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## Biology of *Maruca vitrata* (Gayer) on groundnut (*Arachis hypogaea* L.)

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### Abstract

Biology of *Maruca vitrata* (Gayer) on groundnut under laboratory conditions with room temperature of 26 to 27 °C was studied during *kharif*, 2016 at MARS, UAS, Dharwad, Karnataka. Eggs were laid both individually and in a group of 2 to 4 on lower surface of the groundnut leaves or on liguleli or on calyx of the groundnut flowers. Each larva moulted 4 times and possessed 5 instars. Fully grown caterpillar was translucent and shining with 6 rows of black spots running from thorax to abdomen. Average larval duration was  $16.21 \pm 0.26$ . The final instar larvae that entered into pupation in the webs of groundnut leaves within silken cocoon and pupal duration was  $6.16 \pm 0.04$ . The life span of adult moth was about  $6.91 \pm 0.52$  days. The fecundity was  $97.50 \pm 9.26$  eggs/female. The total life cycle lasted for  $33.30 \pm 1.77$  days to complete on groundnut.

**Keywords:** Biology, groundnut, *Maruca vitrata*, instar, caterpillar

### Introduction

Groundnut (*Arachis hypogaea* L.) is a leading oilseed crop in Karnataka and India. The seeds are rich source of edible oil (43-45%) and protein (25-28%) along with vitamins namely B, E and K. Groundnut cake, after the oil extraction and haulm serve as high quality fodder. Apart from oil extraction groundnut kernels are used in confectionary and other modes of consumption such as roasted or boiled in shell used as snacks in the restaurants. Further, handpicked selected grade is exported.

Groundnut is a most remunerative crop of rain fed farm land with relatively low chance of crop failures due to unpredictable monsoon. But the insect pests form the important constraints in its production. Red Hairy caterpillars: *Amsacta albistriga*, *A. moorei*, Leaf miner: *Aproaerema modicella* Deventer, Bihar hairy caterpillar: *Spilosoma (Diacrisia) oblique*, Tobacco caterpillar: *Spodoptera litura* Aphids: *Aphis craccivora*, Thrips: *Thrips plami* and Leaf hopper: *Empoasca kerri*, are important insect pests of groundnut crop in India. Weather plays an important role on the population dynamics and distribution of insect pests and diseases. Temperature, rainfall, relative humidity, sunshine hours and wind speed are the chief weather parameters influencing the pest and disease incidence. Weather based pest and disease fore warning models have been developed to certain extent (Singh *et al.*, 1990, Jayanthi *et al.*, 1993 and Prasad *et al.*, 2008) [1-3].

*Maruca vitrata* (Gayer) is a notorious insect pest of grain legumes (cowpea, pigeon pea, black gram, green gram, beans and soybeans) in the tropics and subtropics due to its extensive host range, destructiveness and distribution. Generally in pulses the larvae feed on flower bud, flowers and pods by webbing them and this typical feeding habit acts as a natural shield to the larvae against natural enemies and chemicals. Third to fifth-instar larvae are capable of boring into the pods, and occasionally into peduncle and stems. The insect pest not only extending its host range, but also becoming serious on already reported crops like groundnut at Dharwad year after year, since 2011 (Annon.2015) [4]. Unless like in pulse crop/grain legumes, the pest feed on web the leaves and feed on green matter vegetative parts of the plant in groundnut by

The above knowledge when groundnut becomes its host is lacking and correct information on its bio-ecologica is very much required to design management in groundnut crop ecosystem. Hence the present study is conducted to study the biology of *Maruca vitrata* (Gayer) on groundnut under laboratory conditions.

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## Materials and methods

*Maruca vitrata* (Gayer) larvae collected in groundnut field during *Kharif*, 2016 were reared on groundnut terminal buds and shoot until their pupation. Immediately after adult emergence, 10 pairs were released to rearing cage separately for mating and oviposition. Concentrated sucrose solution soaked in small cotton swab was provided as food source and groundnut terminal shoots, leaves and shoots with flowers were provided as oviposition substrate. Eggs laid counted daily and reared individually in transparent plastic boxes of dia. 8cm on groundnut leaves and terminal shoots until larvae reaches pupation. All necessary biological parameters were recorded *viz.* duration of incubation period, duration of different larval instars, pupal period and adult period and number of eggs laid by female moths.

## Results

Freshly laid eggs were milky white to transparent in colour with oval, dorso-ventrally flattened in shape and firmly glued to the surface. The chorion was with a pattern of sculpturing and each egg measured about  $0.64 \pm 0.1$  in length and  $0.35 \pm 0.1$  in width. The eggs were laid either singly or in cluster of 2 to 4 and later became dark yellow or light brown in colour just before hatching. Hatching is observed both during night and day hours. The incubation period reported during the study under laboratory condition at room temperature 26 to 27 °C was  $2.78 \pm 0.50$  days (Table 1).

Each larva moulted 4 times and possessed 5 instars. The characteristics of and the period occupied by each instar under laboratory condition at room temperature 26 to 27 °C were noted. The newly hatched first instar larvae were creamy white in colour except head and prothoracic segment and have series of black or dark brown spots on thorax and abdominal segments. Body appeared to be wider at anterior and tapering towards posterior end. Each thoracic segment bore a pair of true legs and 5 pairs of prolegs on 3<sup>rd</sup> to 6<sup>th</sup> and 10<sup>th</sup> abdominal segments. Head capsule of first instar larva was of  $0.14 \pm 0.10$  mm in length and  $0.21 \pm 0.01$  mm in width and larva measured about  $1.24 \pm 0.47$  mm in length and  $0.15 \pm 0.00$  mm in width. As it grew towards first moult, the body size increased and abdomen became more or less cylindrical in shape. The average duration of first instar observed during the study was  $3.45 \pm 0.06$  days (Table 1).

Head and body of freshly moulted second instar larva was creamy white in colour. Except eye spots which were dark brown to black in colour. After 3 to 4 hours of moult, colour of head and prothoracic shield turned to dark brown and body became dirty white in colour with spots on it. Segment 3 to 6 and 10<sup>th</sup> of abdomen bore prolegs and 2 pairs of spots with minute setae on dorsal side of larvae. These spots arranged in a way such that one behind the other on either side of mid dorsal line and laterally a pair of spots arranged one below the other present on each segment starting from meso and meta-thoracic segments, which ends at 9<sup>th</sup> abdominal segment where they fuse to form a large median spot. The larvae measured about in  $2.45 \pm 1.0$  mm length and  $0.38 \pm 0.00$  mm in width. Head capsule measured about  $0.31 \pm 0.00$  mm in length and  $0.35 \pm 0.00$  in width. The average second instar duration was  $3.43 \pm 0.05$  days (Table 1).

The third instar was almost similar to second instar, except the size. The colouration of head, prothoracic shield and spots on body surface were dark brown to black and each segment with long setae as in second instar. The larvae measured about  $5.27 \pm 1.55$  mm in length and  $0.83 \pm 0.02$  mm in width. The

head capsule measures about  $0.499 \pm 0.00$  mm in length and  $0.563 \pm 0.00$  mm in width. The average duration of instar was  $2.46 \pm 0.07$  days (Table 1). The newly moulted newly moulted one was creamy white except eye spots. Later head and prothoracic shield become dark brown to black colour. Body became dull white with regular pattern of dark spots as from 2<sup>nd</sup> instar except they increased in size than 3<sup>rd</sup> instar. The larvae measured  $9.24 \pm 1.53$  mm in length and  $1.64 \pm 0.01$  mm in width, head capsule measure about  $0.847 \pm 0.00$  mm in length and  $0.957 \pm 0.00$  mm in width. The duration of fourth instar was  $2.45 \pm 0.05$  days (Table 1).

The fourth instar larvae were light green in colour with regular pattern of dark brown to black spots with long slender setae on each of segment. The larvae measured  $13.14 \pm 0.17$  mm in length and  $1.86 \pm 0.07$  mm in width, head capsule was  $1.325 \pm 0.00$  mm in length and  $1.408 \pm 0.00$  mm in width. The head capsule measurements indicated that the growth rate in successive instar varied from  $0.21 \pm 0.01$  to  $1.325 \pm 0.00$  mm in length and  $0.14 \pm 0.10$  mm to  $1.408 \pm 0.00$  mm in width from first instar to fifth instar. The fifth instar had the greatest increase in body measurements and also had the longest duration among all instars. Hence there was high correlation between head capsule growth and period of development. The body of mature larvae was light green in colour with dark brown to black segmentally arranged spots and each spot with two minute setae. While head was dark brown to black colour and also prothoracic shield. The body is slightly tapered towards both ends with maximum width at middle. Head was somewhat oval to trapezoidal in shape. The duration of fifth instar was  $4.42 \pm 0.03$  days. The total larval period varied from 16 to 17 days ( $16.21 \pm 0.26$ ) (Table 1).

Fully grown larvae stopped feeding and started spinning a transparent silken web within that constructed a spindle shaped silken cocoon. Larvae took a day for webbing later larvae shrunk and remain straight with leg stretched forward. The body colour of prepupa was turned from green to light gray. This all took place within the webbed leaves of groundnut under laboratory condition. The duration of prepupa was  $1.24 \pm 0.45$  days at room temperature of about 26 to 27 °C. The pupation took place in the webs of groundnut leaves within silken cocoon. Freshly formed pupae were greenish later turned pale yellow to gray coloured. Before emergence the color of the pupa turned dark brown and measured  $10.69 \pm 0.02$  mm in length and  $2.61 \pm 0.05$  mm in width. The duration of pupal period was  $6.16 \pm 0.04$  days under laboratory condition at room temperature 26 to 27 °C. Adult at emergence, wings were under sized and folded later due to influx of blood from body, the wings expanded completely and moth rested with wings spreaded horizontally. Moths emerged generally during dusk or night hours between 6 pm to 11 pm. Moths are creamy to yellowish brown with large white semitransparent spots slightly beyond mid length and two smaller spots near to it on fore wings. These spots are encircled with dark brown patches. Hind wings are partially hyaline with milky white in colour with yellowish brown coastal margins and dark brown apical patch. Head was narrower than thorax and compound eyes were large, hemispherical blackish brown. The average adult duration was about  $6.91 \pm 0.52$  days (Table 1).

Mating took place about in 2 to 3 days after emergence, mostly at night hours generally after 9 pm. Male and female actively moved along the walls of the cage and mated in end to end position. The mating pair remained in position for 1 to 2 hours after which they got separated.

Oviposition commenced during the same or second night of mating. Moths mostly laid their eggs at night. A female laid eggs individually or in a group of 2 to 4 eggs on lower surface of the unopened groundnut leaves or on calyx of the groundnut flowers and also on ligueli with an average number of  $97.5 \pm 9.26$  eggs. *Maruca vitrata* (Gayer) took about  $35.3 \pm 1.77$  days to complete one generation on groundnut under laboratory conditions at room temperature of 26 to 27 °C (Table 1).

**Table 1:** Durations of different life stages of *Maruca vitrata* (Gayer) under laboratory conditions

Biological events	Mean duration $\pm$ SD (in days)
Incubation period	$2.78 \pm 0.50$
Larval period	
a) 1 <sup>st</sup> instar	$3.45 \pm 0.06$
b) 2 <sup>nd</sup> instar	$3.43 \pm 0.05$
c) 3 <sup>rd</sup> instar	$2.46 \pm 0.07$
d) 4 <sup>th</sup> instar	$2.45 \pm 0.05$
e) 5 <sup>th</sup> instar	$4.42 \pm 0.03$
f) Total larval period	$16.21 \pm 0.26$
Pre-pupal period	$1.24 \pm 0.45$
Pupal period	$6.16 \pm 0.04$
Longevity of adult	$6.91 \pm 0.52$
Total life cycle (egg to adult)	$33.30 \pm 1.77$
Fecundity per female	$97.50 \pm 9.26$

## Discussion

The present laboratory study on biology under room temperature of 26 to 27 °C, of *Maruca vitrata* (Gayer), on groundnut is a pioneer study and the discussion is made with the related published report on *M. vitrata* and different hosts. It was found that the pest completed its life cycle in  $35.3 \pm 1.77$  days on groundnut. Eggs were flat, slightly elongated, pale yellowish, translucent with reticulate sculpturing on thin and delicate chorion. The eggs were laid either singly or in cluster of 2 to 4. Each egg measures about  $0.64 \pm 0.1$  in length and  $0.36 \pm 0.1$  in width. The incubation period was  $2.78 \pm 0.50$  days.

The larvae passed through with five instars in  $16.21 \pm 0.26$  days with four moults. The body measurements were  $1.24 \pm 0.47$  mm in length and  $0.15 \pm 0.00$  mm in width during first instar and  $13.14 \pm 0.17$  mm in length and  $1.86 \pm 0.07$  mm in width in fifth instar. The head capsule measurements indicated that the growth rate in successive instar varied from  $0.21 \pm 0.01$  to  $1.325 \pm 0.00$  mm in length and  $0.14 \pm 0.10$  mm to  $1.408 \pm 0.00$  mm in width from first instar to fifth instar. Morphologically the later instar larvae are light green in colour with regular pattern of dark brown to black spots with long slender setae on each of segment in all the instars. Each thoracic segment bore a pair of true legs and 5 pairs of prolegs with crochets on 3<sup>rd</sup> to 6<sup>th</sup> and 10<sup>th</sup> abdominal segments. Similarly head capsule length was also varied from instar to instar indicating the moulting and growth in the larvae.

There is a little deviation in few parameters such as incubation period and larval duration, pupal duration and in morphometry from earlier findings. However, the present results are comparable with Ochieng and Bungu (1983) [5] who recorded that the eggs hatched in 2.5 days on an artificial diet. The reported average measurements of five larval instars ranged 1.13 to 1.26 mm x 0.13 to 0.16 mm (1<sup>st</sup> instar) and 12.56 to 16.55 mm x 2.43 to 2.62 mm (5<sup>th</sup> instar) on pigeonpea under conditions of room temperature ( $28 \pm 2$  °C) and relative humidity ( $75 \pm 2\%$ ) during *kharif* (Chandrayudu *et al.*, 2005) [6] is nearer to present findings.

The observed little deviation may be due to change of host and weather parameter.

Fully grown larvae stopped feeding and entered into prepupal stage by spinning a transparent silken web within that construct a spindle shaped silken cocoon in webbed groundnut leaves, in field condition the pupation may also takes place in other than webbed leaves like tunneling of groundnut shoots. The body colour of prepupa was turned from green to light gray. The duration of pre-pupa was  $1.24 \pm 0.45$  days under laboratory condition. After pre-pupal stage the larvae enter into the pupal stage in silken webs. Freshly formed pupae are greenish later turned pale yellow to gray coloured. Before emergence the color of the pupa turned dark brown and measured  $10.69 \pm 0.2$  mm in length and  $2.61 \pm 0.06$  mm in width. The duration of pupal period was  $6.16 \pm 0.04$  days. The present finding can be compared with findings of Ramdas Rai (1983) [7] that the pre-pupal period of *M. vitrata* (Gayer) was 1.93 days to 2.58 days in cowpea and measured 13.02 mm in length and 2.5mm in breadth. The male and female pupa of *M. vitrata* has no difference in size and measured 11.81 mm in length and 2.75 mm in breadth.

Moths emerge generally during dusk or night hours between 6 pm to 11 pm. Moths are creamy to yellowish brown with large white semitransparent spots slightly beyond mid length and two smaller spots near to it on fore wings. These spots were encircled with dark brown patches. The average adult duration was about  $6.91 \pm 0.52$  days. The adult male and female actively move along the walls of the cage and mated in end to end position. After mating, oviposition commenced on same or the second night of mating. In the earlier studies it is stated that oviposition starts 2 days after mating and it lasted for 7 days on cowpea (Veeranna *et al.*, 1999) [8] and the male adult period of

*M. vitrata* (Gayer) was 4.70 days and female adult period was 6.00 days on pigeonpea (Panickar and Jhala, 2007) [9].

The females lay individual or in a group of 2 to 4 eggs on ligueli (leaf like structure present on stem), calyx of the flowers and lower surface of unopened groundnut leaves. These findings are mostly in line with Ganapathy (1996) [10] who reported that mean number of egg masses laid by each female ranged from 2.9 in blackgram and 4.1 in cowpea. Average number of eggs laid by a female was  $97.5 \pm 9.26$ . The life cycle of *Maruca vitrata* (Gayer) studied elsewhere on different hosts showed varied duration *viz.*, 23 to 30 days on cowpea in Northern Nigeria (Akinfenwa, 1975) [11], 18 to 25 days in South Nigeria (Taylor, 1978) [12] and 20 to 57 days on cowpea (Okeyo- Owuor and Ochieng, 1981) [13]. The present details can also be compared with findings of Rachappa *et al.* (2015) [14] on pigeon pea during *kharif* season at Kalbugi of Karnataka. Who stated that the incubation period lasted for  $2.85 \pm 0.40$  days, larval period lasted for  $14.03 \pm 1.95$  days and the pupal period lasted for  $10.33 \pm 1.08$  days. Adult longevity of male and female was  $9.0 \pm 1.0$  and  $10.66 \pm 1.52$  days. And also observed total life span of male and female moths was about  $36.21 \pm 4.43$  and  $37.87 \pm 4.95$  days, respectively. Reported variation may be due to change of host, nature of plant parts on which it was fed and also prevailing weather factors.

## Conclusion

The study on biology of *Maruca vitrata* (Gayer) on groundnut crop is a pioneer work. The adult female laid eggs individually or in a group of 2 to 4 eggs mainly on ligueli, lower surface of the unopened leaves or on calyx with an

average number of  $97.5 \pm 9.26$  eggs per adult female. The total larval duration was  $16.21 \pm 0.26$  days. The duration of pupal period was  $6.16 \pm 0.04$  days and moths emerged generally during dusk or night hours between 6pm to 11pm. The average adult duration was about  $6.91 \pm 0.52$  days and the pest took  $35.3 \pm 1.77$  days to completed its one life cycle on groundnut.

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