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SURVEY OF SOIL MITES IN CERTAIN NEWLY RECLAIMED REGION IN EGYPT WITH REFERENCE TO *Laelaspis astronomicus* AS BIO-AGENT AGAINST ROOT-KNOT NEMATODES

Ashoub, A. H.*; M. H. Mowafi and M. A. Nawar***

*** Department of Plant Protection, Nematology Unit, Desert Research Center, Cairo, Mataria, Egypt.**

**** Department of Agricultural Zoology and Nematology, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt.**

ABSTRACT

This investigation was carried out to survey mites collected from certain regions of North Sinai Peninsula, Northwestern Coast and Siwa Oasis. Results indicated that survey proved the occurrence of 48 species belonging to 31 genera and 19 families where gasmid mites ranked the first as it included the highest numbers (37 species) followed by actinedid mites (5 species), oribatid mites(5 species) and acaridid mites(one species).

Concerning *Lealaspis astronomicus* (Koch) that was recorded from North Cost region reared on *Rhabditis scanica* Allgen and *Meloidogyne incognita* (Kofoid & White) Chitwood at 25°C, prey species affected duration, fecundity and feeding capacity of this predator. Generally, *R. scanica* was more suitable prey for *L. astronomicus* comparing with *M. incognita*. However, female consumed an averaged 140.8 and 272.0 juveniles of *M. incognita* during immature and adult stage, respectively. Thus *L. astronomicus* can be considered as biological agent against *M. incognita*.

Keywords: biological agent, *Meloidogyne incognita*, *Lealespis astronomicus*, predator, soil mites, survey.

INTRODUCTION

Soil arthropods particularly predacious mites may play an important role besides other microorganisms in soil fauna to achieve the natural environmental equilibrium. Accordingly, it can be depended on these mites as bio-agents for controlling plant parasitic nematodes. However, the potential of using mites as biological-agents had rarely been studied.

Considerable group of mites live in soil, of which some are predaceous, feeding on soil pests such as nematodes. Recently, several investigations were carried out to investigate the possibility of using some soil predacious meso-stigmatid mites in reduce nematode populations. Since there is a great possibility of using some species of laelapid mites as biological control agents as recorded by several authors on different preys (Rodriguez *et al.*, 1962; Sharma, 1971; Afifi, 1977; Imbriani and Mankau, 1983; Insera and Davis, 1983).

Moreover, Walia and Mathur (1995) reported that *Tyrophagus putrescentiae* (Schrank) and *Hypoaspis calcuttaensis* fed gourmand on the vermiform stages and free eggs of *Meloidogyne javanica* where maximum numbers of nematodes were consumed within the first 24 hours. Also, Mostafa *et al.* (1997) studied the suitability of egg-masses of *M. javanica* as food source to *Lasiosieus dentatus* they found that the predatory mite successfully completed its life cycle on egg-masses.

Therefore, the present work aims to determine the occurrence of mites associated with organic manure and debris at North Sinai Peninsula, North Coast and Siwa Oasis, in addition to evaluate the predacious ability of *Laelaspis astronomicus* as bio-agent against *Meloidogyne incognita* in laboratory conditions.

MATERIALS AND METHODS

Survey studies

Samples of grasses debris, organic manures and soils were collected from several localities of Egypt and brought into laboratory of Desert Research Center in tightly closed polyethylene bags, with all necessary information. Mites were firstly extracted by using modified Tullgren funnels. Adult specimens were examined by stereomicroscope and cleared in Nessbitt's solution, then mounted in Hoyer's medium on glass slides for identification. Evens and Till, 1966 & 1979 and Zaher, 1986 were used as guides in identification.

Source of food

Samples of humidified organic materials were put in Bearman's funnel. The extract (containing free living nematodes) was added to a Petri-dishes contain slices of potatoes as food source for rearing nematodes.

Rearing predacious mite

For culturing mites, several adult females of *Laelaspis astronomicus* (Koch) were placed in plastic cells supplied with food (free living nematodes) and kept in an incubator at 25 °C.

Rearing *Meloidogyne Incognita*

Second stage juveniles (J_2) obtained from egg-masses that produced from females previously identified as *M. incognita* (Kofoid &White) Chitwood according to Taylor *et al.*, 1995 were collected. These juveniles were used to inoculate sunflower plants under greenhouse conditions, to make nematode mass-rear.

Media used for experimental work

Media for both nematodes and predator mites were prepared by adding 1 gm of agar on 100 ml of water. Media was mixed on a boiled water bath and poured in the sterilized plastic cells.

Determination of nematode juveniles consumed by the predatory mite

Nematode egg-masses of equal sizes were separated and gathered. The same numbers of egg-masses were used in plastic cells with or without mites. Cells were replicated 20 times. Egg-masses were submerged half way of their length into the agar to facilitate egg hatching and prevent desiccation. Hatched *M. incognita* juveniles (J_2) were calculated in arenas with or without mites based on different time intervals needed for each stage of the mite life cycle. Through counting of hatched nematodes in different cells, consumption of *M. incognita* juveniles (J_2) by the predator mite was determined throughout its life span. Consumption of the nematodes by the mites was estimated by subtracting numbers of nematodes in arenas without mites.

RESULTS AND DISCUSSION

Survey results

Data in Table (1) revealed that different genera and species were found in many samples which were collected from certain regions of North Sinai Peninsula, Northwestem Coast and Siwa Oasis. Mite survey proved the occurrence of 48 species belonging to 31 genera and 19 families (Table 1). Of these; 37 species belong to 11 families; (Sub-order: *Gamasida*): *Parasitidae, Rhodacaridae, Digmasellidae, Ologamasidae, Ascidae, Phytoseiidae, Amerosiidae, Lealapidae, Machrochelidae,* Pachylaelapidae and *Uropoidae*; 5 species belong to 3 families; (Sub-order: *Actinedida*): *Cunaxidae, Pyemoitidae, Tarsonemidae*, (Sub-order: *Acaridida*) was recorded by family (*Acaridae*); (Sub-order: *Oribatida*) was recorded by four families *Epilohmanniidae Oppiidae*, *Galumnidae*, and *Oribatulidae*.

According to their distribution, mites could be classified to two groups: mites collected from only one locality found in rare numbers and mites collected from more than one locality and found in few numbers.

Predacious potentiality of *Laelaspis astronomicus*

Individuals of the laelapid mite, *L. astronomicus* were detected from organic manure and debris under fig trees, tomato plants and date palm at Northwestem Coast (King Maryut, Alexandria Governorate). Under laboratory conditions, predator different stages were fed on free-living nematodes *Rhabditis scanica* and root-knot nematode *Meloidogyne incognita* (J_2) at 25 °C.

Table (1): Survey of soil mites in some newly reclaimed regions.

Species	Host / Habitat	Region
1- Order: Parasitiformes		
A- Sub-order: Gamasida		
*** Super cohort: Monogynaspides**		
**** Cohort: Gamasina**		
(1) Superfamily: Parasitoidea		
Family: Parasitidae Oudemans		
Parasitus consanguineus Oudemans & Voigts.	Orangic manure & soil.	2
Parasitus wahabi Nasr & Mersal.	Orangic manure & soil.	1
Parasitus sp.	Orangic manure.	1 & 2
Vulgarogamasus burchanensis Oudemans.	Orangic manure.	1
(2) Superfamily: Rhodacaroidea		
Family: Rhodacaridae Oudemans		
Rhodacarus sp_1.	Debris & organic matter under fig trees.	1
Rhodacarus sp_2.	Under tomato.	1

Table (1): Contd.

Family: Digamasellidae Evans		
Dendrolaelaps aegypticus Metwally & Mersal.	Debris, organic matter & manure of sheep's.	1& 2
Dendrolaelaps zaheri Metwally & Mersal.	Debris & under banana.	1 & 2
Family: Ologamasidae Ryke		
Gamasiphis denticus Hafez & Nasr.	Debris & soil.	2
Gamasiphis parpulchellus Nasr & Mersal.	Debris under cucumber & eggplant.	1
Gamasiphis sp.	Debris & organic matter.	1
(3) Superfamily: *Ascoidea*		
Family: *Ascidae Voigts & Oudemans*		
Arctoseius bilinear Nasr.	Organic manure.	2
Protogamasellus denticus Nasr.	Debris of guava, under okra, eggplant & fig.	3
Protogamasellus aegyptica Nasr.	Debris.	1
Proctolaelaps orientalis Nasr.	Debris under citrus.	2
Proctolaelaps aegyptiaca Nasr.	Organic manure.	2
Proctolaelaps pygmaeus (Muller).	Organic manure.	1
Blattisocius dentriticus (Berlese).	Organic manure.	1
Blattisocius keegani Fox.	Organic manure.	2
(4) Superfamily: Phytoseoidea		
Family: Phytoseiidae Berlese		
Amblyseius ovetus (Germen).	Eggplant, organic manure.	2
Amblyseius barkeri Hughes.	Organic manure.	1
Family: Ameroseiidae Evans		
Ameroseius aegypticus El-Badry, Nasr & Hafez.	Organic manure.	1
(5) Superfamily: Deranyssoidea		
Family: Laelapidae Berlese		
Hypoaspis koseii Hafez, El-Badry & Nasr.	Debris under citrus.	2
H. gergus Hafez, El-Badry & Nasr.	Organic manure.	1
H. orientalis Hafez, El-Badry & Nasr.	Organic manure.	1 & 3
H. bregetova Shereef & Afifi.	Organic manure.	2
Laelaspis astronomicus (Koch).	Organic manure & debris under fig tree; tomatoes & date palm.	2
Cosmolaelaps keni Hafez, El-Badry & Nasr.	Organic manure.	2
Ololaelaps bregetovae Shereef & Soliman.	Organic manure.	2
Androlaelaps aegypticus Hafez, El-Badry & Nasr.	Organic manure.	2
(6) Superfamily: Eviphidoidea		
Family: Machrochelidae Vitzthum		
Macrocheles africanus Hafez, El-Badry & Nasr.	Organic manure.	1
Macrocheles muscaedomesticae (Scopoli).	Organic manure.	2
Glyptholaspis sp.	Organic manure.	1
Family: *Pachylaelapidae Berlese*		
Pachylaelaps aegypticus Hafez & Nasr.	Soil under eggplant & okra.	2
Pachylaelaps kievati Davydova.	Debris.	2
**** Cohort: Uropodina**		
(1) Superfamily: Uropodoidea		
Family: Uropodidae Berlese		
Urobovella ovalis Hirshmann.	Okra, watermelon & orangic manure.	1
Uropodes sp.	Organic manure.	1

Table (1): Contd.

2- Order: Acariformes **B- Sub-order: Actinedida** *** Super cohort: Promatids** **** Cohort: Eupodina** **(1) Superfamily: Bdelloidea** **Family: Cunaxidae Thor** *Pulaeus nilotus* Zaher & El Bishlawy *Cunaxa* sp.	 Under apple, orange. Under eggplant.	 1 1
**** Cohort: Eleutherengonina** **(1) Superfamily: Pyemotoidea** **Family: Pyemotidae Oudemans** *Pyemotes* sp.	 Organic manure.	 1
(2) Superfamily: Tarasonemoidea **Family: Tarsonemidae Kramer** *Tarsonemus* sp.$_1$ *Tarasonemus* sp.$_2$	 Under guava trees. Under eggplant.	 1 1
Sub-order: Acaridida **(1) Superfamily: Acaroidea** **Family: Acaridae Leach** *Rhizoglyphus robini* Claparede	 Organic manure.	 1 & 2
Sub-order: Oribatida **(1) Superfamily: Epilohmannioidea** **Family: Epilohmanniidae Oudemans** *Epilohmannia* sp.	 Soil.	 1
(2) Super Family: Oppioidea **Family: Oppidae Grandjean** *Oppia bayoumii* Shereef & Zaher. *Multioppia wilsoni* Aoki.	 Debris. Debris.	 1 1
(3) Superfamily: Galumnoidea **Family: Galumnidae Jacot** *Pilogalumna ornatula* Grandnjean	Under orange & organic manure.	1
(4) Superfamily: Oribatuloidea **Family: Oribatulidae Thor** *Zygoribatula sayedi* El-Badry & Nasr.	 Organic manure.	 1 & 2

1 – North Sinai Peninsula.
2 – Northwestern Coast.
3 – Siwa Oasis.

Biological studies of *L. astronomicus* on two preys

Mating is essential for egg deposition. Cannibalism did not occur. Statistical analysis (Table 2) showed that incubation period of *L. astronomicus* averaged 0.5 day when reared on *R. scanica* or *M. incognita* juveniles (J_2). Larval stage duration was affected by prey type; it was longer on *R. scanica* (1.2 days) than that on *M. incognita* juveniles (J_2) (0.8 day); while protonymphal stage was longer on *M. incognita* juveniles (J_2) (4.0 days) than that on *R. scanica* (2.5 days). Deutonymphal stage was significantly different on both prey types. It was longer on *M. incognita* juveniles (J_2) (5.8 days) than that on *R. scanica* (1.8 days). Life cycle of both female and male were significantly differed on that previously prey species. Also, it could be noted that the shortest period was observed on *R. scanica* (5.9 days); whereas the longest period on *M. incognita* juveniles (J_2). Male showed similar trend as female, but the periods were slightly shorter. Biological aspects such as hatching, moulting and mating habits are similar to those of other species of the family Laelapidae.

Table (2): Developmental times (in days) of *Lealaspis astronomicus* (Koch) fed on two nematodes prey species at 25°C.

Stage	Sex	*Rhabditis scanica*	*Meloidgyne Incognita*
Incubation period (Egg)	♀	0.5+0.0	0.5+0.0
	♂	0.5 + 0.0	0.5+0.0
Larva	♀	1.2+0.2	0.8+0.2
	♂	1.2+0.2	1.0 +0.0
Protonymph	♀	2.5+0.4	4.0+0.6
	♂	2.3+0.3	3.6+0.5
Deutonymph	♀	1.8+0.3	5.8+0.4
	♂	1.6+0.4	5.8+0.6
Total immatures	♀	5.5+0.4	10.7+0.5
	♂	5.1+0.2	10.4+0.2
Life cycle	♀	5.9+0.4	11.2+0.5
	♂	5.6+0.3	10.9+0.2
Longevity	♀	39.5+1.5	46.2+1.8
	♂	38.1+0.7	36.4+1.2
Life span	♀	45.3+1.5	57.4+1.5
	♂	43.7+0.9	47.3+1.1

L. S .D. 0.05 Total immatures = 0.3 L. S. D. 0.01 = 0.6
L. S. D. 0.05 Longevity =1.7 L. S. D. 0.01 = 2.3
L. S. D. 0.05 life span =1.8 L. S. D. 0.01 = 2.4

Adult longevity and fecundity

Data presented in Table (3) indicate that food type significantly affected adult female longevity and fecundity. Free-living nematode *R. scanica* shortened the duration and increased number of deposited eggs; while plant parasitic nematode, *M. incognita*, prolonged the longevity and decreased number of deposited eggs. An average female total deposited eggs and daily rate ranged from 14.8 & 9.2 and 9.2 & 0.3 when fed on *R. scanica* and *M. incognita*, respectively.

Table (3): Effect of prey type on female longevity and fecundity of *Laelaspis astronomicus* (Koch) at 25°C.

Prey	Average duration in days				No. of eggs / ♀	
	Pre-oviposition	Oviposition	Post-Oviposition	Longevity	Total average	Daily rate
Rhabditis scanica	2.4+0.9	21.2+0.9	15.9+2.4	39.5+1.5	14.8+2.2	0.7+0.1
Meloidogyne incognita	3.4+1.12	23.8+1.8	19.1+1.7	46.2+1.8	9.2+1.9	0.3+0.1

L. S. D. 0.05 Longevity = 3.9 L. S. D. 0.01 = 5.4
L. S. D. 0.05 Total average of egg = 2.1 L. S. D. 0.01 = 2.8

Life table parameters

The life table parameters for *L. astronomicus* at 25 °C are as shown in Table (4). The intrinsic rate of increase (r_m) value obtained was 0.0934 and 0.0654 individual /♀ / day when fed on *R. scanica* and *M. incognita* juveniles (J_2), respectively. The multiplication per generation (Ro) was higher on *M. incognita* juveniles (J_2) (3.915 times) than on *R. scanica* (3.780 times). Female generation time (T) also differed according to prey as it averaged 14.2279 and 20.8627 days when fed on *R. scanica* and *M. incognita* juveniles (J_2), respectively.

Table (4): Life table parameters of *Laelaspis astronomicus* (Koch) when fed on *R. scanica* and *M. incognita* at 25°C.

Parameter	*R. scanica*	*M. incognita*
Net reproduction rate (Ro)	3.7800	3.9150
Generation time (T) (days)	14.2279	20.8627
Intrinsic rate of increase (r_m)	0.0934	0.0654
Finite rate of increase (exp . r_m)	1.0979	1.0676
Sex ratio (female/total)	0.6	0.65

The finite rate of increase (exp r_m) was 1.0979 and 1.0676 times/♀/day when fed on previously mentioned prey, respectively, Table (4).

Thus, it could be concluded that according to different life table parameters with rearing on free-living nematodes as prey at 25°C gave highest reproduction rate (r_m = 0.0934 individual / female / day) for the predator *L. astronomicus*.

Although the rate of female survival was less on *M. incognita* juveniles (J_2) than on free-living nematode tested, yet specific rate was higher that greatly affect the intrinsic rate of increase (r_m).

Finally, it could be concluded that the most suitable prey for *L. astronomicus* was free-living nematode *R. scanica* where the higher r_m value (0.0934 individual /female /day) was registered, while the lower r_m value (0.0654 individual /female / day) was recorded when the mite fed on *M. incognita* juveniles (J_2) at 25°C.

Feeding Capacity

Results also showed that at 25°C, the larval, proto- and deutonymphal female stages of *L. astronomicus* consumed an average of 36.7, 48.4 and 55.7 individuals of root-knot nematode, *M. incognita*, respectively (Table 5). The averaged number devoured during adult female longevity averaged 272.0 individuals of *M. incognita*. Male followed similar trend as that of female, but fed on lower numbers.

Abbassy *et al.* (1987) studied the life cycle of predacious mite, *Lealapsis zahari* at 28 °C and found that it was fed on the second stage (J2) of *M. incognita*. Moreover, they recorded that the life cycle required an average of 9.35 days. The predator consumed average of 60 juveniles and injured about 23.78% of the root-knot nematode egg-masses.

However, consideration of the biological characteristics of *L. astronomicus* may classify its potential here as a biological control agent against *M. incognita*. Moreover, the mite's voracious feeding habit indicates that it could be useful in biocontrol of plant parasitic nematodes. More researches must be done in this respect.

Table (5): Food consumption of *Laelaspis astronomicus* (Koch) during its life span when fed on *M. incognita* at 25 °C.

Predator stage	No. of devoured second stage (J2) of *M. incognita*		
	Sex	Total Average	Daily rate
Larvae	♀	36.7+10.5	45.8+13.8
	♂	36.0+12.0	44.0+3.5
Protonymph	♀	48.4+10.25	13.8+4.4
	♂	40.6+12.3	12.7+4.9
Deutonymph	♀	55.7+4.9	12.4+3.4
	♂	52.7+15.1	9.8+1.2
Total Immatures	♀	140.8+11.1	13.2+3.2
	♂	129.0+22.8	12.4+4.3
Longevity	♀	272.0+9.2	5.7+0.9
	♂	270.0+17.8	7.1+0.8
Life span	♀	433.0+8.6	7.5+1.2
	♂	368.0+37.1	7.8+1.3

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حصر أكاروسات التربة في بعض المناطق المستصلحة حديثاً في مصر بالإشارة إلى المفترس *Laelaspis astronomicus* كعامل حيوي ضد نيماتودا تعقد الجذور

عزة هاشم عشوب *، مصطفى حلمي موافي ** و محمد عادل نوار*

* قسم وقاية النبات – وحدة النيماتودا – مركز بحوث الصحراء – القاهرة.

** قسم الحيوان الزراعي والنيماتودا – كلية الزراعة – جامعة الأزهر – القاهرة.

اشتملت هذه الدراسة علي حصر للأكاروسات في مناطق شمال سيناء والساحل الشمالي الغربي وواحة سيوة مع الإشارة إلى المفترس *Laelaspis astronomicus* كعامل مقاومة حيوية للنيماتودا تعقد الجذور (*Meloidgyne incognita*). وقد أسفرت نتائج الحصر على وجود ٤٥ نوعا تتبع ٣١ جنسا و١٩ عائلة. وتمثلت أكاروسات تحت رتبة ذات الثغر المتوسط (*Gamasida*) في ١١ فصيلة، وأكاروسات تحت رتبة ذات الثغر الأمامي (*Actinedida*) تمثلت في ٤ فصائل، و أكاروسات تحت رتبة عديمة الثغر (*Acaridida*) تمثلت في فصيلة واحدة وتضم تحت رتبة مختفية الثغر (*Oribatida*) ٤ فصائل.

اما نتائج الدراسات البيولوجية المعملية للنوع المفترس *Laelaspis astronomicus* (Koch) على كل من النيماتودا حرة المعيشة من النوع *Rhabditis scanica* ونيماتودا تعقد الجذور *Meloidgyne incognita* المتطفلة نباتيا *كفرائس* عند درجة حرارة ٢٥درجة مئوية كانت كالتالي:

- بلغ متوسط فترة الحياة ٥,٩ و ١١,٢ يوم بالنسبة للأطوار غيرالكاملة و ٣٩,٥، ٤٦,٢ يوما بالنسبة للأطوار الكاملة عند التغذية علي الفرائس السابقة علي التوالي.
- بلغ متوسط فترة وضع البيض ٢١,٢ ، ٢٣,٨ يوم وعدد البيض الذي تضعه الأنثى ١٤,٨ ، ٩,٢ بيضة علي التوالي لكل من الفرائس السابقة.
- بلغ متوسط ما تفترسه أنثى المفترس من يرقات نيماتودا تعقد الجذور ١٤٠,٨ و ٢٧٢ يرقة خلال فترة كل من الأطوار الغير كاملة والكاملة لهذا المفترس علي التوالي. بالإضافة لذلك لقد بلغ معدل الزيادة الحقيقي(r_m) عند التغذية علي كل من يرقات النيماتودا الحرة و نيماتودا تعقد الجذور ٠,٠٩٣٤ و ٠,٠٦٥٤ فرد / أنثى / يوم علي التوالي.

يتضح من نتائج هذه الدراسة المعملية أن المفترس *Laelaspis astronomicus* عامل حيوي هام لمكافحة نيماتودا تعقد الجذور.