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BIOLOGY AND POTENCY OF THE PREDATORY MITE, *Macrocheles muscaedomesticae* (Scop.) (Acari : Macrochelidae)

By

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ABSTRACT

The predacious mite, *Macrocheles muscaedomesticae* (Scop.) was reared under laboratory conditions at 24 ± 5 °C and 65 ± 5% R.H. on artificial medium. Duration of the egg and immature stages as well as the life span of the adult female were studied and determined.

Efficiency of *M. muscaedomesticae* (Scop.) in controlling some immature stages of *Musca domestica* L. and *Drosophila melanogaster* Meig. as well as the first instar of Collembola spp. was indicated. The feeding capacity of the adult female of macrochelid mite on different stages was studied and discussed.

INTRODUCTION

Numerous articles dealing with the biology and rearing macrochelid mites in the laboratory were conducted in different parts of the world (Wade and Rodriguez, 1961; Filipponi, 1964;Afifi, 1982; Mahmood and El-Dulaimi, 1986; Bream, 1989 and Royce and Krantz, 1991).

A mass-production method for rearing the predacious mite, *M. muscaedomesticae* (Scop.),

using spent house fly media, frozen house fly eggs, and a nematode, Protorhabditis sp. was carried out. Large numbers of mites (2500) could be produced in eight days from 34.5 female mites at 30 °C. Under optimal weather conditions the duration of each generation of this mite lasted few days (3.2) and the population increased 69.8 times per generation (Ho et al., 1990).

Axtell (1961) indicated that several species of family Macrochelidae are considered as natural control agents of the house fly. The predacious mite M. muscaedomesticae feeds on house fly eggs and first instar larvae. The reduction in numbers of the house fly by the mite was larger as compared to the actual fly production from manure (Axtell, 1963 a; b and c).

In Egypt, Shehata et al. (1989) mentioned that members of family Macrochelidae are the most abundant benificial mites especially M. muscaedomesticae which feeds upon the eggs and first instar larvae of the house fly.

The aim of this study was to threw the light on the efficiency of M. muscaedomesticae as a predatory mite in controlling different stages of M. domestica and D. melanogaster and the first instar of Collembola spp.

MATERIAL AND METHODS

The present work was carried out at the laboratories of Faculty of Agriculture, University of Menoufia, Shebin El-Kom, Egypt.

1. Rearing Methods:

M. muscaedomesticae was collected from manures of different farm animals and received alive mites in glass jars provided with a little amount of water, placed under Tullgren funnels. Then, the collection was examined immediately under stereoscopic binocular microscope to sep-

arate the mite alone. The culture was used as a source for obtaining mite individuals for both biological and biological control studies.

For rearing M. muscaedomesticae adults were transferred in microcells of small petri-dishes 5 and/or 10 cm diameters. In each dish film of Nutrient Glucose Agar media provided with mites were used. The fungi medium used by Ainsworth, 1971 is composed of the following components:

Beef extract	2gm	Yeast extract	2gm
Peptone	5gm	Sodium chloride	5gm
Agar	15gm	Glucose	10gm
Water	1000gm		

The petri-dishes were closed and surrounding by parafilm to prevent escaping of mites.

For studing the life cycle of the predatory mite, a couple of mite are placed in a petri-dish and provided with NGA media. After oviposition of eggs adults were removed, and eggs (of the same age) were left to hatch. Each newly hatched larva, the proto-and deutonymphs were transferred to the rearing petri-dishes under antiseptic conditions. The duration of each stage as well as the longevity of adult female were recorded.

For rearing the house fly,adult insects were collected from the surface area of poultry manure accumulated beyond the poultry farm at Faculty of Agriculture in Shebin El-Kom. A couple of the house fly were mixed together and kept in a rearing cage 50 X 50 X 20 cm covered with muslin on one side. These cages were provided with artificial media consisted of wheat bran, powder milk, powder yeast and glucose. These component were mixed together and kept in plastic cups and provided with water before using. The same procedure was followed for rearing drosophilid fly.

2. Biological Control Studies:

Fresh house fly eggs or alive larval instars

were placed in every dish on cotton wood piecies fully saturated with water and covered with filter paper. The filter paper was surrounded by tangle foot to prevent mites escaping. Adult females of predatory mite were removed from the cultures and held without prey for about twenty-four hours intervals, the mites were transferred to another perti-dishes containing fresh eggs and/or larval of the same instar. Number of consumed or preyed eggs and larvae were determined after about 24 hours by counting the number of intact instar larvae and the number of non-punctured intact egg chorions per petri-dish.

Experiments were carried out under laboratory conditions at 24 ± 5°C and 65% ± 5% R.H. There were 5 treatments and their replicated as follows:

a) 2 mite females + 30 house fly eggs,replicated 10 times.
b) 2 mite females + 30 1st instar larvae, replicated 10 times.
c) 2 mite females + 30 2nd instar larvae, replicated 10 times.
d) 2 mite females + 20 3rd instar larvae, replicated 5 times.
e) 2 mite females + 20 house fly pupae , replicated 5 times.

For determing the feeding capacity of M. muscaedomesticae by feeding females on Drosophila and collembolan the forementioned technique was used. Alive collembolan first instar insects were collected from manures of different farm animals using Tullgren funnels.

The obtained data are calculated and statistically analysed.

RESULTS AND DISCUSSION

1. Biological Studies:

Mass-production of the predatory mite M. muscaedomesticae was developed using artificial medium (NGA). The preliminary study of Rodriguez and Wade (1961) showed that the addition of soybean oil meal and fish meal could increase the number of progeny of M. muscaedomesticae.

Therefore, this nitrogenous food was suggested as artificial media for mass-production of gamasid mites.

Mass rearing of M. muscaedomesticae (Scop.):

This predatory mite passed through a larval and two nymphal stages during its development from egg to adult stage. Parthenogenesis is an important phenomenon in this species, the unfertilized eggs give male progeny only. Because adult females not only consume more than the other stages of this mite, but also proliferate the population, it is obviously more important to produce female mites. Therefore, the sex ratio (females/total adults) at different culture times was observed. The proportion of adult female of mite increased as the colony aged. The same results was given by Ho et al. (1990). However, the increase of adult females proportion resulted also from the decrease in the number of males. The duration period of different developmental stages for mite female reared on NGA media is given in Tables 1 and 2.

Incubation period:

The newly deposited eggs of M. muscaedomesticae are pearl white and translucent in colour and oval in shaped, prior to hatching the chorion becomes shiny. Incubation period averaged 0.8 ± 0,05 days.

Larval stage:

The duration of the inactive larval stage averaged 0.9 ± 0.06 days. The larvae remain near the egg shell without feeding.

The protonymphal stage is a mobile and active stage, white in colour with four pairs of legs and sclerotized ventral shields. Protonymphal period averaged 1.9 ± 0.13 days. At the end of this stage, it enters quiscence for short hours then deutonymph emerges.

The deutonymphal stage is a very active stage, with four pairs of legs. The duration period averaged 2.2 ± 0.19 days. At the end of deutonymphal stage it moults into adult stage.

As shown in Table 1, the total life cycle period ranged between 4.5 - 6.8 days with an average of 5.7 ± 0.23 days.

The adult female is light brown in colour, and becomes darker within one to two days from emergence. Newly emerged females begin oviposition after a period averaged 1.3 ± 0.11 days, continue to oviposit for period averaged 8.4 ± 0.50 days. Post-reproductive period averaged 1.5± 0.05 days. The observed maximum daily number of eggs laid by one female was about 4 eggs. Total number of eggs which were laid by one adult female during oviposition period ranged between 18 - 38 eggs.

Adult longevity:

The longevity of adult averaged 11.1 ± 0.47 days (Table 2). The generation period ranged between 5.5 - 7.8 days with an average of 7.0 ± 0.23 days at laboratory weather conditions of 24 ± 5°C and 65% ± 5% R.H.

The total life span of M. muscaedomesticae averaged 16.8 ± 0.51 days under normal laboratory

Table 1: Average duration periods of different stages of M. muscaedomesticae reared on Nutrient Glucose Agar at 24 ± 5°C and 65 ± 5% R.H.

Stage	Average duration in days	Range
Incubation period (egg)	0.8 ± 0.05	0.5 - 1.0
Larval stage	0.9 ± 0.06	0.5 - 1.0
Protonymphal stage	1.9 ± 0.13	1.3 - 2.5
Deutonymphal stage	2.2 ± 0.19	1.5 - 3.0
Total life cycle	5.7 ± 0.23	4.5 - 6.8

Table 2: Biological aspects of M. muscaedomesticae female fed on Nutrient Glucose Agar at 24 ± 5°C and 65 ± 5% R.H.

Stage	Average duration in days	Range
Pre-oviposition period	1.3 ± 0.11	1.0 - 2.0
Oviposition period	8.4 ± 0.50	6.0 - 10.0
Post-oviposition period	1.5 ± 0.05	1.0 - 2.0
Adult longevity	11.1 ± 0.47	9.0 - 13.0
Life span	16.8 ± 0.51	14.0 - 19.0

conditions.

Trials for mass-production of this mite had been carried out by Rodriguez and Wade (1961) , Filipponi (1964), Ito (1977) and Bream (1989) . However, Ho et al.(1990) gave a primitive method to mass-production of this mite, by using spent house fly media, frozen house fly eggs, and nematode.

2. Biological Control Studies:

Experiments were conducted to study the efficiency of M. muscaedomesticae (Scop.) in controlling some immature stages of M. domestica, D. melanogaster and the first instar of Collembola spp. (Table 3).

As shown in Table 3, the adult female mites appeared high tendency to feed on house fly eggs more than movable immatures of the fly.The daily consumption rate ranged between 4 - 15,1 - 5 and 0 - 2 preys of eggs, first and second instar larvae, respectively. High potency of this predator towards eggs and relatively to first instar larvae of house fly, where predation percentages were 78% and 24%. On the other hand, obtained results revealed that the mite females had no effect on both third instar larvae and pupal stage even after starvation for 24 hrs.This may be due to the thickness of the body wall.

The present results are supportive the findings of Axtell (1963b and 1981),Krantz (1983)and Wallace and Holm (1985) who assured the fact that M. muscaedomesticae was highly mobile searching for the prey (eggs, 1st and 2nd larval instars of the fly) which exist only in the breeding sites in manure. Also, adult mites and nymphs do not attack and feed or oviposit on adult fly.

The high tendency for the mite predator towards preys eggs more than preys larval instar

and pupal stage, are in general harmony with those of Wilis and Axtell (1968) who mentioned that the larval stage is immune to attack by the mite due to the thickness of the body wall which may makes it difficult to penetrate by the mites. Also, Shehata et al. (1989) mentioned that this mite predates upon the immature stages of house fly mainly the eggs and first larval instar .

Results in Table 3, indicated that M. muscaedomesticae successfully controlled eggs and first larval instar of D. melanogaster with daily averages of 8.95 ± 1.29 and 5.80 ± 1.02, respectively and ranged between 4 - 15 eggs and 2 - 11 1st instar larvae.The adult females of predatory mite appeared low tendency to feed on the pupal stage of this fly, giving an average number of 0.90 ± 0.40 pupae attacked per day.

Data in Table 3, reveal that the adult mite females showed high preference to feed on the eggs of house fly more than that of drosophilid fly. An invers trend was observed according to the predation rates on the first larval instars of the two dipterous preys, where the adult females of mite were more effective on the first larval instar of D. melanogaster than that of M. domestica. The predation percents were 59.67 % for adult females mite on eggs of the drosophilid fly and 38.67% on first instar larvae and 9 % on pupae of the same fly.

Predation rates on the first instar of Collembola spp. was indicated as food consumption for M. muscaedomesticae. Other stages of collembolans were difficult to collect and capture.

As shown in Table 3, obtained results indicated that this mite had high efficiency towards the first instars of collembolans. The consumed numbers averaged 8.50 ± 1.02 first instars/mite/day with 56.6% percentage of predation.

Table 3: Average number of immature stages of M. domestica, D. melanogaster and Collembola spp. consumed by M. muscaedomesticae .

Prey stages	Average No. ± S.E. of attacked preys/day by one adult female of predator		
	M. domesticae	D. melanogaster	Collembola spp.
* Egg stage	11.70 ± 1.05	8.95 ± 1.29	-
* 1st instar larva	3.60 ± 0.45	5.80 ± 1.02	8.50@ ± 1.02
* 2nd instar larva	1.15 ± 0.24	-	-
** 3rd instar larva	0.00 ± 0.00	-	-
** Pupal stage	0.00 ± 0.00	0.90 ± 0.40	-

* = Passed from 30 preys in 10 replications.

** = Passed from 20 preys in 5 replications.

@ = 1st instar of collembolan insect.

It could be concluded that macrochelid mite had the highest effect in predation of eggs of dipterous flies followed by first instar of collembolans followed by first larval instar of dipterous flies.

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الدراسة البيولوجية للحلم المفترس ماكروكيلس مسكادومستيكا وكفاءته على بعض الحشرات

اشتملت الدراسة على جزئين رئيسيين :

أولا : تربية ودراسة بيولوجية الحلم المفترس ماكروكيلس مسكادومستيكا :

١- لقد تمت تربية هذا الحلم المفترس باعداد كبيرة معمليا على بيئة غذائية صناعية من الجلوكوز آجار تحت درجات حرارة ٢٤ ± ٥ م° ورطوبة نسبية ٦٥ ± ٥ ٪ .

٢- لقد تم تحديد الفترات المختلفة لجميع الاطوار لهذا الحلم المفترس وكانت كما يلى :

أ) فترة حضانة البيض ٨ر ± ٠٥ر يوم .
ب) طور اليرقة ٩ر ± ٠٦ر يوم .
ج) الحورية الاولى ٩ر١ ± ١٣ر يوم .
د) الحورية الثانية ٢ر٢ ± ١٩ر يوم .
هـ) دورة الحياة ٧ر٥ ± ٢٢ر يوم .
و) فترة وضع البيض لانثى الحيوان ٤ر٨ ± ٠٥ر يوم .
ز) طول حياة الحيوان الكامل (الانثى) ١ر١١ ± ٤٧ر يوم .
ل) طول فترة الحياة الكلية ٨ر١٦ ± ٥١ر يوم .

ثانيا : دراسة الكفاءة الافتراسية للحلم المفترس ماكروكيلس مسكادومستيكا :

تمت دراسة القدرة الغذائية والكفاءة الافتراسية لانثى الحلم المفترس على الاطوار الغير كاملة للذباب المنزلى وذبابة الدروسوفيلا والكولمبولا ولقد أوضحت النتائج مايلى :

١- اناث هذا الحلم كانت ذو كفاءة عالية على التغذية وافتراس بيض الذباب المنزلى أكثر منه على العمر اليرقى الاول ثم الثانى وأخيرا العذراء .

٢- كانت نسبة افتراس البيض أعلى منه فى حالة اليرقات والعذراء فى حالة ذبابة الدروسوفيلا .

٣- كانت نسبة افتراسه على الحورية الاولى للكولمبولا عالية .

٤- يعتبر هذا الحلم ذو كفاءة عالية على البيض أكثر منها على اليرقات والعذراء .

٥- يرجع ضعف التغذية على اليرقات الكبيرة والعذراء الى سمك جلد تلك الاطوار الغير كاملة .