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BIOLOGICAL STUDIES ON THE PREDACIOUS MITE *Proctolaelaps pygmaeus* (ACARI, ASCIDAE) IN RELATION TO THE RELATIVE HUMIDITY

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ABSTRACT

The predacious ascid mite, *Proctolaelaps pygmaeus* (Muller) was reared on motile stages of the eriophyid grass mite, *Aceria dioscoridis* (Soliman and Abou-Awad) and the root-knot nematode, *Meloidogyne incognita* Chitwood egg-masses. The rate of development was faster when the predator fed on *A. dioscoridis* than the root-knot nematode. The results indicated that the eriophyid grass mite *A. dioscoridis* was the most favorable prey for the predator egg production; the average number was 3.41 eggs/female/day. In contrast the root-knot nematode *M. incognita* gave the lowest reproduction rate 0.53 eggs/female/day. Data showed that no significant difference in the developmental time at relative humidity ranged between 30 and 90%, while 60% R.H. increased both food consumption/female/10 days (88.89 prey/day) and the female fecundity (1.98 eggs/female/day) when the ascid mite, *P. pygmaeus* fed on *A. dioscoridis*.

INTRODUCTION

Ascid mites comprise a large group of free living predatory mites. They have been commonly found in the upper layers of the soil on plants and stored products (Gerson and Smiley, 1990). Some of them were recorded as facultative predators feeding on acarid mites, insects and fungi (Shreef *et al.*, 1980; Haines, 1981; Smith, 1983; Kheir, 1986; Rasmy *et al.*, 1987; Nasr *et al.*, 1990), although, a few others are specialized predators feeding on nematodes (Sharma, 1971; Karg, 1983; Imbriani and Mankau, 1983; Walter, 1987). The predatory ascid mite *P. pygmaeus* was found in association with herbaceous plants and fallen leaves infested with eriophyids and tetranychids.

The present study was performed to investigate the food behaviour, reproduction response and developmental rate of *Proctolaelaps pygmaeus* as an soil predator utilizing eriophyid mite and plant parasitic nematodes as an alternative aerial and ground prey under laboratory conditions, and to study the effect of relative humidity on the duration, food consumption and oviposition rates when the ascid mite *P. pygmaeus* fed on *A. dioscoridis*.

MATERIALS AND METHODS

Individuals of ascid mite *P. pygmaeus* were obtained from fallen leaves in fruit orchards at Giza Governorate using Tullgren funnels, and then mass-reared in the laboratory. Two types of plastic cells containing a floor of

plaster of Paris and charcoal (mixed in a ratio of 9:1 w/w) were used. The big rearing cells were 2.5cm in diameter and 2cm in depth and used for laboratory cultures, whereas the small ones were 1.0cm in diameter and 0.8cm in depth used for biological experiments. A heavy glass cover was used for each cell to prevent the escape of mites. The plaster floor was kept moderately moist by adding droplets of distilled water to the surface. The predacious mite *P. pygmaeus* was maintained on the eriophyid grass mite *A. dioscoridis.*

To study the effect of the two diets on the development, feeding behaviour and fecundity, newly hatched larvae were transferred singly to the experimental cells (40/each test) then supplied with a single diet. These included the motile stages of the eriophyid grass mite *A. dioscoridis,* obtained from heavily infested ploughman's spikenard grass leaves (*Pluchea dioscaridis* L.) and egg-masses of the root-knot nematode *M. incognita* obtained from heavily infested tomato plants. To study the effect of nematodes as diet, the bottom of the experimental cells was divided into two equal parts. The plaster floor was removed from the first part and then replaced with a smaller piece of wet cotton to confine the egg-masses and the second one was left for the predator activity. Each cell received an egg-mass, which was replaced daily with fresh one. Predator larva was supplied with surplus number of prey and kept until maturity. Replacement of diet was carried out daily and records of development twice a day. When individuals reached adulthood, the males were transferred and kept with females for 24 hours to secure mating. Deposited eggs were counted and removed daily. Experiments were conducted at 27±2°C and 70% R.H.

The previous biological aspects, i.e., the reproduction response and developmental rate of *P. pygmaeus* were studied under three different relative humidity (30, 60 and 90%) at 25°C temperature.

RESULTS

The predatory ascid mite *P. pygmaeus* developed from larvae to adult stage when fed on both the eriophyid mite *A. dioscoridis* and the *M. incognita* egg masses. Average of the developmental time of the different stages of the predator on the two animal foods were recorded in table (1). Immature stages of *P. pygmaeus* developed faster when fed on eriophyid mites than nematodes, since the generation time was 8.10 and 10.73 days, respectively. Kind of food significantly affected the longevity and life span of the female being shorter (18.60 and 25.60 days, respectively) when the female fed on *A. dioscoridis* and longer (30.13 and 38.13 days, respectively) when the predator fed on *M. incognita* egg masses (Table 1). Also, both the oviposition and postoviposition periods were shoeter on eriophyid diet than on nematode diet. Food markedly affected oviposition rate. The average number of eggs laid per female was recorded in table (2). Motile stages of the eriophyid mite *A. dioscoridis* were more favourable prey for egg production (3.41 eggs/female/day) than *M. incognita* (0.53 egg/female/day).

Table 1: Developmental times (in days) of the immature and mature stages of Proctolaelaps pygmaeus on Aceria dioscoridis and Meloidogyne incognita at 27°C

Developmental stage	Prey		T-value
	A. dioscoridis	*M. incognita*	
Egg	1.70±0.48 b	2.87±0.92 a	3.685**
Larva	1.60±0.52 b	2.33±0.49 a	3.598**
Protonymph	1.90±0.57 a	1.40±0.51 b	2.304*
Deutonymph	1.80±0.42 a	1.40±0.51 a	2.061^{NS}
Total	7.00±0.13 b	8.00±0.47 a	2.627*
Preoviposition	1.10±0.32 b	2.73±0.70 a	6.856**
Generation	8.10±0.32 b	10.73±1.16 a	6.946**
Oviposition	13.40±0.57 b	19.33±3.04 a	4.465**
Postoviposition	4.10±1.06 b	8.07±2.05 a	5.151**
Longevity	18.60±3.98 b	30.13±3.67 a	7.457**
Life span	25.60±4.12 b	38.13±3.64 a	8.007**

Values in a row with the same letter(s) are not significantly different at 0.5% level of probability
NS= Not significant *= Significant **= Highly significant

Table 2: Oviposition rates of *Proctolaelaps pygmaeus* fed on *Aceria dioscoridis* and *Meloidogyne incognita*

Type of food	Average No. of eggs/ female	Daily rate
Aceria dioscoridis	44.70±10.12 a	3.41±0.58 a
Meloidogyne incognita	10.33± 3.00 b	0.53±0.14 b
T-value	12.439**	18.490**

Values in a column with the same letter(s) are not significantly an 0.5% level of probability
= Highly significant

Effect of three different relative humidity on the egg hatching and development of the immature stages of *P. pygmaeus* was recorded in table (3).

Table 3: Effect of relative humidity on egg hatchability and duration of *Proctolaelaps pygmaeus* fed on *Aceria dioscoridis* at 25°C

Developmental stage	Relative humidity			F-value
	30%	60%	90%	
Hatching percentage	100	100	100	
Egg	2.30±0.67 a	2.70±1.05 a	3.30±1.16 a	2.601^{NS}
Larva	2.00±0.67 a	2.50±1.27 a	2.00±0.94 a	0.849^{NS}
Protonymph	2.40±0.69 a	2.30±0.48 a	2.10±0.57 a	0.670^{NS}
Deutonymph	2.20±0.42 a	2.20±0.63 a	1.80±0.42 a	2.118^{NS}
Total	8.90±0.99 a	9.70±2.00 a	9.20±1.75 a	0.607^{NS}

Values in a row with the same letter(s) are not significantly different at 0.5% level of probability
NS= Not significant

Data revealed that all three-tested relative humidity (30, 60 and 90%) had any effect on egg hatching, all resulted in 100% hatching. Results also showed that no significant difference in the developmental time at all tested

RH from 30-90% at 25°C. Significant differences were recorded between the three tested RH on food consumption (Table 4). The consumption rate increased throughout the life cycle and the adult female/10 days (77.80 and 888.90 preys) when the predator fed on *A. dioscoridis* at 60% RH and decreased (54.90 and 736.60 preys) at 90% RH. Data presented in table (4) also indicated that the average number of egg laid/female/10 days was influenced by the tested relative humidity. It was observed that female fecundity was more at 60% RH (19.80 eggs) than at 90% (18.6 eggs) while it was 13.00 eggs at 30% RH.

Table 4: Effect of relative humidity on food consumption and oviposition rate of Proctolaelaps pygmaeus fed on Aceria dioscoridis at 25°C

Stages of *P. pygmaeus*	Relative humidity			F-value
	30%	60%	90%	
Protonymph	26.10±12.09 a	27.30± 5.89 a	17.10± 8.58 b	3.665*
Daily rate	10.26± 3.64 ab	12.13± 2.48 a	7.79± 2.48 b	4.015*
Deutonymph	44.60± 6.11 ab	51.60±12.18 a	37.80±11.90 b	4.366*
Daily rate	20.59± 3.18 a	24.00± 3.17 a	21.35± 5.56 a	1.879^{NS}
Total	68.30±15.66 ab	77.80±14.92 a	54.90±16.00 b	5.484**
Daily rate	14.98± 3.30 ab	17.39± 2.92 a	13.48± 3.25 b	3.889*
Adult fecundity/ 10 days	806.20±92.38 ab	888.90±120.08 a	736.60±126.77 b	4.469*
Daily rate	80.62± 9.24 ab	88.89±12.01 a	73.66±12.68 b	4.469*
No. of eggs/ 10days	13.00± 4.11 b	19.80± 8.15 a	18.60± 4.01 a	3.979*
Daily rate	1.30± 0.41 b	1.98± 0.82 a	1.90± 0.48 a	3.887*

Values in a row with the same letter(s) are not significantly different at 0.5% level of probability
NS= Not significant ***= Significant** ****= Highly significant**

DISCUSSION

The ground mites may undertake a role in suppressing some pest population such as acarid mites, collembola, housefly (eggs & larvae) and nematodes. Some of them also feed on fungi (Shereef *et al.*, 1980; Overmeer, 1985; Takahashi and Chant, 1992; Aly, 1994; Abou-Awad *et al.*, 2001). The predacious ascid mite *P. pygmaeus* was recorded in fruit orchards associated with eriophyids, tetranychids and insects infesting the fallen leaves. Several studies indicated that the eriophyid mite were more favourable prey to phytoseiid and ascid mites than tetranychid (Abou-Awad and El-Banhawy, 1986; Duso and Comparese, 1991; Momen and El-Sawi, 1993; Abou-Awad *et al.*, 2001).

Kinds of food significantly affected duration of adult longevity and life span being shorter (18.60 and 25.60 days, respectively) when the predator fed on *A. dioscoridis* and longer (30.13 and 38.13 days, respectively) when the predator fed on *M. incognita*.

The oviposition rates ranged from 0.41 to 3.41 eggs/female/day). The highest oviposition rate was found when *P. pygmaeus* fed on *A. dioscoridis* (3.41/eggs/female/day). Aly, 1994 indicated that intermediate oviposition value was found when the same predator fed on *Eutetranychus orientalis*

nymphs (1.43 eggs/female/day) while the lowest oviposition rate was found when the predator fed on *Aphis duranta* adults (0.41 egg/female/day). In spite of the oviposition rate of *P. pygmaeus* feed on eggs of root-knot nematodes *M. incognita* was very low (0.53 egg/female/day) other ascid mite are voracious predators on nematodes (Sharma, 1971; Karg, 1983; Walter, 1987).

Atmospheric moisture is a factor that determines the existence of a mite in a certain locality, it can be measured by RH (Birch, 1944 and Moraes, 1978). The tested RH 60% was suitable for *P. pygmaeus* at 25°C as it increased the food consumption and female fecundity. Data presented showed that no significant difference in the duration time at tested RH (30, 60 and 90%), this result are in agreement with those of Caceres (1990) who stated that no significant difference in the developmental time when reared *Galendromus helveolus* at different RH levels (76-95%). In contrary, Aly (1994) found that there was a significant difference in the developmental time of *Amblyseius swirskii* at 25°C and RH levels (55-95%).

Morases (1978) found that among different relative humidity levels ranged between 55 to 95% only 70 and 85% were the most suitable for *Typhlodromus athiasae* at 25°C as it accelerated development and increased female fecundity.

It could be concluded that the optimum relative humidity for *P. pygmaeus* ranged from 60 to 70% as it increased food consumption and female fecundity.

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دراسات بيولوجية على المفترس الأكاروسى " بروكتوليلابس بيجمايس " تحت درجات رطوبة نسبية مختلفة

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يعد الأكاروس " بروكتوليلابس بيجمايس " من المفترسات الأكاروسية الأرضية الواسعة الانتشار فى حدائق الفاكهة وله مدى غذائى واسع. وفى هذه الدراسة تم اختبار نوعين من الغذاء على بيولوجية هذا المفترس وهما الحلم الدودى وبيض نيماتودا تعقد الجذور. وكذلك تم اختبار درجات رطوبة نسبية مختلفة (٣٠ و ٦٠ و ٩٠%) ودرجة حرارة ٢٥ درجة مئوية، على تطور وتكاثر هذا المفترس، وقد أوضحت الدراسة مايلى:

- كانت فترة الجيل وفترة وضع البيض فى حالة التغذية على الأطوار المتحركة من الحلم الدودى أقصر منها فى حالة التغذية على بيض نيماتودا تعقد الجذور (٨,١ ، ١٣,٤ يوم) و (١٠,٧٣ ، ١٩,٣٣ يوم) على الترتيب.
- دورة حياة المفترس كانت أقصر عند التغذية على الحلم الدودى (٢٥,٦ يوم) بينما كانت (٣٨,١٣) يوم عند التغذية على النيماتودا.
- معدل وضع البيض لإناث المفترس بلغت ٣,٤١ بيضة/يوم بينما كانت ٠,٥٣ بيضة/يوم فى حالة استخدام النيماتودا كغذاء.
- أوضحت الدراسة أن درجات الرطوبة المختبرة لم يكن لها تأثيرا معنويا على دورة حياة المفترس، بينما كان تأثيرها معنويا على معدل الافتراس ومعدل وضع البيض.
- كان معدل الاستهلاك اليومى لانثى المفترس ٨٨,٨٩ و ٨٠,٦٢ و ٧٣,٦٦ فرد/يوم من الحلم الدودى عند درجات رطوبة نسبية ٦٠ و ٣٠ و ٩٠% على الترتيب.
- كان المعدل اليومى لوضع البيض ١,٩٨ و ١,٩٠ و ١,٣٠ بيضة/يوم عند درجات رطوبة نسبية ٦٠ و ٩٠ و ٣٠% على الترتيب.
- تشير النتائج السابقة الى أن الرطوبة المثلى لهذا المفترس تتراوح بين ٦٠-٧٠%.

ونستخلص من هذا البحث ان الحلم الدودى غذاء هام بالنسبة لهذا المفترس وبالتالى يمكن الاستفادة منه فى الانتاج الكمى لهذا المفترس لاستخدامه فى برامج المكافحة المتكاملة.