



## Bionomics of the marmorated bug, *Halyomorpha marmorata* Fab. (Hemiptera: Pentatomidae) in arecanut plantation ecosystem

(Manuscript Received: 24-02-09, Revised: 14-09-09, Accepted: 28-12-09)

**Keywords:** Arecanut plantation, bionomics, *Halyomorpha marmorata*

Phytophagous stink bugs are important pests of many crops, feeding mostly on seeds and immature fruits. This results in drop and malformation of seeds and fruits. In arecanut palms, fertilized flowers and various stages of immature fruits shed throughout the year, but more from November to July. Shedding of flowers due to any insect damage is very low. Damage by insects sets in from February- March and continues up to July-August. This is caused by the perianth mite *Dolichotetranychus* sp (Acari:Tenuipalpidae) (Sadanandan and Antony, 1973) and by the pentatomid bug, *Halyomorpha marmorata* Fab. (Vidyasagar and Shama Bhat, 1986).

The pentatomid bug is a low density insect which is conspicuous only by the damage it causes. These insects are seasonal in its appearance and not easily found on the palm host but are seen on other host plants for most part of the year. As only limited information is available about the phenology of this insect in the ecosystem of arecanut plantations, the present study was undertaken.

Seasonal abundance of *H.marmorata* was studied by examining all fallen fruits from a five acre arecanut plantation of the institute. The dropped fruits from the base of individual palms were collected separately and examined for damage. This was also done as a random survey in other plantations for 15 years. When surveys were undertaken to other districts of Karnataka and other states, the dropped fresh fruits were collected from these plots and examined for the feeding by these insects during infestation period (March- September). The collected fruits were measured and cut longitudinally to see the insect damage or otherwise. The point of

proboscis insertion on the fruit surface was classified as follows:

1) at the perianth's attachment to the rachis, 2) at the end of the perianth on the fruit body, 3) at the middle of the fruit body and 4) at lower end of the fruit body.

Some aspects of field biology of this bug was studied by conducting observations on arecanut palms in the plots of its incidence for the presence of life stages of the insect and was done throughout the year. All the cultivated and non-cultivated plants inside and in the vicinity of the plantations were examined for the presence/feeding by any stage of the insect. All the immature stages of the insect collected from these plants were reared to adult stage. The search was continued throughout the year for about five years.

The immature fruit drop due to *H.marmorata* attack in arecanut palms was found to be a problem from March to July months in certain localities of Dakshina Kannada district, Sirsi area of Uttara Kannada district of Karnataka and northern parts of Kasaragod district of Kerala. Immature fruit drop by this bug was found to set in after a certain growth of the flower button when the perianth was distinguishable from the main fruit body and the fruit has a definite shape and green colour and the endosperm is differentiated with a fluidy central part. The attack continued till the nut body mass was formed. Infestation was noticed occasionally on very tender fruits before the formation of the fluidy central part. Feeding was not seen on any other part of the inflorescence.

The incidence of this bug could be recognized by the shed immature fruits concentrated more on the palm

basins of individual palms from March/April to July. The symptom of injury of bug attack was seen on the dropped fruits as a microscopic pin-prick black dot left by the insertion of proboscis on the fruit surface. The tissues surrounding the puncture discoloured later to light brown to black and this was seen more on the inner surface of the husk. The point of insertion of proboscis on the outer surface of the endosperm was thickened and could be felt. Injury caused by the bug was primarily due to the mechanical destruction of the cells and the sucking of the cell contents. Shriveled and sunken endosperm tissue was a specific sign of *Halyomorpha* attack. When very tender fruits were attacked, the liquid endosperm was sucked out leaving only the atrophied, sunken tissue. The developing kernel became discoloured to dark brown. Some of the attacked fruits showed signs of malformation and dried resins (gummosis) near the point of attack at the perianth end. Fruits dropped due to physiological, genetical or pathological reasons had the endosperm content intact. The feeding points on the fruit surface were not uniform (Fig. 1). Proboscis was inserted mainly through three areas viz; top portion of the perianth near the attachment of the fruits to the rachii, at perianth's end and at middle point of the fruit body. The least preferred site was the lower part of the fruit body. *Halyomorpha* did not feed on fresh fruits once the endosperm was hardened. This was evident from the shed fruits collected during September to November.

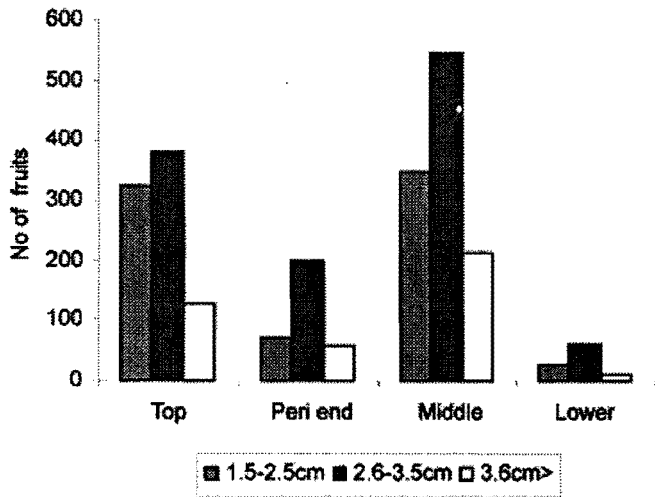


Fig. 1. Site of proboscis insertion by *H. marmorata* on immature fruits of arecanut palm

Immature fruit drop caused by *H. marmorata* was noticed initially during March and was seen up to August. The highest incidence was seen during June when the area receives the highest rainfall and the tender fruits are having more sap inside. The field observations recorded in the last 15 years indicated that this insect

was not widely present in the area of its occurrence and is a low density pest. Even within a plantation, the activity of the bug was confined to a few palms. Whenever the intensity of attack was severe in a plot, it was surrounded by secondary jungles of different trees, shrubs etc. Such locations were found in the south and southeast parts of Dakshina Kannada bordering Kerala State. Intensity of *Halyomorpha* attack varied widely and ranged from 8 - 78 per cent. Mostly fifth instar nymphs and adult bugs injured the immature fruits. Shed fruits collected separately from each palm basin showed a variation of 0 - 79.5 per cent attack.

Observations on the seasonal incidence of *H. marmorata* on arecanut plantation indicated that this bug started visiting arecanut palms from other host plants earliest by March and continued up to early August. A five year study in a plot with known history of attack by this pest indicated that the intensity of drop gradually increased from April - May, reached a peak during June - July, and decreased thereafter with the least injury in August when the endosperm had differentiated into a solid mass (Fig. 2). The arecanut palms were sparsely populated by this bug. All the collections made during the surveys in different areas of Dakshina Kannada, Sirsi area of Uttara Kannada and northern parts of Kasaragod districts indicated 0-72 per cent damage by this insect. It was evident from these observations that immature fruit drop was more in April-July. It could be concluded that this pentatomid spends its time on arecanut palm from March/April to July/August for feeding on the tender fruits and switches back to its permanent hosts for feeding and reproduction.

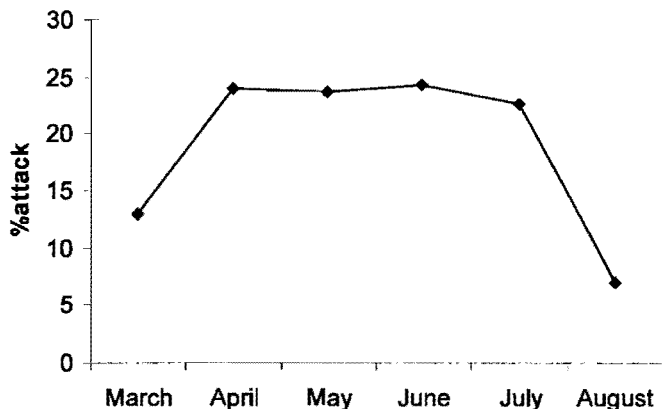


Fig. 2. Seasonal incidence of *H. marmorata* on arecanut palm

All stages of the bug from the third instar nymph to adult bugs could be collected from the inflorescences and bunches of arecanut palm but in very few numbers. Egg clusters of this bug were collected from very wide habitats. It was found laid on the underside of the pinnae

of young nonbearing arecanut palms, on the underside of mature green coloured leaves of cocoa, leaves of black pepper and on the underside of mature leaves of some vegetable crops like ash gourd and bitter gourd and on the thorn less variety of *Erythrina* also. Barrel shaped white eggs were laid in a few rows and it appeared as a compact circular mass and each cluster contained 23-24 eggs. Nymphs and adults were also collected from mature leaves and trunk region of cocoa trees and leaves of pepper April to August and during November in the plots of attack.

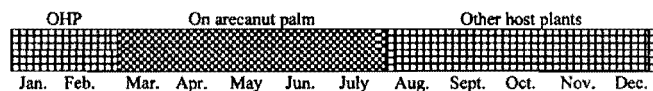
Adults of *H. marmorea* were not easily located on arecanut palms. One reason for this might be that these inhabit the fruit bunches, and palms after reaching certain height could not be easily searched. Adults were observed on vegetable crops like cowpea, ash gourd, chillies, bitter gourd, salad cucumber and the little gourd coccinia grown near and inside arecanut plantations. Biology of this pentatomid was studied under laboratory conditions by Vidyasagar (1988). The total life cycle from egg to adult stage is completed in 36-41 days. The longevity of male bug lasts 24 days and that of female insect 40 days.

*H. marmorea* was seen inhabiting many other plants in the vicinity of arecanut plantations (Table 1). During this observation, *H. marmorea* was never found to feed on any part of cocoa tree though eggs were found on cocoa leaves. There may be a few other wild fruit trees like wild figs which these bugs may use for feeding (farmer's observation).

**Table 1. Host plants of *H. marmorea* in Dakshina Kannada**

Sl. no.	Common name	Scientific name	Plant parts feeding on
1	Cowpea	<i>Vigna unguiculata</i> (L.) Walp. (Fabaceae)	Leaves and pods
2	Bitter gourd	<i>Mormodica charantia</i> L. (Cucurbitaceae)	Tender fruits
3	Okra	<i>Abelmoschus esculentus</i> (L.) Moench (Malvaceae)	Green fruits and leaves
4	Red chilli	<i>Capsicum annum</i> L. (Solanaceae)	Green fruits and leaves
5	Ash/wax gourd	<i>Benincasa hispida</i> (Thunb.) Cogn. (Cucurbitaceae)	Leaves
6	Jungle flame	<i>Ixora coccinia</i> L. (Rubiaceae)	Fruits
7	Little /ivy gourd	<i>Coccinia grandis</i> (L.)J.Vogt (Cucurbitaceae)	Fruits
8	Arecanut palm	<i>Areca catechu</i> L. (Arecaceae)	Immature fruits
9	Shoe flower plant	<i>Hibiscus rosasinensis</i> L. (Malvaceae)	Flower buds
10	Salad cucumber	<i>Cucumis sativus</i> L. (Cucurbitaceae)	Very tender fruits

In the arecanut growing tracts of south India, this pentatomid was observed to damage immature fruits of arecanut palms only in certain localities of Karnataka and Kerala, mostly confined to the Dakshina Kannada and Kasaragod districts. This may be because the main host plants of this insect are present only in these locations. These observations clearly indicate that host plants other than *A. catechu* play an important role in the phenology of *H. marmorea* in the area of its distribution. The occurrence of an egg parasitoid (*Anastatus banglorensis* Mani & Kurien) from egg clusters collected from leaves of ash gourd (Mariamma Daniel *et al.*, 2003) also shows the importance of other host plants in the bionomics of this bug. A generalized host sequence of *H. marmorea* in arecanut plantation system is given in Fig. 3. It is concluded that *H. marmorea* feed and reproduce on cow pea, ash gourd, bitter gourd, chillies etc. of the locality and switch over to *A. catechu* as later instar nymphs and adults and feed on immature fruits during March to July. Thus, this pentatomid spends only four to five months on arecanut palms for feeding and rest of the year they spend feeding and reproducing on other cultivated/wild plants.



**Fig. 3. Host sequence of *H. marmorea* on *A. catechu***

Very few species of *Halyomorpha* are reported from all over the world. *H. mista* Uhler feeds on several horticultural plants in Japan including the legumes like pea, and kidney bean, and trees like cedar, hinoki, cherry, maple birch and on rape and cucumber (Kawada and Kitamura, 1983). *H. picus* (F.) is reported as a pest of beans in southern China (Hoffman, 1931). *H.sp.nr. picus* (Fab.) is reported as a pest of vanilla (Prakash and Sudharshan, 2002) and of vegetable cowpea in Kerala (Sudharma and Rani, 2005). The Asian Brown Marmorated Stink bug, *H. halys* (Stål) is a recently introduced insect to the western hemisphere and is first reported from Pennsylvania (Hoebeke and Carter, 2003). It is feared that this polypahgous stink bug may become a major agricultural pest in North America (Gyeltshen *et a l.*, 2008). Members of the genus *Halyomorpha* are widespread in West and Central Africa as very minor pests of cocoa. *H. annulicornis* feeds on pods in Ghana and the Congo Republic but the eggs are laid in clusters on leaves. *H. reflexa* (Sign.) is one of the commonest pentatomids of the cocoa regions of Ghana where its main host is *Solanum verbascifolium* aut.non. L. though in addition it feeds on orange. It also occurs on S.

*verbasifolium* and cocoa in Nigeria. Adults and nymphs feed on the pith of chupons which become brown, but populations on cocoa are low. *H. viridescens* was found on the trunk and branches of cocoa at Mayumbe in the Congo (Entwistle, 1972). Though egg clusters of *H. marmorea* were seen laid on mature cocoa leaves, no feeding/damage was observed on cocoa grown under arecanut palm here. *H. marmorea* is the only species of the genus known to damage a palm species.

Pentatomids attacking palms in other countries include the coconut spathe bug, *Axiagastus cambelli* Dist. reported as infesting male and female flowers and immature fruits of coconut palm and *A. catechu*. It can cause immature fruit fall, but its economic status is difficult to assess, since the damage done by it appears to be much less than the number of insects present would suggest. It is present in Solomon Islands, Vanuatu, New Hebrides and New Guinea and is reported as causing severe fruit fall in parts of the Bismarck Archipelago (Lever, 1969). This bug is of significance only when it occurs in high numbers. The damage can result in fruit fall, probably due to loss of sap rather than the injection of toxin (Howard *et al.*, 2001).

Most of the phytophagous pentatomids are polyphagous, feeding on cultivated and uncultivated plants. Because of their feeding habits, wild hosts play an important role in the buildup of pentatomids that are agricultural pests. The importance of wild hosts in the build up of populations on crops is magnified in tropical and sub-tropical regions where pentatomids are able to reproduce during most of the year because suitable food plants are also available year round (Panizzi, 1997). In arecanut growing tracts of south India, the attack by this insect is observed only in certain localities. This might be because the main host plants of this insect are present only in these locations. The arecanut palm may be one of its alternate host plants. Since later instar nymphs and adults of this bug are found feeding on arecanut palm, it is important to monitor the development of the population of this bug on its other host plants in the vicinity of the plantation and reduce its numbers on these host plants.

## References

- Entwistle, P.F. 1972. *Pests of cocoa*. 779 pp. Tropical Science Series. Longman, London.
- Gyeltshen, J., Bernon, G and Hodges, A. 2008. Brown Marmorated Stink bug, *Halyomorpha halys* (Stål) (Insecta: Hemiptera: Pentatomidae) IFAS Extension at <http://edis.ifas.ufl.edu>. 7pp.
- Hoebeke, E.R. and Carter, M.E. 2003. *Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae). A polyphagous plant pest from Asia newly detected in North America. *Proc. Entomol. Societ Washington* **105**: 225-237.
- Hoffman, W.E. 1931. A pentatomid pest of growing beans in south China. *Peking Natural History Bulletin* **5**(3): 25- 26.
- Howard, F.W., Moore, D., Giblin-Davis, and Abad, R.M. 2001. *Insects on Palms*. 400pp. CABI Publishing, U.K.
- Kawada, H. and Kitamura, C. 1983. Bionomics of the brown marmorated stink bug, *Halyomorpha mista* Uhler. *Jpn. J. appl. Ent. Zool.* **27**: 304-306.
- Lever, R.J.A.W. 1969. *Pests of the coconut palm*. 190pp. FAO Agricultural Studies No. 77.
- Mariamanna Daniel., Narendran, T.C. and Keshava Bhat, S. 2003. The eupelmid egg parasitoid of the pentatomid bug, *Halyomorpha marmorea* F. in Dakshina Kannada district of Karnataka. *J. Plantn. Crops* **31**: 57- 59.
- Panizzi, A.R. 1997. Wild hosts of pentatomids: Ecological significance and role in their pest status on crops. *Annu. Rev. Entomol.* **42**: 99- 122.
- Prakash, K. V. and Sudharshan, M.R. 2002. Vanilla bug, *Halyomorpha* sp.nr. *picus* (Fabricius) (Hemiptera: Pentatomidae)- a new pest of vanilla (*Vanilla planifolia* Andrews). pp. 493-496. In: PLACROSYM XIV (Eds.). Rethinam, P., Khan, H.H, Reddy, V.M., Mandal. P.K. and Suresh, K). Indian Society for Plantation Crops, Kasaragod.
- Sadanandan, A.K. and Antony, K.J. 1973. Control of a new calyx mite of arecanut in Kerala. *Arecanut and Spices Bull.* **4**: 17- 18.
- Sudharma, K. and Rani, J. 2005. *Halyomorpha* sp.nr. *picus* (Fabricius) Hemiptera: Pentatomidae) and *Pagria signata* (Motschulsky) (Coleoptera: Chrysomelidae), two new pests of vegetable cowpea. *Entomon* **30**: 235- 236.
- Vidyasagar, P.S.P.V 1988. Studies on *Halyomorpha marmorea* F. (Pentatomidae: Heteroptera), associated with tender nut drop in arecanut. *J. Plantn. Crops* **18**(Suppl.): 305- 311.
- Vidyasagar, P.S.P.V. and Shama Bhat, K. 1986. A pentatomid bug causes tender nut drop in arecanut. *Curr.Sci.* **55**: 1096- 1097.