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LIFE CYCLE OF RICE MEALYBUG *BREVENNIA REHI* (LINDINGER, 1943) IN CULTIVARS RICE PLANTS UNDER THE LABORATORY CONDITIONS

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Abstract

The rice mealybug *Brevennia rehi* (Lindinger,1943) is one of the invasive species recently introduced to Iraq and nowadays, it is wide spread among various parts of the country. The life cycle of *B. rehi* was studied under the laboratory conditions by using rice cultivars Yassamen, Anbber 33 , Furat1, as host plant. This paper describes the lifecycle and discusses about the reproductive parameters of *B. rehi* under laboratory conditions 27±1 CÚ and 65±5% relative humidity to the appearance of symptoms on the host plant and the importance of making management interventions during the effective reproductive period of the insect.

Female adults of *B. rehi* Total life cycle lasted for average of 36.5, 41.5 and 34.2 days, Males ranged from 5 days with an average of and total life cycle 27.7, 29.1 and 27.1 days cultivars Yassamen, Anbber 33 and Al-Forat, respectively.

Key words : Rice cultivars, Neonate crawlers and *Brevennia rehi*.

Introduction

The rice mealybug, *Brevennia rehi* (Lindinger, 1943) (Hemiptera, Pseudococcidae) is a widely distributed insect throughout rice growing areas. It has a huge host range, particularly in the family Poaceae and occurs in all of the zoogeographic regions of the world (Ben-Dove *et al*., 2015). It was first reported in Iraq by Bodenheimer (1943) under *Rhizoecus cynodontis* Bodenheimer (1943) on *Cynodon dactylon* (L.) Pers. (Poaceae) at Basra province south of Iraq. The mealybug *B. rehi* Lindinger, (Hemiptera: Pseudococcidae) has new synonyms and new distribution records from Iraq by Ben-Dov (2008).

The life history has elongate eggs are laid a chain. Each egg measures about 0.3 mm long. A female lays 58 to over 300 eggs. The crawlers hatch out from the eggs in about 3 to 24 hours. The crawlers are initially white and later the nymphs become pinkish. Nymphal period ranges from 17 to 37 days (Vasantharaj and Ananthakrishnan, 2010). Officially recorded in the United States only from Arizona, California, Floride and Texas (Ben-Dev, 2012). This species is also known as the rice mealybug typically small (less than 2mm) and pink, and because they hide between the grass blade and the stem they can be difficult (ian stocks). The adult females are wingless, oblong and 3-4 mm long. The body is soft, and covered with white waxy theads. Males, pale yellowish, are seldomfound in the colonies (Alam, 1965).

Materials and Methods

Collection of insects

Studies on biology of *B. rehi* were conducted at the Plant Protection Laboratory, University of Kufa by using the population collected from unsprayed rice plants in Najaf Governorate. Mealybug specimens of mealybugs used for the study were confirmed as *B. rehi* by Dr. Mohammed Saleh Abdul Rasool University of Baghdad –Iraq; Natural History Research Center and Museum.

The newly hatched crawlers were placed on rice plant leaves with the help of fine camel hair brush. . Each leaf was infested with an adult female mealybug individual and was individually transferred to separate plastic Petri plates (12 × 6 cm) each containing a rice plant. The study was conducted between June and October 2016 in the laboratory when temperature and relative humidity of the study area from 27±1ºC and 65±5% RH, respectively.

Insect rearing

Insect were cultured on host plants (rice). The Mealybug insects (*B. rehi*) were collected from the different parts of the infected rice plants. After identified the mealybug insects, they puck up to the laboratory of the department of plants protection in the College of Agriculture, University of Kufa, Iraq. Three different cultivars were tested, which were Yassamen, Anbber 33, and Al-Forat rice. All these cultivars were increased to utilize for experimental tests. All seeds of the rice were brought from the Rice Research Station located in the Al-Mechkaab city, Najaf Governorate, Iraq. The seeds were officially validated by the Ministry of Agriculture, Iraq. The seeds were completely washed with the clean water. Then, they were placed in the plastic sieves having a capacity of 250 mg including the solution of sodium hypochlorite sterilization with 10% of pure concentration. This solution was used to sterile the seed from bacterial and fungal infestation for 15 minutes.

The seeds, after that, were carefully washed with the clean water and placed again in the clean sieves to remove the Sodium hypochloride. They were placed on the new sheet inside plastic cans having dimensions of 6 × 12 cm (D×H) with 30 tables of the seeds for each can. The cans, then, were placed inside the incubator with the temperature of 27 ± 1^{0}C and relative humidity of 65 ± 5% for 12 hours. This is to get the seeding at the age of 4 to 5 cm, for 3 to 5 days for each piece.

Data collection

When the newly emerged crawlers settled for feeding on rice plant leaves, the crawlers were marked by drawing a circle around them. The crawlers thus marked were observed daily in the morning till they attained adult stage for further aspects of biology. The eggs laid by females of *B. rehi* were examined under binocular microscope for colour, shape and size. The adult female of mealy bug were picked up and placed individually on rice plant were leaf with the help of fine camel hair brush. The time of egg laying was noted. Freshly laid eggs were counted and transferred to fresh shoe flower leaves. Time taken for egg hatching was recorded to obtain the incubation period. Hatching percentage of eggs was calculated from the number of eggs hatched out of total number of eggs kept under observation for three replication for each treatment. The freshly emerged nymphs were marked individually on shoe flower leaves and observed daily under microscope to note moulting process. The moulting was confirmed by the presence of exuivum on the leaf or on the posterior end of nymphs. The colour, shape and size of each nymphal instar were critically observed.

Adult females emerged after the last moulting was observed for molting and shape. Measurements of the females were made by using measuring scale. Similarly, adult males emerged out from the silken cocoons were observed under microscope to study their colour, shape and size. Freshly emerged females were reared separately on rice plant leaves to study their, oviposition periods. Since the female laid their eggs in rice plant sac located at posterior end of its abdomen, the ovisacs were collected during the oviposition period and counted the number of eggs in each ovisac for calculating fecundity. Longevity of male and female was assessed separately *i.e.* days of survival from emergence to the death of adults. Total 100 newly hatched crawlers were reared on rice plante leaves up to third instar to determine the sex ratio. The third instar stage forming cocoons were separated as male and female and sex ratio was worked out. Total life cycle of female and male was calculated from the egg laying to the death of adult stage.

Statistical analysis

Experiment reseal were analysis by using completely randomized by design and tested significantly by using level different test (L.S.D.) at level (0.05) far showing results significantly (Al. Roui and Khalf Alla, 2000). Data were statistically analyzed using statistical software Gen stat.

Results and Discussion

To understand the mode and degree of its population growth of an insect pest, it is important to understand the environmental conditions of the crop. Since a study of the life history and pattern of biological activities are difficult under field conditions because of the interference of biotic and abiotic factors, laboratory studies have become essential. Studies conducted in the laboratory using rice plant leaves placed in plastic containers with detailed observations of reproductive and developmental stages of *B. rehi* formed the basis for the present study. they were easily observed under the microscope. The *B. rehi* female laid their eggs in cottony ovisac located at posterior part of abdomen. The eggs were smooth translucent, light creamy pink in colour and oblong in shape with tapering ends (fig. 1). *B. rehi* exhibited variation in males and females at immature stages itself. The female nymphs moulted three times and males four times. Freshly emerged first instar nymphs were oblong in shape, dorsally convex, light pink in colour with three pairs of legs. Body colour of newly hatched nymphs changed to dark pink within two days after hatching from eggs. The

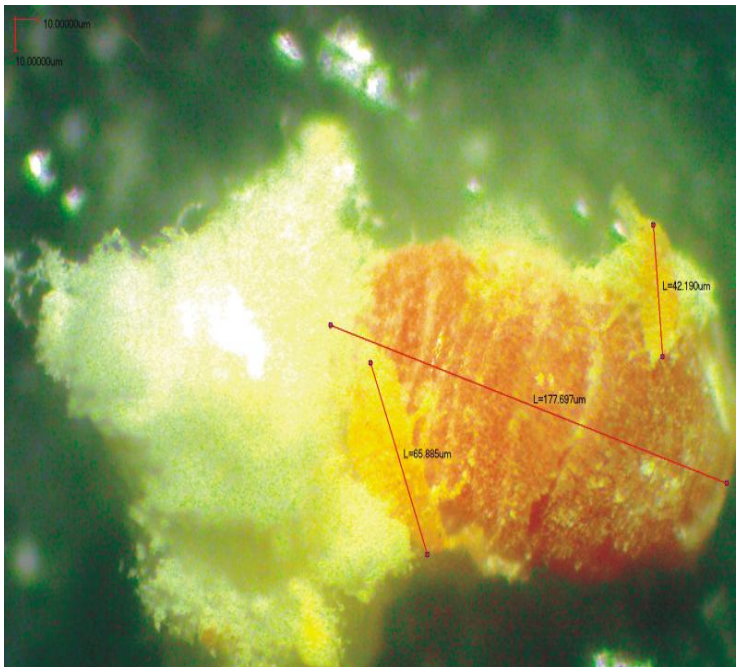

Fig. 1 : Colony of adult female of *B. rehi*.

newly emerged nymphs crawled over to leaf surface for some time in search of suitable place for feeding and then settled down.

Duration period of first instar nymphs lasted for with an average of 7.9, 8.15 and 7.8 days in the cultivars Yassamen, Anbber 33 and Al-Forat, respectively (table 1). After first moulting, the second instar nymphs found to be oblong and pink in colour. The second instar nymphs were similar to that of first instar nymphs in general appearance and morphological features, except in size. They secreted white waxy powder and waxy fibres on dorsal side after about 24 hours of first moulting. The exuvium of the instar was seen near the posterior end of the abdomen. Duration periode of second instar nymphs with an average of 7.85, 8.33 and 7.5 days cultivars Yassamen, Anbber 33, and Al-Forat respectively (table 1). Duration peroide of third instar nymphs with an average of 10.7, 10.8 and 9.6 days cultivars Yassamen, Anbber 33 and Al-Forat, respectively (table 1).

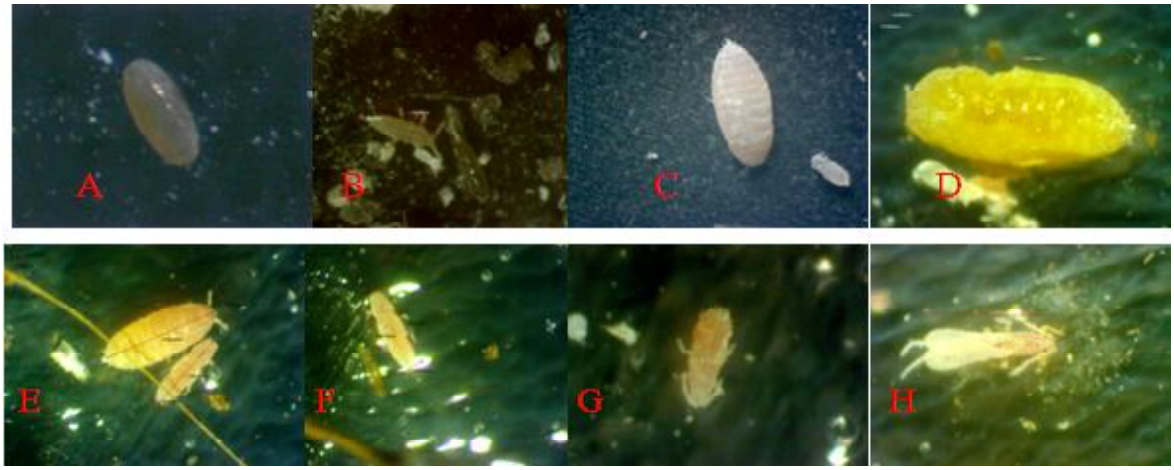

Fig. 2 : Female life stages : **A.** Egg, **B.** First instar, **C.** Third instar, **D.** Adult Female and **E.** Nymph Female and Male. Male life stages: **F.** Third instar, **G.** Fourth instar, **H.** Adult.

Fig. 3 :

Male and females of *B. rehi* nymphs can be distinguished from third instar onwards. The male nymphs formed a white silken cocoon after their third moulting, but no such phenomenon in females. They continued to moulting for remain in juvenile stage still. Male cocoons were cylindrical in shape and white in colour. Adult males of *B.rehi* (fig. 2) were delicate, slender and elongated in shape. The colour of head, thorax, antennae and legs was yellowish-brown, whereas abdominal region pale yellow. A pair of well- developed metathoracic milky white wings and three pairs of well-developed legs could be seen easily. The antennae were ten segmented and found to be much longer than that of female antennae. It was

Table 1 : Lifecycle for female o *B. rehi* in rice plants in labratary.

1st instar /mm		Duration /period	2ntl instar / mm		Duration / period	3rtl instar / mm		Duration / period	Adult/mm		Duration / period	Total period per insat stages
Length	Width	Days	Length	Width	Days	Length	Width	Days	Length	Width	Days	Days
0.9	0.4	7.9	1.53	0.72	7.85	2.83	1.13	10.7	3.95	2.13	10.1	36.5
0.9	0.4	8.15	1.85	0.76	8.33	2.7	1.18	10.8	4.76	2.94	14.3	41.5
0.9	0.4	7.8	1.84	0.80	7.5	2.95	1.2	9.6	4.38	2.53	9.3	34.2
0.9	0.4	7.9	1.74	0.76	7.8	2.82	1.17	10.3	4.36	2.53	11.23	37.2
0.06	0.14	1.69	0.220	0.08	1.37	0.30	0.70	2.72	0.79	0.58	2.611	-

Table 2 :

Type of cultivar	1st instar days	2th instar days	3rd instar days	4th instar days	Adult Days	Total Duration Days	Sex ratio %
Yasamen	7.9	7	4.3	2.3	5	27.7	4.28
Anber33	8.1	7.3	5	2.6	5	29.1	7.58
Furat1	7.8	7	4.3	2	5	27.1	8.51
$L.S.D._{0.05}$	1.69	1.48	1.38	0.94	-	-	-

Table 3 : Reproductive parameters of *B. rehi* reared in rice plants in laboratory.

Types of Cultivar	Size egg		Oviposition/ hours	Reproductivelyeggs /female	Egg hatching %
	Length	Wide	Average	Average	%
Yasamen	0.7	0.3	26.5	52	83.56
Anber33	0.7	0.3	34.8	60.6	88.86
Furat1	0.7	0.3	28.71	46	79.98
Mean	0.7	0.3	30	57.8	84.13
$L.S.D._{0.05}$			1.098	8.47	8.93

as long as the total body length of males. Two pairs of waxy filaments were present at anal end of body of which the inner pair was long while the outer pair was short or to an extend half of the inner pair. Longevity of males ranged from5 days with an average of and total life cycle 27.7, 29.1 and 27.1 days cultivars Yassamen, Anbber 33, and Al-Forat, respectively (table 2). The sex ratio of *B. rehi* in laboratory culture revealed that out 14.28, 27.58 and 18.51% (table 2).

Female adults of *B. rehi* were oblong in shape. Females were apterous, soft bodied, well distinguished segmented and body covered with white dusty secretion. It also possessed a pair of brownish, short antennae and three pairs of red coloured legs. Duration per of female with an average of 10.1, 14.3 and 9.3 days for cultivars Yassamen, Anbber 33 and Al-Forat, respectively (table 1). Total duration period fof insat stages lasted for average of 36.5, 41.5 and 34.2 days for Yassamen, Anbber 33, and Al-Forat respectively (table 1). Observations on post oviposition periods of *B. rehi* revealed that it varied from with an average of 26.5, 34.8 and 28.7 hours, for cultivars Yassamen, Anbber 33 and Al-Forat, respectively (table 3).

Also the reproductively and eggs hatching were 52, 60.6 and 46 eggs female and 83.56, 88.86 and 76.98 respectively for Yassamen, Anbber 33, and Al-Forat. The size of eggs were 0.3 ml in wide as well as 0.7 ml in length for Yassamen, Anbber 33 and Al-Forat, respectively.

The present study is first report on detailed reproductive biology of *B. rehi* from Iraq. However, majority of observations match with the biological features of *B. rehi* on rice explained by from Sirisena *et al.* (2012) Sri Lanka and with the observations of Pathak and Khan (1994) in rice plants in India. Rice, sorghum and some of the other preferred hosts which are agricultural crops are of Family Poaceae. Therefore, the results would be comparable to other crops and weeds act as host of *B. rehi*. The present study would lead a better understanding of incidence and spread of mealybug, *B. rehi* in rice and alternate hosts which may be used in drafting management strategies. Lower numbers and shorter life span of males suggested that they have a minor role in reproduction, although under field conditions sexual reproduction also could be a possibility. In relation with the biology of *B.*

rehi, it is quite clear that the longevity of the adults, and their larger size with increased waxy coating, and higher food requirement, result in visibility of the pest and symptoms on the crop. Therefore, with the initial notice of *B. rehi* infestation on few plants it is essential to monitor the plants regularly for at least 14 to 20 days, which is when reproduction by females occurs, to make management decisions for using insecticidal sprays. Higher mortality of the crawlers, the longer effective reproductive period and increased longevity of adult females along with the expected natural mortality factors such as predation, parasitization and action of abiotic factors on crawlers and adults under natural field conditions, suggest that management interventions should be focused against reproducing adult females rather than crawlers to prevent the multiplication and spread of the pest. Therefore, bioassay studies should use adult females instead of crawlers to determine an efficacious management scheme.

However, *B. rehi* under laboratory conditions had longer developmental periods for the cultivar Anbber 33 over the other two cultivars Yassamen and Al-Forat, as well as host plants that could influence *B. rehi* development. The total developmental duration of a closely related species *N. viridis* reared two different vegetarians is potato tuberna and the fruit of the long-term. The rate of this period was 28.66 days, Potato tubers, while 35.31 days of breeding on the fruits of local pumpkin (AL-Shamary, 2006). This suggested that *B. rehi* has become acclimatized to a tropical environment that may have allowed its rapid spread across widely differing agro climatic zones of the country.

Further studies are required to determine developmental rates at different constant temperatures in growth chambers, ability of *B. rehi* to multiply, survive and spread across regions among many host plants and the continuing molecular studies on the variations in their populations would be able to resolve and strengthen the species identity, biology and effect of environmental factors.

References

AL- Shamary, Hazim Idan (2006). Studies in Mass Rearing and Releasing of the Introduced Predator *Cryptolaemus montrouzieri* Muls. (Coleoptera: Coccinellidae) of Spherical Mealybug *Nipaecoccus viridis* (Newst.), infesting Citrus Trees in Iraq. P 42.(Arabic)

Al Roui, M. and A. M. Khalfalla (2000). Agricultual experiments analysis and design. Mesoul university press, 2nd edi 488 pp.(Arabic)

Alam, M. Z. (1965). Insect Pest of Rice in East Pakistan and their Control. Agric.Inform. Services, Dacca 3.98p.

Ben-Dov, Y. (2012). ScaleNet. World Wide Web electronic publication. blood meals in mosquitoes by a multiplex Polymerase chain reaction tarycting cytochrome B . *Am. J. Trop . Med . Hyg.*, **73(2)** : 336 - 342 .

Ben-Dov, Y. (2008). The Rice mealybug, Brevennia rehi(Lindinger,1943) : new synonyms, and new distribution records (Hempitera, Coccoidea Pseudococcidae). *Bulletin de la Societe Entomologique de france*, **113(1)** : 65-88.

Ben-Dov, Y., D. R. Miller and A. P. Gibson (2015). ScaleNet. Available at:. http://www.sel.barc.usda.gov/scalenet/scalenet.htm/ .(Accessed July 2015).

Bodenheimer, F. S. (1943). A first survey of the Coccoidae of Iraq. Directorate General of Agriculture. Baghdad, Bulletin, No. (28): 33 pp.

Pathak, M. D. and Z. R. Khan (1994). *Insect Pests of Rice*. International Rice Rrsearch Institute (IRRI).

Sirisena, U. G. A. I. , Mandanayake G. W. Watson, H. N. P. Wijayag and K. S. Hemachandra (2012). *Brevennia rehi* (Lindinger) (Hemiptera: Pseudococcidae) A Potential Pest of Rice in Sri Lanka. *Postgraduate Institute of Agriclture, University of Peradeniya. specific baculoviruses Virology*, **325(1)** : 36- 47.

Vasantharaj David, B. and T. N. Ananthakrishnan (2010). *General and Applied Entomology*. (3rd ed.). New Delhi: Mc Graw-Hill offices.p 432.