INCIDENCE AND SUCCESSION OF BRINJAL PESTS WITH SPECIAL REFERENCE TO STUDIES ON BRINJAL LEAF ROLLER, EUBLEMMA OLIVACEA WLK.

(LEPIDOPTERA: NOCTUIDAE)

THESIS

SUBMITTED TO THE JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN AGRICULTURE (ENTOMOLOGY)

-By-

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C E R T I F I C A T E

This is to certify that Shri Sudhakar Gopalrao Marathe has worked and prepared his thesis under my guidance on "Incidence and Succession of Brinjal Pests, with Special Reference to the Studies on Brinjal Leaf Roller, Eublemma olivacea Wlk.", for the degree of M.Sc.(Agr) J.N. Krishi Vishwa Vidyalaya, Jabalpur.

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C O N T E N T S

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CHAPTER I

INTRODUCTION

One of the greatest problem facing India today is that of feeding her over increasing population. The vegetables are important essentials in the human diet as a potentially rich source of vitamins and minerals which are often deficient in other food. The Nutritional Advisory Committee of India (1956) has emphasized the value of fruits and vegetables by recommending that they should constitute fifty percent of the total food consumed per day per individual.

Among vegetables, brinjal (Solanum melongena Linn.) occupies a place of special importance. It is available throughout the year. There is a common belief that brinjal does not possess any food value, but this is not true, because according to Choudhary and Kelda (1968) it contains the following food values per 100 gms. on edible portion:

Moisture	92.70 gms.	Iron	0.9 mgs.
Proteins	1.4 "	Sodium	3.0 "
Fats	0.3 "	Potassium	20.0 "
Minerals	0.3 "	Copper	0.17 "
Fibre	1.3 "	Sulphur	44.0 "
Carbohydrates	0.4 "	Chlorine	52.0 "
Calcium	18.0 mgs.	Riboflavine	0.11 "
Magnesium	16.0 "	Nicotinic acid	0.09 mls
Oxalic acid	18.0 mls	Vitamin A	124 IS
Phosphorus	47.0 mgs	Vitamin C	12.0 IS

Heat 24 calories.

It is also important because it is supposed to contain many medicinal virtues. It acts like medicine for those suffering from liver complaints. If the brinjal fruits are pierced all over with a needle and fried in til oil, the fruits can be employed as a cure for tooth-ache. The green leaves of brinjal are the main source of the supply of vitamin C.(Nadkarni 1927).

The brinjal or egg plant is a perinnial herb, but generally cultivated as annual. It has originated from India (Vavilov: 1951). It belongs to the Solanaceae family and is known under the Botanical name Solanum melongena Linn. It is widely cultivated on the plain and covers a comparatively high percentage of acreage. In Madhya Pradesh the area under brinjal was 11.6% of the total area under vegetables in 1956-57. In India it is generally sown twice or thrice in a year for getting the regular supply.

Successful growing of the crop calls for an adequate knowledge of insect pests, least the work done and money spent in various operations viz. cultural operations, mannuring, irrigation etc. may be undone by the ravages of the insect pests. The insects can damage to the crop either by directly feeding on some parts of the plants or by dissemination of virus from diseased to a healthy plant. The brinjal crop is subjected to the attack of a

large number of insects. The major pests of brinjal with regular occurance in this area include:

SPECIES	TAXANOMIC POSITION	PARTS DAMAGED
Leucinodes orbonalis Gun.	Lepidoptera Pyraustidae	Shoots & fruits
Euzophera perticella Rag.	Lepidoptera Pyralidae	Stems & roots
Eublemma olivacea Wlk.	Lepidoptera Noctuidae	Leaves
Phthorimoea blapsigona Meyr.	Lepidoptera Gelechidae	Flowering buds
Aphis gossypii Glov.	Hemiptera Aphididae	Leaves
Empoasca devastans Dist.	Hemiptera Jassidae	Leaves
Urentius sentis Dist.	Hemiptera Tingidae	Leaves
Tetranychus telarius Linn.	Class Acarina Fam. Tetranychidae	Leaves.

The brinjal shoot and fruit borer Leucinodes orbonalis Gun. Is the most destructive and notorius pest. It feeds on brinjal shoots in the initial stages and later on fruits, rendering them unfit for human consumption. Lefroy (1907), Fletcher (1914), Henry (1917), Pillai (1921) Hussain (1924), Corbett (1928) and many other workers have dealt about its distribution and host plants. Lefroy (1907) put it in the status of a minor pest but, Fletcher (1917), Pillai (1921), Hussain (1924-28), Ayyar (1940)

Wesley (1950-52) and others reported it as a serious pest of brinjal, whereas bionomics of the pest has been worked out by Fletcher (1914), Pillai (1921), Hussain (1931-35), Ayyar (1940) and Basu and Patel (1948).

Brinjal root and stem borer Euzophera perticella Rag. is a major pest of brinjal distributed throughout India and Ceylon, observed feeding on brinjal, chillies, potato and tomato. It has been recorded by Lefroy (1907), Fletcher (1914), Poutiers (1919), White (1919), Husain (1929), Pruthi (1936), Sinha (1951), Gupta (1956), Bhandari (1962) and Lall (1964). Lefroy (1907), Fletcher (1914) and Gupta (1956), had given a short account of nature of damage and its life history.

Eublemma olivacea Wlk. the brinjal leaf roller is considered as a minor pest of brinjal. Hampson (1894), Lefroy (1907), Fletcher (1914-21), Sharoff (1919), White (1919), Pillai (1921), Ayyar (1934), Pruthi and Issac (1946) Kadam and Patel (1960), Bhandari and Sohi (1962) and Srivastava (1966) recorded it on brinjal through out India, Burma and Ceylon. Lefroy (1907), Fletcher (1914), Kadam and Patel (1960) and Srivastava (1966) put this pest in the status of a minor pest however Fletcher (1914) and Srivastava (1966) reported that some times it is very destructive.

The brinjal bud worm Phthorimoea blapsigona Myer. bores through the young flower buds and feeds on developing ovary and causes considerable damage to the crop. Fletcher (1917), Corbett and Galis (1926), Krishnamurti and Usman (1954) and Chauhan (1965) found it feeding on the brinjals.

Being a minor pest of brinjal very little literature was available on brinjal lace wing Urentius sentis Dist.

Besides all these, there are many minor pests viz. Aphid (Aphis gyssypii Glov.), Jassid (Empoasca devastans Dist), and mite (Tetranychus telarius Linn.). These are mainly the pests of cotton however brinjal crop is also affected.

Leucinodes orbonalis Guen. and Euzophera perticella Rag. are the most serious and destructive pests of regular occurence in this locality, whereas Eublemma olivacea Wlk. some times becomes a very serious pest in this area. However for want of an uptodate data regarding the important aspects of the pest, it is very difficult to advocate full control measures and keeping in this view, the studies on "THE INCIDENCE AND SUCCESSION OF BRINJAL PESTS WITH SPECIAL REFERENCE TO STUDIES ON BRINJAL LEAF ROLLER EUBLEMMA OLIVACEA WLK. (NOCTUIDAE : LEPIDOPTERA)", were undertaken in Jabalpur district during the year 1968-69.

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CHAPTER II

REVIEW OF LITERATURE

From the records available, many insect pests have been found damaging the brinjal crop.

The brinjal shoot and fruit borer Leucinodes orbonalis Guen. was recorded feeding on brinjals, by Hampson (1896), Lefroy (1907), Fletcher (1914), Henery (1916), Fletcher (1916-19), Sharoff (1919), White (1919), Fletcher (1921), Pillai (1921), Corbett (1928), Hussain (1929), Bunting and Milsum (1930), Hussain (1936), Pruthi (1936), Lall (1941), Wesley (1942), Pruthi and Isaac (1944-46), Patel and Basu (1948), Wesley (1948), Sinha (1951), Banerjee and Basu (1956), Wesley (1956), Kadam and Patel (1960), Srinivasan (1961), Bhandari and Sohi (1962), Jotwani and Sarup (1963), Thakur (1963), Singh and Sinha (1964), Lall (1964) and Chauhan (1965), whereas the bionomics of the pest has been worked out by Fletcher (1914), Pillai (1921), Ayyar (1940), Basu and Patel (1948) and Thakur (1963).

Brinjal root and stem borer Euzophera perticella Rag. was observed feeding on brinjal, chillies, potato, tomato and other host plants by Hampson (1896), Lefroy (1907-9), Fletcher (1914-19), White (1919), Fletcher (1921), Ayyar (1921), Hutson (1926), Husain (1929), Pruthi (1936), Sinha (1951), Krishnamurti and Usman (1954), Gupta (1956), Kadam and Patel (1960), Bhandari and Sohi (1962), Thakur (1963)

Jotwani and Sarup (1963), Lall (1964), Chauhan (1965) and Srivastava and Saxena (1966). The bionomic and life history was worked out by various workers like Lefroy (1907), Fletcher (1914) and Gupta (1956). These authors have also recorded the nature of its damage.

Eublemma olivacea Wlk., the brinjal leaf roller is a minor pest of brinjal. It was recorded feeding on brinjals by Hampson (1894), Lefroy (1907), Fletcher (1914-19), White (1919), Fletcher (1921), Pillai (1921), Ayyar (1934), Pruthi and Isaac (1944), Thompson (1945), Pruthi and Isaac (1946), Kadam and Patel (1960), Bhandari and Sohi (1962), Jotwani and Sarup (1963) and Srivastava (1966). The life history was studied by Lefroy (1907), Fletcher (1914), Kadam and Patel (1960) and Srivastava (1966).

The various workers have studied the nature and extent of damage viz. Hompson (1894), Lefroy (1907), Fletcher (1914-21), Kadam and Patel (1960), Bhandari and Sohi (1962) and Srivastava (1966).

The incidence of brinjal bud worm Phthorimoea blapsigona Meyr. on brinjal was recorded by Fletcher (1917), Ayyar (1919), Fletcher (1919), Poutiers (1919), Fletcher (1921), Corbett and Galis (1926), Krishnamurti and Usman (1954) and Chauhan (1965).

Many other species of the genus Phthorimoea were also recorded by many workers which are -

P. operculella Tell.

P. ergasina Mey.

P. heliopa Low.

Aphis gossypii Glov. is mainly a pest of cotton. Being a minor pest of brinjal very little literature is available on it. The following workers have studied its distribution on brinjal:- Lefroy (1907), Fletcher (1914), Fletcher (1917), Smith (1917), Fletcher (1919), Sharoff (1919), Leonard (1931), Goff and Pissot (1932), Pruthi (1940), Fennah (1943), Nangpal (1948), Kirkpatrick (1954), Wesley (1956), David (1957), Momura (1957), Subba Rao and Sharma (1958), Kadam and Patel (1960), Bhandari and Sohi (1962), Jotwani and Sarup (1963), Lall (1964) and Chauhan (1965).

Empoasca devastans Dist., the cotton jassids are mainly the pests of cotton. Being a minor pest of brinjal a little work was done by the following workers.

Lefroy (1907), Fletcher (1914-19), Pruthi and Isaac (1946), Nangpal (1948), Afzal and Ghani (1953), Ali (1958), Dastur and others (1959), Kadam and Patel (1960), Bhandari and Sohi (1962), Jotwani and Sarup (1963), Autar Singh and Butani (1964), Lall (1964), Chauhan (1965) and Subba Rao (1966).

The incidence of the brinjal lace wing Urentius sentis Dist., on brinjals was recorded by the following workers viz. Distant (1910), Fletcher (1914), Sharoff (1919), Bhandari and Sohi (1962), Mohansundaram (1962). The other species of the genus Urentius i.e. U. echinus, which is also common on brinjal was studied by Henry (1916), Hutson (1931), Isaac (1933), Jepson (1934), Sinha (1951), Jotwani, Sarup and Pradhan (1961) and Jotwani and Sarup (1963).

The red mites Tetranychus telarius Linn. are considered as a pest of cotton, but various workers had recorded its occurence on brinjals through out the India and many other places. Vinal (1918), Klein (1936), Yogo and Furukori (1937), Roberti (1946), Nangpal (1948), Smith (1952), Moutia (1953), Krishnaswami (1954), Ku. Khot and Patel (1956), Sardar Singh and Saini (1956), Gaines (1957), Lall and Datta (1959), Kadam and Patel (1960), Bhandari and Sohi (1962), Srivastava and Mathur (1962), Jotwani and Sarup (1963), Lall (1964), Goyal and Singh (1965), Bindra and Goyal (1966), Lall, Dutta and Jayaswal (1966) and Basu and Pramanik (1969).

Various workers have recorded many other pests excluding these, feeding on brinjal. They includes; Epilachna vigintioctopunctata F., Prodenia litura Fab., Laphygma exigua Hub., Achrontia styx West.,

Atractomorpha crenulata Fab., Phenacoccus spp., Myzus persicae Suizer, Heliothis obsoleta F., Ligyrus tumulosus, Bur., Acrocercorps sanctaecrucis brinjal leaf minor, Selepa docilis Bhr., Phycita clientella Zeel., Leptinotarsa decemineata Say, Spodoptera mauritia Boisd, and Phytomyza atricornis Meigen etc.

Bionomics of Eublemma olivacea Wlk.

The brinjal leaf roller Eublemma olivacea Wlk. being a minor pest of brinjal has received a very little attention from the point of view of research. Thus our knowledge about the brinjal leaf roller E. olivacea Wlk., is far from complete as extremely meagre literature is available on the same.

1. Distribution and Host plants :

Hampson (1894) observed the pest on brinjal in Punjab and Coimbatore (India). Lefroy (1907) found the pest infesting brinjal and wild Solanacesus plants. Fletcher (1914-17) noted it on brinjal and other solanaceous plants in Southern Indian and Bihar, Sharoff (1919) also noted in U.S.A. and Burma feeding on brinjal, White (1919) recorded this pest on brinjal in Ceylon, Pillai (1921) noted it on Solanum melongena at Travancore, Ayyar (1934) had observed it infesting brinjal crop in South India, Pruthi and Isaac (1946) concluded that the pest feeds on brinjal in Delhi.

It was also observed on brinjal in Bombay (Kadam and Patel, 1960), Bhandari and Sohi (1962) recorded it on brinjal in Punjab and Jotwani and Prakash Sarup (1963) in Delhi & U.P. Srivastava (1966), the pest is distributed through out the India and it was found feeding on brinjal and Solanum xanthocarpum.

2. Morphology :

Morphological studies of the individuals of the order Lepidoptera have engaged the attention of several workers, but particularly on this pest Eublemma olivacea Wlk. very scantly literature is available.

Hampson (1894) and Lefroy (1907) have studied the morphology of the moths (Eublemma olivacea Wlk.), Fletcher (1914-21) dealt with the colouration of the caterpillar, external morphology and also studied the morphology of the moths. Kadam and Patel (1960) had given a good description on marks of identification. Whereas Srivastava (1966) described the morphology of the moths.

3. Bionomics :

As regards the bionomics of this pest very little work has been done. Earlier, Fletcher (1914) observed the life-cycle, Kadam and Patel (1960) had given a short account about the oviposition and incubation period etc.

Srivastava (1966) dealt with the life-history of the pest including the site of oviposition, fecundity, incubation period, larval and pupal periods.

4. Nature and Extent of Damage :

As regards the nature and extent of damage Lefroy (1907), Fletcher (1914-21), Kadam and Patel (1960) and Srivastava (1966) put this pest in the status of a minor pest of brinjal moreover, Fletcher (1914-19) and Srivastava (1966) reported that some times it is very destructive and acts as a major pest of brinjal.

5. Natural Enemies :

Some of the natural enemies of Eublemma olivacea Wlk. were also recorded by the following workers.

Ayyar (1934) reared an Ichneumon parasite Hymenobosmena sp. and a braconid parasite Microdus sp. in South India. Thompson (1945) had also reared an Ichneumon parasite Hymenobosmena sp. and two Braconid parasites viz. Bassus sp. and Brachymeria tachardiae, Cam. at London.

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CHAPTER III.

MATERIAL AND METHOD

Experimental Site:

The experiment was laid out at Agriculture College Jabalpur (M.P.) during the kharif season of the year 1968-69. The soil of the experimental plot was a typical medium black clay soil with pH 7 to 8.

Season and climate:

Jabalpur is situated at 23.43°N latitude and 79.57°E longitude. It is 393 meters above the mean sea level. It is situated in the heart of the Madhya Pradesh and enjoys the subtropical climate with minimum temperature 45.12°F and maximum temperature 102.95°F during the months of December, 1968 and April, 1969, respectively. The average rainfall ranges from 55 to 60 inches per year. Damage due to water logging conditions is common during rainy season.

The weather conditions during study from July,1968 to April, 1969 are shown in table 1.

Table 1.

Month	Temperature in °F Max.	Minm.	Relative humidity	Rainfall in mm.
July	86.19	76.19	74.35	329.80
August	83.73	74.57	76.22	355.99
September	89.49	74.89	69.63	79.28
October	86.73	63.10	64.13	8.89
November	82.22	50.57	58.43	-
December	77.18	45.12	60.54	-
January	77.28	66.00	62.14	-
February	99.89	81.01	59.20	8.87
March	95.41	62.87	40.00	-
April	102.95	75.99	28.00	-

Lay out:

Size of the plot = 19.20 x 18.75 meters

Total area = 360 sq. meters

Row to row distance = 2½ feet or 75 cms.

Plant to plant distance = 2 feet or 60 cms.

Total number of plants = 800.

25 rows each containing 32 plants.

Manuring and transplanting:

The following doses of fertilizers were applied.

Farm yard manure = 13.50 mds.

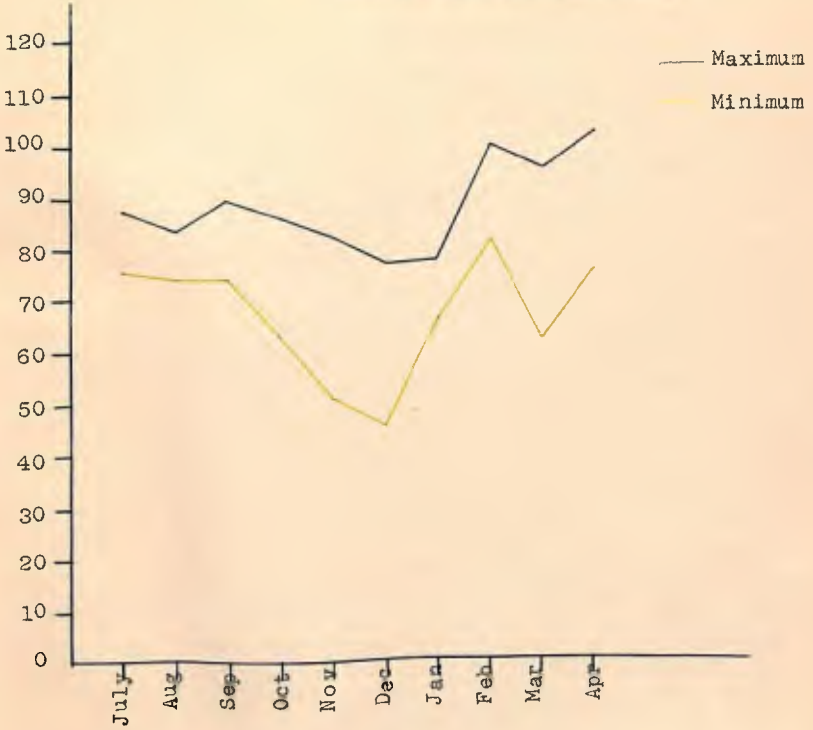
Urea = 51.17 kgs

Single super phosphate = 14.06 kgs

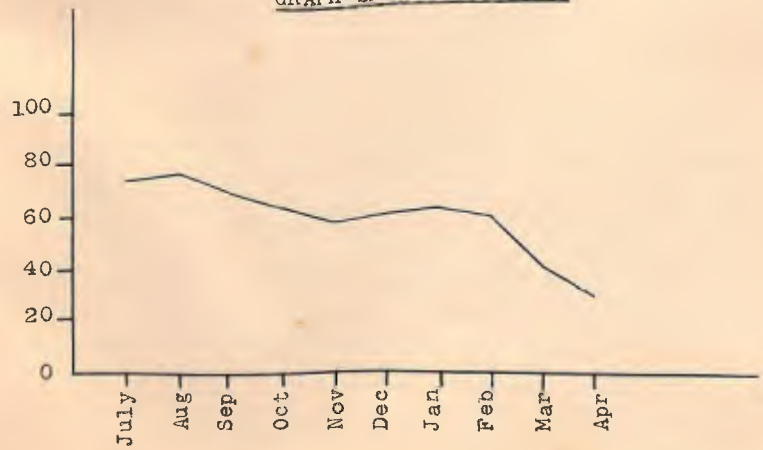
Muriate of potash = 3.82 kgs

Transplanting was done on 17th July, 1968.

GRAPH SHOWING TEMPERATURE



GRAPH SHOWING HUMIDITY



Methods of observation:

Sampling was done in the following way for the different pests.

1. Shoot and fruit borer (Leucinodes orbonalis Gun.)

For infestation in shoots, 100 plants at random were observed at fortnightly intervals.

For infestation in fruits, random sampling was done for 5 samples, each consisting of 10 labelled plants, the fruits of which were examined at each picking which was done at the interval of 10 days.

2. Root and stem borer (Euzophera perticella)

Five samples each of 10 randomly selected plants were examined at fortnightly intervals.

3. Leaf roller (Eublemma olivacea Wlk.)

The observations were made in five samples, each of 10 labelled plants at fortnightly intervals.

4. Bud borer (Phthorimoea blapsigona Meyr.)

Five samples each of 20 randomly selected buds were examined at fortnightly intervals.

5. Red mite (Tetranychus telarius Linn.)

One square inch area of each terminal, middle and lower leaf from five randomly selected plants, was examined to note the population (number of adults and nymphs) per leaf

at fortnightly intervals.

6. Lace wing, Aphid and Jassid (Urentius sentis Dist.), (Aphis gossypii Glov.) and (Empoasca devastans Dist.)

Random sampling was done of five samples each consisting 5 randomly selected plants. From such selected plants three leaves, one terminal, one middle and one lower were observed to note the number of adults and nymphs present over each leaf at fortnightly intervals.

Bionomics of Eublemma olivacea Wlk.

Mass collection of larvae was done at regular intervals from the college fields as well as from the fields of cultivators of nearby locality.

Rearing was started in the last week of July, 1968. Larvae of various sizes were collected from the fields and were reared in laboratory, in small petridishes. They were fed on fresh brinjal leaves, this food was changed daily. After pupation the pupae were kept in wire-gauze. The emerged moths were used for copulation and egg laying purposes. The sex ratio of the moths was also recorded by counting the number of emerged male and female moths.

In order to study the longevity and fecundity, each female was kept with two males emerged on the same day. The sexes of moths were identified by examining their abdominal end. The moths were confined in glass bands, placed over

small pots consisting of brinjal seedlings. The moths were provided with 20% sugar solution, honey and tape water, soaked in cotton wool. The open tops of the bands were covered with a piece of muslin cloth. The records of each experiment were kept about the -

Date of confinment of the moths,
Conditions of feeding,
Date and details of oviposition and
Date on which moths died etc.

Observations were also taken at short intervals to note the time and manner of metting and egg laying.

The eggs which were laid, were collected in morning with the help of a soft brush soaked in water. They were counted and kept in labelled petridishes on moist blotting paper for hatching and further studies. Ten larvae, freshly hatched on the same day were kept individually in separate small petridishes, provided with fresh, soft brinjal leaves daily. For detail life history observations were taken daily on length, width, colour pattern of body, number of moults and duration of various stages etc.

Field observations were made for recordding the nature and extent of damage, habits, seasonal activity and host plants if any. The incidence of the pests was recorded at fortnightly intervals.

In order to study the extent of parasitisation by different parasites, the parasites emerged from the eggs, larvae and pupae, previously collected from the fields for mass collection were recorded.

All rearing and experiment for studying the bionomics of brinjal leaf roller Eublemma olivacea Wlk. were done at preferably room temperatures. The maximum and minimum room temperatures during the course of studies are as shown in the table 2.

Table 2.

Months	Temperature in °F	
	Maximum	Minimum
July, 1968	86.60	79.20
August	83.30	79.00
September	87.00	82.60
October	84.50	77.80
November	78.50	70.90
December	74.00	65.50
January, 1969	71.50	67.00
February	76.40	71.50

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CHAPTER IV

EXPERIMENTAL FINDINGS

A. Incidence and succession:

Various insect pests of brinjal caused considerable damage to the crop throughout the year. The incidence of pests, have appeared soon after transplanting of brinjal and first appearance of Leucinodes orbonalis Gun. was recorded on 31st July, 1968 in the experiment. The infestation continues till harvest of the crop by any of these pests.

Table 3.

Observations on Leucinodes orbonalis Guen. on shoots.

S. No.	Date of observations	Total no. of shoots observed	Number of shoots infested	Percentage shoots infested
1	31. 7.68	100	4	4
2	13. 8.68	100	7	7
3	27. 8.68	100	12	12
4	10. 9.68	100	9	9
5	24. 9.68	100	5	5
6	8.10.68	100	3	3
7	22.10.68	100	0	0

Results: It may be noted from the table that the infestation of shoot and fruit borer, Leucinodes orbonalis Gun., during the season was recorded for first time during the last week of July,68, till 22nd October,68, however the infestation was maximum during the last week of August and then it declined.

Table 4.

Observations on Euzophera perticella Rag.

S.No.	Date of observations	Total number of plants observed	Number of plants damaged	Percentage plant infested
1	27. 8.68	50	1	2
2	10. 9.68	50	3	6
3	24. 9.68	50	4	8
4	8.10.68	50	6	12
5	22.10.68	50	5	10
6	5.11.68	50	3	6
7	19.11.68	50	2	4
8	3.12.68	50	0	0
9	17.12.68	50	1	2
10	31.12.68	50	0	0

Results: It is concluded from the table that the incidence of root and stem borer, Euzophera perticella Rag. was recorded for first time on 27.8.68 and was further recorded upto 17.12.68. The infestation was maximum on 8.10.68 i.e. 12 percent.

Table 5.

Observations on Eublemma olivacea Wlk.

S.No.	Date of observations	Total number of plants observed	Number of plants damaged	Percentage plants infested
1	10.9.68	50	1	2
2	24.9.68	50	2	4
3	8.10.68	50	5	10
4	22.10.68	50	3	6
5	5.11.68	50	4	8
6	19.11.68	50	2	4
7	3.12.68	50	-	-
8	17.12.68	50	-	-
9	31.12.68	50	-	-
10	14.1.69	50	-	-
11	28.1.69	50	-	-
12	11.2.69	50	1	2
13	25.2.69	50	1	2
14	11.3.69	50	3	6
15	25.3.69	50	2	4
16	8.4.69	50	1	2
17	22.4.69	50	-	-

Results: The brinjal leaf roller, Eublemma olivacea Wlk. was recorded for the first time in the field during the first week of September. The infestation was maximum during the 1st week of October, then it declined and became zero in the first week of December, however it again appeared during the second week of February and the incidence was maximum on 11.3.69. It was further observed till the 1st week of April, later on it disappeared.

Table 6

Observations on Phthorimoea blapsigona Myer.

S.No.	Date of observation	Number of buds examined	Number of buds infested	Percentage buds infested.
1	8.10.68	100	67	67
2	22.10.68	100	61	61
3	5.11.68	100	57	57
4	19.11.68	100	53	53
5	3.12.68	100	49	49
6	17.12.68	100	53	53
7	31.12.68	100	51	51
8	14.1.69	100	44	44
9	28.1.69	100	38	38
10	11.2.69	100	33	33
11	25.2.69	100	27	27
12	11.3.69	100	24	24
13	25.3.69	100	20	20
14	8.4.69	100	18	18
15	22.4.69	100	14	14

Results: The table clearly indicates that the infestation of brinjal bud worm, Phthorimoea blapsigona Myr., was observed on 8.10.68 and continued upto 22nd April 69. The infestation was maximum during the first week of October i.e. 67% on 8.10.68, then it was declined.

GRAPH SHOWING THE PERCENTAGE INFESTATION OF -

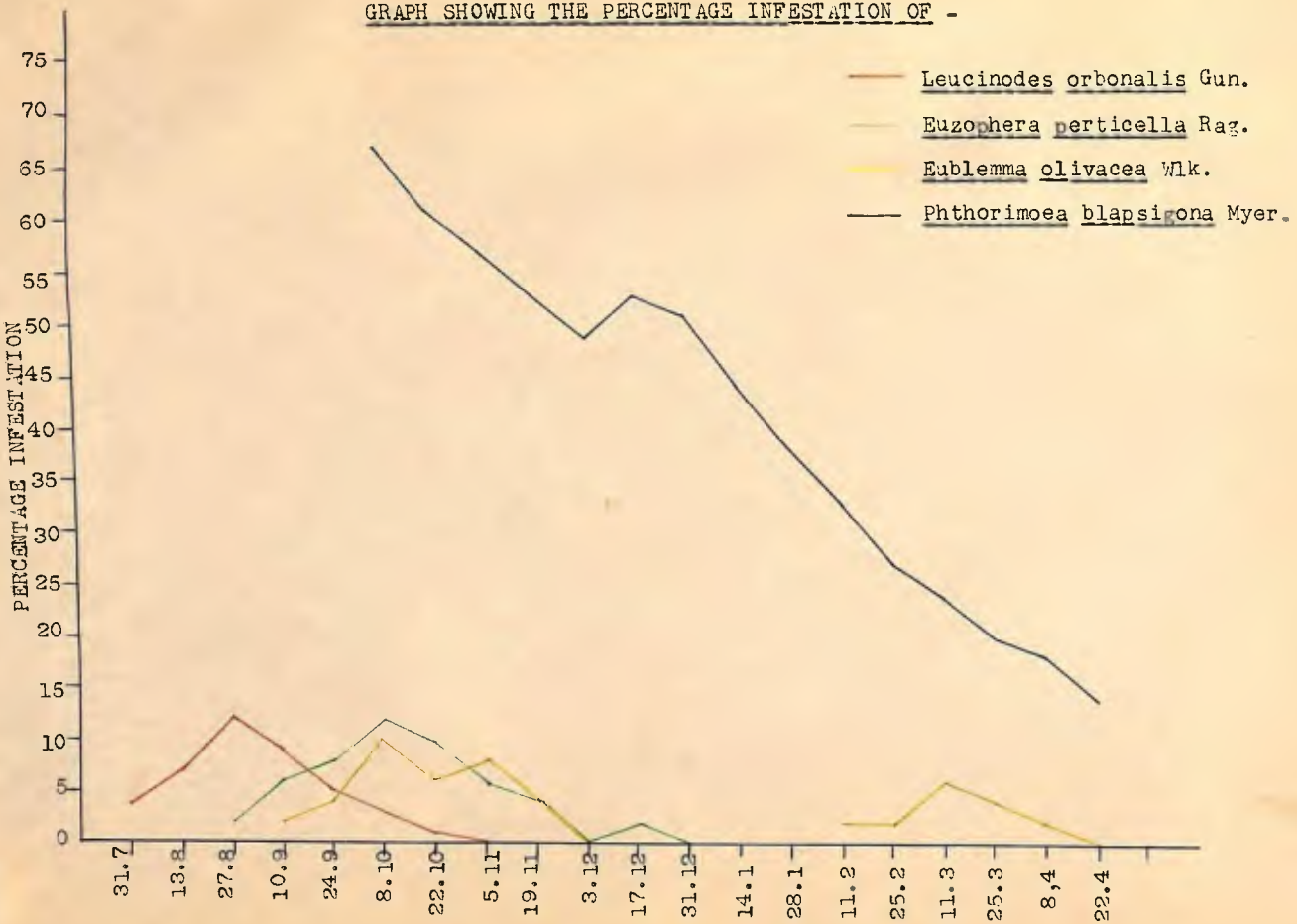

Table 7.

Observations on *Aphis gossypii* Glov.

S.No.	Date of observations	Number of leaves observed	Total number of adults & nymphs.	Number of adults & nymphs/leaf
1	10.9.68	75	525	7.00
2	24.9.68	75	1213	16.17
3	8.10.68	75	1081	12.40
4	22.10.68	75	545	7.26
5	5.11.68	75	345	4.60
6	19.11.68	75	178	2.37
7	3.12.68	75	243	3.24
8	17.12.68	75	89	1.86
9	31.12.68	75	54	0.72
10.	14.1.69	75	36	0.48

Results: From the data shown in table 7, it is clear that the pest was recorded for the first time on 10.9.68. The infestation continued upto 14th January,69. The population per leaf recorded was maximum i.e. 16.17, during the last week of September.

Table 8

Observations on Empoasca devastans Dist.

S.No.	Date of observation	Number of leaves observed	Total number of adults & nymphs	Number of adults & nymphs/leaf
1	27.8.68	75	48	0.64
2	10.9.68	75	135	1.80
3	24.9.68	75	172	2.90
4	8.10.68	75	840	11.20
5	22.10.68	75	562	7.49
6	5.11.68	75	327	4.36
7	19.11.68	75	225	3.00
8	3.12.68	75	122	1.62
9	17.12.68	75	63	0.84
10	31.12.68	75	28	0.37

Results: It is clear from the above table that the Jassid, Empoasca devastans Dist. recorded for the first time on 27.8.68 and then the infestation continued upto 31st December,68. The average population per leaf was maximum i.e. 11.20 on 8th October, 1968 and then it was declined.

Table 9.

Observations on Urentius sentis Dist.

S.No.	Date of observations	Number of leaves examined	Total number of adults & nymphs	Number of adults & nymphs/leaf
1	10.9.68	75	105	1.40
2	24.9.68	75	305	4.06
3	8.10.68	75	540	7.20
4	22.10.68	75	355	4.73
5	5.11.68	75	270	3.60
6	19.11.68	75	160	2.13
7	3.12.68	75	85	1.13
8	17.12.68	75	42	0.56
9	31.12.68	75	-	-

Results: From the table it is apparent that the brinjal lace wing, Urentius sentis Dist., was recorded for first time on 10.9.68. The population per leaf was maximum during the first week of October i.e. 7.20 adults and nymphs. After 17th December, 68 there was practically no infestation of this pest.

Table 10.

Observations on Tetranychus telarius Linn.

S.No.	Date of observations	Total number of leaves observed	Total number of adults & nymphs	Number of adults & nymphs/leaf
1	5.11.68	15	13	0.83
2	19.11.68	15	20	1.33
3	3.12.68	15	41	2.73
4	17.12.68	15	62	4.13
5	31.12.68	15	49	3.26
6	14.1.69	15	32	2.13
7	28.1.69	15	27	1.80
8	11.2.69	15	11	0.73
9	25.2.69	15	5	0.33
10	11.3.69	15	-	-

Results: It is evident from the table that the brinjal mites were recorded for the first time on 5.11.68 and the pest more or less disappeared after 25th February,69. The average population per leaf recorded was maximum on 17th December, 68 i.e. 4.13 .

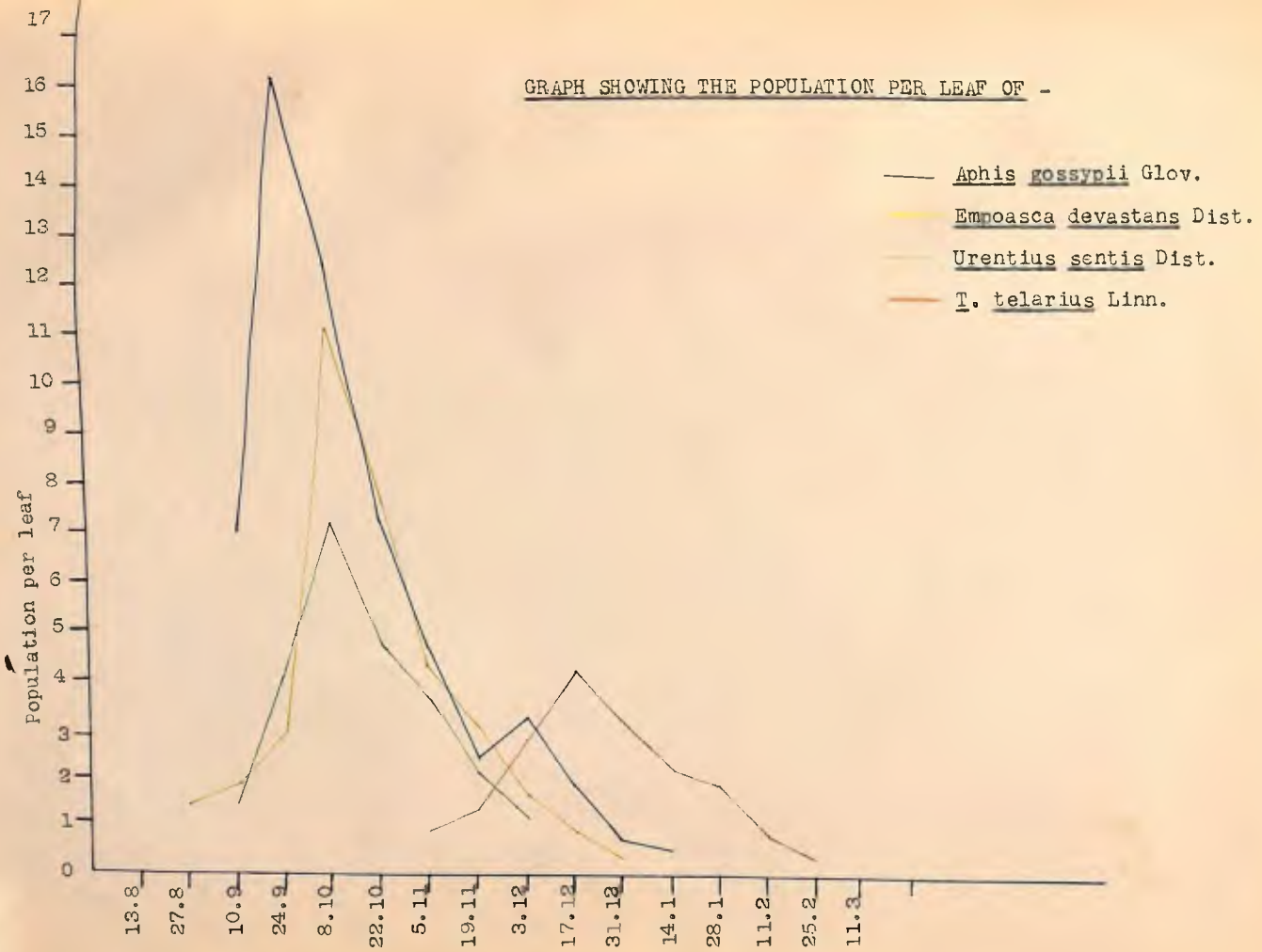
GRAPH SHOWING THE POPULATION PER LEAF OF -
Aphis gossypii Glov.
Empoasca devastans Dist.
Urentius sentis Dist.
T. telarius Linn.
Population per leaf
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
13.8
27.8
10.9
24.9
8.10
22.10
5.11
19.11
3.12
17.12
31.12
14.1
28.1
11.2
25.2
11.3

Table 11.

Observations on Leucinodes orbonalis Guen. on fruits.

S.No.	Date of observations	Percentage fruits damaged
1	27.10.68	45.88
2	6.11.68	54.66
3	16.11.68	67.96
4	26.11.68	73.13
5	6.12.68	61.90
6	16.12.68	58.13
7	26.12.68	43.72
8	5.1.69	47.16
9	15.1.69	43.13
10	25.1.69	32.35
11	4.2.69	27.65
12	14.2.69	20.51
13	24.2.69	17.55
14	6.3.69	25.00
15	16.3.69	31.34
16	26.3.69	38.29
17	5.4.69	42.17
18	15.4.69	38.46
19	25.4.69	35.71

Results: It is seen from the above table that the infestation of the pest on fruits was recorded for the

GRAPH SHOWING PERCENTAGE INFESTATION ON FRUITS BY -

Leucinodes orbonalis Guen.

first time on 27.10.68 and was recorded upto 25th April. The incidence was maximum during the last week of November, further the incidence was declined till last week of February and then the pest resums infestation which continued till the last harvest of the crop.

B. Bionomics of Eublemma olivacea Wlk.

Host plants:

Eublemma olivacea, Wlk. has been known as the pest of brinjal (S. melongena) from long time. Hampson (1894), Lefroy (1907), Fletcher (1914-17), Sharoff (1919), Fletcher (1919), White (1919), Pillai (1921), Ayyar (1934), Pruthi and Isaac (1944-46), Kadam and Patel (1960), Bhandari and Sohi (1962), Jotwani and Prakash Sarup (1963) and Srivastava (1966) have recorded this pest infesting the brinjal plant. But Lefroy (1909),and Fletcher (1914) have recorded it on wild solanaceous plants with brinjals. Srivastava (1966) had recorded it on Solanum xanthocarpum along with S.Melongena. During the course of study at Jabalpur, the pest was recorded throughout the year only on brinjal.

Nature and extent of damage:

As regards the nature and extent of damage of brinjal leaf roller Eublemma olivacea Wlk. Hampson (1894), Lefroy (1907), Fletcher (1914-21), Kadam and Patel (1960), Bhandari and Sohi (1962) and Srivastava (1966) have put it in the

status of a minor pest of brinjal but Fletcher (1914-19) and Srivastava (1966) reported that some times it is very destructive pest of brinjal. In the initial stages of development the caterpillar remain concealed within the leaf hair and feed on the green matter of the leaves, but 2nd moult onwards, the caterpillars roll up the leaves and feed on the green pddtion of the leaves thus lead a concealed life. The infested leaves ultimately wither and die. The pest was active from August to November and passes the winter under hibernation in pupal stage. It further became active during 2nd week of February. It was recorded damaging the crop till April. The pest again passes the summer months in pupal stage. The incidence of Eublemma olivacea Wlk. is given in table 5.

Precopulation and copulation:

The precopulation period i.e. time from the emergence of moth to the copulation is very short and varies from 24 to 32 hours. The copulation generally occurs late in the evening i.e. at dusk, when moths remain most active. Generally male shows more activity than the female. The female show more activity after metting. The copulation always takes place in a end to end manner. The copulation period varies from 10 to 20 minutes.

Oviposition and fecundity:

The oviposition period varies from 2 to 4 days. The eggs were laid on the leaves singally or in small groups of 8 to 15 eggs on the both sides of leaves particularly on midrib or on secondary ribs. The lower surface of the leaves is generally prefered. The fecundity of the female varies from 27 to 68 (Table 12) but the maximum number 83 was recorded when fed on 20% sugar solution. Further, it was observed that the fecundity of female normally can be regulated with the quantity and type of food supplied. Srivastava (1966) has reported that a single female laid about 25 to 35 eggs.

Viability of eggs:

The viability of eggs vary very much according to the feeding conditions. The moths fed on 20% sugar solution laid more viable eggs, however, the viability recorded was from 52.94 to 88.37 as shown in the table 12, but in some cases the viability was recorded upto 95%. However, when the moths were fed on tap water, they laid totally unfertile eggs as such viability was zero.

Longevity of adults:

The longevity of adults also vary according to food supplied and sex. Longevity of the adult was found to be maximum when fed on honey i.e. female 5 to 6 days and

male 2.3 days. It was optimum when 20% sugar solution was supplied. (Female 4 to 5 days and male 1 to 2 days). However, the minimum when fed on the tap water alone (2 to 3 days in females and 24 to 30 hours in males). In general the longevity of female vary from 2 to 6 days and that of males 1 to 3 days.

Incubation and hatching:

The incubation period vary from 3 to 6 days as shown in the table 12. At the time of hatching first the head of the larva is protruded out and than the rest of the body is extricated from the egg by means of wriggling movements. The process of hatching took place in about 4 to 5 minutes. After emergence from the eggs the larvae do not eat the egg shell.

Moulting:

Before each moult the larvae stop feeding. This generally took place some hours prior to moulting. Thus the larvae became inactive. The head capsul shed first and after this the larvae start to wriggle out gradually by forcing the old cuticle behind by contraction and expansion movements of the body. The newly moulted larvae was some what pale yellow in colour. But after some time it attains the original colour.

Number of moults, duration of different larval instars and total larval period:

The number of moults, duration of different larval instars and total larval period were shown in table 15 and 13 respectively. The larvae passes through five moults and six instars before pupation.

Pupa and Pupal period:-

The full fed caterpillar became inactive and remain slugish within the folded leaves. A slight change in colour was recorded i.e. the colour became greenish or some what darker. The length of the larvae also reduced to some extent before pupation. The pupal skin was pale yellow to some what light brown and transparent. Later on it gradually changed to redish or dark brown. It took about 2 to 3 hours for the complete emergence of pupae through the raptured larval skin. The prepupal period vary from 2 to 3 days and the pupal period vary from 5 to 7 days as shown in table 14, but in some cases it was recorded upto 20 days. The pest hibernate during winter in pupal stage. The pupal period also vary according to temperature. It decreases with the increase in temperature and viceversa. According to Srivastava (1966) the pupal stage lasts for about 10 to 15 days.

Emergence of Imago and its activity:-

The moths were found to emerge out from the pupae. Only during night. At the end of the pupal period the

fully developed imago start to exert some pressure on the pupal cuticle, with the result of this force a triangular piece separates out longitudinally from the anterior end of the pupal case and the moths emerge out through that rupture. In the beginning i.e. after emergence, the moth posses folded wings and it rests for some time. After a short time the wings get fully expanded.

In some cases the rupture takes place at the posterior end of the pupal shell. In such cases the moths failed to emerge out and die within the pupal shell itself. The moths were active after or at dusk. During day time they generally rest on the lower surface of the leaves.

Sex ratio:-

Out of the 108 moths examined on emergence (from mass collection) from pupae, 67 were found to be female while 41 males. Thus the ratio of females to males was 67.41 or 1.63 : 1.

Seasonal history:-

The pest was active in the field from the last week of August to November. Onwards November the pest disappears and passes winters by hibernating in pupal stage untill the approach of warm season. The pest again becomes active from February and was recorded till April. Summer months were also spent in pupal stage till the approach of the favourable

season. The pest completes 3 to 4 generations before commencement of winter and than one, two or more generations after winter and before summer. Thus there are in all 4 to 6 generations in a year.

Description of various stages:-

Egg:

The eggs are small and roundish and are slightly flattened at the place of attachment. The eggs measures 4 mm in diameter. They are redish to pink in colour and are covered with small hair or projections. The eggs are laid on leaves either singly or in small groups and can be located easily.

First larval instar:

The newly hatched larva measures about 1.3 mm in length and 0.16 mm in width but the size towards the end of stadium increases to about 3.6 mm in length and 0.53 mm in width. The body colour of the freshly hatched larva is uniformely light pale yellow with a prominent light brown or some what darker head. The body wall of the larva is of semitransparent nature. The larva is of somewhat dorsoventrally flattened. The body remains covered with tiny hairs. Prothorox and more so the head are broader than the posterior portion of the body. Three pairs of true legs and five pairs of prolegs are situated on 3rd, 4th, 5th, 6th and last abdominal segments.

Second instar (larval):

The larva shows greater activity after 1st moulting and start feeding rapidly. The body colour changes from pale yellow to pinkish. The yellow spots on the larval body also becomes darker are easily distinguished. Mouth-parts are of brown colour. Three pairs of true legs and five pairs of prolegs are distinct. In earlier stage the larva measures about 4 mm in length and 0.55 mm in width, which later increasing, at the end of the 2nd instar the larva measures about 7.01 mm in length and 0.77 mm in width. The larva still remain concealed in leaf hairs.

Third instar:

It measures about 7.25 mm in length and 0.8 mm in width, which increases continuously and reaches to about 11.00 mm in length and 1.00 mm in width at the end of the stadium. The colour of the body as well as head capsule becomes more darker. The larva start rolling leaves and leads a concealed life. The yellow spots becomes more distinct on the dark brown background. The mouth parts and their activity can be easily noticed. The true and prolegs resume the body colour.

Fourth instar:

The body colour is dark brown with uniform yellow spots through out the body. The hair on the body can also

be easily visible. The larva measures about 11.25 mm in length and 1.1 mm in width, later on increases about 14.10 mm in length and 1.6 mm in width. Tubercles and setae are present visible on the whole body surface and head.

Fifth instar:

A slight change in colour is observed. It changes to some what dark. The head is prominent and can easily distinguished by its darker colour. Tubercles and setae are present all over the dorsal and lateral surfaces. Complete band of prothoracic shield is present. Some blackish spots are also present on the head. The larva measures about 14.5 mm in length and 1.75 mm in width, which increases to about 18.00 mm in length and 2.0 mm in width at the end of stadium.

Sixth instar:

In this instar the larva measures about 18.25 mm in length and 2.25 mm in width but later at the end of the stadium length and width increase the about 24.00 mm and 2.75 mm respectively. The larva attains its maximum size. Head is slightly flattened and attains a "V" shape. The epicranial suture is prominent. Ocelli are clearly visible under magnification. Setae, tubercles and spiracles are distinctly visible.

At the end of each stadium the body contracts a little and the larva stops feeding and becomes some what lethargic or sluggish.

Pre-pupa:

Before pupation larva stops feeding and becomes inactive. The hairs shade off and larva becomes smooth, losses much of water from its body and shrinks much due to the contraction of its body segments. Due to the contraction of body segments length is reduced the about 14.00 mm to 15.00 mm.

Table 12.

Showing the fecundity, incubation period and viability of eggs of Eublemma olivacea Wlk.

S. No.	Date of egg laying	No.of eggs laid	Date of hatching	No. of larvae hatched	Incubation period	Percentage viability
1	23.9.68	38	27.9.68	17	4	68.42
			28.9.68	9	5	
2	27.9.68	51	30.9.68	27	3	80.39
			1.10.68	14	4	
3	30.9.68	43	4.10.68	24	4	
			5.10.68	11	5	88.37
			6.10.68	3	6	
4	30.9.68	27	3.10.68	16	3	85.18
			4.10.68	7	4	
5	2.10.68	68	6.10.68	27	4	52.94
			7.10.68	9	5	

Results: From the above table it has been observed that -

a. The fecundity varies from 27 to 68 per female with an average of 47.50

b. The incubation period varies from 3 to 6 days with an average of 4.5 days.

c. The percentage viability of eggs is very high and varies from 52.94 to 88.37 with an average of 75.06 percent.

Table 13.

Showing the larval period of Eublemma olivacea Wlk.

S. No.	Date of hatching	Number of larvae hatched	Date of pupation	Number of larvae pupate	Larval period in days
1	27.9.68	10	15.10.68	7	18
2	30.9.68	10	20.10.68	6	20
3	10.10.68	10	30.10.68	8	19
			31.10.68	1	20
4	3.10.68	10	25.10.68	8	22
5	8.10.68	10	1.12.68	7	24

Results:

It is apparent from the above table that in each observation all the caterpillars did not pupate. The mortiality varied from 10% to 40%. There was also variation in larval period, which varied from 18 to 24 days with an average of 20.60 days.

Table 14.

Showing the pupal period of Eublemma olivacea Wlk.

S. No.	Date of pupation	Number of pupae kept	Date of emergence	Number of moths emerged	Pupal period	Percentage viability
1	19.9.68	1	24.9.68	1	5	100
2	23.9.68	5	28.9.68 29.9.68	3 1	5 6	80
3	1.10.68	3	5.10.68 6.10.68 7.10.68	1 - -	4 - -	33.33
4	2.10.68	4	6.10.68 7.10.68	2 1	4 5	75.00
5	3.10.68	2	8.10.68	2	5	100
6	5.10.68	3	10.10.68 11.10.68	1 1	5 6	66.66
7	17.10.68	8	22.10.68 23.10.68 24.10.68	5 - 2	5 - 7	85.50
8	20.10.68	3	25.10.68	3	5	100
9	26.10.68	5	1.11.68 2.11.68	3 1	6 7	80.00
10	28.10.68	6	3.11.68 4.11.68 5.11.68 6.11.68	4 - - 1	6 - - 9	83.33

Results:

It is apparent from the table that the pupal period varied from 4 to 9 days. Emergence of moth was not observed from all the pupae which were kept. The viability varied from 33.33% to 100%.

Table 15

Showing the incubation period, duration of different larval stages, larval, prepupal and pupal period and life cycle of Eublemma olivacea Wlk.

S. No.	Date of ovipo-sition	Date of hatching	Incub-ation period	Duration of different instars (larval) 1	2	3	4	5	6	Total larval period	Prepupal period	Pupal period	Total life-cycle in days
1	23.9.68	27.9.68	3	5	2	2	2	3	5	19	2	6	30
2	27.9.68	1.10.68	4	4	3	2	3	5	6	23	2	5	34
3	30.9.68	5.10.68	5	4	2	2	2	4	6	20	3	6	34
4	30.9.68	4.10.68	4	5	2	2	2	3	5	20	2	7	33
5	2.10.68	6.10.68	4	5	3	2	3	5	6	24	2	6	36
Average			4.0	4.6	2.4	2.0	2.4	4.0	5.6	21.20	2.2	6	33.60

Results:

It can be concluded from the observations (table 15) that the maximum development period of the pest is 36 days where as the minimum 30 days The complete life-cycle is ranging from 30 to 36 days with an average of 33.60 days. From this table it is also clear that the total incubation, larval and pupal period varied from 3 to 5 days, 19 to 24 days and 5 to 7 days with an average of 4 days, 21.20 days and 6 days respectively.

Table 16 Bhowing length and width of different larval stages and pupae of Eublemma olivacea, Wlk.

S. No.	Larval stages												Pupae	
	Ist instar		2nd instar		3rd instar		4th instar		5th instar		6th instar			
	Length in mm.	Width in mm.	Length in mm.	Width in mm.	Length in mm.	Width in mm.	Length in mm.	Width in mm.	Length in mm.	Width in mm.	Length in mm.	Width in mm.	Length in mm.	Width in mm.
1	3.60	0.53	7.10	0.77	11.00	1.00	14.10	1.60	18.00	2.00	24.10	2.70	13.50	3.50
2	3.50	0.63	7.00	0.75	11.25	1.00	14.20	1.45	18.15	2.10	23.50	2.70	13.50	3.45
3.	3.55	3.55	0.55	6.98	0.77	11.10	1.10	14.00	1.57	18.20	2.00	23.78	2.75	13.32	3.54
4	3.45	0.55	7.25	0.82	11.10	1.00	14.10	1.60	18.10	2.15	23.75	2.70	13.25	3.38
5.	3.60	0.55	7.10	0.75	11.20	1.20	14.15	1.50	18.00	2.10	23.78	2.60	13.48	3.25
Total	17.70	2.81	35.43	3.86	55.65	5.30	70.55	7.72	90.45	10.35	118.91	13.45	67.05	17.12
Av.	3.54	0.56	7.08	0.77	11.13	1.06	14.11	1.54	18.09	2.07	23.78	2.69	13.41	3.42

Results:-

From the above table it is clear that the length and width of Ist instar larvae vary from 3.45 mm. to 3.60 mm. and 0.53 to 0.63 mm. with an average 3.54 and 0.56 mm. respectively

The 2nd instar larvae measure 6.98 mm. to 7.25 mm in length while in width from 0.75 to 0.82 mm. with an average of 7.00 and 0.77 mm. respectively.

In 3rd instar larvae the length vary from 11.00 mm. to 11.25 mm. with an average length 11.13mm. while the width vary from 1.00 to 1.20 mm. with an average width 1.06 mm.

The 4th instar larvae measures in length from 14.00 to 14.20 mm. while in width from 1.45 to 1.60 mm. with an average 14.11 mm. and 1.54 mm. respectively

The length and width of the 5th instar larvae varies from 18.00 mm. to 18.20 mm. and 2.00 to 2.15 mm. respectively, with average length 18.09 and width 2.07mm.

The length of 6th instar larvae vary from 23.50 to 24.10 mm. with an average of 23.78 mm while the width vary from 2.60 to 2.75 mm with an average of 2.69 mm.

The length and width of the pupae vary from 13.25 to 13.50 mm. and 3.25 to 3.54 mm. with an average length and width 13.41 mm. and 3.42 mm. respectively.

CHAPTER V

DISCUSSION

A. Seasonal incidence of major insect pests of brinjal:

Leucinodes orbonalis Guen:

It is a very serious pest of brinjal. In earlier stages it bores the young shoots but as soon as fruits appear they are bored. Thus it was found active throughout the cropping season. The infestation on shoots was firstly recorded during last week of July and it was maximum during last week of August and then the infestation declined to zero in 3rd week of October. Firstly infestation on fruits was recorded in the last week of October being maximum in the month of November i.e. 67.96 and minimum i.e. 17.55% during last week of February.

It was further noticed maximum during first week of April. Thus there were two peak periods of the pest, one during November, 1968 and other during April, 1969.

These observations confirms the findings of the previous workers like Wesley (1956), Srinivasan and Basheer (1961) and Thakur (1963) who had reported its activity throughout the cropping season.

Euzophera perticella Rag.

It is also considered as a major and serious pest of brinjal. It attacks the crop in all the stages, but the

infestation was more at younger stages. It was recorded for first time in the 4th week of August. The infestation was maximum i.e. 12% during the first week of October, after this it was declined upto 2%, however, it was recorded upto the second week of December.

Lefroy (1906) has reported that it attacks plants at all stages and is a serious pest of brinjal. Tiwari (1968) had reported its activity from July to October.

Eublemma olivacea Wlk.

It is a minor pest of brinjal but occassionally it becomes very destructive. During course of study it was first recorded in the first week of September. The infestation was the minimum during 2nd and 3rd week of September,68, however, it was maximum i.e. 10% during the first week of October. Its incidence was zero in first week of December. Then it was further recorded during second week of February and the incidence was maximum on 11th March, 1969 and then declined to 0 during 3rd week of April, 1969.

These observations are similar to the findings of previous workers like Srivastava (1966), who reported that the infestation starts from August, then the pest completes two or three generations and spent winter as hibernating in pupal stage until the commencement of warm weather. The pest completes one or two more generations and spent summer by aestivating in pupal stage.

Phthorimoea blapsigona Meyr.:

It was recorded for the first time in the field during the first week of October. The infestation was maximum i.e. 67% during first week of October. Then it declined upto 14% during first and second fortnights of April. The infestation starts with the commencement of flowering and continues onwards till the harvest of the crop.

These observations similar to the findings of Venkataraman, (1945), who had reported that the pest was active from September to April and the percentage of infestation is higher in cooler months.

Aphis gossypii Glov.:

The infestation of this pest in the field was recorded for the first time during second week of September. The average population per leaf recorded was maximum i.e. 16.17 aphids, on 24.9.68. Then onwards the infestation was declined upto the 2nd and 1st fortnights of December, 1968 and January, 1969 and at this time the population of aphids per leaf was 0.72 and 0.48 respectively. After this no infestation was recorded in the field.

A lot of work has been done about this pest on cotton but no work has been done about this pest on brinjal. Wesley (1956) observed this pest on brinjal throughout the cropping season.

Empoasca devastans Dist.:

The incidence of jassids on the brinjal was recorded during the last week of August for first time however it was low during the month of September having the average number of jassids per leaf only 1.80 and 2.90. The infestation was maximum during first week of October i.e. 11.2 jassids per leaf. Then it was declined upto December and after December the pest more or less disappeared.

Lal (1941) had reported that the pest breeds throughout the year around, but the attack increases with the irrigation, while draughty conditions are known to favour jassids attack.

Urentius sentis Dist.

The incidence of this pest was firstly recorded during the first week of September. In early stage of infestation, the population per leaf was low i.e. the average number of bugs per leaf was 1.40 . The infestation was maximum during the last week of September and continued upto 1st week of October when the average number of bugs were 4.06 and 7.20 respectively. Further it was declined upto December when the average number was 1.13 only and onward December the pest more or less disappeared.

Bhandari (1962) had reported that the pest is active from July to December and onward December it hibernates as an adult in cracks and crevices in the soil.

Tetranychus telarius Linn.:

The pest was recorded for first time on 5-11-68. In the later part of November and in the month of December the incidence was very low, i.e. 0.86, 1.33, 2.73 mites in one square inch area per leaf. It was increased and was maximum during 3rd week of December i.e. on 17-12-68 and then it was declined upto the 3rd week of February when the average number of mites/sq. inch per leaf was only 0.33. After February the pest more or less disappeared.

These observations confirm the observations of Lall and Dutta (1959) who had reported that the incidence of the pest on brinjal is form October to April.

B. Bionomics of Eublemma olivacea Wlk.

During the period of study when the newly emerged pairs were released in glass bands, they copulated successfully in end to end method during night. After 24 to 32 hours. The confinded female lay egg during night or in early morning hours on any parts of the plants, specially on lower surface of leaves. The eggs

were laid singly or in small groups of 8 to 15 eggs. Srivastava (1966) reported that the eggs are laid on the leaves either singly or in small groups. The fecundity of female varies from 27 to 68. It was vary with the type of food supplied at and after metting. According to Srivastava (1966) the fecundity vary from 25 to 30. The viability of eggs also vary with the feeding conditions. The moths fed on 20% sugar solution laid more viable eggs than those fed on tap water. The percentage of viability are 52.94 to 88.37% and 0.0%, respectively. The longevity of male as well as female also vary accordingly, but in general it is recorded 1 to 3 days in male and 2 to 5 days in female.

The incubation period vary from 4 to 6 days, which was identical as recorded by Kadam and Patel (1960) and Srivastava (1966) as 3 to 5 days and 3 to 5 days, respectively.

The newly hatched caterpillar in early stages roll up the hairs and remains concealed in them and feed inside on green matter. In later stages of the development it rolls up the leaves and feed on the green matter of the leaf and also lead a concealed life. The pupation take place within the rolled leaves. The total larval period which was recorded vary from 19 to 24 days whereas the same varies from 15 to 20 days in

Rajastan (Srivastava, 1966). Fletcher (1914) and Kadam and Patel (1960) also reported that the pupation takes place within the folded leaves.

The pupal period which was recorded vary from 5 to 7 days which is similar to the observations of Srivastava (1966).

The total life cycle of the pest recorded vary from 31 to 36 days. According to Srivastava (1966) it also takes about a month.

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CHAPTER VI

SUMMARY AND CONCLUSION

Brinjal is important among all vegetables, which are generally prefered for table uses. Even than the entomological aspect i.e. the study of the various insect pests has not been taken seriously so far. In order to know some what more about the pests, the studies were undertaken at Jabalpur, in which the incidence and succession of the following pests of the brinjal was observed at regular intervals.

1. Leucinodes orbonalis Gun.
2. Euzophera perticella Rag.
3. Eublemma olivacea Wlk.
4. Phthorimoea blapsigona Meyr.
5. Aphis gossypii Glov.
6. Empoasca devastans, Dist.
7. Urentius sentis Dist.
8. Tetranychus telarius Linn.

The incidence of the pests have appeared soon after transplanting and was continued till harvest of the crop, by any of these pests.

Leucinodes orbonalis Guen. was recorded for the first time on 31st July on shoot and further observed till the harvest of the crop. The infestation on shoot was maximum during the last week of August while it was maximum on fruits on 26.11.68 and 5.4.69 .

The infestation of Euzophera perticella Rag. was recorded for first time on 27.8.68 and was recorded upto 17.12.68. The infestation was maximum during the first week of October.

The Eublemma olivacea Wlk. was recorded for the first time on 10.9.68. The infestation was maximum during first week of October, than it was declined to zero, however, it again appeared on 11.1.69 and was continued till first week of April. Later on, it disappeared. The incidence for second time was maximum on 11th March, 1969.

In case of Phthorimoea blapsigona Meyr. the infestation was recorded from 8.10.68 to 22.4.69. The incidence was maximum during the first week of October.

The Aphis gossypii was observed for first time in the field during second week of September and the incidence was continued upto the second week of January. The population per leaf recorded was maximum during the last week of September i.e. on 24.9.68.

In case of Empoasca devastans Dist. the incidence was recorded for the first time in the field on 27.8.68 and was continued upto 31.12.68. The population per leaf recorded was maximum during the first week of October.

The brinjal lace wing Urentius sentis Dist. was recorded for first time in the field on 10.9.68. The infestation was continued upto the last week of December, 1968. The population per leaf recorded was maximum during the first week of October.

The incidence of Tetranychus telarius Linn. was recorded from 5.11.68 to 25.2.69. The population per leaf was highest during the third week of December.

During the course of study when the newly emerged moths were released, they copulated successfully in end to end manner after 24 to 32 hours of their emergence. The eggs were laid singly or in small groups of 8 to 15 eggs, on either sides of leaves. The fecundity of female vary from 27 to 68 eggs per female. The viability of eggs vary from 0 to 88.37% according to the food supplied. The longevity of male as well as female vary from 1 to 3 and 2 to 5 days, respectively.

The incubation period vary from 4 to 6 days. The full grown caterpillar is of brown colour having yellow tubercles and hair arising from them. It measures about 23.50 mm to 25 mm in length and 2.60 mm to 2.75 mm in width. The total larval period vary from 19 to 24 days. The full grown caterpillars than pupate within the rolled leaves. The pupal period vary from 5 to 7 days.

The complete life-cycle ranges from 30 to 36 days.

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