85 ab</td>
<td>46.34 ab</td>
</tr>
<tr>
<td>YL 305</td>
<td>68.84 a</td>
<td>60.87 a</td>
</tr>
<tr>
<td>Level of significance</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>CV (%)</td>
<td>12.92</td>
<td>17.27</td>
</tr>
</tbody>
</table>

Means in a column having same letter(s) are not significantly different by DMRT.

Table 5. Percent of total sugar, total protein and total phenol in flower and pods of different yard long bean genotypes

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Total sugar (%)</th>
<th>Total protein (%)</th>
<th>Total phenol (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flower</td>
<td>Pod</td>
<td>Flower</td>
</tr>
<tr>
<td>Green Mollika</td>
<td>18.94</td>
<td>10.60</td>
<td>18.67 b</td>
</tr>
<tr>
<td>Shornolata</td>
<td>18.54</td>
<td>10.46</td>
<td>17.79 bc</td>
</tr>
<tr>
<td>Kagornatki</td>
<td>19.47</td>
<td>10.46</td>
<td>18.08 bc</td>
</tr>
<tr>
<td>SB Quick Long</td>
<td>18.54</td>
<td>10.99</td>
<td>19.25 b</td>
</tr>
<tr>
<td>Long Red Mollika</td>
<td>18.94</td>
<td>10.20</td>
<td>15.17 c</td>
</tr>
<tr>
<td>BARI Borboti 01</td>
<td>18.81</td>
<td>10.07</td>
<td>16.92 bc</td>
</tr>
<tr>
<td>Toki</td>
<td>18.94</td>
<td>10.60</td>
<td>19.54 ab</td>
</tr>
<tr>
<td>YL 305</td>
<td>18.94</td>
<td>11.13</td>
<td>22.46 a</td>
</tr>
<tr>
<td>Level of significance</td>
<td>NS</td>
<td>NS</td>
<td>0.01</td>
</tr>
<tr>
<td>CV (%)</td>
<td>3.46</td>
<td>5.94</td>
<td>6.72</td>
</tr>
</tbody>
</table>

Means in each column followed by the same letter(s) are not significantly different by DMRT, NS = Non Significant

Conclusion

Nine genotypes of yard long bean reacted distinctively to *M. vitrata* with significantly different levels of infestation to flowers, pods and yield. None of the genotypes was found to be completely resistant to *M. vitrata*. However, the genotype Long Red Mollika was categorized as moderately resistant to legume pod borer in both kharif and rabi seasons. BARI Borboti 1 and Shornolata were also categorized as moderately resistant in the rabi season. YL 305 was the susceptible genotype in both the seasons. The plant attributes, both vegetative and reproductive, of yard long bean did not show any significant correlation in favour of resistance to *M. vitrata*. Yard long bean genotypes also did not show resistant reaction to *M. vitrata* in respect of sugar and phenol but particularly protein showed antibodies against *M. vitrata*.

References


Margum V. M., Coates B. S., Ba M. N., Sun W., Binso Baoua I., Ishiyaku M. F., Shukle J. T., Hellmich R. L.,
https://doi.org/10.1007/s11033-010-1823-3  
PMid:20496006


https://doi.org/10.1093/ajcn/70.3.439a  
PMid:10479216


https://doi.org/10.1371/journal.pone.0124057


https://doi.org/10.1016/S0261-2194(98)00045-3


https://doi.org/10.1016/S0261-2194(04)00676-X


https://doi.org/10.1016/j.aspen.2013.05.001