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TAXONOMY AND BIOLOGICAL OBSERVATIONS ON TWO PENTATOMID PESTS *DOLYCORIS INDICUS* STAL AND *EURYDEMA PULCHRUM* WESTWOOD ATTACKING AGRICULTURAL CROPS IN KASHMIR VALLEY

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A B S T R A C T

This paper discusses some ex situ observations on the life history strategies of two Indian pentatomid pests, *Dolycoris indicus* Stal and *Eurydema pulchrum* Westwood infesting the cruciferous crops in Kashmir Valley. Laboratory experiments were carried out during 2013-2014 in the Division of Entomology, Department of Zoology, University of Kashmir, Srinagar. Studies on the biology revealed that the incubation period varies from 3-4 days while a total of 5 nymphal instars were found in both the species during their entire life time. The first instar nymphs are gregarious in nature and never feed notwithstanding, this condition gradually disappears from 2nd instar onwards. The biological observations on the life cycle revealed that both these species are basically similar with other pentatomid bugs. Additionally, the keys for identification of nymphal instars are also provided.

Keywords: Biological observations, pentatomid pests, Cruciferous crops.

INTRODUCTION

A glance on the existing literature reveals that a considerable amount of work has been done outside India on the biology of various pentatomid species (MacGill, 1947, 1950; Mayne and Breny, 1948; Woodward, 1948; Ishihara, 1950; Balcelis, 1951; Hoffmann, 1954; McDonald, 1968, 1971; Mcpherson, 1974, 1975 and McDonald & Grigg, 1988). However, the studies in this field in India are scanty and contributions of those of Ayyar (1929), Rakshpal (1949), Joseph (1953), Pant & Kalode (1971), Rajendra & Patil (1972), Nath (1974) are the handy few available. Altogether neglected biological studies on Indian pentatomid pests have encouraged the authors to undertake the present work which contains observations on the life cycle of two species viz., *Dolycoris indicus* stal and *Eurydema pulchrum* Westwood under comparable laboratory conditions of temperature, humidity and light. For more accuracy, replicates of at least four generations of each species were examined.

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MATERIAL AND METHODS

The adults of the two species were collected from the field in the month of April, 2013 and kept separately in 21 cm high X 14 cm diameter glass jars. The insects were fed on the cabbage leaves which were placed into the jar. The open end of the jar was covered with a piece of muslin cloth and held in a position with the rubber band. The feed was changed every day. Copulation and preoviposition periods were recorded. Leaves containing eggs were removed and placed in separate jar. Observations were also made on the number of egg masses laid by a single female and the number of eggs in a single egg mass. Besides, the eggs were examined daily and as the eggs started hatching, hatching period was also recorded. Different nymphal stages and duration of each nymphal period were observed by searching cast skins in each jar.

Dolycoris Indicus Stal

Plants attacked: Cruciferous vegetables such as Cabbage, Cauliflower, Mustard.

Copulation and egg laying: Copulation takes place 8-10 days after the last moult. The process lasts for about4-5 hours. A single female may copulate at several times. Preoviposition varies from 1 to 2 days. Eggs are laid in

batches and arranged regularly in rows and glued vertically to the undersurface of the leaves. A single female usually lays 5-6 batches of eggs but this number varies from female to female. Each batch consists of 10-14eggs. Freshly laid eggs are creamy white in colour and remains same in colour upto hatching.. They are barrel shaped and reticulately sculptured with a lid or pseudoperculum apically. Each egg is 1.04mm long and 0.76mm wide. The egg buster is well developed and T-shaped, present beneath pseudoperculum. The incubation period varies from 2-3 days.

Key to nymphal instars of *Dolycoris indicus* Stal

1. Wing pads indistinct, ocelli indistinct, antennal segment second much shorter than fourth……..2
   Wing pads distinct, ocelli distinct, antennal segment second slightly shorter than fourth……4
2. Head normal or slightly deflexed; rostrum with segment much longer than fourth; antenna with segment second longer than third, together longer than fourth, body finely punctuate……..3
   Head strongly deflexed; rostrum with segment second slightly shorter than fourth; antenna with segment second sub equal to third, together shorter than fourth……Ist instar
   Head slightly deflexed; second rostral segment slightly shorter than third and fourth together……2nd instar
3. Head never deflexed; second rostral segment as long as 3rd and 4th together ……3rd instar
4. Mesothoracic wing pads developed, metathoracic wing pads indistinct; second antennal segment slightly shorter than fourth; rostrum extending beyond hind coxae; sexes not differentiated……4th instar
   Meso and metathoracic wing pads well developed; second antennal segment longer than fourth; rostrum extending up to hind coxae; sexes differentiated……5th instar.

***Eurydema pulchrum* Westwood**

Crops attacked: Cruciferous Crops such as cabbage, cauliflower and mustard.

Copulation and egg laying: Similar to *D. indicus* Stal except that freshly laid eggs are creamy white in colour but black bands appear after few hours. The incubation period varies from 3 to 4 days.

Key to nymphal instars of *Eurydema pulchrum* Westwood

1. Wing pads indistinct;head with juga atmost slightly longer than tylus,lateral margins never reflexed……2
   Wing pads developed; head with juga distinctly longer than tylus, lateral margins more or less reflexed……4
2. Rostrum with segment second longer than fourth; second antennal second longer than third; together longer than third……3
   Rostrum with segment second shorter than fourth; second antennal segment sub equal to third; together as long as fourth……1st instar
3. Head strongly deflexed; juga slightly shorter than tylus; rostrum extending much beyond hind coxae……2nd instar
   Head slightly deflexed; juga slightly longer than tylus; rostrum extending slightly beyond hind coxae……3rd instar
4. Mesothoracic wing pads developed, metathoracic wing pads indistinct;juga separated apically second antennal segment as long as fourth……4th instar
   Mesothoracic and metathoracic wing pads well developed; juga dilated and meeting apically; second antennal segment longer than fourth……5th instar.

Statistical Analysis (Mercator series): From a life table we can calculate life expectancy as follows. Assume the stages x are uniformly spaced. The average proportion L_x of organisms alive at stage x between beginning and end is;

$$Lx = \frac{L_x + L_{x+1}}{2}$$

The total number Tx of future stages to be lived by individuals at age x and older is:

$$Tx = Lx + Lx + 1 + Lx + 2 + \cdots$$

Then the life expectancy ex at age x is:

$$ex = \frac{T_x}{L_x}$$

We could have done the same computation with raw numbers of individuals rather than proportions.

Basic reproductive rate: If we further know the number F_x of eggs produced (fecundity) at age x, we can

calculate the eggs produced per surviving individual m_x as; $m_x = \frac{F_X}{a_x}$

Where a_x is the number of individuals alive at that stage.

The basic reproductive rate R_0, also known as the replacement rate of a population, is the ratio of daughters to mothers. If it's greater than 1, the population is increasing. In a stable population the replacement rate should hover close to 1. We can calculate it from life-table data as; $R_x = \sum_x l_x m_x$.

This is because each $l_x m_x$ product computes (first-generation parents at age x) / (first-generation eggs) times (second-generation eggs produced by age-x parents) / (first-generation parents at age x).

If N_0 is the initial population size and N_T is the population size after a generation, then; $R_0 = \frac{N_T}{N_0}$

Generation time: The cohort generation time T_c is the average duration between when a parent is born and when its child is born. If x is measured in years, then;

$$T_c = \frac{\sum_x x\, l_x m_x}{\sum_x l_x\, m_x}$$

Intrinsic rate of increase: If R_0 remains relatively stable over generations, we can use it to approximate the intrinsic rate of increase r for the population: $r \approx \frac{l_n R_0}{T_C}$

This is because, $l_n R_0 = l_n \frac{N_T}{N_0} = l_n \frac{N_0 + \Delta N}{N_0} l_n(1 + \frac{\Delta N}{N_0}) \approx \frac{\Delta N}{N_0}$

Where the approximation follows from the Mercator series. TC is a change in time, Δt. Then we have; $r \approx \frac{\Delta N}{\Delta t} \frac{1}{N_0}$, Which is the discrete definition of the intrinsic rate of increase.

Table 1. Life table for *Eurydema pulchrum* during the 2013-2014.

Stage (x)	Number alive at stage (a_x)	Number dying	Proportion of original cohort surviving (l_x)	Proportion of original cohort dying (d_x)	Mortality rate at this step (q_x)
Egg	1000	386	1	0.386	0.386
Egg	614	232	0.614	0.232	0.378
1st Instar	382	90	0.382	0.090	0.236
2nd Instar	292	59	0.292	0.059	0.202
3rd Instar	233	34	0.233	0.034	0.146
4th Instar	199	59	0.199	0.059	0.296
5th Instar	140	69	0.140	0.069	0.493
Adult	52 (28 males, 24 females)		0.052	-	-

Table 2. Life table for *Dolycoris indicus* during the year 2013-2014.

Stage (x)	Number alive at stage (a_x)	Number dying	Proportion of original cohort surviving (l_x)	Proportion of original cohort dying (d_x)	Mortality rate at this step (q_x)
Egg	1000	370	1	0.370	0.370
Egg	630	230	0.630	0.230	0.365
1st Instar	400	80	0.400	0.080	0.200
2nd Instar	320	60	0.320	0.060	0.180
3rd Instar	260	45	0.260	0.045	0.173
4th Instar	215	80	0.80	0.080	0.372
5th Instar	135	60	0.60	0.060	0.444
Adult	55 (35 males, 20 females)		0.055	-	

RESULTS AND DISCUSSION

The biological observation on *Dolycoris indicus* Stal and *Eurydema pulcrum* Westwood under laboratory conditions revealed that the life cycle of these species are basically similar with other pentatomid species. Both males and females attain sexual maturity at about the same age. Adults of D. indicus and E. pulchrum were found to copulate8-10 days and 10-12 days respectively after the last moult. Although one mating is sufficient to ensure egg laying, adults of both the species were found to mate several times. Preoviposition period varies to 1-2 days for both the species. Eggs laid on an average are 65 and 95 respectively. There are five nymphal instars. The nymphal instars are differentiated on the basis of normal or deflexed condition of head; distinct or indistinct condition of meso and metathoracic Wing pads; length of antennal and rostral segment.

The first instar of nymphs is gregarious in nature and never feed. This condition gradually disappears from second instar onwards. Head is strongly deflexed in first instar, slightly deflexed in second instar and normal in 3rd-5th instar.

Eggs Nymphs Adults

Figure 1. Showing different stages in the life cycle of *Dolycoris indicus.*

Eggs Nymphs Adults

Figure 2. Showing different stages in the life cycle and mating behavior of *Eurydema pulchrum*.

Rostral segment second is shorter than fourth in 1st instar,longer in remaining instars.Antennal segment second and third are together shorter than fourth in 1st instar,longer in remaining instars. Meso and metathroacic wing pads are indistinct in 1st, 2nd and 3rd instars; metathoracic wing pads developed in 4th instar,while in 5th instar both meso and metathoracic wing pads developed. Antenna is 4-segmented and tarsi 2-segmented in all nymphal instars,while in adults Antennae is 5-segmented and tarsi 3-segmented.

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