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COURTSHIP AND MATING BEHAVIOUR OF *LIPOLEXIS SCUTELLARIS* MACK. (HYMENOPTERA : BRACONIDAE), A PARASITOID OF *APHIS GOSSYPII* GLOV. (HOMOPTERA : APHIDIDAE) :

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We report on the courtship and mating behaviour of *Lipolexis scutellaris* Mack., a parasitoid of *Aphis gosypii* Glov. The courtship and copulatory behaviour involves the exchange of several sexual stimuli between the two sexes. The actual copulation lasts for 5.6 ± 1.36 sec. Mating sequence of the male consisted of wing vibration, approach to the female, visual recognition of the female, antennal contact of female wings, mounting and copulation. Male readily mated more than one female. A fully fed male of *L. scutellaris* mates with upto 15 females while starved male mates only with upto 3-4 females in his life. The wasp also exhibit post-copulatory behaviour. Olfaction of pheromones secreted by female plays a significant role in exciting and luring the male. Older mates do not actively court or copulate.

INTRODUCTION

Courtship and mating behaviour in the aphidiidne parasitoids is an aspect of sexual reproduction and it involves the exchange of sexual stimuli between the sexes which act as an ethological barrier between closely related sympatric species (van den Assem & Powel, 1973; Evans & Mathews, 1976). Stary (1970) considered it as a factor that determines the working efficiency of the parasitoid. Few genuinely ethological studies of mating behaviour in parasitic wasps have been published so far (Barrass, 1960a, b & 1976; Dahms, 1973; van den Assem, 1975; Gordh & DeBach, 1976 & 1978; von den Assem & Vernal, 1979; Viggiani & Battagi, 1983; Antolin & Strand, 1992; Kimani & Overholt, 1995). However, for aphidiine wasps, the report of mating procedures are limited to a few species *viz. Aphidius matricariae* Haliday (Shalaby & Rabase, 1979), *A. testaceips* (Cresson) (Sekhar, 1957), *Diaeretiella rapae* (Mcintosh) (Askari & Alishah, 1979; Dhiman *et al.*, 1987), *Kashmiria aphidis* Stary & Bhagat (Das & Chakrabarti, 1986), *Praon palitans* Muesebeck (Schinger & Hall, 1960), *Binodoxys indicus* (Subba Rao & Sharma) (Subba Rao & Sharma, 1962; Singh & Sinha, 1982), *Trioxys utilis* Muesebeck (Schlinger & Hall, 1961), *Lysiphlebia mirzai* Shuja-Uddin (Tripathi & Singh, 1990), and *Lysiplebus delhiensis* (Subba Rao & Sharma) (Mishra & Singh, 1993) (Table I).

Lipolexis scutellaris Mack. is widely distributed aphid parasitoid of particularly *Aphis craccivora* Koch., *Aphis gosypii* Glover, *Aphis nasturtii* Kalt., and *Myzus persicae* (Sulzer) on several vegetable crops, *viz.* brinjal (*Solanum melongena*), bean (*Dolichus lablab*), chili (*Capsicum frutecens*), pigeonpea (*Cajanus cajon*) and *Toxoptera citricida* Kirkaldy on citrus crops. The purpose of this study was to examine the courtship and mating behaviour of *L. scutellaris*.

MATERIALS AND METHODS

The courtship and mating behaviour of *L. scutellaris* was studied at Gorakhpur (U.P.) in the year 2002-2003. The *aphid, A. gossypii* and the parasitoid *L. scutellaris* were cultured in the laboratory on seedlings of *Solanum melongena* potted in clay pots at 22^{0}C in screened (625 mesh/cm^2) cages (45 x 45 x 60 cm) at 12 hour photoperiod, 5000-10000 lux light intensity and 60-80% R.H. Only freshly emerged (0-12 hour old) and naïve parasitoids fed on a mixture of

honey, honeydew and water in the ratio of 30 : 30 : 40 (v/v) were used for the experiments. For the study of the mating behaviour, cohorts of 10 pairs of virgin females and males were selected. The newly emerged and fed (with 50% honey solution) mates (a pair) were released into a glass tube/Petri dishes in a series. The behaviour was observed visually. The following observations were recorded : (a) pre-excitation period, (b) pre-encounter period, (c) pre-copulation period, (d) events of the mating behaviour and (e) successive mating by male in his life.

Table I : Number of successful mating in aphidiine wasp.

Wasp species	Number of successful matings	References
Aphidius matricariae	18	Vevai (1942)
Aphidius smithi	6	Wiachowski (1962)
Aphidius testaceipes	19	Sekhar (1957)
Binodoxys indicus	5 12	Singh & Sinha (1980 & 1982) Subba Rao & Sharma, (1962)
Diaeretiella rapae	6	Dhiman *et al.* (1987)
Kashmiria aphidis	7	Das & Charkrabarti (1986)
Lysiphlebia mirzai	22	Tripathi & Singh (1990)
Lysiphlebus delhiensis	24	Mishra & Singh (1991 & 1993)
Praon aguti	22	Sekhar (1957)
Paron palitans	>10	Schlinger & Hall (1960)*
Trioxys utilis	>9	Schlinger & Hall (1961)

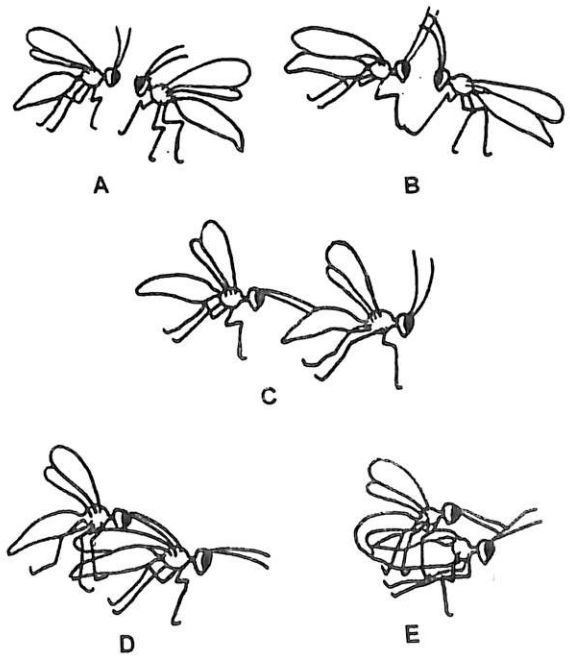
RESULTS AND DISCUSSION

After emergence males of *L. scutellaris* actively search for mates. The courtship and mating behaviour of *L. scutellaris* may be divided into three steps for convenience *viz.* courtship (pre-couplatory), copulatory and post copulatory behaviour.

Courtship behaviour : *L. scutellaris* starts copulation just after emergence from mummies. The period between emergence and mating varies from 4 to 39 min (20.9 ± 1.56 min). In this phase, the parasitoid after the emergence of mummies, dry and cleans it body parts namely, antennae, mouthparts, wings, abdomen and genitalia with the help of pretarsi of all the legs which possess the spurs and spines and feed if the food is available. It lasts after 4-27 min (20.9 ± 1.56 SD min). This observation (delayed courtship) was reported only among few species (Vevai, 1942; Arthur, 1944; Sekhar, 1957; Tripathi & Singh, 1991; Mishra & Singh, 1993). However, most aphidiine mate immediately or soon after emergence (Singh & Agarwala, 1992).

When pairs of male and female were introduced in Petri dishes the males performed various behavioural patterns including antennal waving and vibration, antennal contact with female and wing fanning showing initiation of male excitement. Odours emitted by the females (sex pheromones) help in the sexual receptivity of the wasps (Jacobson, 1965; Decker *et al.*, 1993; Kimani & Overhalt, 1995). During excitement, the male *L. scutellaris* displays following activity : the male moves antennae up and down with a higher frequencies (Fig. 1A); vibrates the wing and makes contact with female (Fig. 1B), and trails the female. Virgin females show readiness to copulate during the first display by a conspecific male (Fig. 1C). Thereafter, the female is excites and gets ready for mating; she gives positive signals by sitting quietly, folds her legs slightly and spreads her wings horizontally over the abdomen (Fig. 1D). This characteristic posture is adopted makes him switch to copulatory behaviour.

Copulation behaviour : In the copulatory behaviour firstly male *L. scutellaris* secures his position on the back of the female (Fig. 1D). He taps the head of the female with antennae and brushes the antennae of female with his own. After this he grasps the female firmly with his legs in such a manner that his fore - and midlegs hold her mid - and hindlegs, respectively. The forelegs of the female and hindlegs of the male remain free. Simultaneously the male places his hindlegs against the posterior abdominal part of the female which result the abdominal segment of the male to bend downward and foreward in such a way that his genitalia makes contact with that of female (Fig. 1E). During copulation male vibrates his wings at high frequency and continues to brush female's antennae with his own. Then he inserts the aedeagus into the genital orifice of the female and inseminates her. The copulation last for 5.6 ± 1.36 sec. The copulation period remains unaffected by the starvation of the males.



Figs. 1A-E : Different phases of courtship and mating behaviour of *Lipolexis scutellaris* Mack.

Post-copulatory behaviour : After the completion of successful copulation the male dismounts from female and goes away from her immediately. After insemination the male shows post-copulatory behaviour. Within few seconds the male exhibits the same courtship pattern for the repetition of post copulatory courtship. Usually at this time the female again signals her receptivity (at the very start of display) but as a rule the male's internal condition soon changes. He becomes unresponsive to such stimulus. Similarly female is no longer in a receptive condition following signaling and copulation.

Second signal for mating by the female soon after the first act due to inadequate sperm transfer has already been refuted. This behaviour is regarded as a requisition to switch off the receptive conditions (van den Assem & Visser, 1976; Viggiani & Battaglia, 1983). After

sometime if the same male tries to mount her back again, she totally refuses. She either moves away as soon as male approaches her or discourages the male by characteristic antennal movement, head jerking (sidewise in no position) and bending down the abdomen.

For the completion of different phases of mating, fed parasitoid takes significantly less time than starved parasitoids (Table II). A fully fed male of *L. scutellaris* may mate with upto 15 females while a starved male mates only 10 females in his life.

Table II : Quantitative measurements of sexual receptivity in *L. scutellaris*.

Different phases of mating	Fed parasitoids (mean ± SD) n=10	Starved parasioids (mean ± SD) n=10
Pre-couplation period (min.)	20.9 ± 4.79^a	26.4 ± 6.96^b
Time taken by male for excitement (sec.)	26.8 ± 4.79^a	51.9 ± 4.52^b
Duration of male excitement (sec.)	17.1 ± 3.20^a	21.2 ± 11.41^b
Time taken by male in making first contact with female (sec.)	37.1 ± 4.63^a	97.9 ± 12.53^b
Courtship period (sec.)	8.2 ± 1.53^a	13.1 ± 2.96^b
Copulation period (sec.)	$5.6 \pm 1.30a$	8.1 ± 1.65^b
Successive copulation by male in whole life	12.8 ± 2.43^a	7.5 ± 2.91^b

Column means followed by common letters are not significant of $p<0.01$ (t-test).

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