

Studies on the Biology of Leaf Roller, *Ancylis sativa* (Liu) (Lepidoptera: Tortricidae) a Major Pest of Jujube (*Ziziphus mauritiana*)

Imtiaz A. Nizamani^{1,*}, M. Ibrahim Khaskheli¹, Aslam Bukero², Niaz A. Wahocho³, Shafique A. Nizamani¹ and Naeem A. Qureshi⁴

¹Department of Plant Protection, Sindh Agriculture University Tando Jam, Pakistan

²Department of Entomology, Sindh Agriculture University Tando Jam, Pakistan

³Department of Horticulture, Sindh Agriculture University Tando Jam, Pakistan

⁴Department of Statistics, Sindh Agriculture University Tando Jam, Pakistan

Abstract: Jujube, *Ziziphus mauritiana* Lam. is one of the most important fruit crops of Sindh, Pakistan, and is consumed due to good flavour and high nutritional value. However, the occurrence of Jujube leaf roller *Ancylis sativa* (Liu) is a major threat to reduce the production of fruits, ultimately causing tremendous economic loss to the growers. The present study is the first comprehensive attempt on biology of Jujube leaf roller. There were five larval stages between egg and pupa. Adults were usually tan or brown, have mottled areas or dark bands. Average size of adult measured 9.53 mm long and 2.85 mm wide, wing span ranging from 16 to 19 mm.

Keywords: *Ancylis sativa* Liu, Jujube leaf roller, Biology.

INTRODUCTION

Jujube *Ziziphus mauritiana* Lam. is a beautiful evergreen tree and has dark, rounded green leaves, which are very attractive to various foliage pests. Superior varieties for quality fruit are grafted for commercial purpose. It is adapted to wide range of soil types, usually after pruning, seems to have several pest problems [1-3]. In Sindh province many varieties are successfully cultivated viz: White Gola, Golden Gola, Soofi Umran, Soofi Sialkoti, Lootri Gola and White Kherol [4, 5]. Jujube is attacked by different insect pests including; Leaf roller, Hairy caterpillar, Jujube beetle, leaf hopper, Jassid and Thrip [6, 7]. Among these insect pests Jujube leaf roller is serious insect pest in India and Pakistan. This pest is active from May to September (Summer season). Newly hatched larvae feed from lower surface of the leaves but when full grown, larvae roll-up leaves from the edges to midrib and feed on leaf tissues [8-10]. From Sindh and Pakistan no systematic research work is reported on the biology of Jujube leaf roller, hence the present work was planned to study the biology of Jujube leaf roller that may help in planning strategies to manage this pest.

MATERIALS AND METHODS

The experiment on the biology of Jujube leaf roller, *Ancylis sativa* (Liu) were carried out during 2007 and 2008 growing seasons at Department of Plant Protection, Sindh Agriculture University, Pakistan.

Development and Maintenance of Laboratory Culture

The larval stages of Jujube leaf roller (*A. sativa*) were collected from the jujube orchards of Tando Kaiser, District Hyderabad, Sindh and maintained under the laboratory of Plant Protection Department, SAU, in wire mesh wooden cages measuring 60 cm³ at room temperature (27±3 °C). Tender leaves of Jujube placed as food source for the larval stages and were changed regularly until the pupal stage. The developed pupal stages were collect and placed in cage for oviposition and the procedure repeated. This initial culture was build up for subsequent studies.

Life History of the Jujube Leaf Roller

Since adequate knowledge on the biology of an insect pest is an essential prerequisite in the study of population dynamics, detailed studies on biology of the insect pests have carried out in the laboratory for three generations, during March-April, June-July and August-September of 2007-08, respectively. The studies were conducted in the laboratory of Plant Protection Department, Sindh Agriculture University. Life history of

*Address correspondence to this author at the Department of Plant Protection, Sindh Agriculture University Tando Jam, Pakistan;
Tel: 03003077503; E-mail: imtiaz69nizamani@gmail.com

individual moths of Jujube leaf roller were checked out from egg to adult in plastic cages measuring 60 cm³ at room temperature (27±3 °C). Individually fresh eggs of Jujube leaf roller obtained from laboratory culture were maintained in plastic cages. After placing the eggs on the next day, then fresh jujube leaves were provided inside each plastic cage for the emerging larvae to feed. After emergence, individual larvae were transferred to other plastic cages containing fresh jujube leaves, this was maintained until the larvae pupated. In each season, life history data on 20 larvae have been collected. Observations were made on a daily basis to determine the incubation period of eggs, number of larval instars based on molting, duration of each larval instar and size, pupal period and total developmental period. However, the morphological characters such as color, shape, habits of larvae were also recorded and observed during the experiment.

Longevity and Fecundity

In this parameter, one newly emerged female moth and two males were confined along with a fresh jujube leaf in a lantern chimney of 25 cm height covered at the

bottom with Petri plate and at the top with muslin cloth using rubber band. 10 percent honey solution was provided as food and then kept at room temperature (27±3 °C). During the study period, the experiment was replicated 10 times. Fresh jujube leaves and flowers of different plants were provided daily for oviposition and the eggs laid by each female counted with the help of a hand lens. The maintenance of records continued until the death of the female. Total number of eggs laid by the mated fed female and longevity of male and female were also recorded. This experiment was carried out for three generations once in each season of a year (viz: March-April, June-July and August-September, 2007-8, respectively).

RESULTS

Development and Maintenance of Laboratory Culture Biology

Life History in the Laboratory

The results depicted here include the morphological characters, duration of development of all the stages and habits of Jujube leaf roller (*A. sativa*).

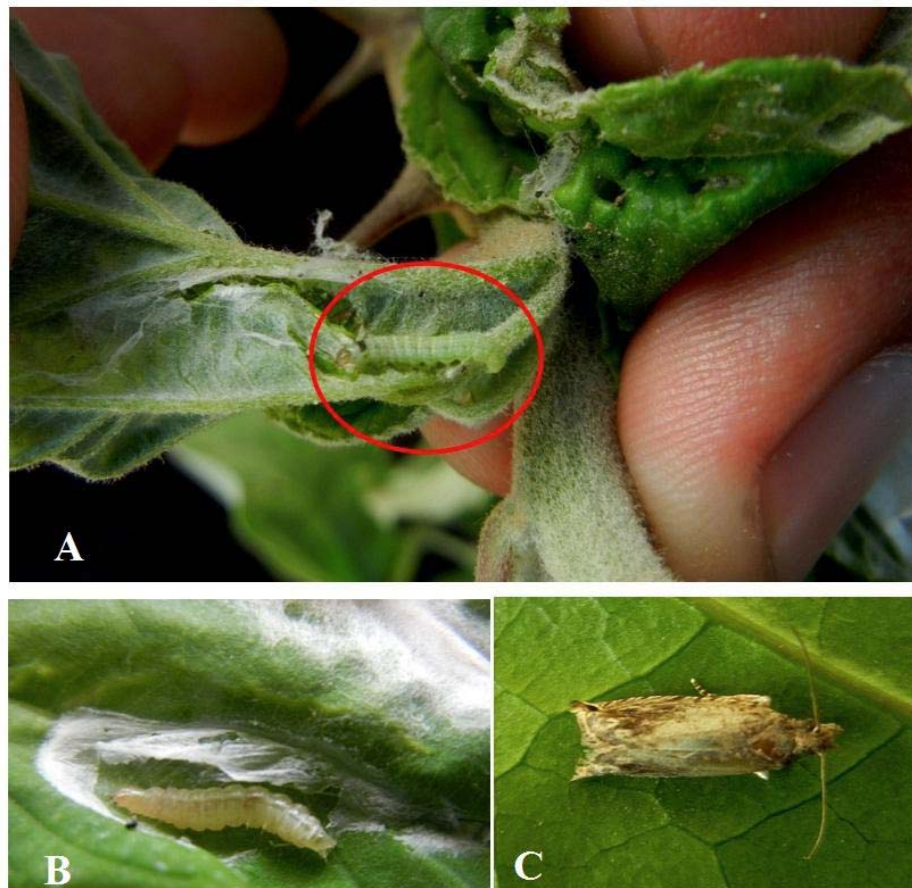


Plate 1: Larva (A & B) and adult moth (C) of Jujube leaf roller (*Ancyliis sativa*).

Egg

Eggs of Jujube leaf roller were minute about 0.61 and 0.49mm (length and width), respectively, whitish in color with oval to oblong shaped (Plate 1). Eggs were laid singly or sometimes in groups of 2 to 3 under the lower surface of newly or tender jujube leaves. The average egg period lasted for 3 days in summer season.

Larva

The larva of Jujube leaf roller emerged through gnaws a circular opening at one end of egg. There were five larval instars and the exuvium was shed off on larva. Just after shedding off the exuvium larva of all instars were having light to dark black colored head and pale green body and setae. When these larvae disturbed, in all the instars wriggled backwards quickly and became "U" shaped, and dropped from the surface through silken thread. However, when these larvae were relaxed, they climbed back through the silken thread.

Larval Stage-I

Freshly emerged first stage larvae were light to dark black head and light green colored body bearing green setae all over (Plate 1). Newly emerged first stage was very sensitive and once it entered the leaf roll will not

come out till next stage and lasted for 2.64 days. The dimension of first stage larvae was 1.28 and 0.45mm in length and width, respectively (Table 1).

Larval Stage-II

The larvae were cylindrical with light to dark black head and pale green colored. The larvae fed on leaf tissue by keeping the head and thoracic segments inside rolled leaf. The average duration of the 2nd stage larvae was 4.55 days. The dimension of length and width of 2nd stage larvae was 2.28 and 0.95mm, respectively.

Larval Stage-III

The head of 3rd stage larvae were light to dark black in color and body was initially green and then became light brown pale covered with setae. The larvae was also had the small hair over the surface of body. The 3rd stage larvae fed on mature jujube leaves and lasted for 4.55 days.

Larval Stage-IV

The head of 4th stage larvae was black colored and the body was initially pale green, later became light brown to dark brown (Plate 1). Fully-grown caterpillars were light brown to dark brown in color, with short scattered hairs. The average duration of the 4th stage larvae was 4.62 days. The dimension of length and

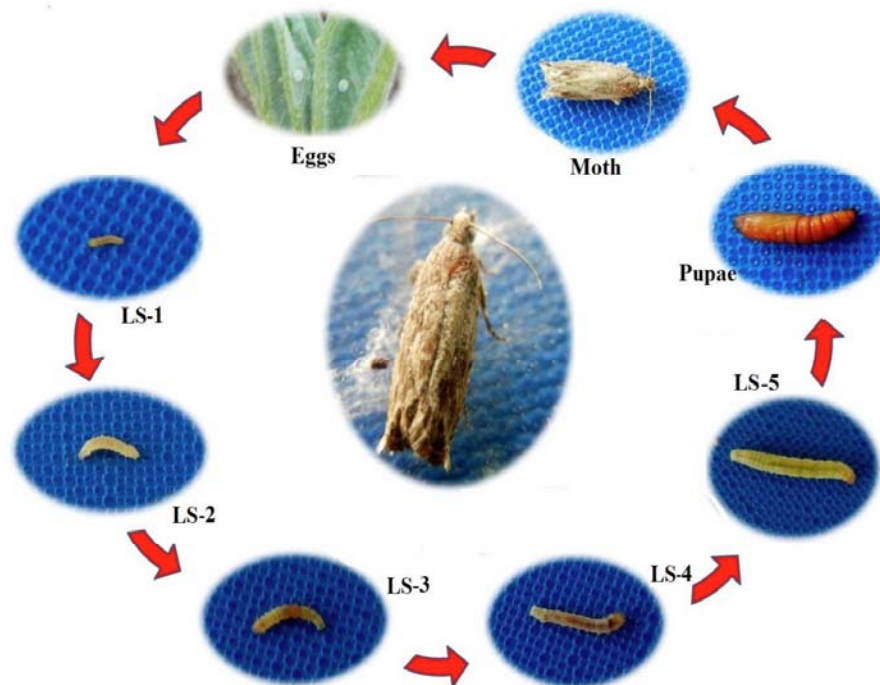


Plate 2: Different life stages of Jujube leaf roller (*Ancyliis sativa*) studied under laboratory conditions (Photograph: Imtiaz A. Nizamani).

width of 4th stage larvae was 8.08 and 2.95mm, respectively.

Larval Stage-V

The head of 5th stage larvae was also black colored and body was light green (Plate 1). Fully-grown caterpillars were light green in color, moderately stout and smooth with short scattered hairs. The 5th stage larvae were feeding inside the rolled leaf till pre-pupal stage that lasted in 4.51 days and the dimension of length and width was 13.08 and 3.07mm, respectively. The mature caterpillar stopped feeding and built a loosely spun silk cocoon on the surface of the leaf bit. The cocoon was spindle shaped having an opening at the anterior end.

Pupa

The newly formed object pupa was yellowish green in color, however, after a day or two it became brownish and gradually attained dark brown color by the time of adult emergence (Plate 1). The pupal period ranged from 6.99 to 8.24 days, with an average of 7.43 days (Table 1).

Adult

The moth emerged from pupa and came out from cocoon through the opening present at the anterior end. The adult was holding their wings over their abdomen in a bell shape when at rest, and have protruding mouthparts that resemble a snout. Antennae are usually threadlike and adults have a 0.25-1.25 mm wingspan. These were usually gray, tan, or brown with dark bands or mottled areas and about 9.53mm long

and 2.85mm wide with wingspan ranging from 16 to 19mm (Plate 1).

Longevity and Fecundity

The results regarding the adult longevity and pattern of variation in number of eggs (fecundity), of female *A. sativa* is presented in Table 2. Eggs were laid individually and in the group of 2-3 on the lower surface of jujube leaves. The mean number of eggs laid by individual females of *A. sativa* was 71 during June and July followed by 60.5 (August-September) and 55.5 (March-April) when reared under laboratory conditions. The longest longevity period was also recorded in the second generation (June-July) for male that ranged from 9.49-9.99 with mean 9.77 days under laboratory conditions. The maximum longevity of *A. sativa* female was ranged from 9.24- 8.44 with average 8.84 days under laboratory conditions (Table 2).

DISCUSSION

Jujube, *Z. mauritiana* is one of the most important fruit, consumed worldwide for its nutritional and medicinal purpose [11]. There are several insect pests and diseases are deteriorating the yield of jujube every year. Amongst those, jujube leaf roller, *Ancylis sativa* Lin. (Tortricidae: Lepidoptera) is one of the most important serious insect pest of foliage in jujube (*Zizyphus mauritiana* Lamk). Recently, in our other study, it was highlighted that jujube cultivars were severely infested with leaf roller and showed greatest percentage [12]. However, the biology of leaf roller including life span, growth stages and morphological

Table 1: Mean Standard Error 30 Individuals for the Duration of Stages in the Life Cycle of Jujube Leaf Roller (*Ancylis sativa*)

Stages	Duration (days)			Overall Mean±SE
	Mean±SE	Mean±SE	Mean±SE	
	Mar.-Apr. (1st gen.)	June-July (2 nd gen.)	Aug.-Sept. (3 rd gen.)	
Egg	6.00	7.25	6.08	6.44
LS1	2.20	3.45	2.28	2.64
LS2	4.11	5.36	4.19	4.55
LS3	5.36	6.61	5.44	5.80
LS4	4.18	5.43	4.26	4.62
LS5	4.07	5.32	4.15	4.51
Pupa	6.99	8.24	7.07	7.43
Adult	18.33	19.58	18.67	18.86
SE	0.52	0.76	0.76	0.37
LSD	1.11	1.63	1.63	0.74

Table 2: Adult Longevity and Fecundity of Jujube Leaf Roller (*Ancylis sativa*)

Period	Adult longevity				Fecundity	
	Male		Female		Range	Mean
	Range	Mean	Range	Mean		
March-April (First Generation)	8.13-10.20	9.16	9.32-8.32	8.82	47-64	55.5
June-July (Second Generation)	9.49-9.99	9.77	9.24- 8.44	8.84	65-77	71
August-September (Third Generation)	8.53-10.03	9.28	9.14-7.23	8.19	51-70	60.5

studies are not elaborated in the available literature. Some reported research line revealed that one or two days old larvae of *Ancylis sativa* were observed on young leaves of jujube (*Zizyphus mauritiana* Lamk. var. *Umran*) [10].

Thus, biological studies of Jujube leaf roller *A. sativa* conducted under laboratory conditions of Plant Protection Department the morphological characters, duration of development of all the stages and habits of Jujube leaf roller has been highlighted. In the current study, it has been observed that there are five larval stages between egg and pupal stage to become adult of *A. sativa*. Eggs were about 0.61 and 0.49mm (length and width), respectively, whitish in color with oval to oblong shaped, laid singly or sometimes in groups of 2 to 3 under the lower surface of newly or tender jujube leaves. The first stage larvae emerged in 2.64 days and were around 1.28 and 0.45mm in length and width, respectively. The average duration of the 2nd stage larvae was 4.55 days and was 2.28 and 0.95 mm in length and width, respectively. The 3rd stage larvae fed on mature jujube leaves and lasted for 4.55 days and the length and width was 3.98 and 1.55 mm, respectively. The average duration of the 4th stage larvae was 4.62 days. The dimension of length and width of 4th stage larvae was 8.08 and 2.95mm, respectively. Whereas, the 5th stage larvae were feeding inside the rolled leaf till pre-pupal stage that lasted in 4.51 days with the dimension of 13.08 and 3.07mm in length and width, respectively. However, in all larval stages, the head was black colored and the body was initially pale green, later became light green to dark green and light brown to dark brown. Fully grown caterpillars were light green in color, moderately stout and smooth with short scattered hairs, which were feeding inside the rolled leaf till pre-pupal stage. The mature caterpillar stopped feeding and built a loosely spun silk cocoon on the surface of the leaf bit. The cocoon was spindle shaped having an opening at the anterior end. The newly formed pupa was yellowish green in color, however, after a day or two it became

brownish and gradually attained dark brown color by the time of adult emergence, it lasted in 6.99 to 8.24 days, with an average of 7.43 days. The moth emerged from the pupal case. The adult was holding their wings over their abdomen in a bell shape when at rest, and have protruding mouthparts that resemble a snout. Antennae are usually threadlike. Adults were usually gray, tan, or brown with dark bands or mottled areas. It was about 9.53mm long and 2.85mm wide with wing span ranging from 16 to 19mm. significantly higher percentage of adults was observed on leaves than on webs, branches, the ground, or hovering [10]. It is important to mention here that our study is the first reported based on the literature available particularly in Pakistan as well as worldwide with reference to this injurious insect pest biology.

REFERENCES

- [1] Rao GG, Khandelwal MK. Performance of ber (*Zizyphus mauritiana*) and pomegranate (*Punicagranatum*) on sandy loam saline and saline black soils. *Indian Journal of Soil Conservation* 2001; 29: 59-64.
- [2] Pandey A, Sharma E, Palni L. Influence of bacterial inoculation on maize in upland farming systems of the sikkim Himalaya. *Soil Biology and Biochemistry* 1998; 3: 379-384. [http://dx.doi.org/10.1016/S0038-0717\(97\)00121-1](http://dx.doi.org/10.1016/S0038-0717(97)00121-1)
- [3] Hooda PS, Sindhu SS, Mehta PK, Ahlawat VP. Growth, yield and quality of ber (*Zizyphus mauritiana* Lam.) as affected by soil salinity. *Journal of Horticultural Science* 1990; 65(5): 589-593. <http://dx.doi.org/10.1080/00221589.1990.11516097>
- [4] JRS. Jujube Research Station (JRS) Sindh Horticultural Research Institute, Mirpurkhas, Sindh, Pakistan 2013.
- [5] Sharif N, Jaskani M, Memon N, Alwi M, Bloch DM, Abbas MM, Ishfaq M. Categorization of ber varieties in relation to blooming period, fruit setting and harvesting time. *Pak J Agri. Sci* 2013; 50(3): 407-413.
- [6] Khan AA. Insect pest management horticultural and forest crops. *Pak Agric Res Council (PARC) Islamabad, Pakistan* 1994; pp. 664.
- [7] Sarwar M. Incidence of Insect Pests on Ber (*Zizyphus jujube*) Tree. *Pakistan Journal of Zoology* 2006; 38(4): 261-263.
- [8] Shi G, Xi Y, Wang H, Li Z, Xia N. The niche of important pests and natural enemies and competition among the species in jujube orchard ecosystem. *Scientia Silvae sinicae* 2003; 39(5): 78-86.
- [9] Atwal AS. *Agriculture Pests of India and South East Asia* (2nd ed.) Kalyani Publ. New Delhi, India 1993; p. 230.

- [10] Singh D, Mann GS. Behavioral studies of the mobile forms of *Synclerau nivocalis* on jujube, *Ziziphus mauritiana*. *Phytoparasitica* 1982; 10(3): 201-204.
<http://dx.doi.org/10.1007/BF02994529>
- [11] Padmanabhan S, Vishwanatha S, Narasimhamurthy K, Rao SV. Effect of feeding ber (*Ziziphus mauritiana* Lam.) juice on growth, blood composite. *International Journal of Food Sciences and Nutrition* 1993; 44(2): 91-94.
<http://dx.doi.org/10.3109/09637489309017427>
- [12] Nizamani, Imtiaz A, Rustamani MA, Nizamani SM, Nizamani SA, Ibrahim KM. Population Density of Foliage Insect Pest on Jujube, *Ziziphus mauritiana* Lam. *Ecosystem. Journal of Basic & Applied Sciences* 2015; 11: 304-313.
<http://dx.doi.org/10.6000/1927-5129.2015.11.45>

Received on 26-01-2016

Accepted on 21-03-2016

Published on 13-06-2016

<http://dx.doi.org/10.6000/1927-5129.2016.12.36>

© 2016 Nizamani *et al.*; Licensee Lifescience Global.

This is an open access article licensed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>) which permits unrestricted, non-commercial use, distribution and reproduction in any medium, provided the work is properly cited.