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Biology of a Pentatomid Bug *Amyotea malabarica* (Fabricius) and its Predatory Efficiency in Rice Field of Vidarbha, India

Barsagade D.D.¹ and Salwe A. A.^{2*}

¹P.G. Department of Zoology, M.J.F. Educational Campus, R.T.M. Nagpur University, Nagpur 440 033, India

²Department of Zoology, S. N. Mor College of Arts, Commerce and Smt. G. D. Saraf Science College, Tumsar 441 912 (M.S.), India

*Corresponding Author

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Abstract: *Amyotea malabarica* (Fabricius) (Heteroptera: Pentatomidae: Asopinae) is a predaceous stink bug. Life cycle of *A. malabarica* was studied in rice fields of east Vidarbha, India during Rabi season of 2018-20 on its prey, *Riptortus linearis* (Fabricius) (Heteroptera: Alydidae). The female laid 180 eggs in 4 to 8 batches on upper surface of leaves and each batch consisting of 20 to 45 eggs. The egg was barrel shaped, convex ventrally, flattened dorsally and measured 1.0 ± 0.047 mm, 0.76 ± 0.02 mm in length and width, respectively. The percentage of hatchability was very low (60%) and incubation period was 8.3 ± 0.33 days at 30 to 35 C. Pre-oviposition and oviposition period was 1 to 3 days, respectively. First, second, third, fourth, and fifth instar nymphal period were 4 ± 0.57 , 4.3 ± 0.33 , 5.3 ± 0.33 , 4.6 ± 0.33 and 5.6 ± 0.33 days, respectively. The mean consumptions of prey by second, third, fourth and fifth instar were 4.3 ± 0.33 , 8.6 ± 0.33 , 17.6 ± 1.4 and 26 ± 1.1 preys/bug, respectively, while adult fed on 39 ± 0.5 prey/bugs. In entire life a single *A. malabarica* killed 96.0 ± 3.7 preys. The nymphs of *A. malabarica* show cannibalism behaviour in scarcity of food only. Total developmental period from egg to adult was 32.3 ± 2.02 days. Longevity of female was longer (11 to 27 days) than male (10-25 days). Present study provides important life history information of *A. malabarica* which is natural bio-agent against pests found in rice fields.

Keywords: *Amyotea malabarica*, Biology, Predatory efficiency, *Riptortus linearis*, Rice fields

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Introduction

Amyotea malabarica (Fabricius) (Heteroptera: Pentatomidae: Asopinae) is a brilliantly reddish coloured bug with black spots on dorsal surface and alternate white and black transverse lines on ventral side of abdomen. The bug is widely distributed in Bangladesh, Borneo, Burma, Celebes, China, India, Indonesia, Japan, Java, New Guinea, Phillipines, Sumatra, Sri Lanka and Taiwan in rice, cotton, soybean and other crop ecosystems

(Thomas, 1994). In India, it is recorded in several states (Salini and Viraktamath, 2015). Both nymphs and adults are predatory feeding by sucking the body juice of several insects, including rice pests such as rice bug *Leptocorisa acuta* (Thunberg), *Nezara viridula* (Linnaeus) (Singh *et al.*, 1973) and lepidopteran larvae (Pati and Mathur, 1986). In Vidarbha (Maharashtra) *A. malabarica* was observed to consume a number of

rice pests in fields. Since, the detailed biology of *A. malabarica* is not well understood, hence, the present study was carried out to account its life cycle and predatory behaviour.

Materials and Methods

Adults of the pentatomid bug *A. malabarica* were collected from the rice fields of Vidarbha of Maharashtra, India during Rabi season 2018-2020. In laboratory, females and males of *A. malabarica* were reared and allowed mating in plastic containers (top: 12 cm diameter; bottom: 10 cm diameter; 8 cm height) covered with muslin cloth. Males were separated from females after mating. After egg laying, female was taken out and wet cotton plug was kept in plastic container egg containing to maintain humidity. The newly moulted second to fifth instar nymphs were offered sufficient number rice pod sucking bug, *Riptortus linearis* (Fabricius) (Heteroptera: Alydidae) as food. Photographs were taken of every stages of this bug in natural habitat as well as in the laboratory condition by digital camera Nikon Coolpix. The rearing container contained paper towels to absorb excreta of the predator and also provide hiding places. Simultaneously, field observations were carried out in the local rice fields. Every day the containers were cleaned and provided with new preys. The survivability, mortality, and molting data were recorded.

Results and Discussion

Life history:

1. Eggs (Fig. 1):

A. malabarica deposit its eggs in cluster generally on upper surface of rice leaves. The clusters of eggs were closely packed by cemented substance of the surface. Female laid 180 eggs in 4-8 batches and each batch consists of 20-45 eggs. Freshly laid eggs were creamy white in colour and after sometime they turned yellowish brown and before two day of hatching it turned red. Eggs were barrel shaped, convex ventrally, flattened dorsally and provided with hair like structure on their

edge. Length and width of egg was 1.0 ± 0.05 mm and 0.76 ± 0.02 mm, respectively (Table 2). The incubation period was 8.3 ± 0.33 days at 30 to 35 °C (Table 1). The percentage of hatchability was very low (60%) and pre-oviposition and oviposition period was 1 and 3 days, respectively.

2. Nymphs:

Five nymphal instars were observed in *A. malabarica* and total nymphal period was 24 ± 1.73 days (Table 1). Each instar is described below in detail:

2.1. First Instar (Fig. 2):

Freshly hatched nymphs were red in colour with black eyes and after sometime it turn black and red. The four segmented antenna, head, thorax and legs were black in colour and abdomen was red in colour with 3 black strips in center with black border line. Length and width of this instar was 1.4 ± 0.2 mm and 1 ± 0.03 mm, respectively (Table 2). The duration of the first instar nymphal period was 4.0 ± 0.57 days (Table 1). This stage of *A. malabarica* is not predaceous but sap feeder.

2.2. Second Instar (Fig. 3):

Second instar nymph was similar in colour and appearance with first instar except half thorax region which was red in colour and half black in colour. The length measured 2.5 ± 0.26 mm and width 1.5 ± 0.17 mm (Table 2). The second instar nymphal period was 4.3 ± 0.3 days (Table 1). It consumes 4.3 ± 0.33 preys and then moult to third instar nymph (Table 3).

2.3. Third Instar (Fig. 4):

The third instar nymph was totally different from second instar. Colour of whole body was now red and having three black bands in the center of abdomen and after two days of moulting two white band were developed. The antennae were four segmented and black in colour but leg's first two segments coxa and trochanter were red in colour and remaining segments were black in colour. This stage instar measured 4 ± 0.46 mm in length and 2.6 ± 0.30 mm in width (Table 2). The

Figs. 1-8. Life history stages of *Amyotea malabarica*, a predator of *Riptortus linearis*. 1. Eggs, 2. First instar, 3. Feeding second instar, 4. Feeding third instar, 5. Feeding fourth instar, 6. Fifth instar, 7. Feeding adult stage, and 8. Mating posture.

third instar nymphal period was 5.3 ± 0.33 days (Table 1). It consumes 8.6 ± 0.33 preys and then moult to fourth instar nymph (Table 3).

Table 1: Duration of life stages of *A. malabarica*

Developmental stages		Days	Mean $\pm$ SD
Eggs (incubation)		8-9	8.3 ± 0.33
Nymphs	1 st Instar	4	4 ± 0.57
	2 nd Instar	4-5	4.3 ± 0.33
	3 rd Instar	5-6	5.3 ± 0.33
	4 th Instar	4-5	4.6 ± 0.33
	5 th Instar	5-6	5.6 ± 0.33
Total nymphal period		22-26	24 ± 1.73
Total development period		30-35	32.3 ± 2.02

2.4. Fourth Instar (Fig. 5):

The fourth instar nymph was similar to third instar in colour, except band present on the centre of the abdomen. Fourth instar has three white and two black bands, in front of white band two black spots were present and first segment of antenna (scape) was red in colour. The nymph measured 6 ± 0.54 mm in length and 3.6 ± 0.15 mm in width (Table 2). The fourth instar nymphal period was 4.6 ± 0.05 days (Table 1). It consumes 17.6 ± 1.4 preys and then moult to fifth instar nymph (Table 3).

2.5 Fifth Instar (Fig. 6):

The fifth instar nymph was larger in size; colour pattern and antennae was similar to the fourth instar except well-developed wing pad and, triangular scutellum with two black spots. First three segment of leg were red in colour and remaining segments are black. The mean length of the fifth instar nymph was 9.0 ± 0.57 mm and width 5.6 ± 0.32 mm (Table 2). Mean nymphal period of this instar was 5.6 ± 0.33 days (Table 1). It consumes 26.0 ± 1.1 preys and then moult to adult stage (Table 3).

Table 2: Size of different stages of *A. malabarica*

Developmental Stages		Length (mm $\pm$ SD)	Width (mm $\pm$ SD)
Eggs		1.0 ± 0.05	0.76 ± 0.02
Nymphs	1 st Instar	1.4 ± 0.20	1.0 ± 0.03
	2 nd Instar	2.5 ± 0.26	1.5 ± 0.17
	3 rd Instar	4.0 ± 0.46	2.6 ± 0.30
	4 th Instar	6.0 ± 0.54	3.6 ± 0.15
	5 th Instar	9.0 ± 0.57	5.6 ± 0.32
Adult Female		12.8 ± 0.40	6.5 ± 0.29
Adult Male		12.0 ± 0.50	6.2 ± 0.14

Table 3: Predation rate of *A. malabarica*

Developmental stages		No. of preys consumed	Mean
Nymphs	1 st Instar	Non-feeding	-
	2 nd Instar	4-5	4.3 ± 0.33
	3 rd Instar	8-9	8.6 ± 0.33
	4 th Instar	15-20	17.6 ± 1.4
	5 th Instar	24-28	26.0 ± 1.1
Adult		38-40	39.0 ± 0.5
Total prey consumed		89-102	96.0 ± 3.7

3. Adult (Fig. 7):

Adult bug was pentagonal in shape and red in colour with black spot on the body, two small black spot on basal part of the head, two spot on pronotum and two spot on the scutellum. The head was triangular in shape with black eyes. The antennae were 5-segmented, first segment (scape) was short, and red in colour, remaining four antennal segments are black in colour with very fine setae. Rostrum measured 5 mm in length. Scutellum was broad and triangular, coxae, trochanter and femora are red and remaining

segments of legs are black. Females are little longer than males and the colour is orange red as compared to male which are bright red. Female measured 12.8 ± 0.4 mm in length and 6.5 ± 0.29 mm in width (Table 2). Total developmental period from egg to adult was 32.3 ± 2.02 days (Table 1). Longevity of adult females (11-27 days) was longer than males (10-25 days). The adults consume 96.0 ± 3.7 preys in their life (Table 3).

The bugs mated during morning hours. The mating period ranged from 3 to 4 h. Male aggressively participated in mating. Initially, male moves toward female, rock on back of female and begin to copulate. During this condition female and male faced in same direction. Then after half an hour, male rotated and move in opposite direction, attach with each other by copulatory apparatus (Fig. 8) and may separate with smallest disturbances.

4. Predation:

First instar nymphs show gregarious behaviour. They do not feed in this stage but take water readily from damp cotton. After moulting, they move away from eggs in search of food. They insert their proboscis in the rice leaves and suck sap from leaves. Second to fifth instar nymphs are gregarious and actively forage for prey (Fig. 3). The nymph and adult follow the prey and extend their proboscis into its body, and anchor it so firmly that proboscis remains inserted into the prey body until feeding is over (Figs. 5, 7). They stop feeding only few hours before and after moulting, until a new cuticle had sclerotized. The cannibalism among nymphs is common in scarcity of food.

The predatory bug *A. malabarica* has critical role in controlling pest population in rice fields. Earlier, Pati and Mathur (1986) studied the life cycle on different species of prey as food. The life cycle of *A. malabarica* passes through egg and five nymphal stages followed by adult. The developmental periods of *A. malabarica* varied across different studies from 22 to 24 days (Pati and Mathur, 1986) to 57 days (Singh *et al.*, 1973).

Similarly, *A. malabarica* consumed 54.3 preys (*N. viridula*) (Singh *et al.*, 1973) and 135 last instar larvae of *Melanitis leda* (Linnaeus) (Pati and Mathur, 1986). Indeed, the biological parameters of *A. malabarica* observed in the present case cannot be compared with other studies because of differences in climatic conditions, species of preys and even the quality of food plants as these factors affect tritrophic interactions and population dynamics of phytophage and entomophagous insects (Kollberg *et al.*, 2013). Since, it is a voracious feeder and consumes a lot of pest insects, like other pentatomid predators it can be used in biological control of rice pests provided better understanding of its biology (Barsagade and Salwe, 2020). Moreover, conservation of such predators in the agricultural fields enhances the natural control of insect pests.

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