

STUDIES ON *HALYOMORPHA MARMOREA* F. (PENTATOMIDAE: HETEROPTERA), ASSOCIATED WITH TENDER NUT DROP IN ARECANUT*

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ABSTRACT

The biology of pentatomid bug *Halyomorpha marmorea* F. which causes tender nut drop in arecanut has been studied. The investigations were conducted during post-monsoon seasons of 1985 and 1986. Under laboratory conditions, the female and male bugs lived for 38.0 and 33.8 days, respectively. Females laid, on an average, 4 egg clusters, each comprising 28 eggs. The incubation period varied from 4-6 days with an average of 5.1 days. There were five nymphal instars each with an average duration of 3.7, 6.1, 5.1, 6.5 and 9.3 days, respectively. The description of different instars is furnished in detail. The nature and extent of damage to arecanut and host range of this pentatomid bug are also discussed.

INTRODUCTION

The tender nut drop in arecanut is a serious malady. It has been estimated that nearly 10-20% palms had this malady irrespective of management practices, in the gardens surveyed in Karnataka (Anonymous, 1984). Many authors reported the association of insects, mites and pathogens in the damage of inflorescence, bunch and tender nut (Rao, 1965; Sadanandan and Antony, 1972; Saraswathy, Reddy and Nair, 1977). The actual causes of the malady and causal organisms involved were not identified till recently. The first report has briefly described the role of *Halyomorpha marmorea* F. (Pentatomidae: Heteroptera) as the causal agent of the tender nut drop in arecanut (Vidyasagar and Bhat, 1986). As this new insect pest has not been reported from any other crop in India, a detailed investigation on the biology and its role in tender nut drop in arecanut was carried out.

MATERIALS AND METHODS

Life history

The study was conducted at Central Plantation Crops Research Institute, Regional Station, Vittal, Karnataka during 1985 and 1986. From the field-collected bugs a laboratory culture was established and biology of the insect was studied. Rectangular glass jars (12 x 15 x 24 cm) covered with muslin cloth were used for maintaining the culture. All nymphal instars were provided with fresh pods of cow pea (*Vigna sinensis*) on alternate days and the studies were carried out under a range of 28-33°C temperature and 70-85% relative humidity. When the insects attained fifth instar fresh tender arecanut bunches were supplemented with pods of cow pea on alternate days. Adults on emergence were sexed and two pairs per jar were released for further studies on mating and egg laying.

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habits. Egg cluster usually laid on the muslin cloth were transferred to small cylindrical glass jars (8 x 18 cm) and the rectangular glass jars covered with fresh cloth. Each egg cluster was kept separately for hatching and allowed to develop till the first moulting. After moulting the second instar nymphs were transferred to rectangular jars. Observations were recorded during September-November 1985 and October-December 1986.

The descriptions and measurements of individuals were made from live specimens and specimens preserved in 80% ethanol. The description of each stage is based on 10 individuals. Drawings were made with a camera lucida and measurements with an ocular micrometer.

Nature and extent of damage

Last instar nymphs as well as adults were used in this study. Freshly cut arecanut bunch with 4-11 tender nuts (3cm length) was provided to each pair of adults/nymphs. After two to three days all the nuts were split and observations recorded on the nature of feeding. Some observations on the length of feeding and site selection were also recorded.

During 1985 and 1986 a few field visits were made to arecanut gardens to collect nymphs and adults from the areca palm.

RESULTS AND DISCUSSION

Egg

The eggs were 0.9-1.00 mm long and 0.75-0.9 mm wide. They are laid in a cluster of 28. Each egg is milky white in colour when freshly laid and turning to cream colour on the 3rd day. The shape of the egg is more or less spherical. The egg cluster is laid in a triangular formation on the rachis.

The first instar is described in detail, but only important changes from the previous instar are described for subsequent instars. The comparative measurements are given in Table I.

First instar

2.29 mm long and 1.86 mm wide (Fig. 1). Body semispherical, yellowish orange, tylus slightly exceeding juga, eyes scarlet; antenna 4-segmented, fusiform with the smallest 1st segment and longest last segment. Thoracic nota with lateral and mid-dorsal black patches. Femora and tibiae fuscous, tibiae slightly dilated distally with outer surface grooved along the entire length; tarsi yellowish and 2-segmented; tarsal claws and pulvilli tinged with yellow and translucent; dorsum of abdomen showing two lateral and one mid dorsal black patch.

Second instar

4.08 mm long and 2.62 mm wide. Black and oval. Anteocular tooth acute; juga exceeding the tylus; eyes fuscous; antenna fuscous with the longest distal segment. Lateral margins of thoracic nota acutely dentate with 4 pronotal, 3 mesonotal and 3 metanotal dentations; impunctate area along the mid dorsal line from anterior pronota to posterior metanota. All femora with a subacute tooth at the anterior distal end. Abdomen with 5-segmented rectangular, medial plates; lateral plates albidous with impunctate area adjacent to lateral margin of abdomen. Last medial fused with albidous pleura. Each lateral plate has a conspicuous central tubercle with central seta.

Third instar

5.65 mm long and 3.24 mm wide. Black and oval; antennal segments 2-4 of ca. equal length; head longer; juga equal to tylus.

Table I. Measurements (mm) of various stages of *Halyomorpha marmorea* F.

Stage		Mean	S. E.	CV (%)
Egg		1.00	0.007	2.24
I instar	L	2.29	0.046	6.36
	W	1.86	0.044	7.44
II instar	L	4.08	0.042	3.04
	W	2.62	0.051	6.20
III instar	L	5.65	0.042	2.33
	W	3.24	0.094	9.16
IV instar	L	7.64	0.023	0.93
	W	4.56	0.017	1.15
V instar	L	12.10	0.272	7.11
	W	7.39	0.106	4.52
Adult ♀	L	17.50	0.100	1.81
	W	10.05	0.085	2.68
Adult ♂	L	16.65	0.124	2.35
	W	8.65	0.124	4.51

L: Length; W: Width

Dorsal side with more numerous punctures. Thoracic nota with dentations laterally and impunctate area along the base of dentations; pro and mesonota with lateral circular patches devoid of punctures, mesonotum with medial area strongly extended posteriorly. Femora with one acute and another subacute tooth at the distal end. One and two abdominal segments with lateral acute dentations; abdominal medial plates 2-6 highly sclerotised.

Fourth instar

7.64 mm long and 4.56 mm wide. Body black, and oval; distal 1/3 of 3rd antennal segment albidous; dorsal side more densely punctate. On dorsal side of head a white, impunctate, crescent at the base of each eye. Lateral margin of each thoracic tergite with

8-shaped impunctate, albidous area near the lateral margin; femora with a few stout setae; protibiae often with one or two white incomplete annulus at the distal end; meso and meta tibiae with a white, complete annulus in the middle 1/3; outer surface of tibiae grooved along the entire length; mesonota subarcuate but not extending posteriorly; metanota lacking lateral dentation which was present in the previous instar. Meso and metanotal wing pads often extending to the posterior margin of 1st abdominal segment. Lateral abdominal tergites without conspicuous tubercles as in the third instar.

Fifth instar

12.10 mm long and 7.39 mm wide (Fig. 2). Body pyriform; punctures more numerous; dorsal side black and ventral side white with

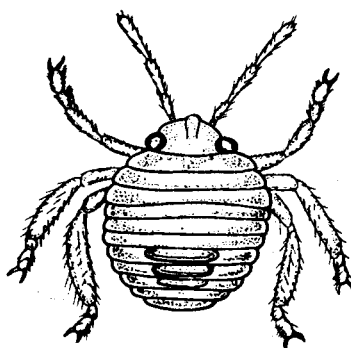


Fig. 1. First instar nymph

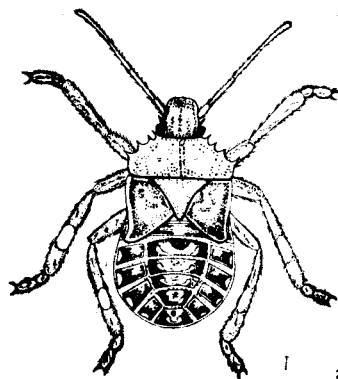


Fig. 2. Fifth instar nymph



Fig. 3. Adult bug

pinkish tinge on the abdominal sclerites. Head distinctly elongate; ratio of last 3 antennal segments same as in previous instar. Mesonotal wing pads extending upto 2nd abdominal segment while metanotal wing pads extending to the 3rd abdominal segment. Pronota with lateral dentations and meso and metanota completely lacking them. Femora without distal teeth which were present in the earlier instar. Protibiae with an incomplete annulus at the 1/3 distal portion. Meso and metatibiae with complete annulus in the middle region. Acute dentations on the lateral margins of first and second abdominal segments of the previous instar are absent. Lateral plates impunctate, elliptical, white, extending dorsally and ventrally from margin of abdomen.

Adult

Female: 17.50 mm long and 10.05 mm wide (Fig. 3). Body pyriform and stramineous on dorsal side; abdominal tergites black, while ventral sternites are white. The head is elongated with tylus equal to jugus; second segment of antenna longest and third and fourth segments albidous at the 1/3 proximal end; dorsal side of head, pronota and mesonota with numerous punctures. Lateral margins of pro, meso and metanota without dentations; anterior margin of mesonota with four white spots; pro and meso tibiae

with a complete white ring at the middle. Metatibiae with incomplete white annulus on the posterior side and red coloured anterior side. The fused lateral margin of abdomen with five white spots extending from dorsal to ventral side. The female is larger than male in size and the last three abdominal segments are bulged on the ventral side.

Male: 16.65 mm long and 8.65 mm wide. Morphologically it is similar to the female except in the last 3 segments of abdomen. In male a pair of anal cerci are clearly visible on the ventral side of last abdominal segment.

Life history

Adults mated on the rachis of arecanut in the laboratory. The female laid 28 eggs in the form of a triangular cluster mostly during night time. Each female on an average laid about four egg clusters consisting of 112 eggs with a range of 2-6 clusters. The incubation period varied from 4-6 days with an average of 5.1 days. The eye spot was noticed on the opercular side about 24 before hatching. The life span of different stages is given in Table II. The first instar nymphs emerged through the operculum. They were gregarious and remained atop the egg shell on the first day after hatching. Though they moved actively on the food plant from the second day onwards, the feeding activity was

Table II. *Life span (in days) of different stages of Halyomorpha marmorea F.*

Stage	Mean	Range	S.E.	CV (%)
Egg (224)	5.1	4-6	0.12	11.98
Instar I (47)	3.7	3-5	0.12	21.74
Instar II (36)	6.1	5-7	0.12	12.06
Instar III (31)	5.1	5-7	0.12	11.59
Instar IV (18)	6.5	5-8	0.21	13.66
Instar V (12)	9.3	9-10	0.14	5.05
Adult female	38.0	25-55	2.28	20.03
Adult male	33.8	23-58	2.46	22.99

Number of individuals is given in parentheses

almost nil. The first instar period lasted for about 3-5 (mean 3.7) days. The second instar nymphs were active and fed continuously on the food source. The period of development of the second instar varied from 5-7 (mean 6.1) days. The third instar nymphs were also gregarious and completed their growth in 5-7 (mean 5.1) days. From fourth instar onwards the nymphs were observed to form smaller groups of 3-4 individuals and fed voraciously. The fourth instar lasted about 5-8 (mean 6.5) days. The fifth instar nymph fed on tender nuts of arecanut and moulted to adults after 9-10 (mean 9.3) days. The entire development period averaged 35.8 days.

The adults were also observed feeding on the tender nuts of arecanut and mated in about 4-7 days after emergence. The pre-ovipositional period ranged from 9-12 days. The longevity of females on an average was 38.0 days compared to 34.8 days of males.

Nature and extent of damage

Both fifth instar nymphs and adults fed on the tender nuts of arecanut. The bugs pierced the fibrous pericarp and soft kernel with their long proboscis and sucked the sap

The piercing was completed in 10-15 min. and the feeding continued for 2-4 h at a stretch. Interestingly, the bugs were observed to make use of the same puncture repeatedly until the sap is exhausted from the nut. In most of the cases the insects were found to visit the same nut for subsequent feedings. Due to the depletion of sap content, the nuts get detached from the rachis and drop. On an average one bug was able to suck the sap from one nut a day. The results of the damage potential of the insect are given in table III. The feeding activity remained more or less same throughout adult life. Under laboratory conditions the nuts dropped on the third day after damage. When the nuts damaged by bugs were cut and observed they showed the typical discolouration of kernel and total depletion of the sap of the endosperm. (Fig. 4). When the surface of nuts was scraped the usual pin prick-like marks mentioned in the earlier literature were observed. In healthy non-infested nuts, there was neither discolouration of kernel nor depletion of sap and the nuts did not drop as in the case of damaged ones.

In a sample of 106 nuts damaged, 58 (55%) nuts showed punctures in the middle portion,

Table III. *Damage potential of Halyomorpha marmorea F. on tender nuts of arecanut*

S. No.	No. of insects	No. of nuts offered	No. of nuts damaged	Average feeding durations (days)	Daily average damage by one insect
1	11	43	29	2.8	0.94
2	8	38	19	2.4	0.99
3	7	28	21	2.2	1.36
4	7	28	14	2.0	1.00
Average					1.07

whereas, 28 (26%) and 20 (19%) nuts exhibited punctures in the distal and proximal portions of the nut. Earlier reports have stated that the shedding of nuts was more in some palms. This can be easily explained by the fact that the bugs tend to be gregarious resulting in heavy dropping in some palms compared to others. This type of behaviour was reported in other bugs also (Hoffman, 1931; Cuda and McPherson, 1976). Besides arecanut and cowpea, this insect was found feeding on fruits of bitter gourd and fingers of okra in the field. When these hosts were

offered under controlled conditions, the adults/last instar nymphs readily accepted them for feeding. However, their first preference was always arecanut/cowpea.

It has been noticed from farmer's reports and field visits that the tender nut drop begins around April and becomes severe during monsoon. The main alternate/collateral host cowpea which is grown as a vegetable by most of the farmers during monsoon is not grown during summer. During this period the insect migrates to the crowns of area



Fig. 4. Longitudinal section of the tender nut showing insect damage to kernel

palms and multiplies there. Several nymphs and adults were collected from the palms showing tender nut drop during the field visits. Once the hardening of kernel begins, the insect moves to other host plants like cowpea, bitter gourd, okra etc. which are available in the field. This way the insect is sustained in the farmers' gardens almost throughout the year.

Pentatomid bugs are known to cause economic damage to many agricultural crops. A related species *Halyomorpha picus* F. was reported as a pest of beans in China (Hoffman, 1931) and as a minor pest on citrus in Ceylon (Hutson, 1936). It has been reported that *Halyomorpha reflexa* Sign. feeds on *Solanum verbascifolium* while *Halyomorpha mista* damages soybean pods and other legumes (Golding, 1941; Kadosawa and Santa, 1981). However, from India *H. marmorea* F. or other allied species has not been reported as pest on any other crop. Hence, this is the first detailed study conducted on *H. marmorea* F. in arecanut.

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