ABSTRACT

Field study and laboratory rearing revealed that Epilachna viginti-octopunctata is a serious pest of Momordica charantia showing complete metamorphosis in their life history with egg, four larval instars, pupa and adult, causing more than 80% damage to the host plant. Egg and I and II instar grubs can be reared successfully in petri dishes and III and IV instars, in wide-mouthed plastic bottles. Eggs were yellowish, elongated and cigar-shaped, laid on the under surface of tender leaves in clusters of 20-60 or more at a stretch. All the grubs were yellowish and oval-shaped with head, neck, trunk and six rows of dorsal body spines. Abdomen of II, III and IV instar grubs appeared greenish due to the green leafy matter inside and had abdominal spines ending in black tips. Pupae were quiescent, rectangular and shining yellow, bearing 2 anterior dorsal black spots with spines all over the body, whose color changed to copper brown later. Egg, I instar, II instar, III instar and IV instar grubs and pupa measured 1.94 ± 10.08mm and 1.01 ± 0.09mm; 2.30 ± 0.23mm and 1.28 ± 0.19mm; 3.40 ± 0.14mm and 1.42 ± 0.08mm; 6.30 ± 0.83mm and 3.10 ± 0.43mm; 9.30 ± 1.20mm and 4.20 ± 0.60mm and; 7.70 ± 0.34mm and 3.86 ± 0.21mm in length and breadth respectively and their longevity was 3-4 days; 3-4 days; 5-6 days; 4-5 days; 5-7 days and 5-7 days respectively. Adults were initially smoky orange in color and later appeared orange red with 28 black spots on the elytra. Females measured 7.46 ± 0.67mm in length and 5.56 ± 0.67mm in breadth while males were 5.88 ± 0.17mm in length and 4.26 ± 0.25mm in breadth and lived 20 – 28 days. Both adults and grubs were polyphagous and serious pests of M. charantia which resulted in skeletonisation of leaves leading to drying, defoliation, stunted growth and finally loss of yield. The pest caused more than 85% damage in the study field.

Key words : - Pest, Instar, Moultmg, Yield, Epilachna viginti-octopunctata, Momordica charantia.

I. INTRODUCTION

Coleoptera comprising the beetles and weevils is the largest order, not only in the class Insecta but also in the entire animal kingdom. It includes 40% of all insects and nearly 30% of all animal species showing cosmopolitan distribution. They show complete metamorphosis with egg, larva, pupa and adult stages in their life history. Many species are herbivorous variously adapted to feed on roots, stems, leaves or reproductive structures of their host plants having strong mandibulate mouth parts (Nayar et al., 1989).

Momordica charantia, the bitter gourd/bitter melon is a flowering vine in the family Cucurbitaceae. It is a tropical plant that is widely cultivated in Asia, East Africa and South America for its intensely bitter fruits that are commonly used in cooking and as a natural remedy for treating diabetes.
It is a powerful nutrient dense plant composed of a complex array of beneficial chemicals, vitamins, minerals and anti-oxidants. The fruits contain high amounts of vitamin A, B₁, B₂, B₃, B₉, C and E, minerals such as potassium, calcium, zinc, magnesium, phosphorous and iron and dietary fibre (Joseph and Jini, 2013).

Bitter gourd is attacked by many insect pests such as Aulacophora foveicollis, Bactrocera cucurbitae, E. vigintioctopunctata, E. dodecastigma, Aphis malvae, Diaphania indica, Sphenarches caffer, Lasioptera falcata etc. (Bhaskaran and Franzy, 2010; David and Kumaraswami, 1996). Many lady bird beetles are cosmopolitan helping in pollination. Two species of Epilachna beetles or hadda beetles common in India - E. vigintioctopunctata (28 spotted) and E. dodecastigma (12 spotted) - are harmful, causing damage to cucurbitaceous and solanaceous vegetables (Khan et al., 2000). Adult beetles and grubs consume epidermal tissue of the leaves by scraping on the leaf surface. Hossain et al., (2000) have studied the effect of different host plants on the growth and development of Epilachna. However, information on the biology of this ubiquitous pest is scanty. The present study focuses on bionomics, damage caused in the field and biology of this pest and formulates a convenient method of its laboratory rearing.

II. MATERIALS AND METHODS

A. Field cultivation of M. charantia

In order to access and study the bionomics of E. vigintioctopunctata and the damage caused, field cultivation of bitter gourd M. charantia of the variety- Preethi, was carried out in an area of 5 cents in the college campus during September 2014 to December 2015. The field was cleaned and pits of size 1x1x1ft were taken at a distance of 2m each. Pits were filled with dry leaves, cow dung and soil, one above the other. They were watered twice a day and kept undisturbed for 2-3 weeks to aerate the soil, enhance humidity and increase fertility to facilitate better growth of seeds. Cow dung was added as manure once in two weeks and a bamboo support of size 70x12x2m was provided.

Percentage of damage caused by the pest was calculated by counting the number of leaves damaged per plant and total number of leaves. Ten such replications were taken at a time and six such observations were taken in different cultivations. Damage caused is represented as Mean±SD.

B. Laboratory rearing of E. vigintioctopunctata

For laboratory rearing, leaves containing egg masses were collected from the field in small plastic cages with holed caps and placed inside sterilized petri dishes floored with bitter gourd leaves. Eggs and I and II instar larvae were reared in petri dishes. Third and IV instars were reared in 3L sterilized wide-mouthed plastic bottles or flat plastic cages with holed caps. The mouth of the bottles were covered with band-aid cloth to ensure aeration and tightened with rubber band. One or two egg masses were kept inside a single petri dish for incubation. Cages were placed in well-aerated space and replaced once in every 2 days with sterilized containers to maintain cleanliness and avoid contamination. After hatching, the old leaves in the culturing dishes were replaced with fresh tender leaves as food for the newly emerged grubs. Grubs were fed once or twice a day with fresh leaves.

Measurement of each instar was taken and represented as Mean ± SD.
III. RESULTS

A. Field study

The seeds of *M. charantia* germinated within 6-7 days of sowing. Flowering and fruiting took place within 30-40 days. Crops flourished well for 3 months. When the plants were 3-4 feet high, pumpkin beetles, melon flies, lady beetles, aphids and snake gourd semi loopers were seen attacking the crop (personal observations).

In the field, *E. vigintioctopunctata* appeared immediately after vegetative growth flourished. Adults were spherical, pale and molted with black spots. During the day time they moved among the leaves and plants, feeding on the leaves. During late evening and night they moved to more shady, darker lower surface of leaves and remained resting. They normally came out of the resting places only after sunrise. Females were slightly larger and many mating pairs were seen during day time between 8.00am- 4.00pm. Egg laying was maximum during morning hours between 8.00am-10.00am and mostly on the under surface of tender leaves with enough shade. Adults and the grubs were damaging to the host plant. Development included complete metamorphosis with egg, larvae, pupa and adults.

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Month</th>
<th>Total no. of leaves</th>
<th>No. of infected leaves</th>
<th>% of damage</th>
</tr>
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<tr>
<td>1</td>
<td>November 2014</td>
<td>185.30±18.27</td>
<td>149.10±16.15</td>
<td>83.42</td>
</tr>
<tr>
<td>2</td>
<td>December 2014</td>
<td>161.40±27.25</td>
<td>136.90±22.67</td>
<td>84.88</td>
</tr>
<tr>
<td>3</td>
<td>May 2015</td>
<td>186.80±14.09</td>
<td>155.30±12.78</td>
<td>83.10</td>
</tr>
<tr>
<td>4</td>
<td>June 2015</td>
<td>179.60±15.33</td>
<td>163.10±15.46</td>
<td>90.75</td>
</tr>
<tr>
<td>5</td>
<td>November 2015</td>
<td>159.50±28.23</td>
<td>134.50±23.15</td>
<td>84.40</td>
</tr>
<tr>
<td>6</td>
<td>December 2015</td>
<td>149.30±29.04</td>
<td>137.50±29.84</td>
<td>91.72</td>
</tr>
</tbody>
</table>

Table 1: Percentage of Damage

They fed on the chlorophyll containing green matter of the leaves, skeletonising them. The leaves turned fully netted and the plants became totally dried soon (Plate I –Fig 1). The infestation of *E. vigintioctopunctata* caused 86.37% damage to *M. charantia* in the field (Table 1).

B. Laboratory study

Laboratory rearing of the pest, showed that its life history involved different stages such as Egg, I, II, III, and IV instar larvae or grubs, pupae and adults (Plate I-Fig 2). Rearing of eggs and I and II instar larvae in petri dishes was found to be a more convenient and easy way to handle, transfer, feed and observe them (Plate I-Fig 3). Rearing of III and IV instar larvae in large plastic containers provided space for free movement, feeding and a convenient place for pupation. Natural aeration was made by covering the mouth of the bottles with band-aid cloth (Plate I- Fig 4).

Eggs of *E. vigintionoctopunctata* was laid one after another in clusters or groups of 20-60 or more on the lower surface of young leaves. Freshly laid eggs were bright yellowish, elongated and cigar-shaped with smooth surface. They were attached to the leaf surface erectly or vertically with their long axis and measured 1-2mm in length (Mean-1.94 ±0.081mm) and 1mm in width (Mean- 1.01 ± 0.09mm). Older eggs became light orange in color. Incubation period was 3-5 days (Mean - 3.10 ± 0.54 days) and egg shells after hatching appeared as white cases.
The I, II, III and IV instar larvae or grubs were yellowish in color with oval shaped body divided into head, neck and abdomen, bearing three pairs of legs and 6 rows of dorsal spines with black tips (Plate I- Fig. 1). Wings were absent. The I instar normally remained in groups near their place of hatching. They feed tender leaf tissue and in search of food, moved in groups from one leaf to another.
The II, III, and IV instar grubs were very active, fed voraciously and their abdomen appeared greenish due to green leafy matter inside. The average length and breadth of I, II, III and IV instar larvae were 2.30 ± 0.23mm and 1.28 ± 0.19mm; 3.40 ± 0.14mm and 1.42 ± 0.08mm; 6.30 ± 0.83mm and 3.10 ± 0.43mm; and 9.30 ± 1.20mm and 4.20 ± 0.60mm respectively. Longevity of the I instar was 3-4 days (Mean- 3.40 ± 0.65days); II instar was 5-6 days (Mean- 5.36 ± 0.47days); III instar was 4-5days (Mean- 4.52 ± 0.50days); and IV instar was 4-5 days (Mean- 5.00 ± 0.35days). Subsequently the IV instar entered a pre-pupal period of 1-2 days (Mean- 1.60 ± 0.41 days), during which the larvae became inactive and sluggish. They were 8mm long (Mean- 7.70 ± 0.34mm) and 4mm wide (Mean- 3.86 ±0.21mm). The total larval period was 17-22 days in the present study with mean value 20.00 ± 1.76 days.

Pupa was the non-feeding quiescent stage where the yellowish grubs became more or less rectangular with 8mm in length (Mean- 7.86 ± 0.21mm) and 5mm in width (Mean- 4.98 ± 0.10mm), bearing last larval skin as pupal case and two anterior black spots. Newly formed pupae were shiny-yellow in color that later changed to copper brown molted with black spots. Pupation lasted for 5-7 days (Mean- 6.30 ± 0.83 days) and then moulted to adult.

Adult beetles were circular, hemi-spherical in shape and initially smoky orange in color and later changed to orange red with 28 black spots on the elytra. (Plate I-Fig 5). Females were bigger and paler than males and males had a slit at the sub genital plate. Males were 5-7mm in length (Mean- 5.88 ± 0.17mm) and 4-5mm in breadth (Mean- 4.26 ± 0.25mm). Females were 7-8mm in length (Mean- 7.46 ± 0.67mm) and 5-6mm in breadth (Mean- 5.56 ± 0.67mm). Laboratory survival extended for 15-20 days (Mean- 22.60 ± 5.12 days), feeding fresh leaves. They usually resided on a particular spot feeding green tissue of the leaves steadily. Mating was observed between 7am and 10pm and life cycle lasted for 50–55 days with multiple life cycles a year. The pest caused netting, curling and drying of leaves, defoliation, stunted growth and finally reduced yield (Plate I- Fig 6).

IV. DISCUSSION

According to Richards and Filewood (1990), *E. vigintioctopunctata* is restricted to solanceous hosts. But Deshmukh *et al.*, (2012) observed its attack on wild bitter gourd *M. dioica* causing defoliation, stunted growth and reduced yield. Studies on the biology and morphometrics of *E.vigintioctopunctata* in Uttar Pradesh have shown that it is a serious pest of *M. charantia* (Tayde and Simon, 2013).

Rearing of eggs and grubs of *E. vigintioctopunctata* was performed in plastic containers covered with muslin cloth (Deshmukh *et al.*, 2012), but Tayde and Simon (2013) performed rearing in glass jars covered with muslin cloth. For laboratory studies adult *Epilachna* beetles were reared in petri dishes during the studies of Veesar *et al.*, 2014. Studies on biology and life history of *E.vigintioctopunctata* on brinjal (Verma and Anandhi, 2008; Qamar, Haseeb and Sharma, 2009) have shown similar results in their morphology as observed in the present study, but variations were found in the size of each stage, incubation period of the eggs and longevity. The number of eggs laid by the females at a time on *M. dioica* was 16-40 (Deshmukh *et al.*, 2012) and on *M. charantia* was 5-45 (Tayde and Simon, 2013). But it was 20-60 or more in the present study. Total larval period was observed to be 13-21 days on bitter gourd (Tayde and Simon, 2013) and 15 days on brinjal (Qumar *et al.*, 2009; Verma and Anandhi, 2008). Studies of Tayde and Simon (2013) have shown that average longevity of male and female was 51.4 and 64.8 days respectively. Prodhan *et al.*, (1990) observed that adults
usually fed on the upper surface of leaves and grubs ate the lower surface, which is in conformity with the present study. Different chemical stimuli and physiological factors in host plants influence the food consumption rate of *Epilachna* beetles (Jones and Hoggard, 1981). Leaf consumption rate of grubs on different hosts was influenced by many factors (Hossain et al., 2009).

However the present investigation shows that *E. vigintioctopunctata* is a pest of cucurbitaceous host plants and is a serious pest of *M. charantia* in Kerala. The pest showed many life cycles a year in the field and can be reared in laboratory employing suitable methods using petri dishes and plastic bottles or cages. Rajagopal and Trivedi (1989) reported that *Epilachna* beetles may damage up to 80% of the plants. Present study showed a damage of 86.37% to the host plant, *Momordica charantia*.

Information gathered on life cycle parameters such as duration of life cycle, size and longevity of each instar, egg laying pattern and nature of the pest is helpful for providing information on population build up, identification of the biotype and their management. Variations observed by different investigators could be attributed to differences in host plant, change in climatic conditions, locality and other environmental factors.

**BIBLIOGRAPHY**


