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BIOLOGICAL ASPECTS AND LIFE TABLE PARAMETERS ON TWO PHYTOSEIID MITES FED ON *Petrobia tritici* KANDEEL, EL-NAGGAR AND MOHAMED (Acari: Phytoseiidae, Tetranychidae)

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ABSTRACT

Development, consumption rate, fecundity and life table parameters of both predatory mites, Amblyseius swirskii (Athias-Henriot)and Typhlodromus pyri Scheuten fed on the phytophagous mite, Petrobia tritici Kandeel, El-Naggar and Mohamed were studied under laboratory conditions of 25±2°C and 70±5% R.H.. Developmental stages of mite female of both A. swirskii and T. pyri fed on nymphs of P. tritici durated (9.75 and 11.4) days, respectively. Preoviposition, oviposition, postoviposition periods and adult longevity lasted (2.05&1.75); (20.3&16.4); (2.55&1.7) and (24.9&19.19.85) days for the two predatory mite species, respectively.

The calculated life table parameters were, the mean generation time (T) was (16.33 & 18.55); The doubling time (DT) was (2.75& 4.68); The intrinsic rate of natural increase (r_m) and finite rate of increase (λ) were (0.19 & 0.15) and (1.20 & 1.16), respectively; while the net reproductive rate (R_o) was (20.5 and 15.71); and Gross reproductive rate (GRR) was (25.17&18.86) for A. swirskii and T. pyri, respectively.

Total fecundity (45.7&34.9 eggs), as well as, total prey consumption (131.8 & 90.2 nymphs) of A. swirskii significantly surpassed those of T. pyri.

The two predators were successfully developed from larva to adult when fed on the prey. A. swirskii the best predator to suppress P. tritici than T. pyri.

Key words: Biological aspects, *Amblyseius swirskii*, *Typhlodromus pyri*, intrinsic rate of increase, life table parameters.

INTRODUCTION

Predacious mites of the family Phytoseiidae are cosmopolitan and play role as natural enemies of several mite pests on various crops (McMurtry, 1977; Bonde, 1989; El-Laithy and Fouly 1992; Fouly, 1997;

McMurtry & Croft 1997; Shrewsbury and Hardin, 2003; Gerson *et al.*, 2003; Fouly *et al.*, 2011 and Mostafa, 2012). This family includes a large number of the predatory mites that can develop and reproduce using various food sources.

Therefore, species of the family Phytoseiidae are used as biological control agents all over the world where they serve to suppress arthropod pests on cultivated and non-cultivated plants, (McMurtry and Croft, 1997). Generally, phytoseiid mites can prey on insects (*e.g.* thrips) and mites other than tetranychids (*e.g.* eriophyid, tydeid and tarsonemid mites) (Overmeer, 1985; Calis, *et al*. 1988; Momen, *et al*. 2009 and Momen, 2011).

The genera, *Amblyseius* Berlese and *Typhlodromus* Scheuten are the most important and widely distributed of the family Phytoseiidae. The species of the two genera are active predators of scale insects, tenuipalpid , eriophid and tetranychid mite species that found on trees, shrubs, fruit trees, vegetables, grasses and decaying leaf litter (Evans, 1992 and Kostiainen & Hoy, 1996).

Therefore, the present study aims to add highlight on the biological aspects and life table parameters of two phytoseiid mite species fed on *Petrobia tritici* Kandeel, El-Naggar and Mohamed as prey under laboratory conditions.

MATERIALS AND METHODS

Sample plants and mites:

The suitability of the nymphs of the phytophagous mite, *Petrobia tritici* as a food source was tested for two species of Phytoseiidae. Those species are *Amblyseius swirskii* was collected from wheat plants, while *Typhlodromus pyri* was collected from mango leaves. Both predators were reared on nymph of *P. tritici* under laboratory conditions of 25±2°C and 70±5% R.H., at Faculty of Technology and Development, Zagazig University, Egypt. Samples of plant leaves were collected in cellophane bags and brought to the laboratory for direct examination using stereoscopic binocular microscope. Some adult specimens were individually mounted in Hoyer's medium on glass slides for microscopic identification.

Predatory mite rearing:

For rearing experiments, about 30 copulated adult females of each predator, *A. swirskii* and *T. pyri* were left 24 h. on leaf discs of castor plants, *Ricinus communis* infested with *Tetranychus urticae* Koch as prey and kept on moist cotton pad in Petri- dish (15 cm in diameter), suitable moisture was added daily to keep leaf discs fresh for a longer time. A few cotton fibers was added to the discs to rest sides and collect the deposited eggs of the predatory mites easily. Thereafter, when a sufficient number of eggs were laid, the adult females were removed and thus eggs of the same age were obtained to start the experiment. Observations were recorded at each 6 hours intervals to observe if the eggs were hatched. As the eggs hatched into larvae, the larvae were transferred as individuals very carefully onto leaf disks of mulberry leaves (3 cm in diameter). Leaf discs were placed with the upper surface down on cotton layer in Petri-dishes (6 cm in diameter). Water was added when needed maintaining suitable moisture. The leaf margin was surrounded by a cotton strip to prevent the escape of mites. Ten replicates were maintained for each predator, so 20 Petri dishes were maintained simultaneously. Nymphs of *P. tritici* was given as food for all predators. Duration of the life cycle; longevity; fecundity; food consumption and life table parameters were recorded by taking observations under a stereo binocular microscope.

Statistical analysis:

Data were statistically analyzed by using the analysis of variance according to Sendecor and Cochron (1982) using the computer program SPSS (2006). The fecundity of the predators were determined at 25°C and 70±5% R.H.

From the above study, before the final molt of the female deutonymph, one adult male was provided and was ensured to mate once. Then, the male was removed and observations were made at every 6 hour intervals until the first egg was laid. Thereafter, the number of eggs laid was recorded every 24 hours until the ovipositing female died. Oviposition period, pre- and post-oviposition periods were also calculated. The life table parameters, the intrinsic rate of natural increase (r_m), net reproductive rate (R_o), mean generation time (T), doubling time (DT), gross reproduction rate (GRR) and finite rate of increase (λ) were estimated according to (Birch, 1948) using the GW Basic computer program of (Abou -Setta *et al*., 1986).

RESULTS AND DISCUSSION

Rare previous studies has been done concerning the predation of those species. However, there are numerous investigations on other phytoseiid species, revealing the effect of prey on the biology and life table parameters of the two predators.

Developmental times of both predators:

Individuals of mites *Amblyseius swirskii* and *Typhlodromus pyri* successfully developed from larva to adult when fed on *Petrobia tritici* nymphs , Tables 1 and 2.

Data in Table 1, showed similarity in the incubation period and deutonymphal stages of tested predators. Female larval and protonymphalstage of *T. pyri* lasted obviously longer than in *A. swirskii*. These results agreed with the findings of Yousef, *et al*. (1982); Metwally, *et al*. (1984) and El-Laithy & Fouly (1992).

Table 1: Means developmental times(in days) of the two phytoseiid mites fed on nymph of *P. tritici* at 25±2°C and 70±5 % R.H.

Items	**Eggs**	**Larvae**	**Protonymph**	**Deutonymph**	**life cycle**	**Adult longevity**	**life span**
Predators							
A.swirskii	1.65 ±0.24[a]	2.2 ±0.42[a]	1.7 ±0.35[b]	4.2 ±0.54[a]	9.75 ±0.86[b]	24.9 ±1.22[a]	34.7 ±1.12[a]
T. pyri	1.75 ±0.26[a]	2.65 ±0.24[a]	2.8 ±0.35[a]	4.3 ±0.34[a]	11.5 ±0.84[a]	19.85 ±0.82[b]	31.3 ±1.25[b]

Means with different superscripts in the same row differ significantly (P < 0.05).

The total developmental time from egg to adult emergence was (9.75 and 11.4 days) for females of *A. swirskii*, and *T. pyri* ,respectively. Regarding to the adult longevity of the two phytoseiids, fed on *P. tritici* nymphs, the predator, *A. swirskii* showed a longer duration of the adult stage (24.9 days) than *T. pyri* (19.85 days). Thus, indicating that the supply of *A. swirskii* nymphs had a positive influence on the postembryonic development. Similar finding have been reported by Bonde (1989)*;* El-Laithy & Fouly (1992) and Momen (2009).

***Adult longevity and fecundity of both predators*:**

All emerged females of both predators oviposited within 2.05 and 1.75 days after emergence, respectively (Table 2).

During adulthood, *T. pyri* female tooks an average of 1.75 ±0.26, 16.4 ± 0.84 and 1.71 ± 0.48 days in preoviposition, oviposition and postoviposition period, respectively. These periods significantly varied from 2.05 ± 0.16 and 2.55 ± 0.60 days for preoviposition and postoviposition periods to 20.3 ± 1.33 days for egg-laying period of *A. swirskii*. The oviposition period ranged from 20.3 and 16.4 days, and post-oviposition from 2.25 and 1.71 days at both predatory mites, respectively. Regarding to the fecundity it was higher at *A. swirskii* more than at *T. pyri*. The predators, *A. swirskii* and *T. pyri* laid 45.7 and 34.9 eggs, respectively during their oviposition period in spite of their equal daily

Table 2: Mean durations of adult stage and fecundity of two phytoseiid mites fed on nymphs of *P. tritici* at 25±2°C and 70±5 % R.H.

Items	Pre-oviposition	Oviposition	Post-oviposition	Fecundity	Eggs/ female/day
Predators					
A. swirskii	2.05±0.16[a]	20.3±1.33[a]	2.55±0.60[a]	45.7±4.39[a]	2.25±0.25[a]
T. pyri	1.75±0.26[b]	16.4±0.84[b]	1.71±0.48[b]	34.9±2.42[b]	2.13±0.15[a]

Means with different superscripts in the same row differ significantly ($P < 0.05$).

rate(2.25 & 2.13 egg/female/ day). Similar results were obtained by (Rasmy, 1977; Fouly, 1982; El-Laithy & Fouly, 1992) and Momen, 2009, who found that the number of eggs deposited per day by *Typhlodromus athiasae* was (2.8 eggs/female/day) on *Eriophes dioscoridis* as prey.

The females during oviposition consumed a significantly higher number of prey, suggesting that females need extra food for egg production during this period. This new information is in agreement with other findings of (Sengonca, *et al*. 2003; Momen, 2009; Kouhjani, *et al.*, 2009) and Lorenzon, *et al.* 2012, reported that, *Amblyseius andersoni* exhibited faster development and higher fecundity than *T. pyri*.

Food consumption of both predators:

The consumption rate increased through the developmental stages respectively (Table 3). The female longevity of *A. swirskii* was (24.9 days) and that of *T. pyri* (19.85 days). Thus, the consumption of *P. tritici* nymphs was significantly more by the first (117.9 nymphs) than the second (81.1nymphs) predator. Similar finding have been reported by (Yousef, *et al.*1982; Marisa & Sauro, 1990 and El-Laithy & Fouly, 1992 declared that, *A. swirskii* female consumed about twice as much as *A. scutali*s (240.8 and 143.6 prey, respectively); Robinson, *et al*. (2005) declared that the predators, *T. pyri* and *Cydnodromns californicus* (McGregor) larvae reached adult stage when fed with eggs or motile immature stages of *Brevipalpus chilensis*. Mated females of *T. pyri* consumed on average 15.7 eggs and 19.38 immature motile stages. Mated females of *C. californicus* consumed on average 28.53 eggs and 18.5 immature motile stages; Fouly, *et al*. 2011).

Life table parameters:

The calculated life Table parameters were constructed using the survival data of specific age class and (LX) and the female offspring produced per female in each age class (mx). The net reproductive rate (R_o), the mean generation time (T), the intrinsic rate of increase (r_m),and the finite rate of increase (λ), Doubling time (DT)and Gross reproduction rate (GRR), Table 4.

Table 3: Food consumption of two phytoseiids fed on nymphs of *P. tritici* at 25±2ºC and 70±5 % R.H.

Items	Larvae	Protonymph	Deutonymph	Immature	Longevity	life span
Predators						
A. swirskii	1.4 ±0.51[a]	4.4 ±0.52[a]	8.1 ±1.28[a]	13.9 ±1.36[a]	117.9 ±13.34[a]	131.8 ±12.1[a]
T. pyri	1.1 ±0.31[a]	2.7 ±0.48[b]	5.3 ±0.82[b]	9.1 ± 0.46[b]	81.1 ±4.04[b]	90.2 ±3.15[b]

Means with different superscripts in the same row differ significantly ($P < 0.05$).

Table 4: Life table parameters of two predatory mite species fed on nymphs stages of *P. tritici* , at 25±2 °C and 85±5 % R.H.

Parameters	*A. swirskii*	*T. pyri*
Mean generation time (T)[a]	16.33	18.55
Doubling time (DT)[a]	3.75	4.68
Net reproductive rate (R_o)[b]	20.57	15.71
Intrinsic rate of increase (r_m)[c]	0.19	0.15
Finite rate of increase (λ-e^{rm})	1.20	1.16
Gross reproduction rate(GRR)	25.17	18.86

[a] Days [b] per generation [c] Individuals/female/ day.

The population of both predators *A. swirskii* and *A. pyri* had the capacity to double (DT) every (3.75and 4.68 times) within a single generation when fed on *P. tritici*, respectively. The intrinsic rate of increase (r_m) was 0.19 and 0.15 individual/day, while the finite rate of increase (λ) was 1.20 and 1.16 female daughters/female/day for *A. swirskii* and *A. pyri*, respectively. On the other hand, it could be observed that the net reproduction rate (R_o) varied from 20.57and 15.71 times during the mean generation time (T) 16.33 and 18.55 days for *A. swirskii* and *A. pyri*, respectively.

Gross reproductive rate (GRR) was (25.17 and 18.86) times/female/day. These results were similar to those of Robinson, *et al*.(2005) who studied the life table parameters of *T. pyri* and *C. californicus* at laboratory conditions of 25 ± 2ºC, 60 ± 5% RH. They found that mated females of *T. pyri* had a higher net reproductive rate and intrinsic rate of increase than *C. californicus*. Momen (2009) studied the life table parameters of *Typhlodromus athiasae* and *Amblyseius cabonus* under laboratory conditions of 25 ± 1°C and 75 ± 5% RH. She used nymphs of *T. urticae* and the motile stages of *Eriophes dioscoridis* as food sources of both phytoseiid mites. She recorded that a higher value of net reproduction rate (R_o = 45.51), intrinsic rate of increase (r_m = 0.2884), finite rate of increase (λ = 1.33) and shorter mean generation time (T = 13.23 days) were recorded when *Typhlodromus athiasae* was offered to *E. dioscoridis* as food.

Also, Tommy & Robinson, 2009 reported that the life table parameters of *Cydnodromus picanus* Ragusa, was net reproductive rate (R_o = 25.41), finite rate of increase (λ = 1.29), and Mean Generation Time (T = 12.46). The Net Intrinsic Rate of Increase (r_m) was significantly higher for *C. picanus* (r_m = 0.25) in contrast with *Amblyseius graminis* Chant, showed (r_m = -0.06) indicating that its population didn't have descendants. Hong, *et al*. (2011) studied Life history parameters of *Amblyseius swirskii* fed on cattail (*Typha latifolia*) pollen and tomato russet mite, *Aculops lycopersici* (Massee) at the same conditions. They found that the net reproductive rate (R_o), intrinsic rate of increase (r_m), and finite rate of increase (λ) and oviposition rate of *A. swirskii* were higher when fed on russet mites. The intrinsic rate of increase (r_m) of the predatory mite was 0.201 on the mite diet. The mean generation time (T) and the population doubling time (DT) were not significantly different for *A. swirskii* on the two diets. Lorenzon, *et al*. (2012) found that, *Typhlodromus pyri* intermediate values of intrinsic rate of increase (r_m) when fed on *Panonychus ulmi* Koch *; Eotetranychus carpini* (Oudemans); whereas the mycelium of Grape downy mildew (GDM) resulted in the lowest (r_m) values. Audun, *et al*.(2013) reported that the life table parameters of *Typhlodromus swirskii* were the intrinsic (r_m) and finite (λ) rates of increase were 0.222 and 1.249, respectively, with average oviposition rate of 1.71 ± 0.07 eggs/female/day.

From these results, it could be noticed that both *T. pyri* and *A. swirskii*, are considered useful agents against phytophagous mites, but generally need more work where their application may be easy to use.

CONCLUSION

The biological aspects and life table parameters of two phytoseiid mite species, *Amblyseius swirskii* and *Typhlodromus pyri* fed on *Petrobia tritici* as preys were studied under laboratory conditions. The two predators were successfully developed from larva to adult when fed on the prey. *A. swirskii* the best predator to suppress *P. tritici* than *T. pyri.*

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الجوانب البيولوجية وجدول الحياة لنوعين من الحلم الفيتوسيدى المتغذى على الحلم النباتى *Petrobia tritici* (أكاري – فايتوسيدى – تترانيكيدى)

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تم دراسة التطور، معدل الافتراس الخصوبة وجدول الحياة لنوعين من الحلم المفترس هم: *Typhlodromus pyri& Amblyseius swirskii* المتغذيان على حوريات الحلم النباتى *Petrobia tritici* تحت ظروف المعمل من درجة حرارة ٢٥±٢°م ورطوبة نسبية ٧٠±٥ % وذلك لدراسة كفاءة كلا المفترسين فى القضاء على تلك الآفة.

وكانت النتائج المتحصل عليها ما يلى:

١- نجحت أطوار الحلم من كلا النوعين فى التطور عند التغذية على الحلم النباتى.
٢- انتهت دورة حياة كلا المفترسين بعد (٩.٧٥ & ١١.٤ يوم) على التوالى.
٣- فترة ما قبل وضع البيض ، فترة وضع البيض، فترة ما بعد وضع البيض وفترة طول العمر للأنثى البالغة كانت كالتالي: (٢.٥ ، ١.٧٥) و (٢٠.٣ ، ١٦.٤) و (٢.٥٥ ، ١.٧٠) و (٢٤.٩ ، ١٩.٨٥) يوم لكلا المفترسين على التوالى.
٤- أوضحت نتائج التحليل الاحصائى لجدول الحياة أن: متوسط مدة الجيل (T) كانت (١٦.٣٣، ١٨.٥٥) - الوقت اللازم لتضاعف الجيل (DT) كانت (٢.٧٥ ، ٤.٦٨) - معدل الزيادة الذاتي وكذلك معدل الزيادة بالنسبة للوقت (r_m , λ) كانت (٠.١٩ ، ٠.١٥) و (١.٢ ، ١.١٦) لكلا المفترسين على التوالي عند التغذية على حوريات الحلم النباتي - معدل مدة الجيل (R_o) كانت (٢٠.٥ ، ١٥.٧١) - وكان معدل البيض الذي تضعه الإناث خلال حياة جيل واحد (GRR) كانت (٢٥.١٧ ، ١٨.٨٦) لكلا النوعين على التوالي.
٥- معدل الخصوبة الكلى وكذلك إجمالي استهلاك الفريسة كان (٤٥.٧ ، ٣٤.٩ بيضة) و (١٣١.٨ ، ٩٠.٢ حورية) لكلا النوعين السابقين على التوالى عند التغذية على حوريات الحلم النباتى *P. tritici*.

التوصية: من دراسة جدول الحياة للمفترسين *T. pyri & A. swirskii* عند التغذية على الحلم النباتى التغذية *P. tritici* تحت ظروف المعمل، يتضح ان كلا المفترسين نجحا فى التطور من طور اليرقة الى الطور البالغ . كما ان المفترس *A. swirskii* له قدرة على اخماد الفريسة افضل من المفترس *T. pyri* .