International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 8, Issue 52, 2016, pp.-2488-2490.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

LIFE CYCLE OF RICE LEAF FOLDER, *Cnaphalocrocis medinalis* (GUENEE) ON RICE CULTIVAR HKR-47

KUMAR ANKIT*, SINGH MAAN, SINGH RAM AND SINGH BANVIR

Department of Entomology, CCS Haryana Agricultural University, Hisar, 125004, India
*Corresponding Author: Email-ankit522@ymail.com

Received: July 21, 2016; Revised: September 01, 2016; Accepted: September 02, 2016; Published: October 30, 2016

Abstract- The biology of *Cnaphalocrocis medinalis*, (Guenee) (Pyralidae:Lepidoptera) was studied in laboratory and screen house under agro-climatic conditions of Haryana, India. Incubation period was 5.32 days with egg viability of 55.31 to 77.33 per cent. Eggs were laid singly or in cluster of 2 to 4 and maximum (48.20 %) were laid on lower surface of leaf. Full grown larvae measured 15.59 mm in length and 1.22 mm in breadth. Male pupae were longer in length than female pupae. The pest completed its post embryonic development in 30.34 days (male) and 31.16 days (female) and passed through five larval instars. The larval survival was 56.66 per with 89.60 per cent moth emergence. Mean larval period was 22.10 days with pupal period of 6.86 (male) and 7.64 days (female), respectively. Pre-oviposition, oviposition and post oviposition periods were 1.7, 4.5, and 2.4 days, respectively. The longevity of male and female moth was 3.4 and 8.7 days, respectively with average fecundity of 100.6 eggs/female.

Keywords- *Cnaphalocrocis medinalis*, Rice, Fecundity, Hatchability, Incubation period

Citation: Kumar Ankit, et al., (2016) Life Cycle of Rice Leaf Folder, *Cnaphalocrocis medinalis* (Guenee) on Rice Cultivar HKR-47. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 8, Issue 52, pp.-2488-2490.

Academic Editor / Reviewer: Dr Shaik Jaffar Basha

Introduction

Rice (*Oryza sativa* L.) is the main staple food of more than 60 per cent of the world population. In India it is grown on an area of 39.16 million ha with total production of 85.59 million tones while in Haryana rice is grown on an area of 10.62 million ha with total production of 33.45 million tones [3]. The rice production in India is constrained due to number of factors of which insect-pests are quite important causing more than 30 per cent yield losses. More than 100 species of insects are known to attack the rice crop, out of which 20 are of major economic significance. In general, yield losses in rice crop due to insect pests has been estimated to be about 25 per cent [4]. Lepidopteron insect-pests are the main class of pests causing significant damage to crop yield in rice. C. *medinalis* is a predominant foliage feeder and one of the most destructive pests, affecting all the rice ecosystems in Asia [10]. Earlier this was considered as the pests of minor importance which have increased in abundance in late 1980's and have become major pests in many parts of India. The yield loss is from 30 to 80 per cent due to this pest in epidemic situation [13,17]. C .*medinalis* has been quite serious in Haryana [8]. An increase in C. *medinalis* population could be attributed to the large scale cultivation of high yielding varieties, application of fertilizers and continuous use of insecticides leading to outbreak of this pest in several countries, including India [7].

The larvae fold the leaves and feed on the chlorophyll tissues leaving white parallel streaks running longitudinally on the leaf blade. Heavy infestation reduces the photosynthetic ability of the plant and yield [1,2]. This is a destructive and widespread pest throughout the rice-growing regions in South and Southeast Asia. Depending on crop age at the time of infestation, the damage caused by the pest ranges between 18.3 and 58.4 per cent [15,16]. A thorough knowledge about the biology of insect and its status as a pest provides important basis for developing efficient pest management strategies.

Materials and Methods

Experimental Site

The experiment on biology of C. *medinalis* was conducted in laboratory and screen house at Chaudhary Charan Singh Haryana Agricultural University, Rice Research station, Kaul (29°51' N latitude, 76°41' E longitude) Haryana, India during *Kharif* 2006.

Biological cycle

The culture was initiated by collecting fully grown larvae, pupae and adults from the farmers field adjoining the research farm. The adults were released on the cut stem pieces of rice (HKR-47) in the jars and covered with muslin cloth to check the escape of adult's in screen house. The moth emerged from collection when starts mating and egg laying were transferred on potted plants (40 days old) in ovipositional cage in a galvanized iron tray and covered with muslin cloth.

Incubation period and per cent hatchability

Two pairs of adults (upto 24 hr of emergence) were released in the cage and the eggs laid on different parts of the plant were observed visually after 24 hours. The plants used for site of oviposition were also used for recording incubation period, percent hatchability and percent viability.

Pre-oviposition, oviposition, and post-oviposition period

The mating behaviour of adults were observed visually. The period from the emergence of a female to the laying of first egg (pre-oviposition), first egg to the last egg (oviposition period) and laying of the last egg to the death of the female was considered as the post-oviposition period.

Larval duration, number of instars and pupal period

In this experiment neonate larvae were released on a cut stem piece whose base

was wrapped with wet cotton swab and placed in a glass tube. Observations were recorded on 50 larvae to record larval moults, duration of larval instars, pre-pupal period and pupal period.

Longevity and fecundity

The longevity of male and female was taken as the period from emergence of adult to its death and the total number of eggs laid during ovipositional period represents the fecundity.

Measurement of different stages of rice leaf folder

Measurement on different larval instars were made with the help of ocular micrometer while the length and breadth of pupae and adult's were measured with vernier caliper.

Result and Discussion

Site of oviposition and ovipositional behavior

The eggs were laid singly or in clusters of two to four on both the surfaces of leaves. Therefore lower surface (48.20%) of leaf followed by upper surface (32.95%) were most preferred by the females for egg laying and maximum eggs were laid during night time between 9 pm to 12 am [5,9,14] [Table-1].

Table -1 *Site of oviposition of C. medinalis on rice cv. HKR-47*

Sr. No.	Plant parts observed	Eggs/clusters (%)
1.	Upper surface of leaf	32.95
2.	Lower surface of leaf	48.20
3.	Leaf sheath	11.83
4.	Stem	7.02

Incubation period and hatchability

The incubation period of C. *medinalis* ranged from 4 to 6 days with an average of 5.32±0.02 days. These finding are in agreement with earlier researchers who reported the incubation period of rice leaf folder ranged from 4 to 6 days [14,16]. The maximum eggs (38.12±0.21%) were hatched on 5th day followed by 6th day and minimum on 4th day. The per cent hatchability ranges from 55.31-70.73 per cent with a mean value of 63.43±0.61 per cent [Table-2].

Duration of larval instars

The results of present study revealed that the larva passed through five instars and mean duration of 1st to 5th instar was 3.48±0.04, 4.20±0.05, 4.48±0.04, 4.44±0.03 and 5.49±0.04 days respectively, [Table-3]. The newly hatched larvae were pale white in colour with black head. Second instar larvae changed from pale white to green in colour with brown head and faint brownish mark on prothoracic shield. In third instar larvae colour appears to be slightly dark green and brownish patch on either side of pronoturn.

Table-2 *Incubation period and hatchability of eggs of C. medinalis**

	Incubation periods (days)	Per cent hatching (days after egg laying)			Total hatchability of eggs (%)
		4th	5th	6th	
Average±SE	5.32±0.02	9.06±0.11	38.12±0.21	16.25±0.29	63.43±0.61
Range	4-6	-	-	-	55.31-70.73

* Sample size: 320; Maximum temperature: 33.0ºC; Minimum temperature: 26.2ºC Relative humidity: 71.7-85.5 %

The fourth instar larvae were dark green with dark brown patch on prothorax. The body turned yellow with light brown head and brownish patch prominent on mesothoracic and metathoracic segments in fifth instar. The present findings on larval instars and colour characteristics are in agreement with those of earlier workers [5,6,14] who reported that the pest completed its larval development in 14 to 18 days after passing through five instars. However, six larval instars has also been reported [16]. The differences in larval instars and their duration reported by earlier workers might be due to variation in temperatures and test plant. When the larvae stop feeding and shedding of last larval skin takes place then there is no fresh frass considered as pre-pupal stage. During this stage, larvae contracted in size and became inactive. The pre-pupal period ranged from 1 to 2 days with an average of 1.38 days. The present finding drive partial support as pre-pupal period averaged 1.76 days [18]. The newly formed pupa in early stage was yellowish in colour and finally turns to dark brown under white silken cocoon. The pupal duration of male and female ranged from 6 to 9 and 7 to 10 days with an average of 6.86±0.06 and 7.64±0.09 days, respectively. These findings are in agreement with earlier researchers [9,14,19] who reported the pupal period of 6 to 10 days. The larvae transformed into adult through pupae in 30.33 days (male) and 31.15 days (female). The developmental period was also recorded comparatively longer in females [12, 13].

Larval survival, Pupation, Moth emergence and sex ratio

The larval survival differed significantly among the intervals. It was maximum (88.00%) on 4th day after release and decreased gradually, thereafter only 56.66 per cent larvae survived on 19th day and at last 51.32±0.80 per cent larvae pupated are in line with [14]. The male and female ratio of moths were 1:0.91 indicating the prepondance of males. The dominance of males has also been observed as 1.38:1 and 1.15:1 [6,9,14] [Table-3].

Table-3 *Biology of rice leaf folder, Cnaphalocrocis medinalis (Guenee) on rice cv. HKR – 47*

Stages	Average	Range	No. of individual observed
A. Immature Stages			
Larval period (days)	22.10±0.39	19-23	50
I instar	3.48±0.04	3-4	50
II instar	4.20±0.05	3-5	50
III instar	4.48±0.04	3-5	50
IV instar	4.44±0.03	4-5	50
V instar	5.49±0.04	5-6	50
Per cent larval Survival	56.66±0.80	50-58	150
Per cent pupation	51.32±0.80	-	150
Pre-Pupal period (days)	1.38±0.03	1-2	50
Pupal period (days)			
Male pupa	6.86±0.06	6-9	50
Female pupa	7.64±0.09	7-10	50
Percent pupal survival/ moth emerged	89.60±1.29	-	-
Sex ratio* (Male : Female)	1:0.91		
B. adult stages			
Male longevity(days)	3.4±0.06	3-4	50
Female longevity (days)	8.7±0.05	7-10	50
Pre-oviposition period (days)	1.7±0.05	1-3	50
Oviposition period (days)	4.5±0.03	4-5	50
Post-oviposition period (days)	2.4±0.03	2-3	50
Fecundity / female	100.6±8.6	74-141	50

Temperature range: 21.9^{0}C – 32.5^{0}C, Relative humidity: 71.6-86.0 %

Reproductive biology (Pre-oviposition, oviposition and post-oviposition periods)

The average pre-oviposition, oviposition and post-oviposition periods were 1.7, 4.5 and 2.4 days, respectively in the present study. The results are in conformity with that of [5,7] who reported the pre-oviposition, oviposition and post-oviposition period of 1.5, 3 to 5 and 2 to 3 days, respectively. However, pre-oviposition, oviposition and post-oviposition of 2.2, 5.5 to 6.4 and 1.7 to 2.4 days, respectively has been reported and these slight differences might be due to difference in the climatic conditions of an experimental site [14] [Table-3]

Longevity and Fecundity

On an average, the adult males were survived for 3.4±0.06 days with a range of 3 to 4 days while the female survived for 8.7±0.05 days with a range of 7 to 10 days indicating shorter life of males than females [Table-3]. These findings are in agreement with some earlier researchers [6,16,12] who observed that the male adult survived for 2 to 4 days while females survived for 7-10 days. The number of eggs laid varied with individual female. On an average 100.6±8.6 eggs were laid by a female with a range of 74-141 eggs in her life span. The similar observations were also made by other researchers [5,6,14].

Table-4 *Measurement of different developmental stages of Body + Head Capsule in different instars of rice leaf folder C. medinalis**

Stages of insect (Larval Instars)	Average measurement (mm)±SE			
	Average length		Average breadth	
	Body	Head capsule	Body	Head capsule
First	2.18±0.03	0.32±0.01	0.31±0.01	0.34±0.03
Second	4.25±0.10	0.60±0.01	0.67±0.02	0.62±0.01
Third	7.57±0.12	0.62±0.02	0.79±0.01	0.81±0.13
Fourth	12.0±0.28	0.84±0.01	0.96±0.12	0.85±0.01
Fifth	15.59±0.24	1.11±0.03	1.22±0.02	1.22±0.24
Pupa (Male)	9.27±0.04	-	1.87±0.0.02	-
Pupa (Female)	8.59±0.01	-	1.95±0.01	-

*Average of ten individual

Morphometrics of different stages of *C. medinalis*

In present study, the average measurement on length of 1st, 2nd, 3rd, 4th and 5th larval instars was 2.18, 4.25, 7.57, 12.0 and 15.59 mm with body breadth of 0.31, 0.67, 0.79, 0.96 and 1.22 mm, respectively. While the measurements on head capsule length was recorded 0.32, 0.61, 0.62, 0.84 and 1.11 mm with breadth of 0.34, 0.62, 0.81, 0.85 and 1.22 mm from 1st to 5th instar larvae. The present findings are in agreement with [6] who reported that during I, II, III, IV and Vth instars the length of larval body measured from 0.88 to 2.51, 2.20 to 5.00, 5.00 to 8.50, 8.00 to 10.00 and 9.60 to 17.00 mm, while breadth measured 0.21 to 0.30, 0.22 to 0.44, 0.61 to 0.72, 0.63 to 0.88 and 1.04 to 1.54 mm respectively. The male pupal length and breadth measured 9.27±0.04 and 1.87±0.02 mm, respectively. While female pupal length was 8.59±0.01 mm with breadth of 1.95±0.01 mm indicating that the male pupa was longer than female pupa as compared with breadth which was less in male. The present findings are in strong agreement with the findings of [14] who reported that the length of male and female pupa was 9.51±0.21 and 8.59±0.24 mm respectively.

Conflict of Interest: None declared

References

[1] Ahmed H., R.B. Khan D., Sharma V.V.S., Jamwal and Gupta S. (2010) *Annals Pl. Prot. Sci.,* 18(2), 38-383.

[2] Alvi S. M., Ali M. A., Chaudhary S. and Iqbal S. (2003) *Int J Agri Biol,* 5, 615–617.

[3] Anonymous (2013) Statistical abstract of India.

[4] Dhaliwal G.S., Jindal V. and Dhawan A.K. (2010) *Indian J. Ecol.,* 37, 1e7.

[5] Gangwar R.K. (2015) *J. Nat. Sci.Res*., 5, 15.

[6] Godase S.K. and Dumbre R.B. (1982) *Pestology*., 6(7), 13-16.

[7] Kaushik C. (2010) *Current Biotica.,* 4, 365–367.

[8] Kushwaha K.S. (1988) *Indian J. Ent*., 50(1), 127-130.

[9] Lingappa S. (1972) mysore. *J. Agric. Sci*., 9(2), 233-236.

[10] Luo S.J. (2010) *Plt. Dis. Pest,* 1, 13–18.

[11] Luo S.F. and Huang Z.N. (1983) *Kunchong Zhishi*, 20, 7-11.

[12] Mishra B.K., Senapati B., Mishra P.R. and Mandal S.M.A. (2001) *Ann. Plant Prot. Sci.,* 9(2), 233-236.

[13] Nanda U.K. and Bisoi R.C. (1990) *OrissaJ. Agric.Res*., 3(2), 130-35.

[14] Paramjeet Singh and Jaswant Singh (2001) *J. Insect Sci. Ludhiana,* 14 (1/2), 40-44.

[15] Pasalu I. C., Katti G., Krishnamurthy P., Subba Rao L. V., Reddy C. S., Subbaiah S.V., Krishnaiah N. V. and Prasad J. S. (2005) Integrated pest management in rice. Technical Bulletin No.15, Directorate of Rice Research, Rajendranagar, Hyderabad- 500 030, Andhra Pradesh, India. 53 pp.

[16] Ramasamy C. and Jatileksono T. (1996) Inter-country comparison of insect and disease losses, pp. 305–316. In Rice Research in Asia: Progress and Priorities (edited by R. E. Evanson, R.W. Herdt and M. Hossain). CABI, Wallingford.

[17] Shah S., Ali M., Rehman U. H., Rehman A., Abbasi F. M., Khalil I. H., and Ali A. (2008) *Sarh. J. Agri.,* 24(1), 69-74.

[18] Vyas A.M., Shah A.H. and Patel C.B. (1981). *Gujarat agric. Univ. Res. J.,* 6, 75-79.

[19] Yadava C.P., Santaram G. and Israel P. (1972) *Indian J. Agric. Sci.,* 42(6), 520-23.