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PRELIMINARY STUDY ON THE OCCURRENCE OF SOIL MITES IN SINAI PENINSULA, EGYPT

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ABSTRACT

This investigation was carried out for the first time to evaluate the distribution ecology of soil mites fauna at El-Maghara region, Sinai Peninsula. Egypt. Soil samples to depth 20cm were collected from different materials. Eighteen soil mite species belonging to eighteen genera and seventeen families were found. Gamasida were represented by seven families, where actinedida, acaridida and oribatida were represented by seven, one and three mite species respectively. Shannon – Wiener index (H'). Pielou's (J') and dominant analysis were estimated. Actinedid mites have been found as numerically among the soil mites (7 species and 222 individuals).

INTRODUCTION

Soil and litter habitats have become recognized as important repositories for biodiversity. The detritus feeding soil mites like oribatids play an important role in the breakdown 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 as an indicator of the soil condition and soil quality **[Curry & Good (1992)]**. Distribution and community structure of these mites generally depend on biotic and abiotic environmental conditions **[Tousignat & Coûrre (1992) and Hansen & Coleman (1998)]**.

In Egypt, several studies have been done to survey and identifiy the mites inhabiting soil, debris and organic manures at different locations in Sinai Peninsula and newly reclaimed lands **[Zaher & Mohamed (1980); Hassan *et al.* (1982); Kandeel (1993); El-Kady & Shoukry (1999) and El-kady & Bahgat (2000)]**. On the other hand, no studies were done at El-Maghara region. Therefore, this study was the

first at this area. Thus, the goal of this work was to study the incidence of soil mites associated with different habitats.

MATERIAL AND METHODS

Site descriptions: The study area, El Maghara, is one of the poorest and environmentally unprivileged areas of Egypt. El-Maghara region is 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 varying 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% - 90% (Egyptian Meteorological Authority (EMA).

Sampling: 58 soil and litter samples (about 500 g) under fig, citrus, olive and grapevine trees were collected from the farm of Desert Research Center (DRC), at El-Maghara region from December 2006 to November 2007. Samples were collected from the top 0 – 20 cm layer of the soil, small core was using as a sampling tool (5cm diameter). Mites were extracted from the soil using Tullgren Funnel (TF), and preserved in 70 % ethanol then mounted in Hoyer's medium. Identification was carried out using stereomicroscope according to Krantz (1979) and Zaher (1986).

Soil analysis: Determination of Electrical conductivity (EC), pH, solouble 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') **[Magurran (1988) and Pielou (1984)]**. The species were classified according to their relative abundances to 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 analysis were done using COSTAT software, two way ANOVA and Duncan's Multiple test was used to analyze the differences between abundances of mites.

RESULTS AND DISCUSSION

Properties of the soil surface under the previous different habitats showed small differences between the soil analyzed (Table 1). The soil of the area studied has a low pH under olive and grapevine trees, where it was nearly high under citrus and fig trees. Low pH suggests poor nutrient relations **[Swift *et al.* (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 grapevine, respectively. Low of organic matter content may be due to no organic manures and this type of soil still virgin. Organic matter is a source and a sink for nutrient elements in the soil. It was appreciable influence on many soil properties, hence its significance of soil fertility **[Enami (2000) and Araki (2002)]**.

Table (1): Properties of soil samples collected under different vegetations 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
grape	0-20	23	7.2	5.3	-	4.8	2.9	12.7	12.8	9.6	12.1	2.8	0.83

Results in Table 2, showed that the total number of mite species (richenns) was 18 species under studied habitats. The species number was high under citrus trees (16 species), while the lower was under grapevine trees (12 species). On the other hand, 13 species were found under olive and fig trees.

Soil mite densities under olive and fig were higher than the other habitats, and the presence of mite species under olive and fig fields are a good indicators of soil fertility and soil quality in this newly reclaimed and districted area .

The total individual number of mites were 476 individuals under all habitats. The total number was high under olive trees, 199 indiv. (41.8 %), while its very low under grapevine 50 indiv. (10.5 %). For fig field, actinedids were high number in individuals (106 indiv. and 4 species). For olive field, one species of acarid mites was recorded , *Tyrophagus putrescentia*, and 7 species of gamasid mites were recorded and 3 species of actinedids and 2 species of oribatids. *Tarsonemus sp.* was the

dominant species under citrus trees. Three predaceous gamasid mite was recorded under grapevine ; *Macrocheles matrius; Rhodacarus rosesus. Protogamasellus denticus* and the actinedids were the major group and highly individual numbers and richness (26 individuals, 6 species).

Table (2): Soil mite species under some fruit trees at El-Maghara, Sinai Peninsula.

Mites	Number of specimens					
	Fig	Olive	Citrus	Grapevine	Total	%
Gamasida (Total)	**14(9.6)**	**28(14.1)**	**24(28.2)**	**7(14.0)**	**73**	15.3
Macrochelidae						
Macrocheles matrius	-	5(2.5)	1(1.2)	3(6.0)	9	1.9
Laelapidae						
Amrolaelaps aegypticus	2(1.4)	2(1.0)	1(1.2)	-	5	1.1
Parasitidae						
Parasitus zaheri	3(2.1)	5(2.5)	10(11.8)	-	18	3.8
Ascidae						
Protogamasellus denticus	-	5(2.5)	2(2.4)	3(6.0)	10	2.1
Rhodacaridae						
Rhodacarus rosesus	2(1.2)	2(1.0)	7(8.2)	1(2.0)	12	2.5
Phytoseiidae						
Typhlodromus zaheri	-	4(2.0)	1(1.2)	-	5	1.1
Ameroseiidae						
Kleemania plumosus	7(4.9)	5(2.5)	2(2.4)	-	14	2.9
Actenidida(Total)	**106(74.6)**	**46(23.1)**	**44(51.8)**	**26(52.0)**	**222**	46.6
Cunaxidae						
Pseudocunaxa simplex	2(1.4)	-	1(1.2)	-	3	0.6
Bdellidae						
Cyta laterostris	2(1.4)	31(15.6)	-	2(4.0)	35	7.4
Cheyletidae						
Eutogenus punctata	11(7.7)	2(1.0)	1(1.2)	2(4.0)	16	3.4
Hemicheyletia bakeri	-	-	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)						
Acaridae						
Tyrophagus putrescentia	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	11(7.7)	5(2.5)	-	12(24.0)	28	5.9
Oppiidae						
Niloppia sticta	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

Table (3): Abundance and relative contribution of dominant soil mites collected from El-Maghara, Sinai Peninsula.

	Species	Total number of individuals	%
Dominant species *	*T. putrescentia*	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 species *	*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 species *	*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 %) -Recessive species (less than 2 %) **[Badejo (1990)]**.

Data in table 3, illustrate dominant analysis of the collected soil mites, the seven dominant species under the different habitats were *T. putrescentia. Pygmephorus sp. Tarsonemus sp.,O. sticta, C., laterostris, E. cylindrical* and *Acaropeslla sp.*(24.0, 19.3, 8.0, 7.6, 7.4, 5.9 and 5.3%). In total, seven dominant species comprised of 77.3 % of the total individual numbers. *T. putrescentia* was a dominant species under olive trees (50.3 %), *Pygmephorus sp.* was a dominant species under fig trees (51.85 %). while *Tarsonemus sp.* was a dominant species under citrus trees (49.3 %).

The differences of mites species and mite numbers is a good indicators of soil fertility and soil quality at this area. Previous studies in similar environment have also shown the distribution of soil mites.

Zaher and Mohamed (1980) surveyed seven genera of five families of soil mites associated with three fields of potato, grapevine and sunflower at Rass Cedr, Sinai Peninsula. Kandeel (1993) surveyed the mite fauna at three districts in North Sinai. The surveyed revealed the presence of 48 species belonging to 37 species and 34 families.

The low diversity of soil mites might be also due to the extensive erosion of the top soil in many habitats **[Badjco & Kinyemiju (1993) and Abdel Wahab (2005)]**, and also might be due to the chemical composition and physical analysis of the soil that can influence on the abundance and diversity of soil mites.

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. With the suitability of soil in El Maghara for agriculture, water supply is still the limiting factor for good agriculture. Peoples are depending extensively on groundwater, mostly with a high salinity level. Soil quality studies conducted in the present work have revealed the high salinity of soil in El Maghara. Salinity is a major factor that contribute to soil degradation and its effected 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 effluent is considered the main sources of acid mine drainage. The acid thus formed lowers the pH of the soil. Agriculture has been hard hit by the coal mine, located in the area. During rainy season wastes produced from the mine are pushed by rain, moving to the surrounding areas, causing soil contamination, killing any vegetation and any soil organisms **[Morsy *et al.* (1992)]**.

The diversity of soil mites expressed by Shannon-Wiener diversity index showed significant differences between all habitats (Table 4). This means that distribution of mite individuals were very low at these area. The volue of H increases dramatically as the number of species increases, while E_H decreases as species number increases, and the area were not complete evenness or not equitability.

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

	Habitats			
	Fig	Olive	Citrus	Grapevine
S	13	13	16	12
H	1.901	1.192	2.304	1.619
E_H (J')	0.667	0.973	0.573	0.933

REFERENCES

Abdel Wahab, R.H (2005): Condition assessment of biodiversity of Gebel Magahra. Final Report Millennium Ecosystem Assessment. Suez Canal . University, Ismailia , Egypt.

Adejuyigbe, C.O.; G. Tian and G.O. Adeoye (1999): Soil microarthropod population under natural and planted fallows in south western Nigeria. Agro. Forestry System. 47: 263-272.

Araki, M. (2002): Annual report for 2001/2002 National for Agro-Environmental Science. p. 34.

Badejo, M.A. (1995): Acarine population of forest and fallow plots in Ile-Ife . Nigeria. Pedobiologia. Jena. v. 39: 555-560.

Badejo, M.A. and O.A. Akinyemiju (1993): Response of soil mites to hexzinone application in Nigeria. Science of the Total Environment , Amesterdame. 1156-1159.

Chiba, S.; T. Abe; J. Aoki; G. Imadate; K.Ishikawa; M. Kondoh; M. Shiba and H. Watanabe (1975): Seasonal changes in density of soil mesofauna : Acari. Collembola and others. Hirosaki University Science Reports, v 22: 87-124.

Curry, J.P. and J.A. Good (1992): Soil fauna degradation and restoration. Advances in soil science, 17: 171 – 215.

Egyptian Meteorological Authority (1996): Climatic Atlas of Egypt, Ministry of Transportation and Communication, Cairo, 157 p.

El-Kady, G.A. and I.M. Bahgat, (2000): Mites of Sinai peninsula, III: Incidence and seasonal abundance of soil mites in North and South Sinai. Bull. Soc. Ent. Egypt. 78: 63-76.

El-Kady H.F. and El-Shourbagy M.N. (1994): Vegetation changes in North Sinai within three decades. Journal of Coastal Research, 10:978-986.

El-Kady, G.A. and A.A. Shoukry, (1999): Mites of Sinai peninsula, II : Survey and ecological studies on mites inhabiting apple and grapevine. 8th Nat. Conf. of Pest.& Dis. Of Veg.& Fruits in Egypt.

Enami, Y. (2000): Oribatid mites as decomposers and their use as bioindicators of upland soil management. Farming Japan, 34: 16-21.

Hansen, R.A. and D.C. Coleman (1998): Litter complexity and composition are determination of the diversity and species of oribatid mites (acari : Oribatida) in litter bags. Applied Soil Ecology, 9: 17-23.

Hassan,M.F.; A.M. Afifi and M.S. Nawar (1982): Mites inhabiting plants and soil in Sinai and newly reclaimed land. Bull. Soc. Ent. Egypt, 66: 211-225.

Jackson, M.L. (1958): Soil chemical analysis. Prentice Hall, Inc., Englewood Cliff.N.J.. Library of Congress. USA.

Kandeel, M.M.H. (1993): Annotated lest and keys to mites occurring in North Sinai. Egypt. J. Product. & Dev. I (1): 55-80.

Kang,B. ; J.H. Lee and S.S. Choi (2001): Soil oribatid mite (Acari) settling in the forest litter in the different microenvironments in MT. Jumbong. Korea. Korean , J. Ecol.. 24 (4): 233-237.

Krantz, G.W. (1979): A manual of Acarology. Oregon State Univ., (Book, Stores Inc., Corvallis 509 pp.).

Magurran,A.E. (1988): Ecological Diversity and its Measurements. Croom Helm. London, UK. 179 pp.

Minor M.A.; T.A. Volk and R.A. Norton (2004): Effect of site preparation techniques on community of soil mites (Acari ; Oribatida,

Acari; Gamasida) under short rotation forestry planting in New York, USA. Applied Soil Ecology. 25: 181-192.

Morsy, A. M., Mostafa, G. M. Naim and M. A. El Ghawaby (1992): Geostatistical Reserve Estimation of the Coal Seams of Gabal El Maghara, N. Sinai, Proc. 3rd Conference of Geol. Sinai Development . Ismailia Egypt pp. 197- 208.

Pielou, E.C. (1984): The interpretation of ecological data. A primer on classification and ordination. John Wiley & Sons. Singapore.263 pp.

Richard, L.D. (1954): Diagnosis and important of saline and alkali soils. US.D.A. Hand Book (No. 601). 160pp.

Seastedt, T.R. (1984): The role of microarthropods in decomposition and mineralization processes. Annual Review of Entomolgy 29: 25-46.

Swift, M.J., Kang, B.T., Mulongoy, K. and Weomer, P. (1993): Organic-matter management for sustainable soil fertility in tropical cropping systems. In: Evaluation for Sustainable Land Management in the Developing World. Volume 2: Technical Papers. IBSRAM Proceedings 12:307-326.

Tousignate,S. and D. Codree (1992): Niche partitioning by soil mites in a recent hardwood plantation in southern Quebec, Canada. Pedobiologia, 36: 287-297.

Zaher, M.A. (1986): Survey and Ecological studies of phytophagous, predaceous and soil mites in Egypt. Final report PL 480, programme USA project No. EG. ARS-30, grant No.FG-139. Faculty off Agricultuure. Cairo University.

Zaher, M.A. and M.I. Mohamed (1980): Soil mites associated with some crops in Sinai Peninsula. Ann. of Agric. Sc., Moshtohor, 13: 209-214.

Zahran, M. A., Murphy, K. J., Mashaly, I. A., and Khedr, A. A. (1996): On the ecology of some halophytes and psammophytes in the Mediterranean coast of Egypt. Verhandlungen der Gesellschaft für Okologie 25: 133-146.

دراسة مبدئية لتواجد قراد التربة فى منطقة المغارة فى سيناء – مصر

تعتبر هذه الدراسة الأولى لتقييم التوزيع البيئى للقراد فى مصر بمنطقة المغـارة – سيناء تم تجميع العينات من عمق ٢٠ سم وتم تحديد ثمانية عشر نوع من القراد ينتمى الـى ثمانية عشر جنس وعائلة.

تنتمى الجاماسيدا الى سبع عوائل بينما الأكتينيديدا والأكاريديا والأورباتيدا إلى سبعة ــ واحد وثلاثة بالتوالى.