Biology and predaceous efficiency of
Macrocheles matrius (Hull) (Acari, Mesostigmata)

By Z. R. Soliman, M. A. Zaher and M. I. Mohamed

Abstract

Macrocheles matrius (Hull) was found in great numbers and fed variously on house fly
eggs and larvae during its different stages except larvae which proved to be unfeeding stage.
The female of this species consumed an average of 12.9 and 118.4 eggs during immature
stages and adult stages respectively. Feeding on house fly eggs increased the female predator
fecundity and prolonged oviposition period. The number of deposited eggs per female
averaged 63.8 and 40.7 eggs when fed on house fly eggs and larvae respectively. Generation
period (from egg to egg) averaged 4.9 and 6.0 days when fed on house fly eggs and larvae
respectively.

1 Introduction

Axtell (1963) recorded seven species of macrochelid mites in manure and
suggested that more than one species were important predators of house fly.
Fillipponi (1955, 1960) studied the association of macrochelids and the
house fly and he pointed that the house fly transported the mite to any other
egg-laying site.
Rodriguez et al. (1962) mentioned that the emerging house flies trans-
ported M. muscaedomesticae to the oviposition site during the fly season.
The objective of the present investigation is to study the biology, pred-
aceous capacity and reproductive potentiality of the predatory mite Macro-
cheles matrius (Hull). This work may throw light on the role of this pred-
ator in checking the soil pests in nature.

2 Materials and methods

2.1 Rearing procedure of mites

A glass ring of 15 mm deep and 20 mm in diameter was fixed by paraffin wax on a glass
slide. Bottom of the resultant chamber was covered with plaster of paris to five millimeters,
than a thin layer of soil was added and kept moistened. Adult females of the predaceous
mite were placed in such prepared rings supplied with prey. Another glass slide was
placed over the ring and fastened with rubber bands. A piece of tissue paper was put in
the rearing ring which contained Macrocheles matrius, for hiding and oviposition site.
Females were left in these chambers to deposit eggs and transferred daily to new rings for estimation of incubation periods and fecundity. Newly hatched larvae were put singly in rearing rings of 13 mm deep and 12 mm in diameter with the previous mentioned substrate and were supplied with known numbers of prey as food. Mite individuals were left in these rearing chambers till maturity and were examined three times daily to count the attacked preys and replaced by fresh ones and to observe the fast development of different stages.

### 2.2 Rearing procedure of house fly

The house fly pupae were placed on wet cotton pads in small petri dishes. These pads were moistened daily to secure enough humidity essential for moth emergence. Each petri dish was kept inside a wooden emergence and oviposition cage of 43 cm long, 29 cm wide and 35 cm high, with two lateral and posterior sides covered with 16 mesh wire gauze. A clothen sleeve was fixed firmly on an opening of 11-5 cm in diameter in the anterior side. A cotton pad saturated with milk kept in a petri-dish placed inside the cage for feeding and serve as oviposition site.

Eggs were collected twice daily from the cotton pad, which was changed and replaced with another fresh one.

Maggots were reared in clear plastic containers of 11.0 cm deep and 10.0 cm in diameter. An opening of 4.0 cm in diameter was made in the centre of each container lid, and covered with fine metal screen to prevent excess moisture.

Each container was filled to 8.0 cm deep with maggots medium, which consists of 300 gm bran, 19 gm fresh yeast, 10 ml cidmalt and 200 ml water. Finally the pupae were transferred to emergence cages.

### 3 Results

#### 3.1 Habitat and behaviour

Members of the macrochelid mite, *Macrocheles matrius* were collected from organic manure and Pigeon droppings. In these habitats they were found associated with the different stages of the house fly, *Musca domestica vicina* Macq. On the other hand this species was also found on the rot onion bulb *Allium cepa* L. associated with the different stages of bulb fly *Delia antiqua* Meig., the acarid mite *Rhizoglyphus echinopus* (Fum. & Rob.) and free-living nematodes.

*M. matrius* was observed to feed on eggs and larvae of the house fly, eggs of *D. antiqua* and on free-living nematodes, while it could not attack the acarid mite *R. echinopus*. The hypopial stage of the mite was found phoretic on the adult stage of this predator. The larvae changed to protonymphs without consuming any prey.

The predaceous mite preferred humid environments. The female also preferred to deposit its eggs in hidden place as it required an oviposition site; thus, a piece of tissue paper was put in the rearing ring. All of the different immature stages were active and moved rapidly.

Cannibalism sometimes occurred in this species. It was observed that some adults attacked their immature stages especially in the case of prey shortage.

#### 3.2 Oviposition

The female of *Macrocheles matrius* began oviposition after a period which varied according to the type of food. This period ranged from one to two
days with an average of 1.5 ± 0.04 days when female fed on the house fly eggs, while it prolonged to 1.5–3.0 days with an average of 2.2 ± 0.2 days when it fed on house fly larvae at 30°C. The female preferred to deposit its eggs in hidden places as it required an oviposition site. Thus, a wet piece of tissue paper was put in a rearing chamber. The female laid its eggs singly and sometimes arranged in small groups of two or four eggs. Here again the number of deposited eggs per female varied according to the type of food. This number ranged from 56 to 86 eggs with an average of 63.8 ± 3.7 and a daily rate of 3.1 eggs, when female fed on the house fly eggs. On the other hand, this number ranged from 29 to 58 eggs with an average of 40.7 ± 3.1 and a daily rate of 2.4 eggs when fed on larvae (table 1). Thus feeding on house fly eggs increased the female predator fecundity.

**Table 1. Effect of food type on female fecundity of *M. matrius* at 30°C**

<table>
<thead>
<tr>
<th>Food</th>
<th>Number of deposited eggs per female</th>
<th>Pre-oviposition</th>
<th>Average duration in days</th>
<th>Post-oviposition</th>
<th>Longevity</th>
</tr>
</thead>
<tbody>
<tr>
<td>House fly eggs</td>
<td>63.8 ± 3.7</td>
<td>1.5 ± 0.04</td>
<td>20.4 ± 1.3</td>
<td>4.4 ± 0.5</td>
<td>26.3</td>
</tr>
<tr>
<td>House fly larvae</td>
<td>40.7 ± 3.1</td>
<td>2.2 ± 0.2</td>
<td>17.0 ± 1.2</td>
<td>5.4 ± 0.6</td>
<td>24.6</td>
</tr>
</tbody>
</table>

The oviposition period averaged 20.4 ± 1.3 days with a minimum and maximum of 16.5 and 28 days respectively, when feeding on prey eggs. This period decreased to 17.0 ± 1.2 days in average with a minimum and maximum of 12.0 and 24.0 days respectively when feeding on prey larvae (table 2).

**Table 2. Effect of food type on *M. matrius* female longevity at 30°C**

<table>
<thead>
<tr>
<th>Food</th>
<th>Average duration in days</th>
<th>Post-oviposition</th>
<th>Longevity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs</td>
<td>20.4 ± 1.3</td>
<td>4.4 ± 0.5</td>
<td>26.3</td>
</tr>
<tr>
<td>Larvae</td>
<td>17.0 ± 1.2</td>
<td>5.4 ± 0.6</td>
<td>24.6</td>
</tr>
</tbody>
</table>

The post oviposition period averaged 4.4 ± 0.5 and 5.4 ± 0.6 days when feeding on house fly eggs and larvae respectively (table 2).

### 3.3 Development

The egg is white and oval. The fertilized one measures 447.21 µ in length and 298.14 µ in width, while unfertilized measures 406.8 µ in length and 271.2 µ in width. The incubation period lasted 0.5 day at 30°C. During hatching a transverse slit occurred in the tapering end of an egg from which the hatching larva crawled outside.

Both sexes of *M. matrius* underwent through three active stages (larva, protonymph and deutonymph) before reaching adult. Each of these stages when full-grown and before changing to the subsequent one passed through a semi-quiescent stage during which the individual ceased only feeding for some time before molting.
After hatching, larva stopped for some time beside egg shell then it began to move actively. It was white, small and did not feed during this stage which lasted about 0.5 day for both sexes at 30°C (table 3). After this period it entered the first semi-quiescent stage before changing to the subsequent one.

Table 3. Duration of *M. matrius* different stages fed on eggs or first instar larvae of house fly at 30°C

<table>
<thead>
<tr>
<th>Prey</th>
<th>Predator sex</th>
<th>Average period in days</th>
<th>Generation</th>
<th>Longevity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Larva</td>
<td>Protonymph</td>
<td>Deutonymph</td>
</tr>
<tr>
<td>Eggs</td>
<td>♂️</td>
<td>0.5 ± 0.0</td>
<td>1.1 ± 0.03</td>
<td>1.3 ± 0.04</td>
</tr>
<tr>
<td></td>
<td>♀️</td>
<td>0.5 ± 0.0</td>
<td>0.9 ± 0.1</td>
<td>1.1 ± 0.1</td>
</tr>
<tr>
<td>Larvae</td>
<td>♂️</td>
<td>0.5 ± 0.0</td>
<td>1.2 ± 0.08</td>
<td>1.6 ± 0.1</td>
</tr>
<tr>
<td></td>
<td>♀️</td>
<td>0.5 ± 0.0</td>
<td>0.9 ± 0.06</td>
<td>1.3 ± 0.09</td>
</tr>
</tbody>
</table>

After larval moulting, the protonymph emerged. It was larger in size and more active than the larva and fed during its moving stage. The period of protonymphal stage slightly differed according to type of food but mainly to sex as the male developed faster. The duration of this stage, for male and female, averaged 0.9 ± 0.1 and 1.06 ± 0.03 days when fed on eggs and 0.9 ± 0.06 and 1.2 ± 0.08 days when fed on prey larvae at 30°C respectively.

When the protonymph became full-grown it entered the second semi-quiescent stage, from which the deutonymph emerged. It was larger than protonymph and lasted for a period slightly longer than protonymph. This period averaged 1.1 ± 0.1 days for male and 1.3 ± 0.04 days for female when fed on eggs and 1.3 ± 0.09 days for male and 1.6 ± 0.1 days for female when fed on larvae. After being full-grown the deutonymph entered the third semi-quiescent stage, then changed to adult.

Thus the total period of the immature stages differed according to sex and type of food, being slightly shorter for male and when feeding on prey eggs. This period for male and female averaged 2.5 and 2.86 days when fed on prey eggs and 2.7 and 3.3 days when fed on larvae respectively. On the opposite to immatures, adult longevity was longer on prey eggs than on prey larvae. Male and female longevity averaged 19.3 and 26.3 days when fed on house fly eggs and 16.1 and 24.6 days when fed on larvae respectively.

The generation period (from egg to egg) of *M. matrius* averaged 4.9 days with a range from 3.5 to 6.5 days when feeding on house fly eggs. This period prolonged to 6.0 days in average with a minimum and maximum of 4.5 and 7.5 days respectively when feeding on the prey larvae at 30°C.

*M. matrius* proved to be arrhenotokous as parthenogenetic progeny developed into males. The sexual reproduction gave a sex ratio of 50% of each sex.

### 3.4 Predaceous efficiency

During this course of investigation it was found that the predatory mite *M. matrius* did not feed on the acarid mite *Rhizoglyphus echinopus* which
was found associated with in great numbers in the rot onion bulbs, *Allium capa*. It was observed that the adult stage fed on the eggs of *Delia antiqua* found on the rot onion bulbs. The predatory mite also fed voraciously on free-living nematodes but it could not reproduce.

During the biological studies of this species, eggs and first-instar larvae of the house fly *Musca domestica vicina* were used as the main source of food for the different mite stages. The predator attacked the prey eggs from any side but mostly in the middle while, it attacked the larvae from the broad side at the posterior end. The predator then sucked the contents of the prey from one place till absorbing all of the body contents.

Although the predator larva changed to the successive stage without feeding, yet the proto- and deutonymph fed voraciously on house fly eggs or larvae. The female and male protonymph consumed an average of $5.5 \pm 0.46$ and $4.8 \pm 0.1$ eggs or $4.5 \pm 0.9$ and $3.6 \pm 0.08$ larvae respectively (table 4). The female and male deutonymph fed on an average of $7.4 \pm 0.62$ and $6.8 \pm 0.5$ eggs or $6.8 \pm 0.5$ and $6.0 \pm 0.42$ larvae respectively (table 4). Thus the female and male immature consumed a total of $12.9$ and $11.6$ eggs or $11.3$ and $9.6$ larvae respectively.

<table>
<thead>
<tr>
<th>Prey</th>
<th>Protonymph</th>
<th>Deutonymph</th>
<th>Total</th>
<th>Average</th>
<th>Daily rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eggs</td>
<td>$5.5 \pm 0.46$</td>
<td>$7.4 \pm 0.62$</td>
<td>$12.9$</td>
<td>$118.4 \pm 5.3$</td>
<td>$4.5$</td>
</tr>
<tr>
<td>Larvae</td>
<td>$4.5 \pm 0.9$</td>
<td>$6.8 \pm 0.5$</td>
<td>$11.3$</td>
<td>$101.0 \pm 2.2$</td>
<td>$4.1$</td>
</tr>
</tbody>
</table>

The adult proved to be the most efficient stage and this might be due to its longer longevity and larger size. The adult female, during its longevity, consumed an average of $118.4 \pm 5.3$ eggs with a daily rate of $4.5$ eggs, while the adult male consumed an average of $76.4 \pm 3.8$ eggs with a daily rate of $4.0$ eggs. On the other hand the adult female and male consumed an average of $101.0 \pm 2.2$ and $69.8 \pm 1.3$ larvae with a daily rate of $4.1$ and $4.3$ larvae respectively.

The whole number of consumed house fly eggs or larvae by the male predator was proportionally smaller when compared with that consumed by the female. This could be attributed to the shorter life span of male as well as its small predation capacity. Protonymph, deutonymph and adult stage of both sexes preferred to feed on the house fly eggs than on larvae. The total number of consumed eggs during the predator life span averaged $88.0$ and $131.3$ eggs for the male and female respectively; that of larvae averaged $79.4$ and $112.3$ individuals respectively.
Zusammenfassung

Zur Biologie und räuberischen Effektivität von Macrocheles matrius (Hull) (Acari, Mesostigmata)


References


Department of Economic Entomology and Insecticides, Faculty of Agriculture, Cairo University

Biological and ecological studies on the house cricket, *Acheta domesticus* L. (Orthopt., Gryllidae) in Giza region, Egypt

By I. I. ISMAIL

With 1 figure

Abstract

The duration of egg stage, nymphal stage, mating, adult longevity, fecundity, sex ratio and life cycle of *Acheta domesticus*, under laboratory conditions were determined. Notes are given also on the distribution, food, seasonal abundance and the effect of weather factors on the population density of the cricket in Giza region, Egypt. The average duration of the developmental stages were 12.4 days for egg incubation period and 40.12 and 39.40 days for the total female and male nymphal stages, respectively.

The insects fed on mixture diet lived longer than those fed on plant diet (corn) or animal diet (pupae and eggs of cotton leaf worm). The females fed on animal diet layed the highest number of eggs (641), while those feed on plant diet or mixture diet layed the lowest numbers (337 and 410). The average life cycle was 49.4 days. The females dominated