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BIOLOGY OF THE MANGO LEAF WEBBER, *ORTHAGA MANGIFERAE* MISRA, (LEPIDOPTERA : PYRALIDAE), A PEST ON MANGO (*MANGIFERA INDICA* LINN.) IN THE FRUIT BELT OF WESTERN UTTAR PRADESH

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Orthaga mangiferae Misra (Lepidoptera : Pyralidae) had been observed by Misra, (1932), Gupta & Rai (1982). But in Western Uttar Pradesh the infestation of this leaf webber on mango trees have been recorded by Singh (1988). The maximum infestation is seen during August to November and when temperature is 32.50°C (max), 23.60°C (min.); R.H.% 91 (max.), 70 (min.); Rainfall 3.80 mm. The life cycle continues from May/June to late November. Likewise, the total duration varies from 40-45 days. The leaf webber damages the foliage and turns in to skeleton of leaf veins so badly that the production of mango is effected in the ensuing mango season causing serious damage to the orchard owners. The life cycle of the pest is significant to make effective IPM measures to suppress the pest manifestation in Saharanpur.

Key words : Biology, *Orthaga mangiferae*, mango pest, Uttar Pradesh.

INTRODUCTION

Mango, the king of fruits, *Mangifera indica* Linn. (Anacardiaceae) is known due to its attractive colour, odour and a nice delicacy. It is the most important fruit crop of India, commanding as much as 70% of the total area under fruit crops. But this important fruit of mango is infested by several pests (approx. 400). These pests damage several parts of the mango tree. Several defoliator, leaf roller, leaf eating caterpillars have been recorded *viz. Orthaga euadrusalis,* (Tandon & Srivastava, 1982); *Lymantria marginata* (Butani, 1979), *Penicillaria jocosatrin* Guenee (Schreiner, 1987). The mango leaf webber *Orthaga mangiferae* Misra (Lepidoptera : Pyralidae), a major cause of damage to the foliage of mango trees was first observed by Misra, (1932) in neighbour hood of Pusa (Bihar). This pest in severe form was observed by Gupta & Rai (1982) in 1968 causing extensive damage to mango trees at and around Tanakpur in Nainital (presently in Uttarakhand).

MATERIALS AND METHODS

All the mango growing areas and orchards including the famous mango belt of the Saharanpur shall be surveyed for the collection. Seasonal collection of leaves infested with *Orthaga mangiferae* taking out of the earliest stage possible. The collected larvae were reared on mango leaves with twig in glass jars covered with muslin clothes. Loose moist soil 4-5cm thick placed at bottom of jar for pupation. The emergence of adult, wait for copulation, note the time and hours. Mango twig is provided for egg laying. Now these eggs are placed to observe hatching time. Hatching of various larvae is observed and duration taken by each moult is recorded. Likewise duration of pupation and pupa stage till their metamorphosing into adult is recorded along with the prevailing climatic factors from meteorological observations. In the study of life history the size (length and width) of various stages *i.e.* egg., larvae and pupa are measured with the help of micrometer.

Table I : Morphological and morphometric measurements of the various larval forms of *O. mangiferae*.

Larval stages	Head (mm)	Length (mm)										Width (mm)	
		Thorax						Abdomen		Total			
		Prothorax		Mesothorax		Metathorax							
		I	II	I	II	I	II	I	II	I	II	I	II
I Instar	0.215	0.257	0.315	0.229	0.300	0.215	0.304	1.334	1.616	2.250	2.750	0.250	0.250
II Instar	0.429	0.443	0.629	0.415	0.615	0.429	0.615	2.288	2.717	4.004	5.014	0.500	0.500
III Instar	0.701	0.729	0.887	0.715	0.844	0.686	0.844	3.175	3.745	6.006	7.021	0.750	1.000
IV Instar	1.316	1.487	1.687	1.459	1.645	1.502	1.673	9.223	9.667	15.000	16.000	1.500	2.000
V Instar	2.074	2.460	2.660	2.402	2.631	2.431	2.646	15.620	16.990	25.087	27.001	3.000	4.000

I : Early to emergence; **II :** Prior to next moulting.

Table II : Variation in duration in life cycle of *O. mangiferae*.

Month & Year	Life duration (In days)	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
		Maximum	Minimum	Maximum	Minimum	
May-June 2003	44	37.80	21.10	51	22	0.41
June-July 2003	41	37.70	25.80	65	43	1.06
July-August 2003	40	33.20	25.60	86	87	5.50
August-Sept 2003	40	32.50	23.10	89	70	3.80
September-Oct 2003	44	31.50	23.60	91	71	6.80
October-Nov 2003	43	31.60	15.60	89	40	0.00
November-Dec 2003	Dipause					
April-May 2004	Dipause					
May-June 2004	44	37.40	22.60	59	30	6.55
June-July 2004	42	34.80	24.20	78	52	6.58
July-August 2004	40	35.50	25.10	81	60	1.30
August-Sept 2004	41	31.60	25.10	90	75	19.80
September-Oct 2004	43	33.20	23.50	91	58	6.92
October-Nov 2004	45	29.80	16.30	93	49	6.87
November-Dec 2004	Dipause					
April-May 2005	Dipause					

RESULTS

During survey found that newly hatched caterpillars feeding on the tender top leaves by webbing the leaves together with silken threads. The caterpillars are very active, voracious feeder and sensitive, easily crawl to the another leaves. They feed the green tissue of leaves leaving the mid ribs and some harder veins. The infested tree soon becomes defoliated and covered with a dense network of webs. Life cycle is studied in following steps :

Copulation : Copulation is the beginning of reproductive life process. Newly emerged imagoes after resting for sometime to achieve full maturity, flutter their wings to initiate the activities. The male rotates around the female moth faster and rides on the wings of the female moth and turn at 180° so as to bring their abdominal tips bearing genital organs (genitalia) of both the sexes which get locked. The locking duration lasts for half an hour to 2.30 hrs. Average duration of copulation is 1.38 hrs.

Oviposition : The oviposition lasts for 2-4 days in small bunches and culminates with the death of the female. Total number of eggs laid ranges from 125-155 in the life span.

The Egg : Freshly laid eggs are dull white in colour, and oval in shape. The average length x breadth of the egg is 0.909 x 0.637 mm.

Hatching : Hatching occurs after an incubation period of 4-5 days. The egg hatches and first instar larva emerges out.

Larval Stage : Five larval stages occur in the life cycle of *Orthaga mangiferae*.

Freshly emerged first instar larvae are small, light red in colour with a prominent black head. The larval length x breadth is 2.25 x 0.25 mm and later grows to length x breadth 2.75 x 0.25 mm. This larva moults into second instar after 2-3 days. After feeding the leaves the colour of larva change into light green. The larva scrub the chlorophyll of the leaf and start the web formation.

The second instar larva is greenish in colour with some irregular patches and hairy setae on the body. The head is black in colour. The larval length x breadth on moulting is 4.00 x 0.50 mm, which grows to 5.01 x 0.50 mm, prior to moulting into third instar larva after 2 to 3 days.

Third instar larva on emergence is light brown in colour. Significantly, the black colour of the head of the earlier instar larva is now bearing dark brown shade with chocolate small patches and markings. In this larva like earlier two larval forms body bears hairy setae. Dorsally the thorax and abdomen are olive grey in colour. It feeds on the mango leaf. The body length x breadth on emergence is 6.00 x 0.75 mm while prior to moulting into fourth instar it acquires length x breadth = 7.0 x 1.0 mm. It moults into fourth instar larva in 3-4 days.

Fourth instar larva is greenish brown in colour. The head black in colour with chocolate spots. Dorsal side of the thorax and abdomen is pale yellow or olive grey in colour. Body smooth with numerous hair like setae on the body like earlier larval stages.

The length x breadth in mm of the larva on emergence is 15 x 1.50 mm, while later on prior to moulting into fifth instar larva it acquires length x breadth 16 mm x 2.00 mm. This caterpillar feeds on green tissue of mango leaf in the web and after 4-5 days moults into fifth instar larva.

The fifth larval stage is sufficiently larger in length than earlier instar larvae. Fifth instar larva on its first appearance is comparatively more robust with higher appetite. Its body is dark brown coloured with chitinous head mottled with chocolate spots. The thorax is clearly divisible externally into three parts *i.e.* prothorax, mesothorax and metathorax while the abdomen in ten well demarcated segments. A pair of spiracles is present on prothorax and each of the first eight abdominal segments. The spiracles are present on either lateral side of the dorsum, a dark fuscous longitudinal line running from pronotum to anal end. Within the above mentioned lines one pair of equidistantly placed tubercles of brown colour are present on either side of the mid dorsal line. One seta is present in each tubercle.

Larval length x breadth is 25.08 x 3.00 mm and later stage (prior to pupation) length x breadth is 27.01 x 4 mm. Various measurements of the body parts of the caterpillars (larvae) are as Table I.

The fifth instar larva is the last feeding stage which feeds voraciously within the web on the mango leaves. On slight touch or itself this larval stage droops down on the ground below. This stage lasts for 5-6 days and then drops in the soil for pupation.

Pupa : The fifth instar mature larvae fall to the ground and become sluggish, spin silken cocoon 3-4 cm deep in soil and pupate inside the soil. The prepupal stage lasts for 1-2 days. At the time of final moult larva becomes wrinkled, movement suspended and turns darker in colour. Pupae of *O. mangiferae* are small, *i.e.* 13-14 mm in length, 3-4 mm in width. The colour of pupae is dark brown which change to blackish on maturity. The duration of pupal period is of about 14-18 days. Dorsally 3 thoracic and 9 abdominal segments are visible.

Diapause : With the onset of winter the pupae do not moult and retain the same stage from late November to April next. Diapause is over in May and new life cycle starts with the emergence of new moths.

Adult **:** The anterior tip of the puparium ruptures and young imago adults emerge out. Adult moth (male) has a wing span of 27 mm and length 10 mm while female moth has a wing span of 30 mm and length 14 mm and male bears a tuft of hair at the anal end. Adult moth is brownish olive green in colour. Male survives for 4-5 days while female for 4-7 days usually male die after copulation. The total life cycle completes with in 40-45 days.

In May-June months life cycle completes in 44 days (Temp. 37.80°C (max.), 21.20°C (min.)-37.40°C (max.), 22.60°C (min.); R.H.% 51 (max.), 22 (min.)-59 (max.), 30 (min.) and Rainfall 0.041 to 0.55 mm during 2003-2004. The further study shows the duration of life cycle 41-42 days (Temp. 37.70°C (max.), 25.80°C (min.)-34.80°C (max.), 24.20°C (min.); R.H.% 65 (max.), 43(min.)-78 (max.), 52 (min.) and Rainfall 1.06 to 6.58 mm

during the study (2003-2004). The trend shows total duration of life cycle up to August-September the same but duration rises from 44 to 45 days by September to November months (temp. 31.60°C (max.), 15.60°C (min.)-29.80°C (max.), 16.30°C (min.); R.H.% 89 (max.), 71 (min.)-93 (max.), 49 (min.); Rainfall 6.8 to 0.87 mm) during 2003-2004 (Table II).

The life cycle of the moth is dependent on the climatic factors. Diapause ends by April month end, the young imagoes (adult : male and female) emerge out by the moulting of the resting pupae and restart their sexual reproduction with the onset of copulation. The first generation of *Orthaga mangiferae* Misra starts by May end, during June to November months 3 to 4 generations are completed by the breeding moth. Peak activity i.e. formation of maximum webs on the mango trees is during August to early November months.

DISCUSSION

The mango leaf *O. mangifeare* has acquired the status of a major limiting factor in mango production in Uttar Pradesh, Bihar and other parts of North India. In India, different species of the genus *Orthaga* cause damage which are as below :

- *Orthaga euadrusalis* Walker
- *Orthaga exvinacea* Hampson
- *Orthaga mangiferae* Misra

The webber infestation begins from May/June to late November in Saharanpur but *O. euadrusalis* Walker the infestation is from June to December months. Three to four generations have been recorded in the present studies during a year in *O. mangiferae* but in *O. euadrusalis* five generation and four to five generations in *O. exvinacea* have been described (Srivastva, 1997).

In *O. mangiferae* a single female moth lays 125-155 eggs while in *O. exvinacea* a single female days 30 to 50 eggs, *O. euadrusalis* lays 55 eggs, (Singh, 1988).

In *O. euadrusalis*, singh (1979) studied that there are five instars, each having 2-3 days duration in July. Total larval period varied between 15 to 33 days. Its pupal period varies with temperature (4-5 days at 35°C and 16-18 days at 25°C). *O. exvinacea* Hampson infests from June to January, peak incidence is in October-November and is a minor pest (Babu *et al.*, 2001) in Tirupati (Chittor district) and in Cuddapah district-Ananthrajupet areas of Andhra Pradesh but *O. mangiferace* in north and western U.P. if not cared well causes heavy loss (Babu *et al.*, 2001).

In *O. euadrusalis* in one web up to ten caterpillars are found (Singh, 1979). Pupation of last caterpillar stage occurs in soil in December and January months. Unlike, *O. mangiferae* where it starts in mid November to April next. The egg, larval and pupal period of *O. exvinacea* 4, 28 to 33 and 11 to 14 days (Butani, 1993).

Cherian & Anthanarayan (1943) described the life cycle of *O. exvinacea* in South India which is almost same as *O. euadrusalis* but there is no mention of diapause stage like *O. mangiferae*.

Duration of life cycle is minimum during July to October months 40 days, while in May and mid November it reaches up to 45 days i.e. extremes of temperature, relative humidity (R.H.%) and rainfall increases the duration while optimum climatic factors minimize the duration. *O. euadrusalis* female moths have grey coloured fore wings, with patches of shining scales. *O. euadrusalis* moths are medium size (female wing span 31 mm, body length 14 mm), male being slightly smaller than females otherwise alike (Singh, 1988). These characters are different from *O. mangiferae* Misra. Another leaf webber, *Macalla thyrsisalis*(Pyralidae : Lepidoptera) has also been described. (Howard, 1990).

Singh (1988) has reported the *O. euadrusalis* in western U.P. covering large number of districts where mango is grown including Saharanpur but the present study with the account of *O. mangiferae* is no doubt an unexplored leaf webber prominently found in the mango orchards in Saharanpur district and is recorded to be a serious pest of mango leaf (vegetative part) of the tree.

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