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Occurrence of Soil Mites at El-Maghara Region, Sinai Peninsula

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ABSTRACT

This investigation was carried out to evaluate the occurrence and distribution of soil mites at El-Maghara region, Sinai Peninsula, Egypt. Soil samples to depth 20cm were collected from different orchards, olive, citrus, fig and vine. Eighteen soil mite species in 18 genera and 16 families were found. Gamasida was represented by seven families, while Actinedida, Acaridida and Oribatida were represented by five, one and three families, respectively. Shannon –Wiener index (H'), Pielou's (J') and dominant analysis were estimated. Diversity index showed that actinedid mites have been found as numerically among the soil mites by 7 species and 222 individuals.

Key Words: Soil mites, Occurrence, Distribution, Orchards.

INTRODUCTION

Soil and litter habitats have become recognized as important repositories for biodiversity. The detritus feeding soil mites as oribatids play an important role in the breaking down of plant residues and are considered an important factor in improving soil fertility (Seastedt, 1984; Adejuyigbe *et al.*, 1999 and Minor *et al.*, 2004). The density of soil mites is considered also as indicator of soil condition and quality (Curry & Good, 1992). Distribution and community structure of these mites generally depend on biotic and abiotic environmental conditions (Tousignat and Coderre, 1992; Chiba, *et al*., 1993 and Hansen & Coleman, 1998).

In Egypt, several studies have been done to survey and identify mites inhabiting soil, debris and organic manures at different locations in Sinai Peninsula and newly reclaimed lands (Zaher & Mohamed, 1980; Hassan *et al*., 1986; Kandeel, 1993; El-Kady & Shoukry, 1999 and El-kady & Bahgat, 2000). On the other hand, no studies were done at El-Maghara region; thus the goal of the present work was to study the incidence of soil mites associated with different orchards.

MATERIALS AND METHODS

Site description

The study area (El-Maghara) is one of the environmentally unprivileged agricultural area, situated in the northern part of the central sub region of Sinai Peninsula. It is about 100 km south of Al-Arish city and the Mediterranean coast (latitude 30410 and 30484 N, longitude 331600 and 333630 E). The mean air temperature varies from 10 °C in February to 27.5 °C in July. The study area receives between 40 to 70 mm/year rain annually during December–February, and the rest of the year is rainless. The relative humidity is quite variable ranging from 5% to 90% (Egyptian Meteorological Authority 1996).

Sampling

Fifty-eight soil and litter samples (about 500 g) under fig, citrus, olive and vine trees were collected from the farm of Desert Research Center, at El-Maghara region from December 2006 to November 2007. Samples were collected from the top layer of the soil (0 – 20 cm). Small core was used as a sampling tool (5 cm diameter). Mites were extracted from the soil samples using modified Tullgren funnel, and preserved in 70 % ethanol alcohol then mounted in Hoyer's medium. Identification was carried out according to Krantz (1979) and Zaher (1986).

Soil analysis

Determination of Electrical Conductivity (EC), pH, soluble anions and other cations and organic matter content (OM) in about 5g soil taken from the study area were analyzed according to Richard (1954) and Jackson (1958).

Statistical analysis

The community structure of soil mites was analyzed using abundance and species number. Species diversity was expressed by the Shannon-Wiener index (H') and the evenness was calculated by Pielous (J') (Pielou, 1984). The species were classified by dominant species (more than 5% of total individual number), influent species (2 – 5%) and recessive species (less than 2%) (Kang *et al.*, 2001).

All statistical analyses were done using COSTAT software, two way ANOVA and Duncan's Multiple test were used to analyze the differences between abundance of mites.

RESULTS AND DISCUSSION

Properties of the top surface soil under the previous different habitats showed that insignificant differences between the soil analyzed (Table 1). The soil of the area studied has a low pH under olive and vine trees, while nearly high under citrus and fig trees. Low pH suggests poor nutrient relations (Swift and Woomer, 1993). Organic matter content was low under citrus tress (0.11 %), where it was 0.69, 0.81 and 0.83 % under fig, olive and vine, respectively. Low of organic matter content, may be due to not receiving organic manures and this type of soil still is virgin. It has appreciable influence on many soil properties, hence having significant effect on soil fertility (Enami, 2000 and Araki, 2002).

Results in table 2, showed that the number of mite species was 18*. The species number was high under citrus trees (16 species), while the lower was under vine trees (12 species). On the other hand, 13 species were found under olive and fig trees. Oribatid mite densities under olive and fig were higher than in other habitats, and the presence of mite species under olive and fig fields was good indicators of soil fertility and soil quality in this newly reclaimed and districted area.

The total individual numbers of mites were 476 individuals under all habitats. The total number was high under olive trees, 199 individuals (41.8%), while it was very low under vine trees, 50 individuals (10.5%). In fig field, actinedids recorded the higher number of individuals (106 individuals of 4 species). At olive orchard, one species of acarid mites, *Tyrophagus putrescentiae* (Shrank), seven species of gamasid mites, three species of actinedids and two species of oribatids were recordrd. *Tarsonemus* sp. was the dominant species under citrus trees. Three predaceous gamasid mites were recorded under vine; *Macrocheles matrius* (Hull); *Rhodacarus rosesus* (Oudemans) and *Protogamasellus denticus*. The actinedids were the major group with high individual numbers (26 individuals, 6 species).

Data in table 3, illustrate dominant analysis of the collected mites, the seven dominant species under the different habitats were *T. putrescentiae, Pygmephorus* sp., *Tarsonemus* sp. *O. sticta, C. laterostris, E. cylindrica* and *Acaropeslla* sp. (24.0, 19.3, 8.0, 7.6, 7.4, 5.9 and 5.3%) respectively.

However, seven dominant species comprised 77.3% of the total individual numbers. *T. putrescentiae* was the dominant species under olive trees (50.3 %), *Pygmephorus* sp. was the dominant species under fig trees (51.85 %), while *Tarsonemus* sp. was the dominant under citrus trees (49.3%).

The differences of mite species and mite numbers were good indicators of soil fertility and soil quality at this area. Previous studies in similar environment also showed the distribution of soil mites. Zaher and Mohamed (1980) surveyed seven genera of five families of soil mites in three fields of potato, vine and sunflower at Rass Cedr, Sinai Peninsula. Kandeel (1993) surveyed the mite fauna at three districts in North Sinai. The survey revealed the presence of 48 species belonging to 37 genera of 34 families.

The low diversity of soil mites might be also due to the extensive erosion of the top soil in many habitats (Badjeo & Akinyemiju, 1993 and Abdel Wahab, 2005). Also, it might be due to the chemical composition and physical feature of the soil that could influence the abundance and diversity of soil mites (Badejo, 1995).

The paucity of soil mites and soil biodiversity in general, might be also due to water scarcity, coal mining, acid mine drainage and quarrying industries. However, water supply is still the limiting factor for good agriculture in El-Maghara district. People are depending extensively on ground water, mostly with

Table (1): Properties of soil samples collected under different habitats at El-Maghara region.

Field	Depth	Analysis of the soil saturation extract											OM
		SP%	PH	EC	Anions				Cations				
					Co_3^{-2}	Hco_3^{-2}	Cl^-	So_4^{-2}	Ca^{+2}	Mg^{+2}	Na^+	K^+	
Fig	0-20	21	7.5	4.1	-	4.6	1.4	10.2	10	6.6	12.6	2.1	0.69
Citrus	0-20	22	7.8	4.2	-	7.1	3.4	8.7	9.3	4.2	9.5	1.7	0.11
Olive	0-20	22	7.2	7.7	-	4.3	5.3	10.1	7.8	4.5	8.9	1.3	0.81
Vine	0-20	23	7.2	5.3	-	4.8	2.9	12.7	12.8	9.6	12.1	2.8	0.83

SP= Saturation Percentage EC= Electrical Conductivity OM= Organic Matter

Table (2): Soil mite species under some fruit trees at El-Maghara, Sinai Peninsula, No. and (%).

Mites	Number of specimens					
	Fig	Olive	Citrus	Vine	Total	%
Gamasida (Total)	**14 (9.6)**	**28 (14.1)**	**24 (28.2)**	**7 (14.0)**	**73**	**15.3**
Macrochelidae						
Macrocheles matrius (Hull)	-	5 (2.5)	1(1.2)	3(6.0)	9	**1.9**
Laelapidae						
**Androlaelaps aegypticus* Hafez, El-Badry & Nasr (1982)	2 (1.4)	2 (1.0)	1 (1.2)	-	5	**1.1**
Parasitidae						
**Parasitus* zaheri Hafez & Nasr (1986)	3 (2.1)	5 (2.5)	10 (11.8)	-	18	**3.8**
Ascidae						
**Protogamasellus denticus* Nasr (1978)	-	5 (2.5)	2 (2.4)	3 (6.0)	10	**2.1**
Rhodacaridae						
Rhodacarus rosesus Oudemans	2 (1.2)	2 (1.0)	7 (8.2)	1 (2.0)	12	**2.5**
Phytoseiidae						
Cydneseius zaheri (El-Badry)		4(2.0)	1 (1.2)	-	5	**1.1**
Ameroseiidae						
Kleemannia plumosus (Oudemans)	7 (4.9)	5 (2.5)	2 (2.4)	-	14	**2.9**
Actinedida (Total)	**106 (74.6)**	**46 (23.1)**	**44 (51.8)**	**26(52.0)**	**222**	**46.6**
Cunaxidae						
Pseudocunaxa simplex (Ewing)	2 (1.4)	-	1 (1.2)	-	3	**0.6**
Bdellidae						
Cyta laterostris(Hermann)	2 (1.4)	31(15.6)	-	2 (4.0)	35	**7.4**
Cheyletidae						
Eutogenes punctata Zaher & Soliman	11 (7.7)	2 (1.0)	1 (1.2)	2 (4.0)	16	**3.4**
Hemicheyletia bakeri (Ehara)	-		1 (1.2)	14 (28.0)	15	**3.2**
Acaropeslla sp.	21 (14.8)	-	3 (3.6)	1 (2.0)	25	**5.3**
Pygmephoridae						
Pygmephorus sp.	70 (49.3)	15 (7.5)	5 (5.9)	2 (4.0)	92	**19.3**
Tarsonemidae						
Tarsonemus sp.	-	-	33 (38.8)	5 (10.0)	38	**8.0**
Acaridida(Total)	**5 (3.5)**	**100 (50.3)**	**6 (7.1)**	**3 (6.0)**	**114**	**24.0**
Acaridae						
Tyrophagus putrescentiae (Shrank)	5 (3.5)	100 (50.3)	6 (7.1)	3 (6.0)	114	**24.0**
Oribatida(Total)	**17 (11.7)**	**25 (12.6)**	**11 (12.0)**	**14 (28.0)**	**67**	**14.1**
Epilohmanniidae						
Epilohmannia cylindrica Berlese	11 (7.7)	5 (2.5)	-	12 (24.0)	28	**5.9**
Oppiidae						
Oppia sticta (Popp)	4 (2.8)	20 (10.1)	10 (11.8)	2 (4.0)	36	**7.6**
Haplochthoniidae						
Haplochthonius sp.	2(1.4)	-	1(1.2)	-	3	**0.6**
Total	142 (29.8)	199 (41.8)	85(17.6)	50 (10.5)	476	**100**

*Cited by Zaher 1986

a high salinity level. Soil quality studies conducted in the present work have revealed the high salinity of soil in El Maghara. Salinity is major factors that contribute to soil degradation and its effect on the soil biodiversity (El-Kady & El-Shourbagy, 1994 and Zahran *et al.*, 1996).

El-Maghara coal mine is one of the main landmarks in Sinai Peninsula. Several millions of tons were extracted. Huge volumes of extracted coal have been left behind. Waste water of coal mining content of heavy metal residues, coal particulates and hydrocarbon constituents are released and spread over a vast open surface area after coal dewatering process. This ifluence is considered the main sources of acid mine drainage. During rainy season wastes produced from the mine are pushed by rain, moving to the surrounding areas, causing soil contamination, killing vegetation and soil organisms (Morsy *et al.*, 1992).

Table (3): Number and % of dominant soil mites collected from El-Maghara, Sinai Peninsula.

	Species	Total number of individuals	%
Dominant	*T. putrescentiae*	114	24.0
	Pygmephorus sp.	92	19.3
	Tarsonemus sp.	38	8.0
	O. sticta	36	7.6
	C. laterostris	35	7.4
	E. cylindrica	28	5.9
	Acaropeslla sp.	25	5.3
Influent	*P. zaheri*	18	3.8
	E. punctata	16	3.4
	H. bakeri	15	3.2
	K. plumosus	14	2.9
	R. rosesus	12	2.5
	P. denticus	10	2.1
Recessive	*M. matrius*	9	1.9
	A. aegypticus	5	1.1
	T. zaheri	5	1.1
	Haplochthonius sp.	3	0.6
	P. simplex	3	0.6

Dominant species (more than 5% of total individual number), Influent species (2- 5%) and Recessive species (less than 2 %).

Table (4): Number of species, species diversity and evenness (E_H) of soil mite communities at El-Maghara, Sinai Peninsula.

	Habitats			
	Fig	Olive	Citrus	Vine
Number of species	13	13	16	12
Species diversity	1.901	1.192	2.304	1.619
Evenness	0.667	0.973	0.573	0.933

The diversity of soil mites expressed by Shannon-Wiener diversity index showed that no significant differences between all habitats (Table 4). This means that distribution of mite individuals was very low at these areas. Species diversity increase dramatically with the number of species increase, while evenness decrease as species number increased and the areas were not complete evenness or not equitable.

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