BIONOMICS OF EARHEAD BUG, *Leptocorisa acuta* Thunberg (Coreidae: Hemiptera) INFESTING RICE

ABSTRACT

Biology of rice earhead bug, *Leptocorisa acuta* (Thunberg) carried out at Laboratory of Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat on rice (Gujarat Rice-11) during *kharif*-2023. Eggs were dark brown with an average length and breadth of 1.28±0.05 mm and 0.85±0.06 mm, respectively. The incubation period varied from 5 to 7 days with an average of 6.07±0.78 days and the average hatching percentage was 81.22±14.93 per cent. There were five nymphal instars in the life cycle of *L. acuta*. The average developmental periods of the first, second, third, fourth and fifth nymphal instars were 2.80±0.41, 1.67±0.55, 1.87±0.57, 2.83±0.53 and 4.23±0.63 days, respectively. The total nymphal period was an average of 13.77±0.86 days. The total developmental period (egg + nymph) was found to be an average of 19.83±1.39 days. The average adult period was 23.50±7.69 days. The average pre-oviposition, oviposition and post-oviposition periods lasted for 4.87±1.50, 9.03±3.36 and 15.63±3.20 days, respectively. The average longevity for male and female adults lasted for 17.47±2.83 and 29.53±3.91 days, respectively. The female laid an average of 53.96±31.90 eggs. The total life cycle from egg to adult was an average of 42.67±7.38 days.

Keywords:*Leptocorisa acuta; earhead bug; gundhi bug; biology; rice.*

1. INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for more than sixty per cent of the world's population. Rice is cultivated in 165.25 million hectares and produced around 515 million metric tonnes worldwide in 2023 [1]. China is the world's leading producer followed by India and Bangladesh. India has the second largest area dedicated to rice cultivation with 46.38 million hectares and a yield of 135.75 million metric tonnes with an average productivity of 2.80 tonnes/ha. Rice is grown in almost all the states in India, and West Bengal ranks first in the area with 5.60 million hectares and production of 16.76 million metric tonnes [2]. In Gujarat, rice is grown under 0.90 million hectares with 2.14 million metric tonnes of production, with a productivity of 2.36 tonnes/ha. Navsari, Surat, Anand, Kheda, Bharuch and Vadodara are the major rice-growing districts in Gujarat [3].

Various factors contribute to the lower productivity in rice production, including insect pests, diseases and weeds. Quantitative as well as qualitative losses occur due to insects, rodents and micro-organisms during storage as well as at the field level. More than seventy species of insects have been recorded as pests of rice in India. Among them, fifteen insect species occurring regularly are of major significance and frequently found to cause severe damage thereby reducing the yield. Among the major destructive pests, is the rice earhead bug, *L. acuta* which is also called as gundhi bug as it releases a sort of foul smell in the field with its stink glands which are found in various rice environments including rainfed and upland areas infesting rice crop in all seasons throughout the

year. *O. sativa* is the main host of this pest besides it also attacks many weed species that act as alternate and collateral hosts in the absence of rice, such as sama (*Echinochloa colanum*), (*Dichantium aristatum*), Hirva chara (*panicum maximum*) and Barnyard grass, (*Echinochloa crusgalli*) upon which all the stages of rice gundhi bug are found in milky stage, while only adults were observed on *Eleusine indica*, *Sorghum helepense*, *Brachiaria cruciformis*, *Digitaria sanguinalis*, *Eragrostis cynosuroides*, *Panicum colonum* and *Sporobolus indicus* [4].

The nymphs and adults of rice earhead bugs particularly target the flowering and milking stages of rice crops. It feeds on the sap of milky grains making them chaffy. This pest not only reduces the quantity but also the quality of rice grains. The rice earhead bug is commonly observed during the flowering stage of the rice crop, which coincides with the onset of rainfall and high humidity at the beginning of the wet season. Both nymphs and adults use their piercing and sucking mouthparts to extract sap from developing rice grains affecting the peduncle, tender stem and milky grains. These bugs prefer to feed on young host plants when the grains have not fully developed [5]. Research on the biology of *L. acuta* provides essential insights into its life cycle, oviposition patterns, feeding behaviour, modes of damage and feeding preferences. Understanding these factors is crucial for identifying the most vulnerable stages in the pest's life cycle, which is critical for plant protection specialists in developing effective management strategies [5]. Hence, this study on the biology of *L. acuta* on rice was undertaken.

2. MATERIALS AND METHODS

Studies on the biology of *L. acuta* carried out on rice variety, Gujarat Rice-11 (collected from Main Rice Research Centre, Navsari) under laboratory conditions (29.35±1.28°C and 70.42±12.53% RH) during *kharif*,2023 at Laboratory of Department of Entomology, N. M. College of Agriculture, Navsari Agricultural University, Navsari. A significant number of adult insects were collected using nets from the rice field.

2.1 Insect culture

Male and female adults were collected from the field and placed in wooden cages (60 x 60 x 75 cm) that contained rice panicles at the milky stage along with leaves which were kept in a 150 ml conical flask filled with water to maintain leaf turgidity. Ten such sets were prepared and kept separately in wooden cages. Each day, these sets were removed from the cages for observation of egg laying and new such sets were provided for further egg laying and as a food source, ensuring a continuous supply of eggs. After egg laying, the leaf blades with eggs were placed in petri dishes (90 mm) with a thin layer of water-soaked cotton wool to prevent the leaves from drying. Upon hatching, the newly emerged nymphs were transferred to glass jars (20.00 cm height x 16.00 cm diameter) containing rice panicles in 50 ml conical flasks filled with water. The jars were covered with fine muslin cloth secured with rubber bands to allow aeration and prevent escape. Food was replaced when necessary and the nymphs were reared individually in the glass jars until they reached adulthood.

A pair of newly emerged male and female adult bugs were taken out and placed in a glass jar (20.00 cm height x 16.00 cm diameter) with milky stage rice panicles for feeding, resting, copulation and egg laying. The open end of the jar was covered with a fine muslin cloth, held in place with a rubber band. The panicles were replaced with fresh ones daily until the female adult bug died and the

eggs laid on the leaves and panicles were removed using a soft camel hairbrush dipped in water. The collected eggs with leaves were transferred to a petri dish containing cotton wool on the bottom and the cycle was repeated (Plate 1) [6].

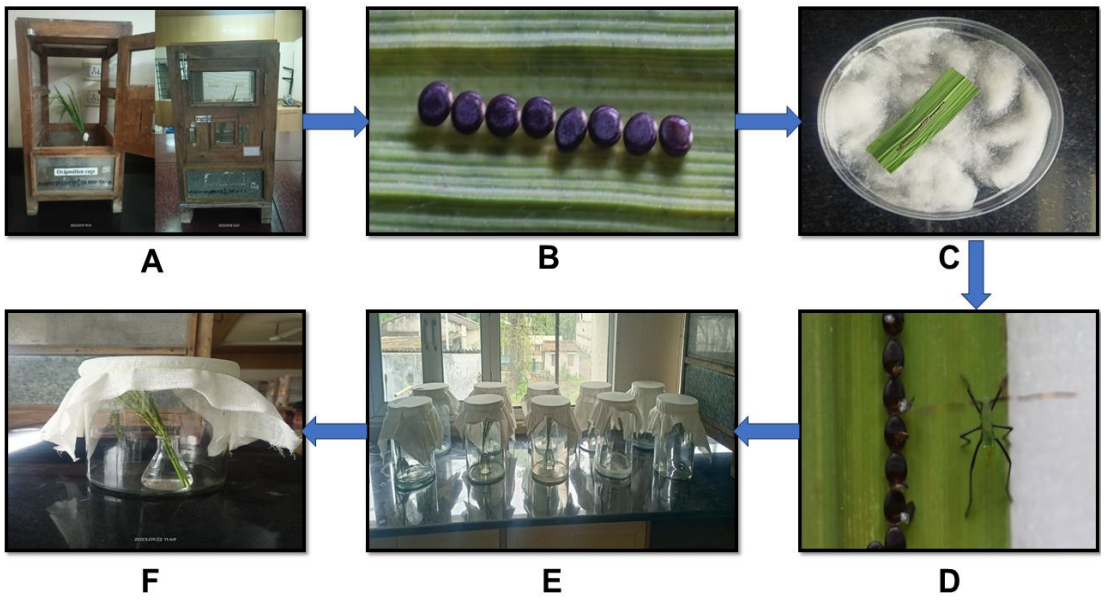

Plate 1. Methodology of rearing *L. acuta* in laboratory [A. Field collected adults were put for egg laying in oviposition cages. B. Collected eggs from cages, C. Eggs kept for incubation in petri dish, D. Emerging nymphs. E. Rearing of individual nymphs in glass jars. F. Rearing of male and female adult in glass jar for mating and oviposition.

2.2 Observations recorded

Detailed observations were recorded on hatching, incubation period and their behaviour during emergence. Thirty pairs of similar sets were kept for biological studies. The eggs deposited on the leaves and panicles were inspected daily for their shape, size, colour and measured using an ocular micrometre. The incubation period was calculated based on egg-laying and hatching time. The hatching percentage was determined by comparing the number of eggs hatched to the total number of eggs kept. The newly emerged nymphs were carefully transferred using a soft camel hairbrush to a glass jar (20.00 cm height x 16.00 cm diameter) containing milky stage rice panicles as food. The panicles were replaced daily to ensure a fresh food supply.Nymphs were observed daily to determine the number of nymphal instars. The number of moult and the duration of each nymphal instar were observed by collecting the exuviae. The colour and size of the nymphs were recorded for each instar. The measurements of body and antennae of each instar were measured using an ocular micrometre. The total nymphal period was calculated from the date of egg hatching to the date of adult emergence [6].

Emerging adults were examined microscopically to assess their shape, size, and color, with body measurements taken using an ocular micrometre. Morphometric differences between sexes were analyzed in detail. Longevity was assessed by rearing newly emerged pairs in separate jars,

recording adult emergence dates and the onset of egg-laying as the pre-oviposition period. The oviposition period was defined by the start and end dates of egg-laying, while the post-oviposition period was the time between the cessation of egg-laying and the female's death. Fecundity, defined as the total number of eggs laid by each female during her lifespan, was recorded for thirty individual pairs in glass jars until the females died. Longevity for both males and females was calculated based on emergence and death dates. Additionally, damage caused by nymphs and adults of *L. acuta* was evaluated through observations of infested rice panicles [6].

3. RESULTS AND DISCUSSION

The results on the biology of *L. acuta* are given in Table 1. The eggs were laid individually in linear rows near the tip and on the upper surface of the leaves, usually close to the midrib. The eggs were arranged in one to three rows, sometimes on panicles and very rarely on the lower surface of the leaves. Each egg was placed in contact with the previous egg and cemented to the surface of the leaf. The freshly laid eggs of *L. acuta*were round to oval in shape with a slight depression on the top and convex ventrally. These were yellowish brown in the early days but the colour changed to dark brown or black with maturity. A similar egg-laying pattern of *L. acuta* was observed by [7] who reported that the eggs of *L. acuta*were laid on the upper surface of leaves, usually very close to the midrib in rows and [8] observed that the eggs of *L. oratorius* were laid on the tip of the upper surface of the leaves. Each egg was placed in contact with the previous egg and cemented to the surface.The incubation period ranged from 5 to 7 days, with an average of 6.07±0.78 days. Hatching percentages varied from 44.44% to 100%, with an average of 81.22±14.93% (Table 1). The eggs ranged in length from 1.17 to 1.37 mm, with an average of 1.28±0.05 mm, while the breadth varied between 0.75 to 0.96 mm, with an average of 0.85±0.06 mm (Table 2). The eggs' colour, shape and size align with previous observations [6,9].

It was easy to observe the moulting of nymphs developing on the panicles. From the exuviae, it was clear that there were five nymphal instars in *L. acuta*. The exuviae of all the instars were different in size (Plate 2). The newly emerged first instar nymphs were pale yellowish green in colour. After 3 to 4 hours of hatching, they moved around and started feeding. First instar nymphs were found in a group on the panicles. The antenna of the first instar was longer than the body, reddish brown with white bands in between. The eyes were light reddish brown in appearance, while the legs were light brown to black with maturity.The duration of the first instar nymph varied from 2 to 3 days with an average of 2.80±0.41 days (Table 1).The newly emerged nymphs were small. The body length of the first instar nymph varied from 2.34 to 2.86 mm with an average of 2.59±0.16 mm and the body breadth varied from 0.30 to 0.65 mm with an average of 0.47±0.11 mm, while the length of the antenna varied from 3.42 to 3.98 mm with an average of 3.72±0.16 mm. Notably, only the first instar nymphs had a longer antenna than their body length (Table 2).

Plate 2. Exuviae of different instars of *L. acuta* [A. Exuviae of first instar nymph, B. Exuviae of second instar nymph, C. Exuviae of third instar nymph, D. Exuviae of fourth instar nymph, E. Exuviae of fifth instar nymph]

The second instar nymph was light green in the beginning but later the colour changed to green. Earlier, the legs were reddish brown to green but later changed to brown. Eyes were reddish brown. The antennal segments were reddish brown initially later changed to dark brown with white bands in between.The duration of the second instar nymph varied from 1 to 3 days with an average of 1.67±0.55 days (Table 1). The body length of the second instar nymph varied from 5.53 to 6.93 mm with an average of 6.17±0.47 mm and the body breadth varied from 0.60 to 0.90 mm with an average of 0.74±0.09 mm, while the length of the antenna varied from 4.75 to 5.89 mm with an average of 5.25±0.40 mm (Table 2)

Third instar nymphs were pale green, but as the nymph grew, the colour changed to green with brown eyes and light brown legs. The antennal segments were pale yellow and brown while the antennae were not much longer than the body. Third-instar nymphs were more active than first and second instars.The duration of third instar nymphs varied from 1 to 3 days with an average of 1.87±0.57 days(Table 1).The third instar nymphs measured 10.29 to 11.34 mm with an average of 10.86±0.37 mm in body length and 0.90 to 1.10 mm with an average of 0.99±1.10 mm in body breadth, while the length of the antenna varied from 6.97 to 8.32 mm with an average of 7.69±0.53 mm (Table2).

The fourth instar nymphs were yellowish green colour with light greenish brown legs, brown eyes and brown to whitish yellow antennae. Green wing pads were developed in this instar. They were more active and remained attached to the host plant even after slight jerks.The duration of the fourth instar nymph varied from 2 to 4 days with an average of 2.83±0.53 days (Table 1).The fourth instar nymphs measured 11.77 to 13.88 mm with an average of 12.71±0.75 mm in body length and the body breadth measured 1.20 to 1.45 mm with an average of 1.32±0.08 mm, while antenna length varied from 9.56 to 11.31 mm with an average of 10.45±0.65 mm (Table2).

The fifth instar nymphs had a much similar body appearance to that of the fourth instar but they were distinguished by well developed brown wing pads in the fifth instar. After moulting, the body colour was light green, the antennal segments were brown and pale green. Legs were brownish green, which later became brown.The duration of the fifth instar nymph varied from 3 to 6 days with an average of 4.23±0.63 days (Table 1). The fifth instar nymphs measured 13.73 to 15.87 mm with an average of 14.64±0.73 mm in body length and the body breadth measured 1.50 to 1.80 mm with an average of 1.63±0.09 mm, while antenna length varied from 11.91 to 12.83 mm with an average of 12.29±0.32 mm (Table 2). The total nymphal period varied from 13 to 15 days with an average of

13.77±0.86 days and the total developmental period varied from 18 to 22 days with an average of 19.83±1.39 days (Table 1).The results were more or less in accordance with[6] and[8].

The adult bugs were slender, pale green in colour when hatched and turned to green with maturity. Adults with well developed wings which were light green colour when hatched later developed into greenish brown colour. Well developed antennae and legs were greenish brown. Adult male and female look similar in shape and size except that the female had a concave shaped abdomen which was bigger as compared to male adult. Generally, males were slightly shorter in length when compared with females (Plate 3).The duration of the adult period varied from 12 to 39 days with an average of 23.50±7.69 days (Table 1).The body length of male adults varied from 15.36 to 17.26 mm with an average of 16.42±0.69 mm and the body width varied from 1.95 to 2.40 mm with an average of 2.21±0.15 mm,whereas antenna length varied from 12.62 to 13.95 mm with an average of 13.20±0.42 mm. The body length of female adults varied from 16.29 to 18.71 mm with an average of 17.60±0.85 mm and the body breadth varied from 2.40 to 2.90 mm with an average of 2.62±0.17 mm, whereas antenna length varied from 13.25 to 14.61 mm with an average of 14.01±0.43 mm(Table 2). Thus, the female was bigger than the male.The pre-oviposition period of *L. acuta* varied from 3 to 7 days with an average of 4.87±1.50 days.The oviposition period of *L. acuta* varied from 4 to 15 days with an average of 9.03±3.36 days.The post-oviposition period of *L. acuta* varied from 10 to 21 days with an average of 15.63±3.20 days (Table 1). These findings are in agreement with the results of [8], [10] and [11].

The longevity of male adults of *L. acuta* ranged from 12 to 22 days with an average of 17.47±2.83 days, while the longevity of female adults ranged from 21 to 39 days with an average of 29.53±3.91 days.The fecundity of the individual female bug varied from 14 to 122 with an average of 53.96±31.90 eggs. The number of eggs laid by every female per day after emergence was counted and it was found that the eggs were laid between 3 to 24 days after emergence, it was highest on the 15th day after emergence.The adult period ranged from 12 to 39 days with an average of 23.50±7.69 days (Table 1).The average duration of the life cycle of *L. acuta* was 37.43±3.13 days ranging from 31 to 45 days in case of males, while 48.33±4.45 days ranging from 35 to 57 days in case of females, whereas the total life cycle ranged from 31 to 51 days with an average of 42.67±7.38 (Table 1). The present findings were more or less similar to the reports of[6], [8],[10] and [11].

Both the nymphs and adult bugs inserted their proboscis into the developing grains, especially where the glumes meet. The sucking of milky juice from the developing grains resulted in partial or complete chaffyness. A small yellowish brown spot developed on the site of feeding initially and gradually enlarged to form an elliptical spot. In severe attack, the panicles turned into a complete brown colour. Similar damage symptoms were reported by[8]and [10] who observed that both nymphs and adults of *L. oratorius* started feeding on the grains soon after the emergence of earheads and continued to feed on them till the grains hardened. The sucking of milky juice from the developing grains resulted in partial or full chaffyness of grains.

Table 1: Biology of rice earhead bug, *L. acuta*

Sr. No.	Life stages	Periods (days)

		Min.	Max.	Avg. ± SD
1	**Egg**			
	Egg period	5	7	6.07±0.78
	Hatching (%)	44.44	100	81.22±14.93
2	**Nymph**			
	I instar	2	3	2.80±0.41
	II instar	1	3	1.67±0.55
	III instar	1	3	1.87±0.57
	IV instar	2	4	2.83±0.53
	V instar	3	6	4.23±0.63
	Total	13	15	13.77±0.86
3	Developmental period (egg-adult emergence)	18	22	19.83±1.39
5	**Adult**			
	Pre-oviposition	3	7	4.87±1.50
	Oviposition	4	15	9.03±3.36
	Post-oviposition	10	21	15.63±3.20
	Fecundity	14	122	52.97±31.91
	Longevity			
	Male	12	22	17.47±2.83
	Female	21	39	29.53±3.91
	Male and female	12	39	23.50±7.69
6	**Total life cycle: Egg to adult death**			
	Male	31	45	37.43±3.13
	Female	35	57	48.33±4.45
	Total life cycle	31	57	42.67±7.38

Table 2: Morphometrics of rice earhead bug, *L. acuta*

Sr. No.	Life stages	Particulars	Measurement (mm)		
			Min.	Max.	Avg. ± SD
1	Egg	Length	1.17	1.37	1.28±0.05
		Breadth	0.75	0.96	0.85±0.06

2	**Nymph**				
	I instar	Body length	2.34	2.86	2.59±0.16
		Body breadth	0.30	0.65	0.47±0.11
		Antenna length	3.42	3.98	3.72±0.16
	II instar	Body length	5.53	6.93	6.17±0.47
		Body breadth	0.60	0.90	0.74±0.09
		Antenna length	4.75	5.89	5.25±0.40
	III instar	Body length	10.29	11.34	10.86±0.37
		Body breadth	0.90	1.10	0.99±0.06
		Antenna length	6.97	8.32	7.69±0.53
	IV instar	Body length	11.77	13.88	12.71±0.75
		Body breadth	1.20	1.45	1.32±0.08
		Antenna length	9.56	11.31	10.45±0.65
	V instar	Body length	13.73	15.87	14.64±0.73
		Body breadth	1.50	1.80	1.63±0.09
		Antenna length	11.91	12.83	12.29±0.32
3	**Adult**				
	Male	Body length	15.36	17.26	16.42±0.69
		Body breadth	1.95	2.40	2.21±0.15
		Antenna length	12.62	13.95	13.20±0.42
	Female	Body length	16.29	18.71	17.60±0.85
		Body breadth	2.40	2.90	2.62±0.17
		Antenna length	13.25	14.61	14.01±0.43

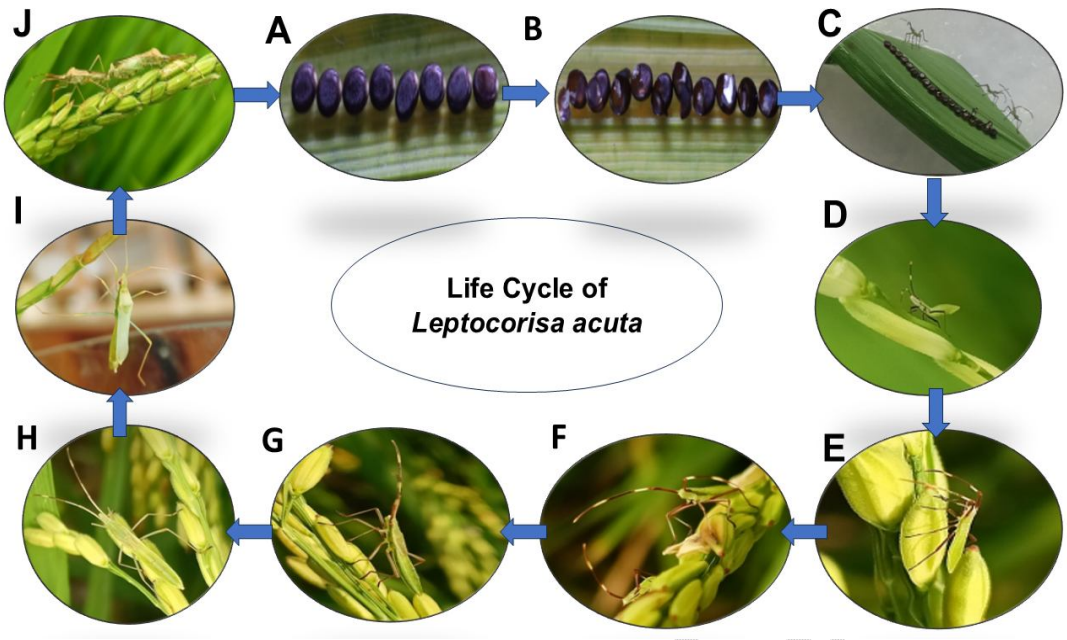

Plate 3. Life cycle of *L. acuta* from egg to adult [A. Eggs before hatching, B. Eggs after hatching, C. Newly emerged nymphs, D. First instar nymph, E. Second Instar nymph, F. Third instar nymph, G. Fourth instar nymph, H. Fifth instar nymph, I. Adult, J. Mating male and female

4. CONCLUSION

The study of the biology of the rice earhead bug, *Leptocorisa acuta*, has revealed significant insights into its life cycle, developmental stages, and reproductive behavior. The eggs displayed a consistent pattern of oviposition, and the incubation period averaged around 6.07 days, with a high hatching percentage of approximately 81.22%. The nymphal development consisted of five instars, with the total nymphal period averaging 13.77 days. Adults demonstrated considerable variability in longevity, with females living longer than males, averaging 29.53 days compared to 17.47 days for males. The fecundity rate also highlighted the potential for rapid population growth, with females laying an average of 53.96 eggs during their lifespan. The damaging effects of *L. acuta* on rice crops, particularly during the flowering and milking stages, underscore its significance as a pest. By feeding on developing grains, both nymphs and adults can lead to substantial yield losses and reduced grain quality. Understanding these biological aspects is crucial for the development of effective pest management strategies, ensuring the sustainability of rice production in affected regions.

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