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E: ISSN NO.: 2349-980X **Shrinkhla Ek Shodhparak Vaicharik Patrika**

Laboratory Studies on The Biology and Morphomertics of Citrus Butterfly, Papilio Demoleus (Linn.), A Serious Pest of Citrus Plants (Lepidoptera : Pailionidae)

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Abstract

To observed the biology and morphometrical studies the citrus butterfly, P.demoleus (Linn.) was reared in laboratory. The female citrus butterfly laid eggs singly or in small group of 4 to 6 eggs on the tender part of plants like fresh leaves, shoots and some times on thorns. The majority of eggs laid on the under surface of fresh leaves with average size of 1.08±0.13mm in diameter. The female adult oviposited the eggs during the time of night or early morning period. Recorded incubation period of on an average of 3.29±0.38 days at moderate temperature with 88.00% viability of eggs. The average duration of larval period of I, II, III, IV, and Vth instar larvae lasted for 2.27±0.03; 2.37±0.01; 2.51±0.25; 3.09±0.08 and 3.31±0.12 days, respectively. The longevity of adult male 3.68±0.72 and female butterfly was recorded as 5.98±1.38 days with an average of 24.02 days of life cycle.

Keywords: Incubation Period, Larva Period, Pupal Period, Fecundity, Mating, Oviposition Period, Longevity

Introduction

Citrus is a genus of flowering trees and shrubs in the family of rue, Rutaceae. It includes a great number of wild and cultivated species plants in genus produced citrus fruits, including important crops such as oranges, lemons, grapefruit, pomelos and limes. Citrus plants are native to subtropical and tropical regions of the world. Resham, Faunindra and Bitani (1988) were reported some sps. of lemon in Nepal and wiedly worked on their pest controls. Several wild species are indigenous to India and others have been brought from other countries and now cultivated in indian soil. A large number of area of indian land, near about 923.2 thousands hectares used for commercial cultivation of citrus plants. An estimated citrus production in India is about 8607.70 thousands metric tonns per annum.(Indian Horticulture Data Base . 2016). The leading citrus fruits producing Indian States are Andhra Pradesh, Punjab, Maharashtra, U.P., Bihar, Orissa, Assam, and Gujarat.It is an important commercial fruit crop due to their fragrance and medicinal properties, enriched with vitamin C, preventing Scurvy disease and achieve third rank of largest fruit industry of world.

Citrus plants are very liable to infestation by aphids, whiteflies, and scale insects etc. In India about 250sps of insects have been identified infesting different sps. of citrus plants. Butani (1979). The highest threats to citrus groves in the Indian regions from varacious foliage feeder larvae of citrus butterfly. The pest occurred at the new flush stage of and damage to new growth thereby hampering the plant development to caused the great economic loss to the culivatiors. It was also stated in the hand book of economic entomology by Ayyer, T. V. R.(1963). The caterpillars of Paplio demoleus are most destructive to citrus nurssaries, feeds on the young foliage at the nurssarie stage and also on young flushes of grown-up trees, Pruthi and Mani (1945). The caterpillars voraciously feed on leaf lamina leaving behind only midrib. In case severe infestation entire tree is defoliated and lead to retarded plants growth and decrease the plant production.Pruthi(1969) and Butani & Jotwane (1975). Although lots of work had been done by distinguished workers but due the importance of

citrus plants and it's losses by papilio caterpillars the present work will be useful for further investigations in this field.

Aim of Study

Information on the biology and morphometric of Citrus butterfly on sweet orange will be helpful to evolve effective management strategy against lemon butterfly

Material and Methods

To study the biology and morphometric of Papilio demoleus in laboratory the fully grown 5th instar larvae were collected from the citrus nurssary of district Shamli Uttar Pradesh. The larvae were reared in different glass jars. The fresh leaves of citrus plants were provided daily as food for larvae. The rearing larvae were changed in to prepupae and pupae were collected and kept in different wire gauge cages finally obtained the adults butterfly. The female butterfly laid eggs on the fresh leaves of citrus twigs placed in water containing conical flasks. The 10% honey solution in cotton swab provided as nourishment for adults flies. The tender leaves and twigs were changed at the intervals of 24 hours.

Almost same time laid eggs were collected and transferred into petridishes in which fresh leaves were placed over moistande blotting paper to prevent drying the leaves. The leaves were changed after 24 hours, continuously till attaining the 3rd instar of larvae. After that these 3rd instar larvae shifted in another rearing jars to complete the Ist generation. This process was continuesly repeated till the maximum data were collected.

During the different developmental stages, observed data like colour, size, incubation period, larval period etc were collected carefully and analysed. Occulomicrometre was used to measured the eggs and Ist instar larvae. The morphometric data of IInd to Vth instar, prepupae, pupae were recorded by using the standard graphic paper method Five pairs of freshly emerged butterfly in saperate cage to observed and record the fecundity, mating, oviposition period, longevity, body measurements and sex ratio of male female adults. (Sukhatme & Amble, 1985).

Results and Disscussion

During the course of study the analysed data could be discussed as below -

Eggs and Egg laying

The female butterfly laid eggs mostly singly or in small groups of 4-6 eggs on the lower surface of tender leaves and shoots also. Almost 84% eggs were on the under surface and 12% on the upper surface of the leaves as well as 04% eggs were also reported on the tender branches of citrus plants. The eggs are attached by means of a sticky substance which harden and glues them firmly in position.

The eggs are almost spherical, basal surface slightly flat, chirion though membranous and smooth, pale yellow or creamy in colour when freshly laid, turns brownish with dark brown spot at the top. As the embryo developed in side the egg shell and finally turning grey just before hatching. the average size of eggs was 1.08±0.01m in diamete. Bell(1911), Atwal(1914), Telbot(1939), Ganguli and Ghosh(1967) and Maheswra babu(1988) were also found similar findings during the study of various developmental stages of Papilio demoleus (Linn.).

Incubation

The duration of development of eggs in to neonates observed during the different months of year and data were placed in the table - 01, as below.

Table-01.Incubation period of eggs.

Months	March	April	May	June	Average
Duration (Days)	4.17±0.99	3.85±0.41	3.22±0.37	2.76±0.45	3.29±0.38

The tabulated data reveals that average incubation period was 3.29±0.38 days at moderate temperature but it was inversely proportional to the temperature, as the temperature increased the incubation period decreased. During the months of March to June the viability of eggs was high as the eggs hatched out with 88.00%. Telbot (1939) and Maheswra (1988) were reported the similar results during his experiments conducting to observe the biological studies of lemon caterpillars.

Caterpillar Stages

A few hours before hatching the eggs appears dark brown indicating the position of the young caterpillars with in the egg shell and crawl out. Neonate larvae eat the egg shell firstly and later on migrate leaves of food plants where it contnuesly feeding throughout its larval stages.

Young caterpillars are blackish with laterally white marking due to which they resemble like bird's excreta. After the fourth moult they became green blending with foliage. In addition to their protective colouration the caterpillars are equipped with striking defensive as well as offensive structure, the reddish colour osmeterium on the prothorax, posterior to the haed. When caterpillar touched or molested the forked process besides acting on a sign of danger released a discomfortable odour which repels the attacking organisms. Burger, B. V. and co workers (1978) analysed the chemical nature of defensive larval secretion if the citrus swallowed tail papilio demoleus. The osmeteria quickly attain their normal position when the danger no longer exists. The role of osmeterial gland of papilio butterfly larvae in defence against an avian predator was recognised by Leslie and Berenbaum in 1990. Since the larvae moults four times during its larval stages, It therefore, passed through 5 instar. Ashoken, R. (1997) reared paiplio larvae at mass level and found an additional instar in the life cycle of Papilio demoleus. The larval period of different instar as well as their measurements related datas are placed in table no.02. and no.03. as follows-

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Table- 02. Duration & measurements of different instar larvae

INSTAR	Ist	IInd	IIIrd	IVth	Vth	Total
DURATION (days)	2.07±0.03	3.37±0.01	2.51±0.21	3.09±0.08	3.31±0.71	13.35±0.18
LENGTH (mm)	2.42±0.25 (neonate) 3.45±0.31	6.43±0.93	11.06±1.32	20.78±1.00	39.35±1.43	----------
WIDTH (mm)	0.89±0.01 (neonate) 0.93±0.14	1.77±0.19	2.78±0.34	5.57±0.28	6.36±0.59	----------

Table-03. Total duration of larval stages in various months

Months	March	April	May	June	July	August	September.	October
Duration (days)	22.78 ±2.94	15.86±2.99	11.35±0.66	8.53±0.69	9.71±0.61	11.32±1.09	12.80±0.50	14.28±1.88

First Instar

Newly hatched larvae is cylindrical and spiny with its thoracic region thicker than rest of the body. General colour light brow when newly hatched, became dark brown later on with an indistinct dirty white V shaped marked on the dorsal side of the middel segments which resemble bird's excreta. Head is light brown in colur and hairy osmeterium looks yellowish brown.

Neonate larvae were measured as 2.42±0.24 mm long and 0.89±0.01 mm width, but fully grown first instar larvae were recorded as 2.45±0.31 mm long and 0.93±014 mm . The observed larval period at optimal temperature and relative humidity was 2..07±0.03 days. The findings were in agreement with the work of Resham et.al.(1986).

Second to Fourth Instar

The fully developed II, III and IV instar were spiny, blackish in colour with distinct creamy white lateral stripe on each side of the thoracic segment.V shaped mark on the abdomen with its stem arising from dorsal side of the 8th segment and arms extending to the lateral area of 5th segment. Visible creamy white latral stripes on each side of the 10th & 11th segment present. The combination of blackish with creamy white marking gaves it the resemble of bird's droppings. The colour of osmeterium is brownish. The length and width of fully mature IInd, IIIrd and IVth instar larvae were measured as 6.43±0.93mm &1.77&0.1mm; 11.06±1.32mm & 2.78±0.34mm and 20.78±1.00mm&5.57±0.28mm, respectively. The tabulated data were shows the average larval period of IInd instar (2.37±0.01days), IIIrd instar (2.51±0.21days) and IVth instar (3.09±0.08days) which resembles to the study of Ramakrishna Rao A.(2015).

Fifth Instar

After fourth moult of larvae became yellow green and spinless except a pair each on prothorax and anal segments. Ventral side is milky white with a strip throughout length of the body just above base of legs. A brown band arising obliquely from the lateral side of the 4th abdominal segment upto the dorsal of the 5th abdominal segment not joining a black band on the anterior margin of the 2nd abdominal segment. Osmeterium reddish and colourful, grown larvae change from yellowish green to deep green , the oblique band became black. The larvae were most voracious at this stage and the larval period of this stage was observed as 3.31±0.71 days, the measured length and width of mature 5th instar larvae were 31.35±1.43mm and 6.36±0.59mm, respectively.

Prepupae and Pupae

The full grown 5th instar larvae ready to enter into the prepupal stage, the caterpillar stop feeding and all activities. The caterpillar void a large quantity of semi liquid excreta and then wandered about for pupation. After selecting a suitable site it spins silk in the form of rough netting over the selected spot of the stem turns away and clasps the netting with its anal props. Next spins a girdle which supports the prepupae and pupae. At the time of 5th moulting the exoskeleton split near the head along the line and by a series of alternate expansion and contractions. The pupae which had formed within, pushes the skin along with the head capsules under the girdle and back to the end of the body. The girdle supported pupae now withdraw its claspers from the shriveled skin which falls and with a twist engaged the cremaster in the silicon pads. It then enter into pupal stage. The prepupal stage lasted for 16 hrs. in summer 38hrs. in winter, respectively. (T. S. Barar1959).

Pupae were obtact type, naked supported by white silicon girdle and a cremaster, head upward free from bristles and spines.Body surface slightly pitted all over pupae. Three coloured pupae were obtained viz. Green (61.80%); Dry straw or brown (30.02%) and Dark grey with black marking (08.18%).

Table.- 04:- Pupal period of papilio demoleus in different months of year

Months	March	April	May	June	July	Aug.	Sept.	Octo.	Nov.	Dec. - Feb.
Duration (days)	10.54 ±0.67	9.05. ±1.01	8.68 ±0.40	8.22. ±0.47	8.65±1.00	8.80±0.71	11.51± 0.67	12.66± 033	18.26± 2.09	122.56± 17.19

The duration of pupal periods varies in different months. The data mentioned in table 04, revealed that the pupal period is shorter in summer and longer in winter. The pupae achieve the hibernation during the month of December and afterward the adult emerged in March. The average

pupal period at moderate temperature (25 - 35C) was observed 7.82±0.52days in laboratory conditions. A detailed study on ecological aspects on the biology of citrus fly with similar observations was also made by Badawi, A. in 1981. The morphometric data indicated that the average length of pupae were 32.50±0.64 mm and 9.25±022mm. width.

Adults

Adults Male and female of citrus butterfly is large sized, tailless, and beautiful having creamy yellow and black spots on wings. The body clothed with tufts of black and creamy yellow hairs, wings were also covered with black and creamy yellow scales, palpi also having same texture as those of tufts. Head and thorax black with creamy yellow streak on each side. Abdomen and legs tusky black. Both fore and hind wings with row of creamy yellow submarginal spots and a small marginal lumiles. Fore wings at the base with little creamy yellow dots united in the form of transverse line. Hind wings with bricks red oval patches on its formal angle and a blue black circular spot near its apical margins, Hind wings black at the base. Abdomen creamy yellow at under side with lateral longitudinal black lines. Antennae club shaped. The average size of male adult was 27.03±2.5 mm. long and 6.23 ±0.95mm width while female adult was 29.07±3.5mm. long and 6.98±1.00 width. The maximum wing expansion is 91.31±7.51mm. Atwal A.S.(1964) reported similar results during his course of study.

Longivity and Sex Ratio

The female live longer than the male. The longivity of male aduls were 3.68±1.72 days and 6.08&±1.38 days of female. Male and female sex ratio were noted as 46 : 54 of lemon butterfly. The mentioned findings were matched with the observations of Singh & Gangwar (1989) and Ramakrishna rao A (2015).

Mode of Mating

A few hours after emergence the butterflies were found on bussiness. The male and female were seen indulging some short of courtship. Male is found to be aggressive and the female vary passive before mating. After some time of the sexual play, the pair sited quietly. The male all the initiatives and sits by the side of female (already sitting) both facing in the same direction, and made intimate convection by bending its abdomen. After this the male at once turned its body to the opposite direction for mating. The average copulation period was 89.95±25.42 minutes recorded in laboratory conditions. This was in agreement with the data of Tadke and Kandalkar (1988).

Pre - Oviposition

The fertilized female usually starts laying eggs the next day after copulation but occasionally the eggs may be laid on the same day. The average pre oviposition period observed during study was 18.25±5.40. Hours.

Oviposition

The oviposition of an egg is involve within a few seconds. After a few minutes flight, the female repeats the operation of egg laying usually taking two or three minutes, often a much longer time elapses between depositions of two eggs. The female usually placed one egg on the leaves, but very often two to five and occasionally more eggs may be found on a single leaf. The oviposition period was the shortest during summer with 2.24±0.71 days and longest in winters with 5.08±1.99 days. (Ramakrishna Rao,A ;2015).The number of eggs laid per female varies from a few eggs to several scores. The average number of eggs laid by per female were recorded as 88.79±20.01.

Post Oviposition

Normally female die a few hours after laying their last quota of eggs but the average post oviposition period of studied female butterflies was 5.96±4.02 hours.

Conclusions :

The laboratory work on the biology and morphometrics of citrus butterfly, Papilio demoleus (Linn) was an evident that the butterfly usually laid the eggs singly, occasionally in groups of 2 to 5 eggs, the total average eggs laid per female was 90 to 110. The incubation period as well as larval periods were directly affected by temperature, therefore, variability were found.The average incubation period at optimal temperature was 3.29±0.38days. The five instars were recorded during larval development with average total larval period 13.35±0.08days. Average Pre pupal period during summer was 16 hours and during winter 38 days, whyl the pupal period during summer was 8.22±0.47 days but during winter it prolonged to 122.56±17.19days, which indicated the hibernation.

The morphometric measurements of the eggs, larvae, pupae and adults were indicated that shape size and colour etc.were remarkable variable during the different developmental stages of the life cycle. Morphomertic observations were very closed to the Madansuri, A. N. el.al. who made a detailed work on chetotaxy of insects.

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References

Arwal A.S. 1964: Insect pest of citrus in the Punjab - Biology and control of citrus caterpillars, Papilio demoleus L. Punjab Hort.J.,4(1):40-44.

Ashoken, R. 1997: Mass rearing and an additional instar of papilio demoleus L. On the acid lime, Citrus aurantifolia Swingle, Insect Envt.,2(4): 128-129.

Ayyer, T.V.R. 1963: Hand book of economic entomology for south India. Govt.Press , Madras; pp. 280-281.

Badari, A. 1981: Studies on some aspect of biology and ecology of citrus butterfly, Papilio demoleus, L . in Saudi Arabia. Zietschriftfar Angewandte Entomology; 91(3):286-292.

Burger,B.V.et.al. 1978: the The chemical nature of defensive larval secretion of the citrus

swallowed tail Papilio demoleus .;J. Insect Physiol. 24(12); 803-805.
Butani, D. K. 1979: Insect pest of citrus and their control. Pesticides. 13(4); 15-21.
Ganguli R. N. and Ghosh M.R. 1967: Biology of Papilio demoleus pest of citrus in Tripura state. Indian Agricul.11:23-18.
Maheswra Babu, P. 1988: Biology and chemical control to citrus butterfly,Pspilio demoleus ,(Linn.), M.Sc.(Ag.) Thesis submitted to Aacharya N. G. Ranga Agricultural university, Hydrabad. 117pages.
Pruthi, H. and Mani M. S. 1945: Our knowledge of the insect and mites pest of citrus in India and their control. Imperial council of Agric. research science monograph.16;42.
Pruthi, H. 1969: Text book of Agriculture Entomology. Indian council of Agril. Res. New Delhi. pp.634.
Tadke, S. G. and Kandalkar, H.G. 1988: Observation on the lemon butterfly, P. demoleus
(Linn.) P. V. K. Res. J.13(2):176-177.
Resham, B. , Fanindra,P. N. and Butani D. K. 1988: Insect pest of citrus in Nepal and their control. Petrology.10(4):24_27.
Sharifi, S. and Zarra ,N. 1970: Biology of citrus butterfly, P. demoleus, (L). Ann. Ent. Soc. Amer.,63(5) :1212-1213.
Singh, Y. P. and Gangwar S. K. 1989 : Biology of the lemon butterfly on Khashi Mandarin and it's development on citrus cultivar. J. Of Andman Sc. Assoc.5(2):151 - 153.
Sukhatme, P. V. and Amble A. N. 1985: Statistical methods for Agriculture worker . Publication and Information division. ICAR.New Delhi.553.