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Biology and seasonal incidence of leafhopper, *Amrasca biguttula biguttula* (Ishida) (Hemitpera: Cicadellidae) on okra

G. T. JAYASIMHA[1], R. R. RACHANA[1], M. MANJUNATHA[1] and V. B. RAJKUMAR[2]

[1]College of Agriculture, Shimoga - 577204, University of Agricultural Sciences (UAS), India
[2]Department of Entomology, University of Agricultural Sciences, G. K.V.K, Bengaluru, India
E-mail: jayaavavaa@gmail.com

ABSTRACT: Biology of *Amrasca biguttula biguttula* (Ishida) and its seasonal incidence in relation to biotic and abiotic factors on okra was studied at College of Agriculture, Shimoga, India. The developmental periods of egg, first, second, third, fourth and fifth instar were 6.42 ± 0.37, 1.49 ± 0.33, 1.19 ± 0.22, 1.16 ± 0.15, 1.60 ± 0.39 and 1.97 ± 0.29 days, respectively. The total nymphal period was 7.41 ± 0.48 days. The pre-oviposition, oviposition and post-oviposition periods were found to be 3.52 ± 0.34, 16.54 ± 0.37 and 3.85 ± 0.24 days, respectively. The fecundity varied from 14.00 to 20.00 with an average of 16.60 ± 1.98 eggs per female. The average longevity of male and female adults was 22.85 ± 1.87 and 26.66 ± 1.92 days, respectively. The highest incidence (16.44 leafhoppers/plant) was observed during March second fortnight, while the lowest (0.25 leafhoppers/plant) was observed during December second fortnight. The leafhopper population had a significant positive correlation with the maximum temperature and a significant negative correlation with rainfall. But relative humidity had no significant effect.

Keywords: *Amrasca biguttula biguttula*, biology, leafhopper, okra, seasonal incidence

INTRODUCTION

India is a major vegetable producing and consuming country and vegetables form an important dietary component. Among them okra, *Abelmoschus esculentus* L. Moench is one of the popular and commercially cultivated vegetable crops, popularly known as Bhendi or ladies finger and is a potential foreign exchange earner, accounting for 60 per cent of export of fresh vegetables (Sharman and Arora, 1993). In India it is cultivated in 4.30 lakh hectares with an annual production of 40.12 lakh tonnes (Anonymous, 2007). Among many factors responsible for low production of okra, the damage inflicted by insect pests has been considered important; leafhoppers are undoubtedly more severe among the many destructive pests of okra. The nymphs and adults suck the plant sap mainly from the lower surface of leaves and cause phytotoxic symptoms known as hopper burn which results in complete desiccation and has become one of the limiting factors in economic productivity of the crop.

MATERIALS AND METHODS

Biology

The initial culture was raised from the final instar nymphs of leafhoppers collected from the okra field and colonized on potted okra plant in the laboratory at College of Agriculture, Shimoga during 2007-08. Newly emerged male and female leafhoppers from the pure culture was introduced into a micro cage made out of a plastic tube of 7.5 cm x 5.0 cm with aluminium lid on one side and wire mesh on the other side. The tube was fixed to the leaf of okra plant in such a way that the adults remain on the under surface of the leaf. The study was conducted at a temperature of 25 ± 1°C and a relative humidity of 71± 2 percent. For investigation on different life stages, freshly hatched adults were paired and released into plastic tubes containing leaf for egg laying. Fresh leaves were provided every day in morning and the leaf with eggs were kept separately in another tube with a wet blotting paper. These leaves were further observed daily for determination of incubation period. The number of nymphs obtained from leaves exposed to the same pair is counted as total number of eggs laid by the female or fecundity. Eggs were measured under microscope with the occular micrometer after calibrating with stage micrometer. The nymphal instars were studied by transferring freshly hatched nymphs into the micro cage individually by fixing the same to the leaves of okra plant raised in pot and the nymphal periods were recorded. Each instar is distinguished on confirming the moulting by the presence of exuviae in the microcage. In each instar the length of the nymph was measured by using millimetric scale. The individual nymphal period was recorded. The total nymphal period was then calculated from the period of egg hatching till the adult emergence. Newly formed adults were anaesthetized with chloroform and observed under microscope to study colour, shape and sex difference. The size of the male

and female adults were also measured and recorded. Pre-oviposition, oviposition and post oviposition periods were studied under constant watching by enclosing ten pairs of newly emerged male and female leafhoppers in the rearing plastic tubes at the rate of 1 pair per tube. Fresh okra leaves were provided daily as food which also served for oviposition. The period between the emergence of adult female and commencing of egg laying was considered as the pre oviposition period. Period between commencing of egg laying and ceasing of egg laying by an individual female was noted as oviposition period, while the period after ceasing of egg laying till the death of female was considered as post oviposition period. Longevity of male and female was calculated separately right from the date of emergence till to the death of adults. The whole study was replicated 10 times in order to confirm the consistency in results.

Seasonal incidence

Three okra leaves were selected from top, middle and bottom of each plant. Samples were taken at fortnightly interval over a period of 24 fortnights starting from 15-03-2007 to 01-03-2008 on the incidence of leafhopper on okra leaves. The samples involved three leaves each selected from top, middle and bottom portions of all the ten plants and were pooled to get the total abundance of leafhopper. An attempt was made to record the natural enemies of leafhoppers, by making weekly collection of their nymphs and adults from the okra field. The fortnightly averages of weather parameters *viz.*, maximum and minimum temperatures, relative humidity and total rainfall were collected from the meteorological observatory of college of Agriculture, Shimoga and were used for correlation studies.

RESULTS AND DISCUSSION

Biology

The female inserted its eggs into plant tissues such as tender petioles, twigs and succulent leaves. But they prefer to lay eggs in the leaf tissue, veins usually in the spongy parenchymatous layer between the vascular bundles and the epidermis. The freshly laid eggs were transluscent, slightly oval shaped and yellow in colour. The incubation period of eggs varied from 6.00 to 7.00 days with an average of 6.42 ± 0.37 days (Table 1).The nymphs of *A. biguttula biguttula* emerged during morning hours and passed through five nymphal instars. The newly emerged nymphs were transparent and yellowish in colour. Eyes were conspicuous, reddish brown in colour and oval in shape. The length of first instar nymph ranged from 0.68 to 0.71 mm with an average of 0.69 mm length. The duration of first instar nymphal stage ranged from 1.00 to 2.00 days with an average of 1.49 ± 0.33 days (Table 1). Unlike first instar, the second instar nymphs were having dull white eyes

Table 1. Duration of different developmental stages of okra leafhopper, *Amrasca biguttula biguttula* under laboratory conditions

Parameter	Duration in days	
	Range	Mean ± SD
Incubation period	6.00 - 7.00	6.42 ± 0.37
First instar	1.00 – 2.00	1.49 ± 0.33
Second instar	1.00 – 1.50	1.19 ± 0.22
Third instar	1.00 – 1.50	1.16 ± 0.15
Fourth instar	1.00 – 2.00	1.60 ± 0.39
Fifth instar	1.50 – 2.50	1.97 ± 0.29
Nymphal period	6.50 – 8.00	7.41 ± 0.48
Pre oviposition period	3.00 – 4.00	3.52 ± 0.34
Oviposition period	16.00 – 17.00	16.54 ± 0.37
Post oviposition period	3.50 – 4.00	3.85 ± 0.24
Fecundity	14.00 – 20.00	16.60 ± 1.98
Male longevity	21.00 – 26.00	22.85 ± 1.87
Female longevity	26.00 – 30.00	26.66 ± 1.92
Total life cycle	28.30 – 34.00	30.31 ± 2.07

(N=20)

and reddish colour underneath. Rudimentary wing pads were present all along the posterior margin of sides of meso and meta thorax. The nymphs measured 1.08 to 1.12 mm in length with an average of 1.09 mm. Second instar nymph lasted for 1.00 to 1.50 days with a mean of 1.19 ± 0.22 days (Table 1). The third instar nymph was almost similar to second instar in its appearance except the colour. The nymph was yellowish green in colour with prominent wing pads. The length of nymph ranged from 1.28 to 1.36 mm with an average of 1.34 mm the third instar nymphal period ranged from 1.00 to 1.50 days with an average of 1.16 ±0.15 days. The fourth instar nymph was yellowish green, with wing pads reaching upto fourth abdominal segment. The length of the nymph ranged from 1.56 to 1.72 mm with an average of 1.68 mm. The duration of fourth instar nymph ranged from 1.00 to 2.00 days with a mean of 1.60 ± 0.39 days. The fifth instar nymph was greenish yellow in colour with wing pads reaching upto ninth abdominal segment. The length of the full grown nymph ranged from 2.25 to 2.29 mm with an average of 2.28 mm. The final instar nymphal period ranged from 1.50 to 2.50 days with an average of 1.97 ± 0.29 days. The total nymphal period of *A.biguttula biguttula* varied from 4.50 to 9.50 days with an average of 7.28 ± 1.27 days. The total nymphal period is in confirmation with the results obtained by Sharma and Sharma (1997) who obtained an average 7.30 days and Bhalani and Patel

Table 2. Measurement of different stages of leafhopper, *A. biguttula biguttula*.

Parameter	Length (mm)
First instar	0.68 – 0.71
Second instar	1.08 – 1.12
Third instar	1.28 – 1.36
Fourth instar	1.56 – 1.72
Fifth instar	2.25 – 2.29
Adult	2.61 – 2.65

Table 3. Seasonal incidence of leafhopper *Amrasca biguttala biguttala* on okra and weather parameters at Shimoga

Date of Sampling	Mean No. leafhopper/plant			Average of leaf hopper	Temperature (^{0}C)		Relative humidity (%)	Rainfall (mm)
	Bottom	Middle	Top		Maximum	Minimum		
March II, 2007	10.75	17.23	21.35	16.44	35.14	20.59	79.62	0.00
April I	8.25	10.95	19.35	12.85	33.66	20.62	76.06	0.30
April II	8.78	10.65	15.26	11.56	36.50	19.02	81.73	2.33
May I	4.23	5.73	11.28	7.08	35.90	20.20	82.26	0.34
May II	6.15	6.40	6.28	6.27	36.21	19.04	79.12	1.60
June I	1.56	1.98	2.93	2.15	34.24	20.59	80.20	5.40
June II	0.02	1.01	0.83	0.62	28.50	20.69	83.20	16.83
July I	0.00	0.93	0.98	0.63	27.50	19.04	82.46	10.89
July I	2.35	3.18	2.80	2.77	29.17	20.20	82.81	4.06
Aug I	0.00	0.55	0.36	0.30	25.96	20.14	80.46	24.08
Aug II	3.25	1.86	4.75	3.28	29.30	20.22	82.25	3.68
Sep I	0.16	1.00	0.98	0.67	28.65	20.11	83.66	13.33
Sep II	2.17	2.60	2.80	2.52	26.40	20.12	82.46	6.41
Oct I	5.12	16.13	4.80	5.35	27.68	19.92	79.93	0.62
Oct II	0.00	0.75	0.78	0.51	32.20	19.90	79.75	10.24
Nov I	0.35	1.01	0.93	0.76	29.17	18.97	81.00	0.38
Nov II	0.48	1.00	0.98	0.82	26.40	14.99	82.60	0.00
Dec I	0.83	1.04	1.01	0.96	29.50	16.4	81.00	0.00
Dec II	0.00	0.51	0.25	0.25	30.04	15.97	74.68	2.94
Jan I, 2008	1.35	1.06	1.21	1.20	30.74	14.48	75.33	0.00
Jan II	3.18	3.33	2.60	3.03	31.96	14.12	83.00	0.00
Feb I	4.28	2.85	5.60	4.24	31.81	16.94	81.25	0.14
Feb II	4.23	5.75	11.28	7.67	31.74	16.02	79.35	0.00
March I	6.15	6.40	6.28	6.07	34.52	18.40	76.60	1.49

Table 4. Correlation coefficient (r) between leaf hopper and weather parameters

Sl. No.	Variables	*r*
X_1	Max. Temperature (^{0}C)	0.677*
X_2	Min. Temperature (^{0}C)	0.244
X_3	Relative Humidity (%)	-0.222
X_4	Rainfall (mm)	-0.440*

P=0.05% *Significant

(1981) who reported seven days. The present findings varied from the results obtained by Shivanna *et al.*, (2009). This may be due to the change in host plant selected for the study. Adults have prominent black spots on both sides of the median line in the vertex of the head and another on the apical area of the forewing. They walked diagonally, face usually pale greenish, tegmina shining and wings hayaline iridescent. Fore wings were yellowish green in color. The length varied from 2.61 to 2.65 mm with an average of 2.61 mm usually the males were smaller than females. Almost similar observations were also recorded by Shivanna *et al.*, (2009). Sex ratio observed from the life history study indicated male to female ratio of 1:1.16. Shivanna *et al.*, (2009) reported the male: female sex ratio as 1:1.22 under laboratory condition. The pre oviposition, oviposition and post oviposition periods varied from 3.00 to 4.00, 16.00 to 17.00 and 3.50 to 4.00 days with an average of 3.52 ± 0.34, 16.54 ± 0.37 and 3.85 ± 0.24 days (Table 1), respectively. The present findings are in close conformity with the reports of Thirumala Raju (1984) and Rajendra Singh (1978). The total number of eggs laid by an individual female varied from 25.00 to 34.00 with an average of 28.56 ± 5.12 eggs (Table 1). The present findings are in close conformity with Sharma and Sharma (1997) who reported an average of 17.55 eggs per female. The longevity of adult male varied from 21.00 to 26.00 days with an average of 22.85 ± 1.87 days, while for female it ranged from 26.00 to 30.00 days with a mean of 26.66 ± 1.92 days (Table 1). The males are short lived compared to females. The entire life span of leafhopper was 28.30 to 34.00 days with an average of 30.31 ± 2.07 days (Table 1). Sharma and Sharma (1997) reported that the average life span was 33.70 days.

Seasonal incidence

The observations on seasonal incidence of leafhopper *Amrasca biguttula biguttula* (Ishida) recorded from March-2007 to March-2008 revealed an incidence ranging from 0.25 to16.44 leafhoppers per leaf. The highest incidence of 16.44 leafhoppers per plant was observed during March second fortnight, while the lowest of 0.25 leafhoppers per leaf was observed during December second fortnight (Table 3). The leafhopper population had a significant positive correlation with the maximum temperature and a significant negative correlation with the rainfall (Table 4). However, relative humidity was non significant and negative with population. Two parasitoids *viz.*, *Arescon enocki* Subba Rao and Kaur and *Anagrus empoascae* Dasier were recorded and the predators noticed were *Geocoris*, *Chrysoperla carnea* Stephens and *Micromus cinearis* Hogan. It is evident from the data that the population build up of the leafhopper is associated with an increase in temperature. Senapati and Mohanty (1980) also reported similar results. However, the population did not attain peak as reported by earlier workers probably due to the difference in rainfall pattern received and fluctuation in temperature. The present findings of significant positive correlation of population with the maximum temperature is in agreement with the findings of Srinivasan *et al.* (1988), who observed that among the environmental factors, maximum temperature had a positive correlation with the density of leafhopper on okra and the same had a negative correlation with rainfall.

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