PREDATORY BEHAVIOR OF SOME SOIL MITES TOWARDS ROOT-KNOT NEMATODE, *MELOIDOGYNE INCOGNITA* INFECTING SUGARBEET CROP

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Abstract

Seven predacious soil mites were extracted from sugarbeet fields namely, *Proprioseiopsis messor* (Wainstein), *Cheyletus malaccensis* (Oudemans), *Cunaxa* sp., *Glycyphagus domesticus* (De Geer), *Macrocheles monchaolska* (B & K), *Platyseius major* (Halbert) and *Uropoda misella* (Berlese). They were evaluated for their predacious activity on immature stages of root-knot nematode, *Meloidogyne incognita* (Kofoid & White) under laboratory and greenhouse conditions. In laboratory test, the data revealed that all tested soil mites (except *Cunaxa* sp.) fed on immature stages of *M. incognita*. These mites could be classified into three groups according the prey type, *P. messor*, *C. malaccensis* and *P. major* were found to be predators on juvenile larvae stage. One mite was a predator on egg-masses stage and two mites were predators on both juvenile larvae and egg-masses stages.The highest predation rate on juvenile larvae was achieved by *C. malaccensis* followed by *P. major*, then by *P. messor*. However, the mite, *M. monchaolska* was ranked the first in predation of both juvenile larvae and egg-masses followed by *U. misella*. In greenhouse test, the results indicated that addition a mixture of two mites, *C. malaccensis* and *M. monchaolska* to soil of sugarbeet infected with *M. incognita* resulted in a significant reduction in all damage parameters of galls, larvae, females and egg-masses numbers/root and juvenile larvae in soil. The highest increase in root weight (75.0%) was obtained in presence of the two mites followed by *M. monchaolska* alone (71.8 %), then *C. malaccensis* (40.0%).

INTRODUCTION

Meloidogyne incognita and *Meloidogyne javanica* were reported as major nematode pests of sugarbeet (Oteifa and El-Gindi, 1982; Maareg *et al.*, 1988 and 1998 and Ismail *et al.* 1996). The importance of biological control depends on microorganisms themselves or natural products extracted from plants, fungi, bacteria, marine organisms including algae and others as potential chemicals for the use as nematicide, (Chang *et al.* 1993; Kerry and Bourne, 1996; Maareg and Badr, 2000).

Until now studies on nematophagous mites have mostly dealt with the predatory gamasids of the suborder Parasitiformes (Rodriguez *et al.*, 1962; Sharma, 1971; Muraoka and Ishibashi, 1976; Mankau and Imbriani, 1978; Karg, 1983; Karg and Grosse, 1983; Walter *et al.*, 1987). However, some investigations have indicated that members of suborder Acariformes also prey on nematodes, e.g. *Pergolumma sp.* (Oribatei) (Rockett and Woodring, 1966), *Cloglyphus sp.* (Acaridae) (Muraoka and Ishibashi, 1976), *Rhizoglyphus echinopus*
(Fumbuze and Robin) (Acaridae) (Sturhan and Hampel, 1977) and *Tyrophagus app.* (Acaridae) (Walter *et al.*, 1986).

In biological control study of root-knot nematode, *Meloidogyne javanica* by manure acari, *Macrocheles muscaedomesticae* (Macrochelidae), and *Fuscuropoda vegetans* (Uropodidae), Maareg (1984) found that the *M. muscaedomesticae* mite caused higher reduction on gall formation of nematode than *Fuscuropoda vegetans.* Also, in similar studies, Nasr *et al.* (1988) reported that the members of genus *Caloglyphus* (Acariforms: Acaridae) predate on egg-masses, females and larvae of root-knot nematode, *Meloidogyne* spp. Walia and Mathur (1995) reported that *Tyrophagus putrescentiae* (Schrank) and *Hypoaspis calcuttansis* fed voraciously on the vermiform (larvae) stages and eggs of *Meloidogyne javanica.* However, Fouly (1997) studied suitability of egg-masses of *Meloidogyne* spp. as a food source to *Lasiosieus dentatus* (Fox.) (Gamaside: Ascidae) and found that the predatory mite fed and successfully completed its life cycle on egg-masses.

The purpose of the present study is to investigate predatory behavior of some soil mites towards root-knot nematode, *M. incognita* infecting sugarbeet crop.

MATERIALS AND METHODS

This study was carried out to assessment of predacious activity for seven soil mites, (i.e. the accoseijied *Platyseius major* (Halbert), the macrochelid *Macrocheles monchaolska* (B. and K.), the phytosiide mite *Proprioseiopsis messor* (Wainstein), the uropodid *Uropoda misella* (Berlese), the cheyletid *Cheyletus malaccensis* (Oudemans), the cunaxid *Cunaxa* sp. and the glycyphagid *Glycyphagus domesticus* (De Geer) against *M. incognita* eggs or alive second stage juvenile larvae in laboratory and greenhouse experiments. The collected mites from sugarbeet fields were maintained at the laboratory over the experimental period in micro-cells of small Petri-dishes 9 cm diameter and were sealed by parafilm to avoid escaping of mites, on a diet consisting

of nutrient glucose agar (NGA), under low temperature conditions (10 C°) and sufficient aeration.

Laboratory test:

The prey either eggs or larvae were prepared as described by Ehwaeti *et al.* (1998). The extracted eggs were re-suspended in sterilized water and justified to be 100 eggs/ml, also the obtained second stage juvenile were justified to be 100 larvae/ml. Petri dishes (88 mm diameter x 13 mm deep) with film of water agar medium (WA- 2% w/v) were used as experimental cells,. Mites were removed with a camel's-hair brush from the stock culture dishes to a small dish of distilled water to rinse away debris clinging to their bodies, then transferred directly to the experimental cells. After twenty-four hours, each cell was pipetted with 1 ml of eggs or larvae suspension (100 eggs or 100 second stage juvenile larvae). Numbers of consumed or preyed eggs and larvae were determined after 1 day (24 hours) by rinsing each cell with 5 ml water after removing the mites from the treated cells. Water of rinsed cells were poured in 20 ml cylinder and completed up to 10 ml. Air blowing with 1 ml pipette was used to distribute the nematodes and/or eggs will, one ml was sampled for 3 times in order to get mean of nematode and/or egg numbers by multiplying it by a factor of 10.

Experiment was conducted under laboratory conditions at 23 ± 3 C° and 60 % ± 5 R.H., as (14) treatments with four replicates. Each replicate contained four predatory species female mite and 100 *M. incognita* eggs or 100 larvae.

Greenhouse test:

The trial was carried out to investigate the impact of the two selected soil mites; *C. malaccensis* (Oudemans) "Cm" and *M. monchaolska* (B and K) "Mm" separately and in combination on root-knot nematodes infecting sugarbeet.

A steam sterilized field soil from Ten-thousand feddan, West Nubariya region was used to fill 48 plastic mono-pots, each holding 300 gm soil, 4 replicates of 4 treatments. Each pot was planted with 2 wks old sugarbeet (cv. Chems) seedlings and simultaneously inoculated with 500 eggs pipetted into three holes made in the soil at its base. The planted pots were placed in a glasshouse with set temperature of 24 ± 2 C° and RH 65% ± 5 through the day hours. Eggs consuming mite (*M. monchaolska*) were added after three days from the addition of eggs inoculums. Two days later, pots treated with larvae preying mite (*C. malaccensis*). The mites were added to 2 cm deep trench around the stem of each plant and covered with soil avoiding any press.

Nutrients were supplied, as liquid feed to ensure plants did not become nutrient deficient. The experiment blocks were randomized and rotated at regular intervals to provide a similar environment for each pot. The four treatments were as follows:

1- 80 adults Mm. (sex ratio 1:1) + 500 Mi eggs.

2- 80 adults Cm (sex ratio 1:1) + 500 Mi eggs.

3- 40 Mm + 40 Cm adults (both sex ratio 1:1) + 500 Mi eggs.

4- 500 Mi eggs only.

After six weeks, plants were removed from the pots. The roots were gently washed free o sand by placing them in a bucket and rinsing with a gentle jet of water. Care was taken not to damage or lose the root tips and galls of root system were counted. Pouring the washing water through 75 µm collected any juveniles or males in the sand and 53 µm sieves and then placing the sieving on a Baermann funnel for 24 hours. The root system of each plant was chopped into short lengths, mixed and 10 % sub-sample stained with acid fuchsin lactophenol to determine the number and stages of development and egg-masses of the nematode. Rates of nematode penetration, reproduction, maturation and build-up were also calculated according to formulae adopted by Maareg *et al.* (1998). Soil of each replicate was also subjected for mite extraction by modified Tullgern funnels for mite individual's enumeration.

Statistical analysis of data:

The obtained data of greenhouse test were subjected to statistical analysis using MSTAT version 4 (1987). Significant differences among the means of different treatment were carried out by Student-Newman-Keuls Test (0.05 & 0.01 probability).

RESULTS AND DISCUSSION

Laboratory test:

Seven predacious soil mites extracted from sugarbeet fields at Ten thousand faddans area, West of Nubaryia were evaluated for their predacious activity on immature stages of *M. incognita* under laboratory conditions. The tested soil mites namely, *P. messor*, *C. malaccensis*, *Cunaxa* sp., *G. domesticus*, *M. monchaolska*, *P. major* and *U. misella*.

The data in Table (1) revealed that all tested soil mites (except *Cunaxa* sp.) fed on immature stages of *M. incognita*. These mites could be classified into three groups according the prey type, *P. messor*, *C. malaccensis* and *P. major* were found

to be predators of juvenile larvae stage. One mite was a predator of egg-masses stage and two mites were predators on both juvenile larvae and egg-masses stages.

The highest predation rate on juvenile larvae (4.27 ± 1.62 juvenile larvae/day/mite) was achieved by *C. malaccensis* followed by *P. major* (3.90 ± 0.88), then by *P. messor* (3.40 ± 1.07). However, the mite, *M. monchaolska* was ranked the first in predation of both juvenile larvae and egg-masses (4.80 ± 1.03 larvae and 12.60 ± 1.26 eggs/day/mite, respectively) followed by *U. misella* (1.80 ± 0.79 larvae and 5.30 ± 1.16 eggs/day/mite).

Greenhouse test:

The effect of two selected predacious soil mites, separately and their mixture on population of the root-knot nematode, *M. incognita* infecting sugarbeet roots tabulated in Table (2). The results indicate that all treatments resulted in a significant reduction in number of galls, larvae, females and egg-masses/root and juvenile larvae in soil compared with the check treatment (nematode alone). Also, addition of *M. monchaolska* mite showed better reduction in these damage parameters of galls (62.5%), larvae (48.0%), females (74.8%) and egg-masses (62.3%) numbers/root and juvenile larvae (61.9) in soil/pot as related to reduction percentage of these parameters were achieved with the mite, *C. malaccensis* (48.2, 29.9, 64.0 and 47.2% in number of galls, larvae, females and egg-masses/root and juvenile larvae in soil/pot, respectively). Treatment with a mixed together soil mites resulted in a significant reduction in all damage parameters of galls, larvae, females and egg-masses numbers/root and juvenile larvae in soil/pot compared with *C. malaccensis* mite treatment. However, the same mixed treatment achieved a very high reduction only in larvae and females/root and juvenile larvae in soil/pot compared with the other mite, *M. monchaolska*.

Extracted mites/pot was significantly increased in all treatments, which varied greatly amongst the tested mites. The highest increase percent was obtained in *C. malaccensis* mite (51.3%) followed (20.0%) in numbers of M. *monchaolska* mite. However, the least increase in numbers of both mites reduced with mixed together treatment.

Concerning reproduction index followed the same trend in result of extracted mite. Whereas, the highest value of reproduction index (1.51) recorded with *C. malaccensis* treatment and the lowest value (1.1) obtained by mixed two mites treatment.

The highest root weight (75.0 %) was obtained by treatment of mixed together mites followed by *M. monchaolska* (71.8 %), then *C. malaccensis* treatment (40.0 %), without significant difference between *M. monchaolska* and *M. monchaolska* plus *C. Malaccensis* treatments.

Several authors reported on small scale, pot experiment that indicated that mites brought about considerable reduction in nematode numbers. Sharma (1971) showed that *Lasioseius penecilliger* (Berlese) reduced the population of plant parasitic nematode by 44%, *Hypoaspis aculeifer* (Canestrini) by 68% and *Rhodacarus roseus* (Oudemans) by 85%. Mankau (1978) found that the mite, *Lasioseius scapulatus* (Kennett) was a predator on most plant parasitic nematode in laboratory. Maareg (1984) found that the *Macrocheles muscaedomesticae* (Scop.) mite caused higher reduction on gall number of *M. javanica* nematode than *Fuscuropoda vegetans* (De Geer) singly and in mixed together. Sell (1988) reported that the numbers of genus *Caloglyphus* mite predate on, larvae, females and egg-masses of the root-knot nematode, *Meloidogyne* spp. Walia and Mathur (1995) found that *Tyrophagus putrescentiae* (Schrank) and *Hypoaspis calcuttansis* (Canestrini) mites fed on larvae and eggs of *M. javanica*. Also, Mostafa *et al.* (1997) found that significant reduction in *M. javanica* in soil; root galls and egg-masses numbers and improved tomato growth were achieved with addition of *T. putrescentiae* and *H. calcuttansis* mites.

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Table (1): Average number of larvae and/or egg-masses of *Meloidogyne incognita* stage preyed by seven soil mites In laboratory assay test.

Tested soil mites	Predacious activity as average No. ± S.D. of consumed preys/day/ adult female	
	Egg stage	Second stage juvenile larvae (j2)
Proprioseiopsis messor	0.00 ± 0.00	3.40 ± 1.07
Cheyletus malaccensis	0.00 ± 0.00	4.27 ± 1.62
Cunaxa sp.	0.00 ± 0.00	0.00 ± 0.00
Glycyphagus domesticus	4.90 ± 0.88	0.00 ± 0.00
Macrocheles monchaolska	12.6 ± 1.26	4.80 ± 1.03
Platyseius major	0.00 ± 0.00	3.90 ± 0.88
Uropoda misella	5.30 ± 1.16	1.80 ± 0.79

Table (2): The relationship between two selected predacious soil mite and *Meloidogyne incognita* infecting sugarbeet root in pot trail.

Treatments	Galls per root		Nematode stages/ root: Larvae		Female		Egg-masses		Juvenile larvae / plot		Final No. of mite / plot		Reproduction index of mite	Root weight	
	No.	Red %	No.	Red. %	No.	Red %	No.	Red. %	No.	Red. %	No.	Incr %		gm.	Incr %
M. Incognita only	51.0	0.0	127.0	0.0	139	0.0	53.0	0.0	189.	0.0	0.0	0.0	0.0	28.0	
Cm + Mi	26.4	48.2	89.0	29.9	50.0	64	20.0	47.2	97.0	48.7	121.	51	1.51	39.2	40.0
Mm + Mi	19.1	62.5	66.0	48.0	35.0	75	28.0	62.3	72.0	61.9	96.0	20.	1.2	48.1	71.8
Cm +Mm +Mi	19.1	62.5	69.0	45.7	25.0	82	19.0	64.2	67.0	64.6	88.0	10	1.1	49.0	75.0
L.S.D. 0.05	0.80		4.30		2.62		1.75		3.57		2.69		0.08	2.86	
L.S.D. 0.01	1.07		5.76		3.51		2.34		4.78		3.60		0.11	3.83	

Cm = *Cheyletus malaccensis* Mm = *Macrocheles monchaolska* Mi = *Meloidogyne incognita*

السلوك الافتراسي لبعض أكاروسات التربة تجاه نيماتودا تعقد لجذور، ميليدوجين إنكوجنيتا التي تصيب محصول بنجر السكر

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تمَ استخلاص سبعة أكاروسات مفترسة من تربة حقول بنجر السكر بمنطقة العشرة آلاف فدان بغرب النوبارية ، و تقييم نشاطها الافتراسي على الأطوار الغير ناضجة لنيماتودا *Meliodogyne incognita* و ذلك تحت ظروف المعمل و الصوبة. كانت أكاروسات التربة المختبرة هي:

Proprioseiopsis messor (Wainstein), *Cheyletus malaccensis* (Oudemans), *Cunaxa* sp., *Glycyphagus domesticus* (De Geer), *Macrocheles monchaolska* (B &K), *Platyseius major* (Halbert) and *Uropoda misella* (Berlese).

و من الدراسة المعملية، وجدَ أن الأكاروسات المختبرة ماعدا حلم *Cunaxa sp* تتغذى على الأطوار الغير ناضجة، الطور اليرقي الثاني و أكياس البيض و قد وضعت هذه الأكاروسات في ثلاث مجاميع منفصلة من حيث طبيعة الافتراس ، المجموعة الأولى تضم ثلاث أكاروسات تفترس الطور اليرقي الثاني و هي *P. messor* (Wainstein); *malaccensis* (Oudemans) *P.* C. *major* (Halbert) و المجموعة الثانية تضم اكاروس *G. domesticus* يفترس أكياس البيض أما المجموعة الثالثة تضم أكاروسان يفترسان كل من الطور اليرقي الثاني و أكياس البيض وهي *M. monchaolska* و *U. misella*.

و وجدَ أن أعلى معدل افتراس للطور اليرقي الثاني سجل للأكاروس *C. malaccensis* يليه *P. major* ثمَ *P. messor* . أما أكاروس *M. monchaolska* كان الأول في افتراس كلاً من الطور اليرقي الثاني و أكياس البيض ثم أكاروس *U. misella* .

و من اختبارات الصوبة وجدَ أن إضافة خليط من الأكاروسين *C. malaccensis* و *M. monchaolska* إلى تربة بنجر السكر المعداه بالنيماتودا أدى إلى خفض مقاييس الضرر الناتجة عنها و الممثلة بأعداد كلاً من التعقدات الجذرية و عدد اليرقات و الإناث و أكياس لبيض على جذور بنجر السكر وكذلك خفض أعداد الطور اليرقي الثاني (الطور المعدي) في التربة – كما وجدَ أن أعلى

زيادة في وزن الجذر (٧٥%) مقارنةً بالكنترول تحقق من إضافة مخلوط هـذين الأكاروسـين ، أمـا إضافة كل منهما منفرد فقد حققَ زيادة ٧١,٨% أما أكاروس *C. malaccensis* حقـقَ ٤٠% فـي وزن الحذر.