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Biology and Morphometry of Jasmine bud borer, *Hendecasis duplifascialis* Hampson (Pyraustidae: Lepidoptera)

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Abstract

The Jasmine bud borer *Hendecasis duplifascialis* Hampson is a key pest on Jasmine causing severe yield losses to farmers. The study was undertaken to explore the morphology, biology and morphometry of jasmine bud borer. The bud borer was collected from the major jasmine growing areas of Tamil Nadu from different locations viz., Tiruchirappalli, Madurai, Thiruvannamalai, Coimbatore, Dindigul, and Dharmapuri districts from March to June 2023 and subjected to the study. The incubation period of egg was found to be 3.7 ± 0.2 days. The colour of the larvae varied from green to pale and green to whitish. There were five larval instars and their mean duration were 3.2 ± 0.20 , 2.4 ± 0.17 , 1.1 ± 0.17 , 2.6 ± 0.32 , 2.4 ± 0.55 , respectively.

The total larval period was 11.1 ± 1.28 days. The larvae pupates by spinning a cocoon at a junction of leaf blade and petiole. The average period for pupation will be 5.6 ± 0.17 . The longevity of male and female moths were 3.12 ± 0.22 and 4.14 ± 0.30 days respectively. The total life cycle was found to be 23.52 ± 1.82 , 24.54 ± 2.02 days respectively. It was found that the female moth has higher longevity when compared to male moth. Morphometric analysis of length and width of the larvae, head capsule width, length and width of pupae, length and width of adult at different locations was measured using a Microsoft imaging software (Leica). The analysis also showed a significant difference between populations. The average morphometric length of eggs was recorded as 0.65 ± 0.06 mm, average larval length for I, II, III, IV and V instars were 6.71 ± 1.00 mm, 1.89 ± 0.20 mm, 8.55 ± 0.76 mm, 1.99 ± 0.18 mm, 2.18 ± 0.19 mm. Average width of larvae for I, II, III, IV and V instars were 1.62 ± 0.19 mm, 1.89 ± 0.20 mm, 1.96 ± 0.18 mm, 1.99 ± 0.18 mm, 2.18 ± 0.19 mm, average head capsule width of I, II, III, IV and V instars were 0.66 ± 0.01 mm, 0.92 ± 0.07 mm, 1.06 ± 0.04 mm, 1.12 ± 0.03 mm, 1.16 ± 0.03 mm respectively.

Keywords: Jasmine bud borer, instar, morphology, morphometric analysis, biology, incubation, longevity

Introduction

Jasmine is an important ornamental flower crop, widely grown and admired for its attractive, aromatic flowers. Jasmine is considered as the "Queen of Perfume" in the Oleaceae family. Besides India, it is also distributed in Sri Lanka, Pakistan, Nepal, Malaysia, China, Indonesia, France, Spain, Hawaii and Australia. Jasmine is known for purity, beauty, love, passion and serenity. There are over 200 species of Jasmine, 40 of which are endemic to India. Of these species, *Jasminum sambac* (Gundamalli/Madurai malli), *J. auriculatum* (Mullai) and *J. grandiflorum* (jathimalli/pitchi) are grown commercially. However, most farmers prefer *J. sambac*, an evergreen tree that grows up to 3 m high with leaves and flowers.

Jasmine is cultivated in more than 8,000 hectares with annual production of about 10t/ha/year. Tamil Nadu is the largest jasmine producer in the country with an annual output of 77,247 tonnes spread over 9,360 hectares. Jasmine production is affected by many factors, of which insect pests are the major affected. There are about 50 different pest species, belonging to eight orders occupying microhabitats of jasmine plant. The major pests of jasmine are *Hendecasis duplifascialis* Hampson and others flower midges (*Contarinia maculipennis* Felt.), spider mites (*Nausinoe geometralis* Guenee.), spider mites (*Elasmopalpus jasminophagus* Hampson) and two mite species (*Tetranychus urticae*. Koch.) (Lanfang *et al.*, 2007) [14]. These spider mites are an important economic factor, as they cause a lot of damage to the silky leaves, which affects the plant's durability.

The budworm, *Hendecasis duplifascialis*, was first reported in 1896 by Hampson in west Africa, India, recorded in South India and Delhi (David *et al.*, 1958) [8]. The jasmine budworm, *Hendecasis duplifascialis* is widely distributed in all jasmine planting areas with jasmine as the only host species. It occurred from April to October, with the ovipositional peaks in July, August and September. A successful management plan requires information about a species biology including its diet and lifecycle, how it interacts with the environment and with other species as well as species behaviour can be manipulated to prevent or reduce yield losses.

Infested flowers turn pinkish-green and drop prematurely. In very large diseases, adjacent buds are interwoven with silk and fed on leaves. The marketable quality of the flower is greatly reduced as the small larvae feed on the flower buds. Jasmine growers often have to use pesticides to control pests. Antibiotics have been shown to be effective, fast-acting and suitable for all conditions.

Materials and Methods

Location

The studies were conducted at Department of Entomology, Anbil Dharmalingam Agricultural College and Research Institute (10.76713°N 10.76713 °E), Navalur Kuttappattu. The biological stages of the pest were collected from March- June from different Jasmine fields at Tiruchirappalli, Madurai, Coimbatore, Thiruvannamalai, Perambalur and Periyakulam Horticultural College and Research Institute as these are the jasmine cultivating districts in Tamil Nadu. The collected insect species were reared at the Department of Entomology, Tiruchirappalli for further detailed study. Identification was done through morphometric of different morphological stages.

Morphometric larval instars of bud borer larvae

The larvae obtained from the field were taken to the laboratory and reared until it reached the 5th instar, when it reached the fifth instar it was preserved in 70% ethanol. Each larvae were kept in glass vial separately for each location, five larvae was used for the morphometric study. The morphometric measurement was taken for each instar, for each larvae which were taken from different locations the length and breadth of the larvae head capsule width, thorax, and abdomen were measured using an image analyzer (Leica). Morphological parameters of individual bud borer species larvae, length and breadth of pupae, length and breadth of adult were determined with a semi-automatic computer image analysis system.

Biological study of jasmine bud worm

Larvae were collected from *Jasminum sambac* field and introduced into the potted plants for culturing. The biology of each instar was documented on the plants and pupae were collected and kept inside the petri plates. For adult emergence these plates were transferred into the oviposition cage and provided with 10 per cent sugar solution with cotton swab for adult emergence.

Statistical analysis

The morphometric data were statistically analysed using a one way analysis of variance (ANNOVA) to determine the significant difference with Mean \pm Standard deviation (SD).

Results and discussion

The results on the biology of the bud borer *Hendecasis duplifascialis* are given in the table 1. It was found that the egg was round in shape and white in colour and the eggs are usually laid around the bud. On hatching the larvae was light green in colour with brown head capsule the size gets increases by each instar and it appear darker prior to moulting. At every progressive instar the larvae becomes darker prior to moulting and becomes transparent after moulting. The incubation period of egg was 3.7 ± 0.2 days. The colour of the larvae was pale green in colour. There were five larval instars and their mean duration were 3.2 ± 0.20 , 2.4 ± 0.17 , 1.1 ± 0.17 , 2.6 ± 0.32 , 2.4 ± 0.55 days, respectively. The total larval period was 11.1 ± 1.28 days. The larvae pupates by spinning a cocoon at a junction of leaf blade and petiole. The average pupal period was 5.6 ± 0.17 . The male and female moths longevity were 3.12 ± 0.22 and 4.14 ± 0.30 days, respectively. The total life cycle was found to be 23.52 ± 1.82 , 24.54 ± 2.02 days, respectively. The female moth has higher longevity compared to male moth.

Lanfang *et al.*, (2007) [14] indicated that the egg, larvae, pupae and adult period lasting for 3.08, 12.30, 5.07, 4.30 days respectively. The total life cycle lasted for 24.05 days. The present findings are in accordance with the above findings.

Hendecasis duplifascialis larvae increases in size during the larval development. The larval instars of I, II, III, IV and V instars were and found to be 6.55, 6.98, 9.31, 12.05, 14.24 mm, respectively and are listed in table 1.

Egg

The eggs of the *Hendecasis duplifascialis* larvae was round in shape and white in color. The freshly laid eggs were milky white in colour and later it turned into golden yellowish cream.

The average egg dimensions (length and width) of *Hendecasis duplifascialis* populations collected from different geographical locations varied significantly (Table 2). The highest egg length was observed from the Madurai and Tiruvannamalai (0.65 ± 0.06), (0.65 ± 0.06). The minimum egg length was recorded from Trichy (0.61 ± 0.05) followed by Coimbatore (0.64 ± 0.06) and Perambalur (0.63 ± 0.05). Madurai populations exhibited the highest egg width (0.55 ± 0.06) followed by Trichy (0.55 ± 0.04) Perambalur (0.54 ± 0.06) Tiruvannamalai (0.53 ± 0.05) and Coimbatore (0.52 ± 0.06).

Larvae

The larval stage of *Hendecasis duplifascialis* passed through five distinct instars. First instars were translucent, creamish white in colour except the head region. The newly hatched larvae has short hairs with black spots all over the body. The second instar larvae was creamy white with dark brownish head. The black spots on the body was more prominently seen in third instar larvae and the length of the larvae increased progressively, which could be clearly distinguished from the second instar. In the fourth and fifth larval instar, the body was light greenish in colour with distinctly visible deep dark spots on the body and dark brown head.

Larval body length

The maximum larval length for the first instar was recorded from the Trichy population of (6.72 ± 1.02 mm). The minimum

larval length was recorded by Tiruvannamali of (6.52 ±0.98 mm) and were listed in table 3.

Larval body width

Larval width variations of *Hendecasis duplifascialis* populations collected from different districts of Tamil Nadu has been shown in table 4. Maximum width of I instar was recorded in a larval populations collected from Trichy (1.62±0.19 mm), the minimum larval width was recorded from Coimbatore 1.44±0.16 mm).

Maximum larval width in second instar larva was observed in populations from Coimbatore (1.89±0.20mm), minimum width was recorded from the Madurai (1.78±0.18mm), all the populations were observed to be significantly different with each other.

Similarly, in the third instar, the maximum body width of (1.96±0.18 mm) was recorded from the Trichy population, and minimum width was recorded from the Perambalur (1.91±0.19 mm).

In the fourth instar the maximum body width of (1.99±0.18 mm) was recorded from Coimbatore population, and minimum width was recorded from the Madurai (1.93±0.20 mm).

The fifth instar larvae also exhibit a similar variation the maximum body width of (2.18±0.19mm) was recorded from Perambalur population and minimum width was recorded from the Madurai (2.04±0.19mm) and has been shown in table 4.

3.3 Width of head capsule

Width of the head capsule collected from different locations of *Hendecasis duplifascialis* the maximum width of the first instar larvae was recorded as (0.66±0.01mm)in Perambalur and minimum width was recorded from the Tiruvannamalai (0.61±0.01mm)and has been shown in table 5.

In the second instar, the width of head capsule varied significantly among the different locations. Among these the highest head capsule width was recorded from the Tiruvannamalai (0.92±0.07 mm) Trichy (0.86±0.05mm), which recorded the minimum head capsule width.

The third instar head capsule width of *Hendecasis duplifascialis* recorded the maximum width of (1.06±0.04 mm) from the Coimbatore populations and Tiruvannamalai recorded the minimum width of 1.01±0.04 mm).

Fourth instar head capsule width also exhibit a similar variation of these Tiruvannamalai recorded the maximum of (1.12±0.03 mm) and (1.05±0.05 mm) recorded the minimum head capsule width from Madurai.

In the fifth instar the maximum head capsule width of (1.17±0.03mm) Tiruvannamalai and recorded the minimum head capsule width of (1.12±0.04) Trichy.

Discussion

These findings are consistent with Okeyo-owuor and Ochien (1981), who recorded an egg size of 0.65 × 0.45 mm for the Puraustid *M. vitrata*. There are significant differences in the morphological dimensions of *M. vitrata* eggs across the country. The mean length and width of *M. vitrata* eggs were reported as 0.67 mm and 0.67 mm, respectively.45 months

respectively in Andhra Pradesh.

The results are consistent with who recorded the average egg length and width as 0.50 to 0.62 mm and 0.55 to 0.61. The five different hosts in Coimbatore ranged from 34 to 0.40 mm in diameter. Similarly, the average egg size in food and natural plants in Gulbarga was recorded as 0.68 × 0.45 mm. Dharwad peas are 36 mm and Parbhani pigeon peas are 0.70 × 0.48 mm.

The maximum height of Rahuri's pigeon pea is 37 mm also observed the larval characteristics of *M. vitrata* in Guntur and found that the average length and width of the first, second, third, fourth and fifth instar larvae was 3.02 × 0.61 mm, 4.43 × 0.87 mm, 8.80 × 1.69 mm, 11.10 × 2.68mm and 15.68 × 3.07mm. Larval length and width reported in this study are in agreement with the results reported by Rachppa *et al.*, (2016), length and width observed in the first stage: 1.25 × 0.17 mm; second period: 2.57 × 0.38 mm, third stage: 5.32 × 0.91 mm, fourth stage: 11.65 × 1.72 mm, fifth stage: 16.94 × 2.56

Biological characterization of Jasmine budworm *H. duplifascialis* and total latent, larval and pupal stages 3.7 ± 0.2, 11.1 ± 1.28 and 5.6 ± 0.17 days, respectively. The total life cycle of male and female moths is 23.52 ± 1.82 and 24.54 ± 2.02 days, respectively (Table 5). Also, for budworms, *H. duplifascialis* females live longer than males. Lanfang *et al.* (2007)^[14] stated that the egg, larva, pupa and adult stages of last 3.05, 11.95, 5.05 and 4.95 days respectively. The entire life cycle lasts 21.05 days, with 10 to 11 overlapping generations occurring in 7 months. The present findings are consistent with the above findings.

Table 1: Biology of Jasmine Bud borer, *Hendecasis duplifascialis* under laboratory condition

S. No.	Stages of bud borer larvae	Mean No. of days ± SE
1.	Incubation period	3.7±0.27
2. Larval period (instar wise)		
A	I instar	3.2±0.20
B	II instar	2.4±0.17
C	III instar	1.1±0.17
D	IV instar	2.6±0.32
E	V instar	2.4±0.35
	Total larval period	11.1±1.28
3	Pupal period	5.6±0.17
4. Adult longevity		
A	Male	3.12±0.22
B	Female	4.14±0.30
5	Total duration	
A	Male	23.52±1.82
B	Female	24.54±2.02

*Each value is a mean of five observation, mean ±SE

Table 2: Morphometry of eggs of Jasmine Bud borer, *Hendecasis duplifascialis* population collected from different locations of Tamil Nadu

S. No	Locations	Length(mm)	(Width)
1.	Madurai	0.65 ±0.06 ^a	0.55 ±0.06 ^a
2.	Trichy	0.61 ±0.05 ^b	0.55± 0.04 ^b
3.	Coimbatore	0.64 ±0.06 ^b	0.52± 0.06 ^b
4.	Tiruvannamalai	0.65± 0.06 ^b	0.53± 0.05 ^b
5.	Perambalur	0.63 ±0.05 ^b	0.54± 0.06 ^b
	CD(0.05)	0.045	0.072

Table 3: Mean larval body length of Jasmine Bud borer, *Hendecasis duplifascialis* populations collected from different locations of Tamil Nadu

S. No	Locations	I instar	II instar	III instar	IV instar	V instar
1.	Madurai	6.55±0.98 ^a	6.92 ±0.91 ^a	8.32± 0.78 ^a	9.23±0.76 ^a	12.92±1.11 ^a
2.	Trichy	6.72±1.02 ^b	6.93±1.05 ^b	8.55±0.76 ^b	9.33±0.69 ^b	12.62±1.07 ^{ab}
3.	Coimbatore	6.71±1.00 ^b	6.81±1.00 ^b	8.32±0.74 ^b	9.22±0.69 ^b	12.52±1.02 ^b
4.	Tiruvannamalai	6.52±0.98 ^b	6.83±0.93 ^b	8.22± 0.63 ^b	9.11±0.72 ^b	12.71±1.00 ^b
5.	Perambalur	6.55±0.98 ^b	6.81±1.00 ^b	8.41±0.69 ^b	9.11±0.71 ^b	12.93±0.97 ^b
	CD(0.05)	0.663	0.949	0.466	0.744	1.265

*Mean± Standard deviation of five replications and each replication consists of 10 observations

*Found significant at 0.05 level of significance

Table 4: Mean larval body width of Jasmine Bud borer, *Hendecasis duplifascialis* populations collected from different locations of Tamil Nadu

S. No	Locations	I instar	II instar	III instar	IV instar	V instar
1.	Madurai	1.57±0.20 ^a	1.78±0.18 ^a	1.92±0.19 ^a	1.93±0.20 ^a	2.04±0.19 ^a
2.	Trichy	1.62±0.19 ^b	1.84±0.18 ^b	1.96±0.18 ^b	1.97±0.18 ^b	2.08±0.18 ^b
3.	Coimbatore	1.44±0.16 ^b	1.89±0.20 ^b	1.92±0.18 ^b	1.99±0.18 ^b	2.13±0.19 ^b
4.	Tiruvannamalai	1.54±0.19 ^b	1.83±0.18 ^b	1.95±0.18 ^b	1.97±0.18 ^b	2.16±0.18 ^b
5.	Perambalur	1.58±0.19 ^b	1.84±0.19 ^b	1.91±0.19 ^b	1.96±0.18 ^b	2.18±0.19 ^b
	CD(0.05)	0.120	0.110	0.113	0.120	0.116

Table 5: Mean larval head capsule width of Jasmine Bud borer, *Hendecasis duplifascialis* from different locations of Tamil Nadu

S. No	Locations	I instar	II instar	III instar	IV instar	V instar
1.	Madurai	0.62±0.01	0.89±0.05	1.04±0.05	1.05±0.05	1.13±0.04
2.	Trichy	0.64±0.20	0.86±0.05	1.02±0.05	1.08±0.04	1.12±0.04
3.	Coimbatore	0.62±0.01	0.91±0.07	1.06±0.04	1.07±0.04	1.14±0.04
4.	Tiruvannamalai	0.61±0.01	0.92±0.07	1.01±0.04	1.12±0.03	1.17±0.03
5.	Perambalur	0.66±0.01	0.88±0.07	1.05±0.04	1.09±0.03	1.16±0.03
	CD(0.05)	0.048	0.033	0.032	0.031	0.026

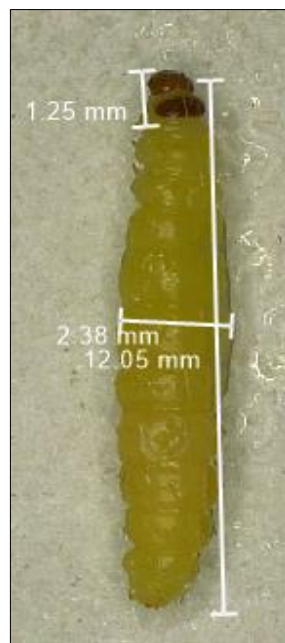
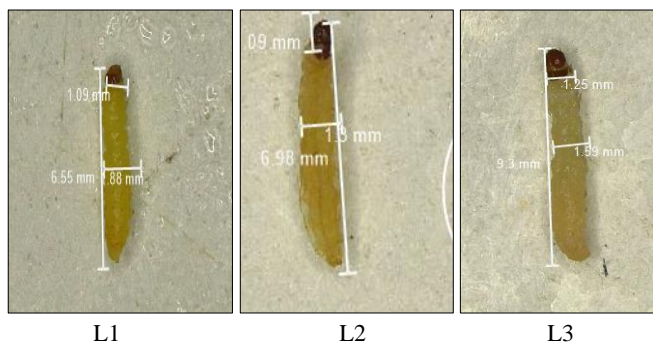
*Mean± Standard deviation of five replications and each replication consists of 10 observations

*Found significant at 0.05 level of significance



Larvae

Length and breadth of different larval instars, pupae and adult of Jasmine Bud borer, *Hendecasis duplifascialis*



L4



L5

Conclusion

Jasmine is the major pests grown all over the world including India. Many of the insect pests and diseases attack the Jasmine. Among these jasmine bud worm is the important pests attacking Jasmine. In the present research which was conducted at Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli revealed that significant variations were recorded in the larval instars duration at each

location and biology of jasmine bud borer was studied.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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