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SOME MORPHOLOGICAI AND BIOLOGICAL ASPECLS, AND LAND SNAIL KILLING BEHAVOUR OF *Megaselia scalaris* LOEW (DIPTERA : PHORIDAE).

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ABSTRACT

All stages of M. scalaris were investigated and described based on morphological characteristics of larva, pupa and adult stages. The results of the biological studies under laboratory conditions (25 ± 2 °C & RH 80 ± 5 %) indicated that the incubation, larval, pupal, preoviposition, oviposition and postoviposition periods were 1 ± 0.0, 4.43 ± 0.14, 6.8 ± 0.08, 1.2 ± 0.08, 4 ± 0.45 and 2.5 ± 0.16 days, respectively. The life span of M.scalaris was 19.93 ± 0.82 day.

M.scalaris females showed differences in their oviposition rates in response to alive and dead snails. However, M.scalaris females exhibited higher response to lay eggs on dead (53.75) as compared to alive snails (20.75 eggs / female / day).

The efficiency of the parasitoid, M.scalaris 3rd instar larvae was affected by the host species. The parasitoid recorded a relatively higher K-values in response to E.vermiculata than M.cartusiana at all tested densities.

INTRODUCTION

The order Diptera, includes a number of gastropod predator and parasite species which can be used for biological control, especially of the Helicidae. Two families of flies, the Phoridae and Sciomyzidae, are of particular interest in this respect, their larvae are at first parasitoid, then predatory and finally, in the third stage, they are saprophagous, (Godan 1983).

Dipteran parasitoids including 22 Orders distributed across 5 phyla, (Ferrar, 1987 & Eggleton and Belshaw, 1993). Host associations unique to the parasitic Diptera include terrestrial flat worms (Order : Tricladida), earth worms (Order : Haplotaxida), freshwater and terrestrial pulmonate (Order : Basomatophora and Stylomatophora), (Eggleton and Belshaw, 1992).

The Phorid species known largely as saprophagous, many phorids are parasitoids, predators, and even herbivorous. Parasitoids are found in three major subfamilies (Hypocerinae, Aenigmatiinae and Metopininae) (Brown, 1992). Species of the subfamilies, Phorinae and Conicerinae, are mostly saprophages. Within the largest subfamily, Metopininae, the Megaselia group include many saprophages and some specialized predators, in addition to the parasitoids.

Because many snail disease vectors are aquatic most studies have focused on Sciomyzids with aqutic or semiaquatic larvae. However, few studies have addressed their possible use as biocontrol agents of terrestrial snails (Knutson *et al.* 1970 ; Vala, 1989 and Foote, 1997) .

In fact many problems resulting from total reliance on pesticides such as developments of pesticide resistance in pest species, resurgences of treated populations which are characterized by an abnormally rapid increase of pest population reach to economic abundance after initial suppression by a pesticide. pesticides also destroy the pest's natural enemies, residue problems. Therefore, the present investigation to study some morphological and biological characteristic in addition to investigate the killing behavour of *Megaselia scalaris* as bio agent against land snails.

MATERIALS AND METHODS

To have a source of *M. scalaris* naturally infested *Eobania vermiculata* snails with insect eggs were collected from different fields at Mansoura district, during October 15th , 2002 . The snails were transported to the laboratory of Plant Protection Research Institute El-Mansoura branch where they were held in glass aquaria (60 × 40 × 70 cm) provided with gauze top, until emergence of the parasitoid adults (The snails were offered lettuce leaves for feeding). Emerged parasitoids (males and females) were collected and identified by Prof. Dr. Aza Salah El-Dein Midicenal and Vetrinalical Insect Research Institute, Egypt.

The newly emerged adult of *M. scalaris* were collected by using an aspirator and sexed. Each pair (male and female) was kept in a plastic container (10cm diameter and 12 cm high) which had gauze tops. The container was provided with moisted soil (80 % RH) at the bottom as food for the flies. An equal mixture of honey, brewer's yeast and skim milk powder was placed on a wooden ice – cream stick within the cage while the water was squirted through the gauze top once daily (Hopkins and Baker, 1991). Five live *E. vermiculata* snails were introduced to each cage as containing a pair of *M.scalaris* adult (male and femmale) oviposition sites for the flies. After egg laying the egg number was counted and recorded, also, the incubation, larval and pupation periods were calculated. The adult longevity (pre-oviposition, oviposition and post-oviposition period)was also recorded.

Behavioral reaction response of *M. scalaris* females to alive and dead snails of *E.vermiculata* was tested by using the same experimental cages. Three groups of homogenous snails in size were introduced into the cages. Inside each cage a pair of *M. scalaris* adults (male and female) was released. . The first group includes alive snails, the second dead snails while the third one contains 2 alive and 2 dead snails, each group includes four snails. Each treatment was replicated three times. Number of deposited eggs per female were counted. Males were removed after mating. The experiment was continued until all flies were dead.

To evaluate the killing power of *M. scalaris* larvae against land snails (*E.vermiculata* & *M. cartusiana*) six alive snails either of *E. vermiculata* or *M. cantiana*, free of any *M. scalaris* eggs were placed into plastic containers provided with moisted soil at the bottom and gauze top. Different levels of M.scalaris 3rd instar larvae (20, 40, 80 and 160) and (5, 10, 20, 40 and 60) 3rd instar larvae of the tested fly were introduced for the two tested snail species respectively. Snails were provided with lettuce leaves for feeding. Mortality were recorded after 3 days. The method of Hopkins and Baker (1991) was adopted with some modification, in concern of the addition of the dead snails.

RESULTS AND DISCUSSION

1- Morphological characteristics of *M. scalaris* (loew).

Eggs: the egg is creamy white in color, elongated oval form its average length and width are about 265.65 and 862.4 mµ average broied, with one end broader and with 2 ridges along its length, the upper surface was nearly flatened and provided with processes. Larvae: dirty white in colour, the head has a pair of toothed mandibles in place of the usual hooks (Fig. 1). Each body segment was provid with short fleshy processes on the dorsal and lateral surfaces, these processes gradually increase in length to the eighth segment, but the longest were shorter than the humps bearing the posterior spiracles; the processes were not hairy. Pupa : was coarctate and had a pair of large respiratory horns.

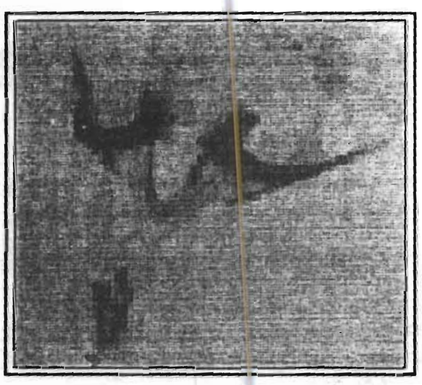


Fig. (1) : Megaslia scalaris toothed mandibles

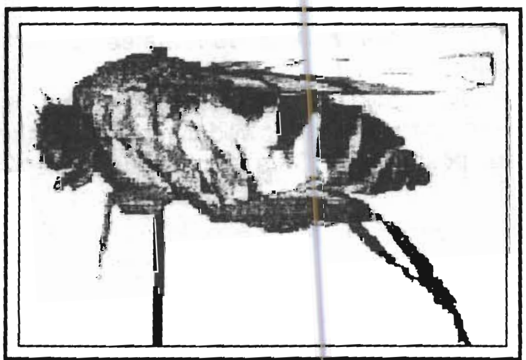


Fig. (2) : *Megaslia scalaris* (Loew) adult fly.

Adult : the thorax is yellow or brownish yello in colour, the halteres and legs clear yellow; the abdomen
is yellowish brown, sometimes light but often darker, usually banded with brown, almost wholly brown in the male, length, 2-3 mm. (Fig. 2).

2- Biology of *M. scalaris* flay

Data tabulated in Table (1) revealed that the incubation period of the eggs was 1.0 ± 0.0 days, while the larval, pupal duration were 4.43 ± 0.15 and 6.80 ± 0.08 days. The first, second and third instar larval durations lasted 0.8 ± 0.08, 1.13 ± 0.04 and 2.50 ± 0.16 days, respectively. Preoviposition, oviposition and postoviposition were 1.2 ± 0.08, 4 ± 0.45 and 2.5 ± 0.16 days, respectively.The life cycle and life span lasted 13.43 ± 1.2 and 19.93 ± 0.82 days.

Table (1): Duration of the different stages of *M. scalaris* reared on *E.vermiculata* at 25 ± 2 °C and 80 ± 5 % RH.

Stage	Duration periods in days
Egg	1 ± 0.0
Larva	4.43 ± 0.15
1st instar	0.80 ± 0.08
2nd instar	1.13 ± 0.04
3rd instar	2.5 ± 0.16
Pupa	6.8 ± 0.08
Adult	7.7 ± 0.66
Pre-oviposition	1.2 ± 0.08
Oviposition	4.0 ± 0.45
Post-oviposition	2.5 ± 0.16
All life span	19.93 ± 0.82

3 – Egg laying behaviour of *M. scalaris* females in response to alive and dead snails.

The parasitoid females exposed to different groups of the host (alive, dead and alive with dead snails) showed differences in their egg laying rates toward the tested host groups. Data tabulated in Table (2) revealed that the dipterous parasitoid exhibited the highest response to dead snails. The parasitoid, oviposition rate was 53.75 ± 6.30 , 31.95 ± 2.91 and 20.75 ± 2.11, respectively.

Table (2): Egg laying behavior of *M. scalaris* adult females in response to three snail groups (alive (A), dead (B) and alive with dead snails (C).).

Snail groups	Av. no. of eggs / female / day	Av. no. of eggs/ female / snail / day
A	20.75 ± 2.11	5.19 ± 0.4
B	53.75 ± 6.30	13.43 ± 0.7
C	31.95 ± 2.91	(3.68 ± 0.3)+ (4.35 ± 0.33)

The obtained results was supported with the finding of Patton (1992), who stated that *M. scalaris* females were attracted to foul-smelling exudations from sores and oviposition there may resulted in wound myiasis. This behavior could be attributed to olfactory singnals as orientation cues, Brown and Feener (1991).

During the course of this study the adult female usually observed laid their eggs on the shell of living snails or in the umbilicus and for instance inside the shell apertures. Also dead snails stimulate egg laying and eggs were found on the shell sarface. The studied insect species developed rapidly after oviposition and killed the host at or close to pupation, which occurred on the shell of the host. Third-instarlarvae were very active and the most papacious predators and paralyse their prey before they eat it. This observations were supported with the finding of coupland *et al.* (1993).

4- The efficiency of *M.scalaris* as bio-agent against the host (*E. vermiculata* and *M.cantiana*).

Data illustrated in Figure (3 a & b) showed the efficiency of different densities of *M.scalaris* 3rd instar larvae against *E.vermiculata* and *M.cantiana* snails after two days of exposure.

Regration analysis indicated that *M.scalaris* exhibited a relatively higher efficiency against *M.cantiana* in comparison with *E.vermiculata*. This effect could be represented by the following formula:

K –value = - 1.74 + 2.12 log p (for *M.cantiana*)

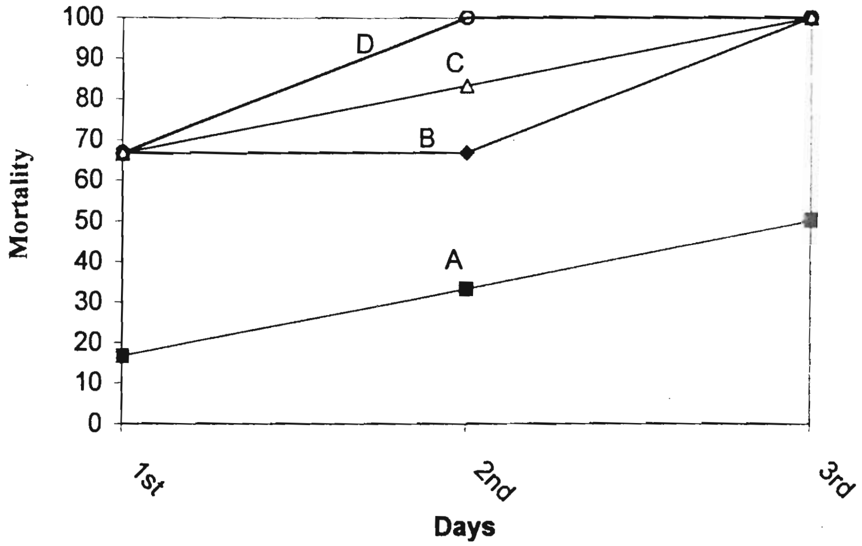
K – value = - 2.50 + 1.92 log p (for *E.. vermiculata*)

The K – value of mortality for M.scalaris larvae was affected by the prey species. However, the parasitiod recorded a relatively higher K- value in rsponse to *M.cartusiana* than *E.vermiculata* at all tested analysis.

Eggleton and Belshaw (1992), reported that, terrestrial snails serve as hosts for species in the Phoridae and Sciomyzidae These unusual non insect hosts are associated with substrate-zone habitats (e.g. soil, leaf litter, or other organic matter on the ground) and reflect the important role these habitats play in the evolution of the parasitoid life-style within the Diptera. Donald *et al.* (1997), stated that in the Megaselia group, there are many scarophages and some specialized predators, in addition to the parasitoids.

In the present study, it is of interesting to stated that the exect of dead snails with the tested alive snails attract adult Megaselia insects and stimulate them to laying their eggs. Moreover, the active larvae transfer to the alive snails and attack them. This behavior can be explain by the finding of Donald *et al.* (1997), they reported that the general trends found in the Phoridae are the apparent acquisition of parasitoid behavior from host association (possibly in the Hypocerinae and Megaselia group).Moreover Eggleton and Belshaw (1992) reported that most dipteran parasitoids arose from saprophagous ancestors and have ancestors and hostes that live in or near the soil surface.

(a)



(b)

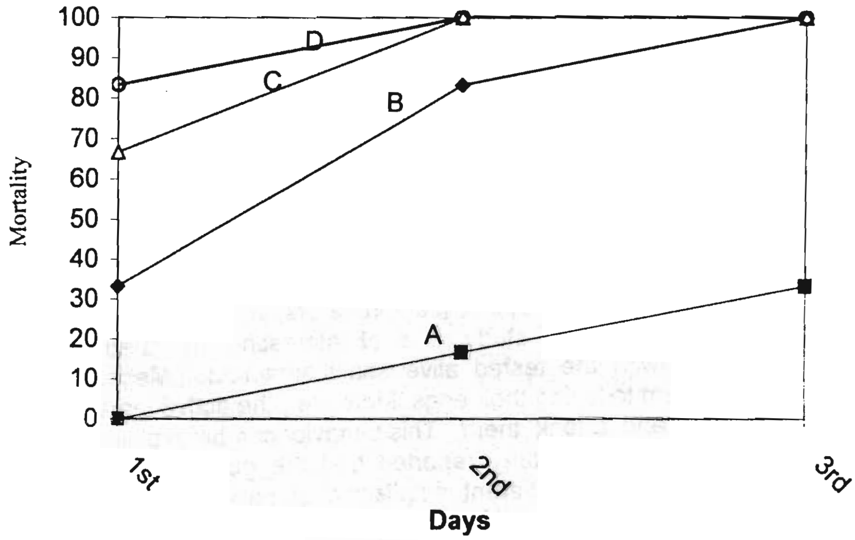


Fig. (3 a&b) : The relation between predator density (log p) and Killing power (K-value) in response to *E.vermiculata* (a) and *M. cantiana* (b) during three successive days

From the above mentioned results, it could be concluded that *M. scalaris* larvae are specialist dipteran predators or parasitoids of terrestrial snails and due to their specific feeding habit they have been considered possible biological control agents.

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دراسات مورفولوجية وبيولوجيــــة لذبابــة ميجــازيلا اســكالارس (ذات الجناحين) وطريقة قتلها للقواقع الأرضية

حلمى على على زيدان
معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقى - الجيزة

١- تم تعريف حشرة الميجازيلا اسكالارس *Megaselia scalaris* بناء على الصفــات المورفولوجيــة لليرقات والعذارى والحشرة الكاملة.
٢- أوضحت نتائج الدراسات المورفولوجية أن فترات حضانة البيض ، الطور اليرقى (يضم ثلاث مراحــل يرقية) ، طور العذراء ، ماقبل وضع البيض ، وضع البيض ، مابعد وضع البيض حيث ســجلت ١ ، ٤,٤٢٥ ، ٦,٨ ، ١,٢ ، ٤ ، ٢,٥ يوم على التوالى .
٣- كانت مدة دورة الحياة ، طول العمر ، وتاريخ الحياة ١٣,٤٢٥ ، ٧.٧ ، ١٩,٩٢٥ يوما على التوالى :
١- فيما يختص بسلوك أنثى الحشرة حسب حالة العائل ونتائج اختبار معــدل عــدوى القواقــع بــالأطوار المختلفة للذبابة أوضحت النتائج أن متوسط عدد البيض واليرقات الموضوعة على ثلاث مجــاميع مــن القواقع (حى + ميت) & (حى فقط) & (ميت فقط) كــان (٣١ & ٥٧,٢٥) ، (٣٩,٢٥ & ٦٤,٢٥)] ، (٢٩,٧٥ & ٣٢,٥) ، (٤٤& ١١٧,٢٥) على التوالى .
٢- عدد البيض الموضوع / أنثى / قوقع / يوم فى الثلاث مجاميع التجريبيــة كــان (٧,٣٥ + ٨,٦١) & ٥,١٩ & ١٣,٤٣ على التوالى.
٣- كان التأثير التطفلى ليرقات العمر الثالث للذبابة ضد قوقعى الحدائق البنــى *E. vermiculata* & قوقع البرسيم الزجاجى *M. cartusiana* عندما استخدما بمعدلات (٢٠ ، ٤٠ ، ٨٠ ، ١٦٠) يرقة عمر ثالث للقوقع الأول ، (٥ ، ١٠ ، ٢٠ ، ٤٠ ، ٦٠) يرقة عمر ثالث للقوقع ا لثــانى . أدى الــى حدوث نسبة موت (٥٠ ، ١٠٠ ، ١٠٠ ، ١٠٠%) بالنسبة للقوقع الأول & (صفر، ٣٣.٣٣ ، ١٠٠ ، ١٠٠ ، ١٠٠%) موت بالنسبة للنوع الثانى بعد ثلاث أيام تعريض على التوالى.
من النتائج السابقة يلاحظ أن أنثى الحشرة تفضل وضع البيض على القواقع الميتة عن الحية .