

E-ISSN: 2278-4136 P-ISSN: 2349-8234 www.phytojournal.com

JPP 2020; 9(4): 3430-3433 Received: 16-05-2020 Accepted: 18-06-2020

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Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com



# Biology of spotted pod borer, *Maruca vitrata* (Fabricius) (Crambiade: Lepidoptera) on pigeonpea under laboratory conditions

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#### Abstract

The present experiment was carried out in laboratory, Department of entomology, pant nagar to study the biology and morphometry of spotted pod borer, *Maruca vitrata* on pigeonpea under laboratory condition during 2019-20. Egg incubation period continued upto  $2.47\pm0.70$  days. After hatching, the larvae undergone four moultings to reach the final larval instar. The total time duration required to complete larval stage was  $2.85\pm0.39$  days. Pupation was observed inside the webbed flowers, leaflets and immature pods. However, the pre pupation and pupation period continued up to  $2.39\pm0.39$ ,  $3.31\pm0.51$  days respectively. Mean adult longevity recorded was  $7.67\pm0.91$ days. Total duration to complete all life stages by *Maruca vitrata* was  $28.20\pm1.70$  days. Mean number of eggs laid per female (fecundity) was  $37.24\pm8.71$ . Average hatching percent from eggs was  $80.34\pm7.02$  per cent. Morphometric study revealed that, the mean diameter of egg was  $0.29\pm0.03$ mm. Larval body length increased gradually with successive instars. Length of larval body from I-V instars ranged from  $3.09\pm0.37-14.45\pm1.53$  mm respectively. Length and breadth of pre pupal and pupal stages were  $12.85\pm1.10-11.74\pm0.35$ mm and  $2.78\pm0.15-2.87\pm0.07$ mm respectively. Mean wing expanse of adult was  $13\pm0.74$  mm in length and  $9.5\pm0.52$ mm in breadth.

Keywords: Maruca vitrata, Crambiade: Lepidoptera, pigeonpea, laboratory

#### Introduction

Pigeonpea or red gram (*Cajanus cajan* (L.) Millspaugh) is an important legume crop grown under rainfed conditions. India is believed to be the primary center of origin of cultivated pigeonpea from where it spread to Africa about 4000 years ago (Vavilov,1939)<sup>[12]</sup>. Pigeonpea is the 2<sup>nd</sup> most important pulse crop in India in terms of area and production after chickpea. According to the annual report (2016-2017), Directorate of Pulse Development, pigeonpea covers 70.33 lakh ha area globally with 48.90 lakh tonnes production and 695 Kg/ha productivity. In India, the area, production, and productivity of pigeonpea during 2016-17 was 39.24 lakh ha, 28.44 lakh tonnes and 725 kg/ha respectively. India ranks first in area and production but lacks in productivity. Attack of insect pests on Pigeonpea is considered to be one of the major constraints of low yield of Pigeonpea. Major insect pests that include the pod boring Lepidoptera (*Helicoverpa armigera; Maruca vitrata; Etiella zinkenella*), pod sucking bugs (*Clavigrella gibbosa*) and pod fly (*Melanagromyza chalcosoma*) have contributed to poor productivity (Minja *et al.*, 2000) <sup>[4]</sup>. Amongst all these major insect pests, the pod borers namely *Helicoverpa armigera* and *Maruca vitrata* are the major and devastating insect pests of pigeonpea in India.

Spotted pod borer *Maruca vitrata* (Fabricius) is a serious pest because of its varied host range, destructiveness and distribution (Taylor, 1967)<sup>[11]</sup>. It is widely distributed in Asia, Africa, Australia and the Americas infesting 40 host plants including pigeonpea, cowpea, green gram, lablab and common bean (Taylor, 1978)<sup>[10]</sup>. In India, *Maruca* is a major pest in pigeonpea causing almost 9 to 51% yield loss (Bhagwat *et al*, 1998)<sup>[1]</sup>. Recently it is becoming a severe pest of pigeonpea in different parts of India. Attack of the pest to the crop starts right from preflowering stage and lasts upto pod maturing stage. It forms a web by using flower buds, flowers and pods through webbing and continues feeding inside it. Damage to the reproductive parts of the plant contributes to major yield loss of the crop. This pest is a single major factor responsible for heavy loss in early and medium late maturing pigeonpea genotypes (Shanower *et al*, 1999)<sup>[8]</sup>. Understanding the biology of the pest in the crop will help to identify its most damaging stages as well as the particular time to start management practices against the pest, which will be beneficial for strategizing the management options of that particular pest. Hence, the present investigation has been carried out to study the biology of legume pod borer on pigeonpea in detail under laboratory condition.

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#### Materials and Method

The present study was carried out in NEBCRC, Pant Nagar during 2019-20. The detailed biology was studied in IPM laboratory, Department of entomology, Pant Nagar. The full grown larvae used for rearing were collected from the infested control plots of pigeonpea under field study. Collected larvae were reared on flowers and pods of pigeonpea in the laboratory. A temperature of 26+1°c and relative humidity 60+10% was maintained during the study. The pupa obtained during rearing were kept separately in plastic containers with plastic bedding for adult emergence. Newly emerged adults were collected and 10 pairs of adults (Male and female) were released in mating chamber.

A cotton swab dipped in 10% honey solution was hanged inside the mating chamber for adult feeding. A fresh inflorescence of pigeonpea for egg laying of the adults was kept inside the mating chamber by using a water filled container having a hole in its lid. Inflorescence kept inside were changed daily and careful examination of flowers, flower buds and leaves were done with the help of hand magnifying glass and microscope for the presence of egg/egg masses. Collected egg masses were kept separately on moist filter paper (Whatsmann No 41) in petri plates. Fresh pigeonpea twigs were provided inside the petri plate and were changed regularly at an interval of one-two days throughout the study. Observations on incubation period, larval instars and durations, pupal duration, adult emergence, adult longevity, fecundity and hatching percentage were taken. Larval instars were determined on the basis larvae colour and cast-off skin.

#### **Results and Discussion**

#### A) Biology of Maruca vitrata on Pigeonpea

The detailed study on biology of *Maruca vitrata* was carried out under laboratory condition. Pigeonpea (Variety UPAS 120) was used as host plant throughout the study. Different developmental stages of maruca was completed in different time duration. The time range for different growth stages expressed in days along with the mean value, fecundity (No. of eggs laid per female), hatching percentage are presented in Table 1.

Various observations during the present study revealed that, the mated female lays egg during night time onto the under surface of leaves, flowers, flower buds, flower petals, immature pods or inner side of the glass jar by pressing its ovipositor. The pattern of egg laying was single/in small overlapping group of 2-15 eggs. Freshly laid eggs were white to light yellowish in colour, oval in shape, reticulated markings on chorion, dorso-ventrally flattened and glued firmly onto the surface. Eggs were very difficult to be seen in naked eye. Eggs can be seen under hand magnifying glass and microscope. Incubation period *i.e.*, the time interval between egg laying to hatching was found to be 2.47±0.70. Maximum incubation period recorded was 4 days, whereas, the minimum incubation period lasted for 2 days. The results obtained were in close agreement with Chaitanya et al. (2012) <sup>[2]</sup> and Rachappa et al. (2015) <sup>[6]</sup> on pigeonpea and Sravani and Mahalakshmi (2015)<sup>[9]</sup> on greengram, Sindhe et al. (2017)<sup>[7]</sup> on lablab bean and Hanbar and Hegde (2018)<sup>[3]</sup> on groundnut.

Crosseth stars	No. chaomad	Period (in days)					
Growth stage	No. observed	Min.	Max.	Mean±SD			
Egg (incubation period)	10	2.0	4.0	2.47±0.70			
Larval duration							
1 <sup>st</sup> instar	10	2.5	3.5	2.85±0.39			
2 <sup>nd</sup> instar	10	1.5	2.5	2.03±0.34			
3 <sup>rd</sup> instar	10	1.5	3.0	2.05±0.58			
4 <sup>th</sup> instar	10	2.5	3.5	2.63±0.47			
5 <sup>th</sup> instar	10	2.5	4.0	3.04±0.53			
Total larval duration		11.5	16	12.53±1.33			
Pre pupal	10	2	3	2.39±0.39			
Pupal	10	3	4.5	3.31±0.51			
Total pupal duration		5.5	7	5.69±0.67			
Adult longevity	10	7	10	7.67±0.91			
Total life span		28	33.5	28.20±1.70			
Fecundity (No. of eggs/female)	10	28	52	37.24±8.71			
Hatching percentage		78	96.15	80.34±7.02			

The newly hatched larvae were slight creamy in colour with a brown head and devoid of black spots on the body. These larvae started moving actively on the surface of leaves, got settled under surface of the leaves and started feeding on the green matter of leaves. Six rows of black spots were present throughout the body but they were not visible to naked eyes during 1st instar. Duration of 1st larval instar ranged from 2.5-3.5 days. Mean larval duration was 2.85±0.39 days (Table 1). Similar results were also observed by Rachappa et al. (2015) <sup>[6]</sup> on pigeonpea. Whereas, Chaitanya et al. (2012)<sup>[2]</sup> reported 1<sup>st</sup> instar duration to be 1.92±0.38 days on pigeonpea. After immediate moulting, the 2<sup>nd</sup> instar larvae appeared to be creamy white in colour. After two-three hours of moulting, body changed greenish colour, with six rows of microscopic brown spots present on the body and prominently brown coloured head and prothorax. The 2<sup>nd</sup> larval instar lasted for about 1.5-2.5 days. Mean larval duration of  $2^{nd}$  instar was 2.03±0.34 days. Larval body slightly tapers towards both ends with maximum width in the middle. The present findings are in close agreement with Chaitanya *et al.* (2012) <sup>[2]</sup>, and Rachappa *et al.* (2015) <sup>[6]</sup> on pigeonpea and Naveen *et al.* (2009) <sup>[5]</sup> on cowpea.

Three remaining larval instar (III, IV, V) were similar to II instar in colour and morphological characters except size. All these three instar larvae were white-greenish in colour with dark brown head and prothoracic shield. Six rows of black spots on the body were prominent during these instars. Feeding of these larvae continued to be inside flower webbings due to its photo negative nature. The larvae exhibited aggressive behaviour upon disturbance. Higher feeding rate was recorded during evening to night time. Larval duration of  $3^{rd}$ ,  $4^{th}$  and  $5^{th}$  instar ranged for  $2.05\pm0.58$ ,

2.63 $\pm$ 0.47 and 3.04 $\pm$ 0.53 days respectively. Total larval duration ranged in between 11.5 to 16 days. Mean larval duration to complete all the larval stages was 12.53 $\pm$ 1.33 days. The present investigation was in accordance with Chaitanya *et al.* (2012) <sup>[2]</sup> and Rachappa *et al.* (2015) <sup>[6]</sup> on pigeonpea and Sravani and Mahalakshmi (2015) <sup>[9]</sup> on greengram, Sindhe *et al.* (2017) <sup>[7]</sup> on lablab bean and Hanbar, Hegde (2018) <sup>[3]</sup> on groundnut and Naveen *et al.* (2009) <sup>[5]</sup> on cowpea.

Fully grown fifth instar larvae stopped feeding and entered into pre pupal stage and body size gradually reduced. Pupation was observed inside flower and leaf webs and sometimes on the base of rearing jar. Initially the larvae spun silken thread webs outside and undergone pupation gradually. Initially, colour of the pupa was greenish in colour which later turned into brownish to dark brown in colour. Pre pupal duration lasted for 3-4.5 days. Total pupal duration was 5.5 to 7 days with mean value of  $5.69\pm0.67$  days. Similar results were also obtained by Chaitanya *et al.* (2012)<sup>[2]</sup> and Rachappa *et al.* (2015)<sup>[6]</sup> on pigeonpea.

The moth had brown body, medium brown wings and long legs. The moth posses a white cross band on dark brown forewing and a dark brown border on the apical margin of silvery white hind wings. Male and female moths could be clearly differentiated by the abdominal shape. Abdomen of male moths are slightly tapered towards the end. Whereas, female abdomen was long, slightly bulged and provided with two openings. Adult longevity ranged from 7 to 10 days with an average of  $7.67\pm0.91$ . The present findings are in concurrence with Rachappa *et al.* (2015) <sup>[6]</sup>. Egg laying by

female started after 2-3 days of emergence. Fecundity per female recorded was  $37.24\pm8.71$  days (Table 1). However hatching percentage recorded was  $80.34\pm7.02$  percentage. Total developmental period of *Maruca* vitrata ranged from 28-33.5 days with a mean value of  $28.20\pm1.70$  days

### **B)** Morphometric Study of Maruca vitrata

Starting from the egg stage, *Maruca vitrata* undergoes 4 moulting (5 larval instars) followed by pupation and adult stage. With each moulting, the larval size increases. Changes in length and breadth during different developmental stages are recorded. Diameter of eggs, instar wise larval measurements, pupal and adult measurements are presented in Table 2.

Diameter of eggs varied from 0.23 to 0.35 mm and mean diameter was 0.29±0.03mm. Body length increased gradually with the changing larval instars. Mean larval body length of 1st, 2nd, 3rd, 4th and 5th instars were 3.09±0.37, 4.30±0.19, 5.22±0.19, 9.39±0.68, 14.45±1.53 mm respectively. Similarly, the body breadth increased with increasing length. Breadth of larvae from I to V instars were 0.17±0.02, 0.38±0.02, 0.90±0.07, 1.63±0.11, 2.75±0.17mm respectively. Before entering into pupation, the larval body shrinks. Length and breadth during pre pupal stage were 12.85±1.10,  $2.78\pm0.15$  mm respectively. Whereas, the measurements during pupal stage were 11.74±0.35mm in length and 2.87±0.07mm breadth. The wing expanse of adult was  $13\pm0.74$  mm in length and  $9.5\pm0.52$  mm in breadth. The results obtained were in close agreement with Rachappa et al. (2015) [6]

Table 2: Mor	phometrics o	f different	developme	ntal stages	of Maruca	vitrata on	nigeonnea
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Growth stage	Parameters	Minimum (mm)	Maximum (mm)	Mean±SD			
Egg	Diameter	0.23	0.35	0.29±0.03			
Larval Instars							
1 <sup>st</sup> instar	Length	2.53	3.46	3.09±0.37			
	Breadth	0.14	0.20	0.17±0.02			
2 <sup>nd</sup> instar	Length	4.0	4.6	4.30±0.19			
	Breadth	0.36	0.42	0.38±0.02			
3 <sup>rd</sup> instar	Length	4.93	5.60	5.22±0.19			
	Breadth	0.80	1.0	0.90±0.07			
4 <sup>th</sup> instar	Length	8.0	10.4	9.39±0.68			
	Breadth	1.44	1.80	1.63±0.11			
5 <sup>th</sup> instar	Length	12	16.6	14.45±1.53			
	Breadth	2.56	3.0	2.75±0.17			
Pupal Stages							
Pre pupa	Length	11.33	14.6	12.85±1.10			
	Breadth	2.60	3.0	2.78±0.15			
Pupa	Length	11.2	12.26	11.74±0.35			
	Breadth	2.8	3.0	2.87±0.07			
Adult	Length	12	14	13±0.74			
	Breadth	9.5	10.5	9.5+0.52			

#### Conclusion

*Maruca vitrata* is a major pest of pigeonpea having enough potential to cause severe damage to the reproductive parts of the crop and yield loss. Differences in crop phenology and agroclimatic conditions may influence the biology and life cycle of *M. vitrata*. Therefore, understaning the biology of the pest in the crop is most important for formulating IPM strategies for effective management of the pest. Controlling this pest became difficult due to its nature of feeding inside the web. Therefore, effective management strategies have to be developed to reduce the losses caused by the pest as well as to protect the crop. Identification of weak points for control amongst all the life stage and the sequence of management practices can be formulated by using this study. More research works on varied hosts and different agro-climatic zones should be carried out to generate good amount of data as well as to understand its biology under varied agro ecosystem.

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