

LIFE TABLES OF THE MANGO LEAF WEBBER PEST, *ORTHAGA EXVINACEA* HAMPSON (LEPIDOPTERA: PYRALIDAE), ON DIFFERENT HOST PLANT LEAVES

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ABSTRACT – Life table studies of the mango leaf webber pest, *Orthaga exvinacea* Hampson were conducted on three different host plant leaves. The basic life table is one of the most important conceptual and analytical tools in entomological research because it serves as a framework for organizing data on age-specific mortality and survival; provides detailed, transparent descriptions of the actuarial properties of a cohort; generates simple summary statistics such as life expectancy and survival rate; and has a basic form that can be expanded, condensed, or modified for analyzing different types of data. The life table information can be used to further develop integrated pest management programs. The raw data were analyzed based on the age-stage, two-sex life table. Age-specific mortality and survivorship data for the pest species is summarized in the form of life table. The result confirmed that there were no differences among host plants in terms of the development of immature stages of the mango leaf webber pest, *Orthaga exvinacea* Hampson. The host plants examined in this study are all suitable for the pre-imaginal development of *Orthaga exvinacea* Hampson.

Key words : Survivorship, Instars, Longevity, fecundity.

INTRODUCTION

Orthaga exvinacea Hampson (Lepidoptera: Pyralidae) commonly called as the mango leaf webber, was considered as one of the minor pests of mango but since last few years, it has attained the status of a major pest of mango in Kerala. The bionomics and behaviour of a related species *Orthaga euadrusalis* Walker was studied by Patel *et al* (2007). The caterpillars of this pest make webbings to join the mango leaves in to clusters and eat those leaving only ribs. It has attained the status of a major pest of mango in several parts of India. Shaw *et al* (1998) and Varghese (1998) recorded the prevalence of *Orthaga exvinacea* in Madhya Pradesh and Andhra Pradesh. The pest is found to infest all varieties of mango trees in Kerala. The complete development of the leaf webber pest, *Orthaga exvinacea* Hampson passes through seven larval instar stages and a pre-pupal stage. The female moths laid greenish dull, oval and flattened eggs singly or in clusters usually on lower surface of leaves near the midrib or vein. The caterpillars on hatching reached to tender leaves nearby and feed gregariously on leaf chlorophyll by scraping the leaf surface.

Different host plants are known to affect insect development, survival, reproduction and life table parameters (Greenberg *et al*, 2001; Hansen *et al*, 2004; Liu *et al*, 2004). There was no information on the life table parameters of *Orthaga exvinacea* on different

mango varieties. The survivorship from egg to adult emergence of *Orthaga exvinacea* Hampson fed on three different host plant leaves were studied in the laboratory and population parameters of *Orthaga exvinacea* Hampson were used for the construction of life table under ideal condition in the laboratory free from natural enemies. Pests cause more damage on susceptible host plants by having a higher population growth rate than on resistant ones. For this reason, knowledge about the population of a pest on different host plants gives us an idea about the resistance or susceptibility of hosts. No information is currently available on the population development of the mango leaf webber pest, *Orthaga exvinacea* Hampson within the context of host plant resistance. In this study, several biological parameters that provide valuable information on population growth rate of the mango leaf webber pest, *Orthaga exvinacea* Hampson (development rate, survival, mortality and fecundity), were examined on different mango cultivars under laboratory conditions.

A life table describes the development, survival, and fecundity of a cohort and provides basic data on population growth parameters. A life table developed from field data may be used to estimate fitness of a population as influenced by various biotic and abiotic factors. Unfortunately, field life tables are often difficult to construct because tracing population survival and reproduction in the open field under variable environmental

conditions is exceedingly difficult. On the other hand, life tables constructed using laboratory data are useful in revealing the maximal growth potential of a population.

Plant species differ greatly in suitability as host plants for specific insects when measured in terms of survival, development and reproductive rates. Shorter developmental time and greater total reproduction of insects on a host plant indicate greater suitability of that plant (van Lenteren and Noldus, 1990). Using resistant cultivars is one of the core strategies of integrated pest management. Understanding the demographic parameters of a pest is essential to develop an integrated pest management strategy. These parameters provide population growth rate of an insect pest in the current and next generations.

The objective of this study was to determine the effect of host plants such as different varieties of mango trees on the development, survival, reproduction and life table parameters of the mango leaf webber pest, *Orthaga exvinacea* Hampson in the laboratory.

MATERIALS AND METHODS

Laboratory Colony of *Orthaga exvinacea* Hampson.

Orthaga exvinacea infestation is found in all mango cultivating countries. In order to maintain a continuous supply of the different stages of the pest, field collections were made regularly. The different stages of the pest (larvae and pupae) were collected from mango trees of different parts of Calicut district. The shoots attacked by *O.exvinacea* were easily distinguishable as their apices remain dry and webbed. Such webbings were collected and brought to the laboratory, from where the different stages were sorted out.

Rearing of the pest

The larvae collected from the field were grouped according to the instars and were reared in glass cages (40cm x 40cm x 40cm), the two sides of which were netted with wire gauze. The cages were cleaned daily to maintain sanitation and fresh mango leaves were added every day. The last instar larvae just prior to pupation were transferred to glass jars containing a layer of dried sand. The adult male and female separated soon after emergence were transferred into sterilized beakers. The adults were fed with 50% honey on cotton swabs. A fresh mango twig was introduced each day into the beaker for oviposition. Eggs laid on the mango leaves were kept in laboratory conditions. The first instar larvae, immediately after hatching, were transferred into clean beakers carrying fresh mango leaves. The beakers were cleaned everyday and were sterilized once in a week to keep away

fungal infection.

Host Plant Sources.

There are nearly 1,000 cultivars or varieties of mango in India. The genus *Mangifera* belongs to the order Sapindales in the family Anacardiaceae which is a family of mainly tropical species with 73 genera. The common south Indian varieties include Neelum, Moovandan, Sindhoor, Banganapalli, olour, pairi, alphonsa, mundappa etc. Leaves of 3 different varieties of mango trees were used in this study: Neelum, Moovandan and Sindhoor. All leaves used in this laboratory experiment were collected from plants growing under field conditions without the use of any pesticides and fertilizers.

Development and Survival of Immature Stages.

Field collected eggs are grouped into three batches and reared on three different host plant leaves. Ten female and ten male pupae were collected from larvae reared on the 3 host plants. When adults emerged, moths were provided with 10% sucrose solution and allowed to mate for 1-2 days in glass jars. Mated moths were transferred to laying containers. The eggs laid on the same day by each pair were observed to determine the hatching rate (%) and the number of larvae emerging (Figure.1).

Newly emerged larvae (20 from each experimental host plant) were transferred individually into glass jars containing fresh mango leaves, Neelum, Moovandan and Sindhoor. The larvae were observed daily through pupation and adult emergence. Individual insects were checked twice daily for development and survival. Larval period (days from first instar to pre-pupation), pre-pupal period

Table 1 : Life table parameters of *Orthaga exvinacea* on the mango variety, Neelum

Development stage(x), Number living at the beginning of the stage noted in the x column(lx), Number dying within the age interval in the x column(dx), Percent mortality based on lx(100qx), survival rate within stage(sx) and life expectancy(ex).

x	lx	dx	100qx	sx	ex
Instar 1	20	05	25.00	75.00	3.65
Instar 2	15	02	13.33	86.67	3.25
Instar 3	13	02	15.38	84.62	3.65
Instar 4	11	01	9.09	90.91	4.20
Instar 5	10	0	0	100	4.20
Instar 6	10	1	10	90	5.37
Instar 7	10	1	10	90	5.53
Pre-Pupa	09	0	0	100	4.20
pupa	09	3	33.33	66.67	10.10
Moth	6	---	---	---	---

Figure. 1

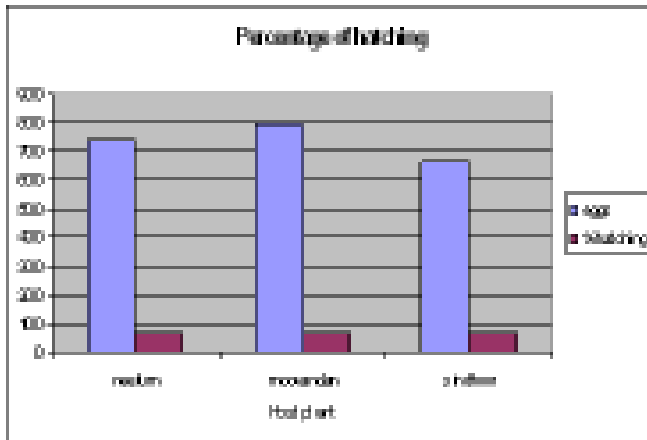


Figure. 2

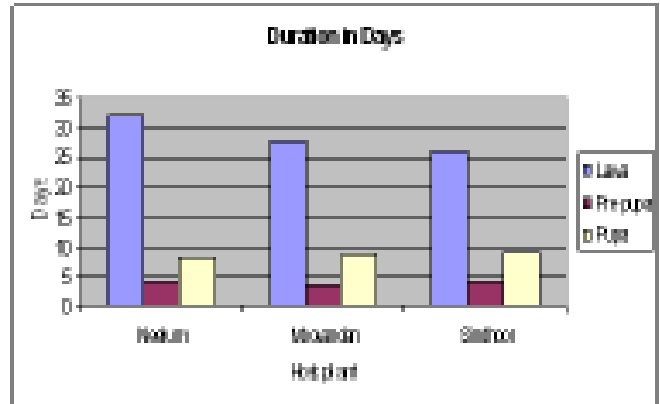


Figure. 3

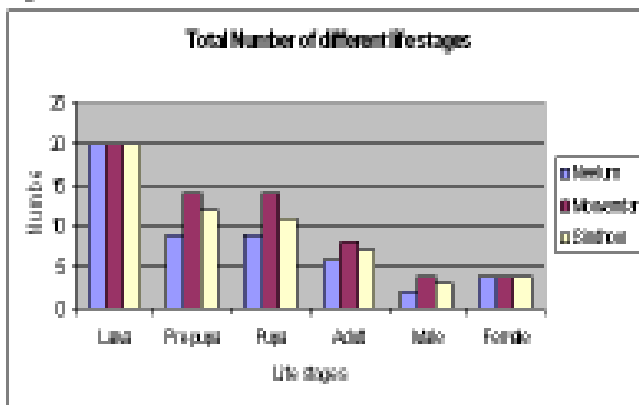


Figure. 4

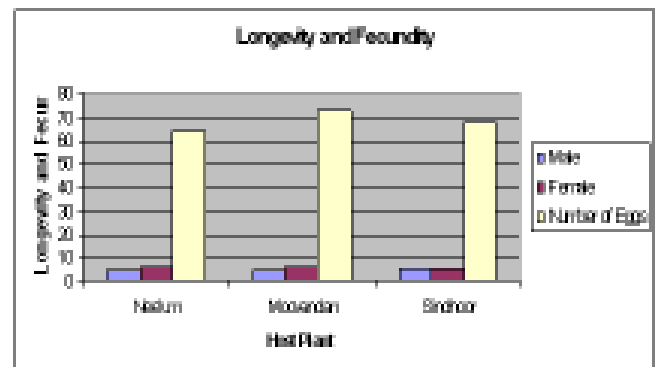
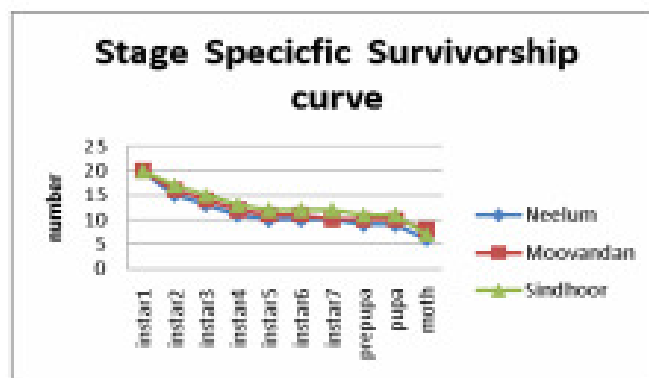


Figure. 5



(days from pre-pupation to pupation) and pupal period (days from pupation to adult emergence) were recorded (Figure.2). Total number of individuals of each stage is also recorded (Figure.3).

Adult Longevity and Reproduction.

Emergent moths from larvae reared on each host plant were allowed to mate for 1-2 days and then transferred to a laying container (one pair per container) and supplied with 10% sucrose solution. After mating, adult mortality

and the number of eggs deposited were recorded daily until the death of each adult (Figure.4).

Data Analysis

In constructing the life table the following symbols proposed by Morris and Miller (1954) and Carey (2001) were used.

x = Age interval (development stage).

lx = Number living at the beginning of the stage noted

Table 2 : Life table parameters of *Orthaga exvinacea* on the mango variety, Moovandan

x	lx	dx	100qx	sx	ex
Instar 1	20	04	20.00	80.00	3.50
Instar 2	16	02	12.50	87.50	3.25
Instar 3	14	02	14.29	85.71	3.90
Instar 4	12	01	8.33	91.67	4.00
Instar 5	11	0	0	100	4.20
Instar 6	11	1	9.09	90.91	5.15
Instar 7	10	0	0	100	5.38
Pre-Pupa	10	0	0	100	3.40
pupa	10	2	20	80	10.40
Moth	8	---	---	---	---

in the x column

dx = Number dying within the age interval in the x column.

100qx = Percent mortality based on lx.

sx = survival rate within stage

ex = life expectancy.

Age-specific survival rate (*lx*) and life expectancy (*ex*) of *Orthaga exvinacea* reared on different host plant leaves were calculated according to Carey (2001). The life table parameters such as dx, 100qx and sx are also calculated for *Orthaga exvinacea* on the three different host plants (Table.1, 2, 3).

RESULTS AND DISCUSSION

Development : Figures 1 and 2 shows the percentage of hatching and duration of different immature stages of *Orthaga exvinacea* reared on Neelum, Moovandan and Sindhoor leaves under laboratory conditions. There were no significant differences in the development times of immature stages among the three host plants. In the other hands, no significant difference was found among plant species in terms of egg hatching.

Survival : Figure 3 shows the survival of different life stages of *Orthaga exvinacea* reared on the same host plants. Survival of different life stages was not different among plants. Larval mortality generally was high and pre-pupal mortality was low on all host plants.

Adult Longevity, Fecundity and Oviposition. Host plant did not affect adult longevity and fecundity (Figure.4). Although adult females from larvae reared on Neelum lived longer than adults from larvae reared on Moovandan and Sindhoor, there was no significant difference among them. Adult male longevity showed the

Table 3 : Life table parameters of *Orthaga exvinacea* on the mango variety, Sindhoor

x	lx	dx	100qx	sx	ex
Instar 1	20	03	15.00	85.00	3.25
Instar 2	17	02	11.76	88.24	3.05
Instar 3	15	02	14.29	85.71	4.15
Instar 4	13	01	7.69	92.31	4.05
Instar 5	12	0	0	100	4.30
Instar 6	12	0	0	100	5.00
Instar 7	12	0	0	100	5.54
Pre-Pupa	11	0	0	100	4.10
pupa	11	4	36.36	63.64	11.10
Moth	7	---	---	---	---

same trend. On the other hand, the mean total number of eggs produced was significantly affected by host plant. Females from larvae reared on Moovandan laid significantly more eggs than those from larvae reared on Neelum and Sindhoor.

There were no differences among the host plants in terms of pre-oviposition. In parallel with the results for fecundity, the oviposition period for females from larvae reared on Moovandan was found to be longer than for other plants. On the three host plants, most of the eggs were laid within 2 to 3 days.

The data on age specific life-table shows that the life table parameters of *Orthaga exvinacea* reared on different host plants did not show any significant differences (Table.1, 2 and 3). In all the three cases the survivorship curve is Type III curve (Figure.5) which occurs when juvenile mortality is extremely high. Mortality at the egg stage and early instar stage was found to be high in all generations. On the other hand, the mortality exhibited a steady decline at later stages of larval period. Age specific survival and mortality data revealed that host plants do not influence survivorship. Therefore, there were not marked differences in survival of larvae among host plants. This result confirmed that there were no differences among host plants in terms of the development of immature stages of the mango leaf webber pest, *Orthaga exvinacea* Hampson.

The life table parameters provide a useful summary measure for characterizing differences in shapes of survival curves among cohorts (Carey, 2001). The shape of the survivorship curve indicates the susceptibility or resistance of a host plant to insect feeding. Therefore, the observed data showed the tremendous growth capacity of *Orthaga exvinacea* on three different host

plants under favorable conditions. In this study, the cohort life table was constructed based on unlimited food supply in the environment free from natural enemies. Therefore, predators, parasitoids or pathogens are not included as mortality factors.

In conclusion, demographic parameters obtained from *Orthaga exvinacea* reared on three host plants under laboratory conditions are useful for the assessment of host plant quality. The different life table parameters reflect the suitability of the host plant. In addition to other factors, survival and fecundity are affected by the host plant's nutritional value (Pereyra and Sanchez 2006). Meanwhile, this study provides a foundation regarding the host range of *Orthaga exvinacea*, and as such, will be useful to pest management.

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