*ACARINES: Journal of the Egyptian Society of Acarology 1:23-27, 2007*

# Some Ecological and Biological Studies on *Typhlodrompis swirskii* (Athias-Henriot) (Acari: Phytoseiidae)

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## ABSTRACT

Relative humidity of 70 to 85% proved to be the most suitable for *Typhlodrompis swirskii* (Athias-Henriot) at 25ºC as it accelerated development (10.0 & 10.8 days) and increased female fecundity (13.0 & 12.0 eggs/♀/10 days) on *Eutetranychus. orientalis* immatures. Low temperature (5 & 9ºC) prolonged egg incubation and decreased hatchability as well as female survival. After one to four weeks, egg hatchability ranged from 90 to 50% and from 100 to 64% and female survival from 50 to 0% and from 80 to 10% at 5 and 9ºC, respectively. Multiple mating due to male company through the whole female longevity or sporadically for 12 hours every 5 days increased female fecundity and longevity as it averaged 47.0 & 35.0 eggs and 37.6 & 35.0 days compared with 25.0 eggs and 29.2 days for once mated female. For food attraction and /or kairomone emitted that affects predator, *T. swirskii* females showed greater percentage of attractance in a shorter period to more advanced prey stage and to mites than insects tested. Also fed females showed more attraction than 24 starved females and the latters better than 48 hours starved ones. *E. orientalis* adults gave the greatest percentage attraction (60%) in the shortest time (3.20 minutes) for fed female, while castor been pollens gave the smallest (1%) and the longest time (121.6 minutes). Host plants of different leaf texture, affected female fecundity, averaging the greatest (15.8 eggs/♀/10 days) on smooth leathery leaf of grape fruit, while coarse reticulated leaf of guava resulted in the least number of deposited eggs (10.8 eggs/♀/10 days).

**KEY WORDS:** *Typhlodrompis swirskii*, Phytoseiidae, biology, low temperature, R. H. %, mating, attraction, host plant.

## INTRODUCTION

Different ecological and biological factors such as relative humidity, low temperature, multiple mating, attraction of predator to its prey and host plant leaf surface have some effects on the bioactivities of plant inhabiting mites including the phytoseiids of which some are considered of great economic importance as biocontrol agents. Of these factors, atmospheric relative humidity and temperature are important that determine the existence of a mite in a certain locality as it affects female mite survival and oviposition (Gillespie and Ramey, 1988, and Takahashi and Chant, 1994).

Observations on mating behavior of the phytoseiids were reported by Shehata, (1967), Amano & Chant (1978), Overmeer *et al*. (1982) and several others. Many species oviposit only after insemination of which some females accept only one copulation, while others receive more than one. Kairomones is an interspecific messenger substance that benefits the receiver i.e., the predator but not the releaser i.e., prey. This phenomenon is an important factor in pest biological control. Also leaf surface texture has an obvious influence on the biology of phytoseiids (Rasmy, 1977, and Fouly, 1982). On the other hand, (Walter 1992) found a relationship between both morphology and occurrence of phytoseiid mites and leaf surface texture.

*Typhlodrompis swirskii* (A. H.) is a worldwide phytoseiid predator and common in Egypt on different fruit trees (Zaher, 1986). Therefore, the objective of this study was to contribute a better understanding on the effect of relative humidity, low temperature, multiple mating, attraction of the predator to different prey and pollen grains and host plant leaf surface on the tested predatory mite *T. swirskii*.

## MATERIALS AND METHODS

Culture of *T. swirskii* was established in the Acarology laboratory of the Faculty of Agriculture, Cairo University. To investigate the effect of some ecological factors on this predatory mite the following experiments were conducted.

**Effect of Relative Humidity:**

Four groups each of 20 newly deposited eggs were confined solitary to upper surface of mango leaf discs kept on wet cotton wool pads in Petri dishes. The hatched larvae were supplied with immatures of the citrus brown mite *Eutetranychus orientalis* (Klein) till reaching adulthood. Emerging females were mated with fresh males and couples were kept each on a leaf disc to oviposit for 10 days. Experiment was undertaken in dissectors with different solutions of glucose NaCl, KCl and $H_2O$ to maintain four relative humidities 55, 70, 85 and 95% at 25ºC for the four groups.

**Effect of Low Temperature:**

Eight groups, each of 20 newly deposited eggs of *T. swirskii*, were placed on mango leaf discs in a covered cylindrical plastic cup (2.8 cm diameter and 2 cm deep) with filter paper on its bottom. Relative humidity was maintained by adding few water drops on the filter paper when needed. Four cups were kept at 9$^o$C and the other four at 5$^o$C. One cup with 20 eggs for every temperature was moved to room temperature after one, two, three and four weeks. Egg incubation period and hatchability were recorded. Also, eight groups each with 20 newly emerged and mated females were confined singly to Munger cages (Munger, 1942) at 9$^o$C and 5$^o$C. Cages were supplied with the citrus brown mite *E. orientalis* (Klein) immatures when needed as prey and kept at the two aforementioned temperature degrees. One group of adult predator females of every temperature degree was moved to room temperature after one, two, three and four weeks of cooling at 9 and 5$^o$C to examine female survival, preovipostion and oviposition periods, number of oviposited eggs and hatchability percentage.

**Effect of Single and Multiple Mating:**

Three groups, each with 10 *T. swirskii* newly emerged females, confined singly to mango leaf discs of 4cm$^2$, were placed on wet cotton wool pads in glass Petri dishes (9cm in diameter). A young male was introduced to every female of the three groups. After first copulation occurred, males were taken away from females of the first and second group, while those of the third group were left with females to live as couples allover females longevity. A newly young male was introduced to every female of the second group for 12 hours sporadically every 5 days for copulation and removed throughout female longevity. Experiment was carried out at 25$^o$C, 70 ± 5% R.H. and 12 hours light. *E. orientalis* immatures were used as prey and female longevity and fecundity were recorded.

**Attraction to Different Prey and Pollens:**

*T. swirskii* females were tested singly to investigate the attraction to different prey species and stages; eggs, immatures and adults of the citrus brown mite *E. orientalis* and the spider mite *Tetranychus urticae* Koch; eggs and immatures of the flat mite *Cenopalpus pulcher* (C.&F.); eggs and 1$^{st}$ & 2$^{nd}$ instars of the whitefly nymph *Bemisia tabaci* (Gennadius); adults of the aphid *Aphis duranta* Theo; and the moving stages of the eriophyid mite *Cisaberoptus kenyae* Keifer; and the pollen grains of the date palm and castor bean at Laboratory temperature 25$^o$C ± 1$^o$C. Eight adults, 15 immatures and 20 eggs of each prey and 30 individuals of the eriophyid mite were used in the three experiments. Tested Prey individuals were placed upside down attached to a small piece of both side sticky scotch tape stuck on circumference of a wide mango leaf disc, 4cm diameter, at equal distances about 1 cm from each other. Ten of each fed and 24 & 48 hours starved predator females were put singly in a successive order in the center of the leaf disc and kept under observation till reaching its preferable food.

**Effect of Host Plant Leaf Surface:**

Leaf discs of different surface texture were used as substratum. Three leaves were of grape fruit (*Citrus paradisi* (McFad), young mango leaves (*Mangifera indica* L.) as a thick smooth surface, mulberry (*Morus alba* L.) and bauhinia (*Bauchenia verie-gata*) as smooth reticulated surface and guava (*Psidium guajava* L.) as coarsely reticulated surface. The leaf discs were put on wet cotton wool pads in Petri dishes (9 cm in diameter). Twenty newly emerged and mated *T. swirskii* females were confined singly together with surplus *E. orientalis* immatures as prey on leaf discs of about one square inch of every plant and kept for oviposition. Deposited eggs per female were recorded daily for the first 10 days of the oviposition. Experiment was conducted at 25$^o$C and 70% ± 5% R.H. and observations were undertaken daily.

## RESULTS AND DISCUSSION

Climatic conditions play an important role in determining the occurrence of a mite in certain locality. Of these conditions, relative humidity is an important factor. Present experiment showed that relative humidity of 70 & 85% proved to be the most suitable for *T. swirskii* at 25$^o$C as it accelerated development (10.0 & 10.8 days) and increased female fecundity (13.0 & 12.0 eggs/10 days) respectively. Before and after this limit reverse results occurred Table (1). Rearing *Galendromus helveolus* (Chant), Caceres (1990) found no significant differences in its developmental time at R.H. from 76% to 100% at 25$^o$C.

During laboratory mass rearing, cold storage can be practiced when prey is scarce or other food deficiency. In addition, temperature usually drops to 10$^o$C or less during some winter nights in upper Egypt. Thus, for these two reasons experiment was conducted to investigate the effect of low temperature at 9 and 5$^o$C on *T. swirskii*. Table (2) showed the effect of low temperature at the two previously mentioned temperatures on *T. swirskii* egg incubation and hatchability as well as female survival after 1 to 4 weeks. Egg hatchability ranged from 100% to 64% and from 90% to 50% at 9 and 5$^o$C respectively. Also, female survival changed from 80% to 10% and from 50% to 0% at the two tested temperature degrees and durations respectively. Thus, it is clear that eggs tolerate low temperature than females. Accordingly, when food is scarce, the eggs can be stored for a month at low temperature of 9°C or less. (Gillespie and Ramy 1988) found that *Neoseiulus cucumeris* (Oudemans) (=*Ambly-seius cucumeris* Oudemans) female survival decreased from 86.9% after 2 weeks to 63% after 10 weeks at 9°. In the same respect, (Ali *et al* 1997) reported that hatch-ability of *Phytoseiulus macropilis* (Banks) eggs changed from 100 to 84% at 10°C and from 100 to 60% at 5°C, while female survival ranged from 100 to 10% and from 90 to 0% at the two temperature degrees respectively, after 1 to 8 weeks. Similar results were also found by (Abou El ella 1998) on *Amblyseius deleoni* (Muma and Denmark).

Some females of the family Phytoseiidae accept only one copulation, while others can be copulated more than once. Multiple mating significantly increased *T. swirskii* female fecundity and prolonged its longevity (47.0 eggs & 37.6 days) for full company with male followed by (35.0 eggs & 35.0 days) when male was introduced to female for copulation every 5 days. Female copulated once gave the lowest egg production (25.0 eggs) and shortest longevity (29.2 days). Moreover, female percentage was greater in the progeny of multiple mated females (70.1%) than in single mated ones (55.0%) Table (3). Amano and Chant (1979) reported that multiple complete mating resulted in transfer of one or two large spermatophores in every one of the two spermathicae. This usually occurred in females of laboratory colonies. However, the spermatophores, usually disappeared in old females, while in older females some had another spermatophore due to repeated mating (Overmeer *et al* 1982). Abou El-Ella (1998) found that *A. deleoni* (Muma and Denmark) females confined with males as couples during its longevity deposited greater number of eggs in a shorter period than those coupled with male for 24 hours every 10 days or females copulated once.

Response of the predator to its prey due to kairomones emitted by the prey play an important role in biological control. Kairomones are specific as that attract one predator does not attract others. Also infested leaves are kept attractant to the predator for sometime after removing the pest (Sabilis & van de Baan, 1983). Table (4) indicated that *T. swirskii* females showed hierarchy of preference for Kairomones released from different prey or pollens. *T. swirskii* females showed greater percentage of attractance in a shorter period to more advanced prey stage and to mites than insects tested. *E. orientalis* adults gave the highest attraction 60% in the shortest time 3.2 minutes for fed females. This is followed in a descending order by *E. orientalis* immatures 8% & eggs 5% ; date palm pollen 10%; *C. pulcher* (C. & F.) immatures 4% & eggs 2%; *T. urticae* Koch adults 2%, immatures 1% & eggs *B. tabaci* 2nd & 1st instar nymph 2 & 1%; *A. duranta* adults 1%; the eriophyid *C. kenyae* moving stages 1% and castor bean pollens 1%. The time required for fed *T. swirskii* female to reach its food ranged from 3 minutes for *E. orientalis* adults to 121.6 minutes for castor bean pollens. The fed predator females generally showed more attraction percentage and in shorter time than those starved for 24 hours and the latters less than females starved for 48 hours Table (4). This may be due to the weakness of the starved females.

Table (1): Effect of relative humidity on egg hatchability, life cycle and female fecundity of *Typhlodrompis swirskii* fed on *Eutetranychus orientalis* at 25°C

| R.H. | 55% (glucose) | 70% (NaCl) | 85% (KCl) | 95% ($H_2O$) |
|---|---|---|---|---|
| Hatching % | 100% | 100% | 100% | 100% |
| Incubation period (days) | 4.0 ± 0.70 | 3.0 ± 0.70 | 3.0 ± 0.71 | 4.0 ± 0.70 |
| Life cycle (days) | 11.2 ± 0.44 | 10.0 ± 0.70 | 10.8 ± 0.44 | 11.0 ± 0.70 |
| No. of eggs/♀ for 10 days | 10.0 ± 0.74 | 13.0 ± 0.71 | 12.0 ± 0.70 | 9.0 ± 0.71 |

Table (2): Effect of low temperature on *Typhlodrompis swirskii* egg incubation period, hatchability, female survival and pre-oviposition period when fed on *Eutetranychus orientalis*

| | Cold storage time | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1 week | | 2 weeks | | 3 weeks | | 4 weeks | |
| | 9°C | 5°C | 9°C | 5°C | 9°C | 5°C | 9°C | 5°C |
| Incubation period (days) A.C.S. | 4.0 ± 0.70 | 5.0 ± 0.70 | 5.0 ± 0.40 | 7.0 ± 0.00 | 7.0 ± 0.54 | 11.0± 0.01 | 9.0 ± 0.44 | 15.0 ± 0.45 |
| Hatchability % | 100 | 90 | 88 | 85 | 79 | 75 | 64 | 50 |
| Female survival % | 80 | 50 | 70 | 20 | 50 | 5 | 10 | 0 |
| Pre-oviposition period (days) | 10 ± 0.45 | 14 ± 0.71 | 13 ± 0.63 | 20 ± 0.43 | - | - | - | - |
| Hatchability of eggs % | 70 | 60 | 40 | 10 | 12 | - | 4 | - |

A.C.S.= After cold storage

Table (3): Effect of single and multiple mating on *Typhlodrompis swirskii* female longevity and fecundity and sex ratio when fed on *Eutetranychus oreintalis* at 25°C

| Matings | No. of eggs/female | Female longevity (Days) | Female % |
|---|---|---|---|
| Female + male allover longevity | 47.0 ± 0.73 | 37.6 ± 0.54 | 70.1 |
| Female + male 12 hours every 5 days | 35.0 ± 0.71 | 35.0 ± 0.70 | 70.1 |
| Single mating | 25.0 ± 0.70 | 29.2 ± 0.44 | 55.0 |

Table (4): Attraction of *Typhlodrompis swirskii* female to different prey and pollens at 25°C

| Food | Time in minutes for predator ♀ to reach prey and pollens | | | |
|---|---|---|---|---|
| | Fed | Starved (24 h) | Starved (48 h) | Attraction % |
| *E. orientalis* | | | | |
| Adults | 3.20 ± 1.03 | 8.20 ± 0.78 | 10.70 ± 0.82 | 60 |
| Immatures | 6.10 ± 0.87 | 9.30 ± 1.05 | 12.90 ± 0.73 | 8 |
| Eggs | 10.70 ± 0.82 | 13.00 ± 0.81 | 70.00 ± 0.81 | 5 |
| Date palm pollen | 7.20 ± 0.78 | 10.80 ± 0.78 | 14.40 ± 0.96 | 10 |
| *C. pulcher* | | | | |
| Immatures | 13.80 ± 0.91 | 17.80 ± 0.78 | 23.90 ± 0.73 | 4 |
| eggs | 16.30 ± 0.67 | 20.90 ± 0.87 | 28.20 ± 0.78 | 2 |
| *T. urticae* | | | | |
| Adults | 19.40 ± 0.96 | 24.10 ± 0.73 | 31.40 ± 0.78 | 2 |
| immatures | 34.20 ± 0.78 | 39.40 ± 0.96 | 45.10 ± 0.73 | 1 |
| eggs | 43.30 ± 0.94 | 50.20 ± 1.03 | 53.70 ± 0.82 | 1 |
| *B. tabaci* | | | | |
| 2nd instar nymph | 47.60 ± 0.96 | 53.70 ± 0.67 | 59.30 ± 0.94 | 2 |
| 1st instar nymph | 51.10 ± 0.73 | 57.20 ± 0.78 | 64.10 ± 0.87 | 1 |
| Eggs | 56.90 ± 0.87 | 62.70 ± 1.15 | 67.90 ± 0.73 | 1 |
| *A. duranta* | | | | |
| Adults | 67.60 ± 0.96 | 73.90 ± 0.99 | 81.30 ± 0.94 | 1 |
| *C. kenyae* | | | | |
| moving stages | 81.20 ± 1.03 | 91.30 ± 0.94 | 97.50 ± 1.26 | 1 |
| Castor bean pollens | 121.60 ± 1.50 | 141.60 ± 1.07 | 162.0 ± 1.33 | 1 |

Table (5): Effect of host plant leaf surface on female *Typhlodrompis swirskii*, development and oviposition, when fed on *Eutetranychus orientalis*

| Plant | Life cycle (days) | No. of eggs/♀/10 days |
|---|---|---|
| *Citrus paradisi* (Grape fruit) | 8.85 ± 1.21 | 15.80 ± 1.09 |
| *Mangifera indica* (Mango) | 10.80 ± 1.09 | 13.20 ± 0.83 |
| *Malus sylvestris* (Apple) | 11.60 ± 0.54 | 12.60 ± 0.54 |
| *Morus alba* (Mulberry) | 11.83 ± 0.75 | 11.50 ± 0.54 |
| *Bauchenia veriegata* (Bauhinia) | 12.16 ± 0.40 | 11.20 ± 0.44 |
| *Psidium guajava* (Guava) | 12.60 ± 0.54 | 10.80 ± 0.44 |

Other ecological factor is plant leaf surface texture. It showed obvious influence on *T. swirskii* biology. Smooth leathery leaf of grape fruit accelerated development and increased female fecundity (8.85 days and 15.8 eggs/10 days), while coarse reticulated leaf of guava gave opposite results (12.6 days and 10.8 eggs/10 days) (Table 5). Moderate results occurred on leaves with textures ranged between the two above mentioned host plants. Accordingly, coarse texture of the leaf may hinder the searching capacity of the predator. However, other factors such as leaf glands, chemical and water contents may have effects on the acarine prey and predator biology and occurrence. Finally, it can be concluded that the aforementioned ecological factors showed obvious effects on the different activities of the phyoseiid predator *T. swirskii*. These factors may be put in consideration with regard to the predatory mite mass rearing cultures and to its occurrence in the field.

## REFERENCES


Ali, Fatma S; Mowafi, M. M. and El-Sherif, A. A., 1997. Some factors affecting the biology of the predatory mite, *Phytoseiulus macropilis* (Banks) (Acari: Phytoseiidae). Bull. Ent. Soc. Egypt., 75 (19): 19-26.

Abou-Elella, G. M. A., 1998. Studies on certain aspects of some predaceous phytoseiid mites. Ph. D. Thesis, Fac. of Agric., Cairo University, 183 PP.

Amano, H. and Chant, D. A., 1979. Mating behaviour and reproductive mech-anisms of two species of predaceous mites, *Phytoseiulus persimilis* Athias- Henriot and *Amblyseius andersoni* (Chant) (Acarina: Phytoseiidae). Acarologia, (20): 196-213.

Blommers, L., 1976. Some Phytoseiidae (Acarina: Mesostigmata) from Mada-gascar, with description of eight new species and notes on their biology. Bijdrangen Tot de Dierkunde. (46): 81-105.

Caceres, S., 1990. Biology and life tables of *Galendromus helveolus* (Chant) (Acari: Phytoseiidae), a spider mite predator, on Florida citrus. M. Sc. Thesis, Graduate School, Florida Univ., 62 PP.

Fouly, A. H., 1982. Studies on Phytoseiid mites. M. Sc. Thesis, Fac. Agric., Mansoura Univ., 93 PP.

Gillespie, D. R. and Ramey, C. A., 1988. Life history and cold storage of *Amblyseius cucumeris* (Acarina: Phytoseiidae). J. Ent. Soc. Br. Columbia, 85 (31): 71-76.

Kennet, C. E., 1958. Some predaceous mites of the subfamilies Phytoseiinae and Aceosejinae (Acarina: Phytoseii-dae, Aceosejidae) from central California with description of new species. Ann. Ent. Soc. Am., (51): 471-479.

Overmeer, W. P. J.; Doodeman, M. and van Zon, A. Q., 1982. Copulation and egg production in *Amblysius potentillae* and *Typhlodromus pyri* (Acari: Phytoseiidae). Z. ang. Ent.,(93): 1-11.

Rasmy, A. H., 1977. Predatory efficiency and biology of the predatory mite *Amblyseius gossipi* (Acarina: Phytoseiidae) as affected by plant surfaces. Entomophaga, (22): 421-423.

Sabelis, M. W. and van de Baan, H. E., 1983. Location of distant spider mite colonies by phytoseiid predators: demonstration of specific kairomones emitted by *Tetranychus urticae* and *Panonychus ulmi*. Entomol. Exp. Appl., (33): 303-314.

Shehata, K. K., 1976. Survey and biological studies on mites of family Phytoseiidae and its economic importance Ph.D. Thesis, Fac. Agric., Cairo Univ., 371 PP.

Takahashi, Fumio and Chant, D. A., 1994. Adaptive strategies in the genus *Phytoseiulus* Evans (Acari: Phytoseiidae) survivorship and reproduction. Internat. J. Acarol., 20 (2): 87-97.

van der Merwe, G. G., 1968. A taxonomic study of the family Phytoseiidae (Acari) in south Africa with contributions to the biology of two species. Ent. Mem. Dep. Agric. Tech. Serv. Repub. S. Afr., (18): 1-198.

Walter, D. E., 1992. Leaf surface structure and the distribution of *Phytoseiulus* mites (Acarina: Phytoseiidae) in south Australian forests. Aust. J. Zool., 40: 593-603.

Zaher, M. A., 1986. Survey and Ecological studies on Phytophagous, Predaceous and soil mites in Egypt. II- Predaceous and Non-Phytophagous Mites. PL 480 Program, U.S.A., Fac. Agric., Cairo Univ. Egypt., 567 PP.