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## Biology of spotted pod borer, *Maruca vitrata* (Geyer) on pigeonpea

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### Abstract

Laboratory studies on biology of the spotted pod borer revealed that the average longevity of male moths was  $3.56 \pm 0.70$  days, while that of female moth was  $7.53 \pm 1.17$  days. The present study showed that spotted pod borer, *Maruca vitrata* passed through the five different larval instars. It is evident from the data that the total larval duration of spotted pod borer, *M. vitrata* varied from 12 to 15 days with an average of  $13.75 \pm 0.64$ . The final instar larvae that entered into a pre-pupal stage. Pupation took place on plant, inner side of damaged pods or some times on rearing containers under laboratory conditions. The average of entire life span of male was  $30.62 \pm 2.45$  days in case of female it was  $34.59 \pm 2.92$  days.

**Keywords:** spotted pod borer, instar, *M. vitrata*, life span

### Introduction

Globally the pulses are one of the important food crops due to higher protein content. Among all pulses, pigeonpea *Cajanus cajan* (L.) Millsp. occupies important position next to chickpea and the pigeonpea crop is widely grown in semi-arid tropical region of the world. Due to various biotic and abiotic factors and necessitating the losses and constraints to be cured the pigeonpea production in recent years is not able to meet the requirements of growing population. The losses due to insect-pests are much higher in pulses than in cereals. Among the insect pests pod borers have been identified as the major constraints in increasing the productivity of pigeonpea (Sahoo and Senapati, 2002) [10]. The legume pod borer or spotted pod borer, *Maruca vitrata* (Geyer) is one of the serious pest and occur during flowering and pod formation stages causing huge losses (Pappu *et al.*, 2010) [7]. Normally, larvae feeds on various floral parts like anthers, filaments, styles, stigma and ovaries. (Singh and Allen, 1980) [13]. At flowering and pod formation stages the attack of spotted pod borer is more and larvae fed on buds, flowers and pods by webbing them (Sharma, 1998) [12]. In India, *Maruca* damage has been found to range from 9 to 51 per cent in pigeonpea crop (Bhagwat *et al.*, 1998) [1]. Randhawa and Verma (2011) [9] reported that in pigeonpea crop 26-28 per cent flower damage due to *Maruca vitrata*. Ganapathy (1996) [5] estimated an avoidable loss due to *Maruca vitrata* of nearly 50 per cent and flower drop ranging from 9.4 to 12.7 per cent in short, medium and long duration pigeonpea cultivars in Tamilnadu. The life cycle or biology is important in managing insects because the habitat, habits and appearance of an insect may change dramatically through the course of a time, depending on the form of life cycle. Insects with complete type of metamorphosis go through four life stages like egg, larva, pupa and adult. Larva and adult stages have very different look and appearances and often live in different habitats, also showing different habits and eating different food. The pupal stage usually does not crawl or feed, and depending on the species the pupation takes place in soil on or inside plant parts or in debris, and that stage may be resistant to some methods of management. Managing insects with complete type of metamorphosis may require different tactics to target immature and adult stages. Understanding the biology of the pest will yield valuable information for strategizing the management options of that particular pest. Hence, the present investigation has been carried out to study the biology of spotted pod borer, *Maruca vitrata* on pigeonpea under laboratory condition.

### Materials and Methods

The life history of the pest was studied under the room conditions at Insect Culture Room, Department of Agril. Entomology, Post Graduate Institute, MPKV, Rahuri, Ahmednagar (M.S.) from August to November, 2017 and 2018.

## Methodology

To initiate the culture, the larvae were collected from the field and reared individually in small plastic pots (4 cm x 3.5 cm) on flowers and pods of pigeonpea. The adult emerged from the pupae were transferred to rearing cage prepared from mosquito net (2 x 1 x 1.5 m<sup>3</sup>). The pigeonpea variety ICPL 87 planted earthen pots were kept in rearing cage for egg laying and a cotton swab soaked in 10% sucrose were provided as food for adults. Observations were recorded on following points.

## Method of recording observations

### Eggs

Eggs were collected regularly from rearing cages along with plant parts. Replacement of plants were done whenever required. The eggs along with plant parts were kept for hatching in the petri dishes (10 cm diameter) and plastic bottles (1/2 (half) kg capacity) supplied with cotton swab soaked with water to provide required humidity for egg hatching. Eggs were observed under microscope and by using magnifying glass for change in color, form, shape etc. the measurement of eggs were taken by using stage and ocular micrometer.

### Larva

After hatching the larvae were transferred to small plastic pots (4 cm x 3.5 cm) having feed. Only one larva was kept per pot and the pots were critically observed with the help of magnifying glass for exuviae of larvae which indicate moulting. After each moult, the larvae were observed for morphological characters and killed them with chloroform. The observations on the length and breadth was recorded for each instar. The measurement of first instar larva was taken with the help of micrometer afterwards by using vernier calliper. Observations on duration of each instar were recorded.

### Pupa

The last instar larva was ceased feeding and started spinning cocoon. The pupae were kept undisturbed upto adult emergence and pre-pupal and pupal periods were recorded. However, the morphological observations were taken using magnifying glass and measurement were taken by using vernier caliper.

### Adult moth

Newly emerged adults were kept in large mosquito net cages (2 x 1 x 1.5 m<sup>3</sup>). Longevity of male and female moths were recorded in captivity. Also the mating behavior of moths at night in the laboratory were observed. The oviposition behavior of female was observed by releasing freshly emerged adults in wire net cages with potted plants of pigeonpea. Individual moths were observed critically to identify sex and sex ratio was worked out.

## Results and Discussion

The detailed study on biology of spotted pod borer, *Maruca vitrata* (Geyer) on pigeonpea with pooled mean of observations taken during year 2017 and 2018 are presented here,

### Eggs

The studies on site of egg laying indicated that the most eggs were laid on flower buds and flower surface, but occasionally

on leaves or tender pods. Freshly laid eggs are milky white and later become translucent. Eggs are oval, dorsoventrally flattened and firmly adhered to the surface. The eggs are usually laid singly or in overlapping groups (Fig 1). The results (Table 1) also revealed that the average incubation period of  $4.28 \pm 0.28$  days and average hatching percentage was  $83.38 \pm 4.48$ . The average morphometric dimensions of eggs of both the year presented in Table 2 showed that the average length and breadth of freshly laid egg were  $0.54 \pm 0.04$  mm and  $0.37 \pm 0.04$  mm respectively. The reports of Naveen *et al.* (2009) on cowpea Sonune *et al.* (2010)<sup>[14]</sup> on blackgram, Savde *et al.* (2018)<sup>[11]</sup>, Rachappa *et al.* (2016)<sup>[8]</sup> and Chaitanya *et al.* (2012)<sup>[2]</sup> on pigeonpea are very nearer to present findings. According to the study of Chandrayudu (2003)<sup>[3]</sup> the incubation period of eggs ranged from 3 to 4 days on different natural hosts like cowpea, pigeonpea, fieldbean, urdbean and mungbean.



Fig 1: Eggs of Spotted pod borer *M. vitrata*

### Larva

The present study showed that spotted pod borer, *M. vitrata* passed through the five different larval instars (Table 1 and Fig. 2).

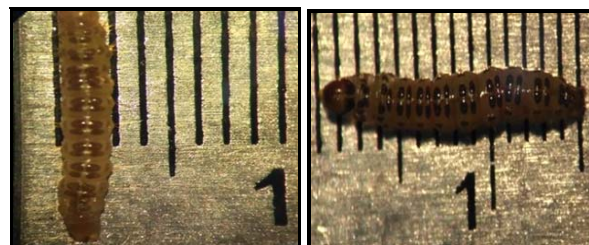


Fig 2: Larva of Spotted pod borer, *M. vitrata*

### First instar larva

The newly hatched larva was active and light brown in colour and 6 rows of black spots were seen all over the body but they were not visible to naked eyes. These larvae move actively on leaf surface and after some time they get settled at one place and feeds on green matter on under surface of leaf. The average measurements of both the year presented in Table 2 indicated that  $1.18 \pm 0.12$  mm with an average length and  $0.36 \pm 0.04$  mm with an average breadth. The results shown in Table 1 revealed that the average duration of first instar was  $2.64 \pm 0.46$  days. According to Savde *et al.* (2018)<sup>[11]</sup> the measurements (length x breadth) of first instar larva was  $1.32 \pm 0.01 \times 0.18 \pm 0.006$  mm and as per the study of Sonune *et al.* (2010)<sup>[14]</sup> the average duration of first instar larva was  $2.12 \pm 0.66$  days on blackgram.

### Second instar larva

The larva was creamy white in colour with six rows of dark spots running from thorax to abdomen. The head capsule was

slightly red in colour. The average length of second larval instar was  $2.30 \pm 0.23$  mm and average breadth was  $0.68 \pm 0.04$  mm (Table 2). The data recorded in Table 1 revealed that average duration of second instar larva was  $2.32 \pm 0.32$  days. The larvae exhibited aggressive behavior when disturbed. These instars found feeding by constructing prominent webbing due to photonegative behavior. The present findings in confirmation with Rachappa *et al.* (2016) [8] who revealed that the average duration of second instar larva was  $2.75 \pm 0.50$  days with 2.57 mm average length and 0.38 mm average breadth.

### Third instar larva

The third instar larva was distinguished from the second instar larva by the presence of prominent black markings on its body. The average duration of third instar larva was  $2.68 \pm 0.37$  days (Table 1). The average body length of third instar larva was  $8.10 \pm 0.54$  mm and average breadth was  $1.08 \pm 0.54$  mm (Table 2). It was found that the larvae became active in evenings and fed on the plant throughout night by constructing prominent webbings and were photonegative. According to Savde *et al.* (2018) [15] the measurements (length x breadth) of third instar larva was  $5.60 \pm 0.07 \times 0.90 \pm 0.02$  mm and as per the study of Sonune *et al.* (2010) [14] the average duration of first instar larva was  $2.76 \pm 0.66$  days on blackgram.

### Fourth instar larva

The fourth instar larva was creamy white in colour with black spots on its body. The colour of head capsule was slightly black. The data on measurements (Table 2) revealed that it measured with an average of  $10.94 \pm 0.48$  mm in length and  $1.99 \pm 0.48$  mm in average breadth. The results shown in Table 1 revealed that the average duration of fourth instar was  $2.39 \pm 0.29$  days. Like second instar and third instar larvae the fourth larval instars also became active in evenings and fed on the plant throughout night by constructing prominent webbings and were photonegative. According to Sureja *et al.* (2010) [15] 4<sup>th</sup> larval instars duration of was  $2.54 \pm 1.04$  days and according to Rachappa *et al.* (2016) [8] the average measurements (length x breadth) of fourth instar larva was  $11.65 \times 1.72$  mm.

### Fifth instar larva

The fifth instar larva was deep creamy white, dark brown head translucent and shiny with prominent 6 rows of black spots on its body. It measured with an average of  $15.17 \pm 0.88$  mm in length and an average of  $2.80 \pm 0.24$  mm in breadth (Table 2). The results shown in Table 1 revealed that the average duration of fifth instar was  $3.71 \pm 0.47$  days. The larvae exhibited aggressive behavior when disturbed. These instars found feeding by constructing prominent webbing due to photonegative behavior. The present findings are in close agreement with Rachappa *et al.* (2016) [8] who revealed that the average measurements (length x breadth) of fifth instar larva was  $16.94 \times 2.42$  mm with average duration of  $3.25 \pm 0.25$  days. According to Savde *et al.* (2018) [11] that the average measurements (length x breadth) of fifth instar larva was  $15.95 \pm 0.13 \times 2.82 \pm 0.09$  mm.

### Total larval duration

It is evident from the data that the total larval duration of spotted pod borer, *M. vitrata* varied from 12 to 15 days with an average of  $13.75 \pm 0.64$ . Slight variation in the total larval period might be due to prevailing laboratory abiotic factors.

### Pupa

There was prepupal and pupal phase occurred after the larval instars. The duration and morphometrics observations presented here. The final instar larvae that entered into a pre-pupal stage could be clearly observed by the change in colour, disappearance of spots and reduction in size. The Table 1 revealed that the average prepupal duration was  $1.53 \pm 0.35$  days. The colour of the pre-pupa was light green and spun silken thread in a net like fashion around it to transform into pupa.

Pupation took place on plant, inner side of damaged pods or sometimes on rearing containers under laboratory conditions. The pupa was soft, brown in colour (Fig.3) and gradually turned darker before the adult emergence. It measured with an average of  $10.90 \pm 0.65$  mm in length and  $2.76 \pm 0.24$  mm with an average breadth as presented in Table 2. The average pupal period was  $7.53 \pm 0.48$  days (Table 1). Some variations in pupal period might be due to effects of prevailing laboratory conditions. These findings are line with Chaitanya *et al.* (2012) [2] who observed that pre-pupal and pupal duration on an average of  $2.17 \pm 0.26$  and  $7.25 \pm 0.82$  days respectively on pigeonpea whereas Naveen *et al.* (2009) [6] revealed that average pupal period was  $10.84 \pm 1.79$  days and measured on an average of  $12.53 \pm 0.14$  mm in length and  $3.11 \pm 0.14$  mm in breadth. According to Sonune *et al.* (2010) [14] the average pupal period was  $10.84 \pm 1.79$  days and measured on an average of  $12.53 \pm 0.14$  mm in length and  $3.11 \pm 0.14$  mm in breadth.



Fig 3: Pre-pupal and pupal stage of spotted pod borer, *M. vitrata*



Fig 4: Morphometrics dimensions of pupa of spotted pod borer, *M. vitrata*

### Adult

The adult moth had medium brown wings and creamy white to brown body with long legs (Fig. 5). Forewings were small with semitransparent bands and the hind wings were silver white with brown spots at the apical margin across the wings. Male and female moth could be clearly distinguished by the

abdominal shape. In male, abdomen was tapered towards the end and the tip of female abdomen was long, slightly bulged and provided with two openings. As per the data recorded in Table 1 the average longevity of male moths was  $3.56 \pm 0.70$  days, while that of female moth was  $7.53 \pm 1.17$  days. Thus, it can be concluded that female adult survives more than the male one. The average body length of male moth was  $9.8 \pm 0.51$  mm while the average body length of female moth was  $11.05 \pm 0.36$  mm. The female adults had larger wing span with an average of  $24.70 \pm 0.41$  mm than male adults with an average of  $20.30 \pm 0.56$  mm. These findings are in confirmation with Chaitanya *et al.* (2012)<sup>[2]</sup>, Chetana (2011)<sup>[4]</sup> and Rachappa *et al.* (2016)<sup>[8]</sup>.

The percentage of adult emergence was on an average 79 with sex ratio 0.68 males per female. Average Pre-oviposition,

Oviposition and Post oviposition periods recorded with  $4.37 \pm 0.47$  days,  $2 \pm 0.57$  days and  $4.62 \pm 0.85$  days, respectively. The result revealed that the average total number of eggs laid by a single female with an average of  $32.16 \pm 2.70$ . The data presented in Table 1 indicated that the average of entire life span of male was  $30.62 \pm 2.45$  days in case of female it was  $34.59 \pm 2.92$  days. According to Sonune *et al.* (2010)<sup>[14]</sup> the mean duration of pre-oviposition, oviposition  $1.25 \pm 0.30$ ,  $4.34 \pm 2.45$  days with a range of 1.25-1.80, 3.20-5.95 and fecundity  $144.5 \pm 100.2$  with a range 95-200. The present findings in line with Naveen *et al.* (2009)<sup>[6]</sup> Fecundity was  $126.8 \pm 103.2$  eggs per female whereas viability of eggs was  $95.45 \pm 2.54$  per cent. Adult longevities of female and male moth were  $10.82 \pm 2.45$  and  $12.41 \pm 2.87$  days, respectively on cowpea in southern India.

**Table 1:** Duration of different life stages of spotted pod borer, *Maruca vitrata* on pigeonpea during, 2017 and 2018 with pooled mean

Biological Events	Year 2017 (Mean $\pm$ SD)	Year 2018 (Mean $\pm$ SD)	Pooled mean (Mean $\pm$ SD)
Incubation period	$4.25 \pm 0.28$	$4.25 \pm 0.28$	$4.25 \pm 0.28$
<b>Larval period</b>			
a) First Instar	$2.71 \pm 0.73$	$2.57 \pm 0.65$	$2.64 \pm 0.46$
b) Second Instar	$2.36 \pm 0.50$	$2.29 \pm 0.47$	$2.32 \pm 0.32$
c) Third Instar	$2.71 \pm 0.47$	$2.64 \pm 0.50$	$2.68 \pm 0.37$
d) Fourth Instar	$2.36 \pm 0.50$	$2.43 \pm 0.65$	$2.39 \pm 0.29$
e) Fifth Instar	$3.79 \pm 0.80$	$3.64 \pm 0.50$	$3.71 \pm 0.47$
Total Larval period	$13.93 \pm 0.92$	$13.57 \pm 1.09$	$13.75 \pm 0.64$
Pre pupal period	$1.53 \pm 0.52$	$1.53 \pm 0.52$	$1.53 \pm 0.35$
Pupal period	$7.87 \pm 0.74$	$7.20 \pm 0.86$	$7.53 \pm 0.48$
Total Developmental period	$27.58 \pm 2.46$	$26.55 \pm 2.75$	$27.06 \pm 1.75$
<b>Longevity of Adult</b>			
a) Male Moth	$3.73 \pm 1.33$	$3.40 \pm 0.91$	$3.56 \pm 0.70$
b) Female Moth	$7.33 \pm 1.59$	$7.73 \pm 1.28$	$7.53 \pm 1.17$
Total Life Cycle (Male)	$31.31 \pm 3.79$	$29.95 \pm 3.66$	$30.62 \pm 2.45$
Total Life Cycle (Female)	$34.91 \pm 4.05$	$34.28 \pm 2.14$	$34.59 \pm 2.92$

**Table 2:** Morphometrics of various developmental stages of *M. vitrata*

<i>M. vitrata</i>	Egg	Larval Instars					Pupa	Adult		
		1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>		Male	Female	
Length (mm)	$0.54 \pm 0.04$	$1.18 \pm 0.12$	$2.30 \pm 0.23$	$3.10 \pm 0.54$	$10.94 \pm 0.48$	$15.17 \pm 0.88$	$10.90 \pm 0.65$	Length (mm)	$9.8 \pm 0.51$	$11.05 \pm 0.36$
Breadth (mm)	$0.37 \pm 0.04$	$0.36 \pm 0.04$	$0.68 \pm 0.04$	$1.08 \pm 0.54$	$1.99 \pm 0.48$	$2.80 \pm 0.24$	$2.76 \pm 0.24$	Wing Span (mm)	$20.30 \pm 0.56$	$24.70 \pm 0.41$



**Fig 5:** Culture of Eggs, Larvae and Pupae of *M. vitrata* and Rearing of moth inside the cage

## Conclusion

Laboratory studies on biology of the spotted pod borer *M. vitrata* revealed that the average incubation period of eggs  $4.28 \pm 0.28$  days. There were five larval instars which required 12 to 16 days with an average of  $13.75 \pm 0.64$  days to complete their development. There was prepupal and pupal phase occurred after the larval instars. The pupa was soft, brown in colour and gradually turned darker before the adult emergence. The average pupal period was  $7.53 \pm 0.48$  days. Forewings of adult moth were small with semitransparent

bands and the hind wings were silver white with brown spots at the apical margin across the wings. As per the data recorded female adult survives more than the male one.

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