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## Impact of crop type on the diversity of soil fauna populations

Mostafa F. Masood<sup>1,3</sup>, Ensaf A. El-Gayar<sup>1</sup>, Hassan M. Sobhy<sup>2</sup> and Wafai Z. A. Mikhail<sup>2</sup>

<sup>1</sup>Zoology Department, Faculty of Science, Al-Azhar University, Assiut, **Egypt**.

<sup>2</sup>Dept of Natural Resources, Faculty of African Postgraduate Studies, Cairo University, **Egypt**.

<sup>3</sup>Biology Department, Faculty of Science, Jazan University, Jazan, **Saudi Arabia**.

\*Correspondence: [wafai47@hotmail.com](mailto:wafai47@hotmail.com) Accepted: 22 May, 2019 Published online: 07 June, 2019

In each of Al-Mahalla Al-Kubra (M-K) and Mahallat Rouh (M-R), Al-Gharbia Governorate, the impact of crop type on population and diversity soil fauna was studied. For this reason, four plots were selected, cultivated with wheat and clover in M-K and strawberries and tomatoes in M-R. Soil fauna were collected from each plot by pitfall trap method. Data of population of soil fauna taxa were treated by multivariate statistical method: de trended correspondence analysis and ascending hierarchic classification. Each of Simpson and Shannon-Wiener indices of diversity were also calculated. Twenty-four different taxa sampled with a total population in all plots was 3479 individuals, the total number of individuals in Al-Mahalla El-Kubra study area was 1601 individuals, while the total number of individuals in Mahallat Ruoh study area was 1878 individuals. The variation of taxa were the higher total number of taxa associated with wheat plot was 22 and total number of individual was 882, while total number of taxa associated with tomato plot was 20, and total number of individual was 1601, and total number of taxa associated with strawberries plot was 19 species, while total number of individual was 811, and total number of taxa associated with clover plot was 18 and total number of individual was 719. The crop type affects each of Simpson and Shannon-Weiner indices of diversity.

**Keywords:** Soil fauna – Formicidae – Spiders - Egyptian clover – Wheat

### INTRODUCTION

Wallwork (1976) classified agricultural practices into two categories; those are detrimental to invertebrate soil fauna, and those that are beneficial. The detrimental include ploughing, crop culture, pesticide applications and inorganic pollutant. The beneficial include; fertilizer applications, drainage, irrigation and maintenance of hedgerows. It will be recognizing that these two categories are not mutually exclusive (Rizk and Mikhail, 1999). The present study was conducted to investigate the effect of crop type on species composition and diversity of surface active soil animal's population in agricultural fields which cultivated with four

different crop types (wheat, Egyptian clover, strawberries and tomato).

### MATERIALS AND METHODS

#### Study area and crops

The experiment was conducted in two different sites El-Mahalla El-Kubra (M-K) and Mahallat Ruoh village (M-R), Al-Gharbia Governorate, Middle of the Nile Delta, Egypt. Four plots were selected, cultivated with wheat (Plot A) and Egyptian clover (Plot B) each was in M-K. Strawberries (Plot C) and tomatoes (Plot D) each in M-R.

## Method of sampling soil fauna

### Pitfall trap method

The soil fauna was collected from study area by the pitfall trap method as described by Slingsby and Cook (1986) and (Araújo et al., 2015). Pitfall traps consisted of 300 ml cups buried in the soil in such a way that the lip of the trap was ground level. The Pitfall were half filled with a detergent solution (1%) to ensure rapid sinking of animals and Pitfall traps were placed before sunset of day, kept open during the night, and the animals collected on the next morning. In this method, the number of individuals trapped is termed activity densities rather than population densities (Kromp, 1990; Mikhail, 1993; Araújo et al., 2015). The activity density cannot be related to the abundance per unit area (Kromp 1990; Araújo et al., 2015), but is taken as number per trap (Mikhail 1993; Araújo et al., 2015). The number of pitfall traps used in the study area with the four plots was 20 traps for each plot with a total of 80 pitfall traps in the two study areas.

### Treatment of data

Data of the activity density of the soil fauna taxa sampled in the present study were statically analyzed by multivariate statistical methods: correspondence analysis CA and ascending hierarchical classification AHC. Simpson(S) and Shannon-Wiener (H) indices of diversity were also calculated. All these calculations were done using PAST3 Programme, Version 1.94b (Hammer, 2009).

## RESULTS AND DISCUSSION

Table (1) show activity density of soil fauna sampled in each of El-Mahalla El-Kubra and Mahallat Rouh study areas. Twenty-four different species and/or higher taxa were sampled with total activity density of 3479 individuals from the studied plots. The total number of individuals in El-Mahalla El-Kubra (M-K) study area was 1601 individuals, while the total number of individuals in Mahallat Rouh (M-R) study area was 1878 individuals. Each of the two areas contains 23 species and/or higher taxa.

Fig (1) shows results of the application of CA and AHC to data of Table (1) Fifty-two percent of the total variance is associated with the first (horizontal) axis and 30% with the second (vertical) one. The first axis separates the two plots of Al-Mahalla El-Kubra at the left hand side of the ordination graph from those of Mahallat Rouh at the right hand side one. The two plots of

each of the two study areas were separated from each other along the second (vertical) axis. Plot (A) cultivated with wheat is more or less characterise by 9 species and/or higher taxa. These are: *Macrocheles muscaedomestcae*, *Friesa claviseta*, *Isotomurus palustris*, Staphilinidae, Diptera, *Aphis* sp., *Aphidius* sp., Pieridae and *Gryllus domesticus*. On the other hand, Plot (D) which cultivated with tomato is more or less characterising by 8 species and/or higher taxa. These are: *Tetranychus urticae*, *Poecilochirus* sp., *Sminthurinus elegans*, Spiders, Carabidae, *Bemisia argetifolii*, *Thrips* sp. and *Liposcelis* sp. Seven species and/or higher taxa are grouped in the middle of the ordination graph. These are: *Arctoseius magnanalis*, *Mesentotoma dollfusi*, *Anthicus* sp., Muscidae, *Orius* sp., *Monomorium* sp. and Acrididae. The other two plots, (B) cultivated with Egyptian clover and (C) cultivated by strawberries, are being outliers in the ordination graph.

The number of species and/or higher taxa, number of individuals and Simpson and Shannon-Wiener indices of diversity of soil fauna are shown in Table (2). It is clear that, number of species and/or higher taxa are equal in either El-Mahalla El-Kubra or Mahallat Rouh (23). However, number of taxa associated with each crop cultivations are differ. The maximum number of taxa was recorded in wheat cultivations (22 taxa), and the lowest one with the cultivations of Egyptian clover (18 taxa). Values of each of Simpson and Shannon-Wiener indices of diversity are generally higher in El-Mahalla El-Kubra than Mahallat Rouh, in the main area or in the different plots.

In the present study, the activity density of the surface active speciez and/or higher taxa of soil fauna under each of wheat and Egyptian clover cultivated in El-Mahalla El-Kubra plots, and strawberries and tomato in Mahallat Rouh plots were investigated. Generally, conventional no-tillage and tillage practices, crops types, and pattern of cultivation, are effective factors that affect activity density of soil fauna. Pitfalls have limited usefulness for assessing population sizes, because catches reflect both density and mobility of arthropod, however, pitfall traps are a valuable method for comparing habitats, assessing seasonal shifts in macro arthropod communities, and evaluating species richness (Coleman et al., 2004).

**Table (1) Activity density of species and/or higher taxa in EI-Mahalla EI-Kubra and Mahallat Rouh study areas.**

Taxa	EI-Mahalla EI-Kubra		Mahallat Rouh		Total
	Wheat	Clover	Strawberries	Tomato	
	Plot A	Plot B	Plot C	Plot D	
Mites					
Tetranychidae					
<i>Tetranychus urticae</i> Koch	212	102	423	482	1219
Mesostigmata					
Ascidae					
<i>Arctoseius magnanalis</i>	5			4	9
Machrochelidae					
<i>Macrocheles muscaedomesticae</i>	16	3	2	3	24
Parasitidae					
<i>Poecilochirus</i> sp.	5	1	15	6	27
Collembola					
Neanuridae					
<i>Friesea claviseta</i>	186	102			288
<i>Isotomurus palustris</i>	26	12	6		44
Entomobryidae					
<i>Mesentotoma dollfusi</i>		185	142	22	349
Katiannidae					
<i>Sminthurinus elegans</i>	9		33	5	47
Araneae					
Spiders	25	32	92	23	172
Coleopteran					
<i>Anthicus</i> sp.	12	15		17	44
Carabidae			4	20	24
Staphilinidae	26	16	5	4	51
Diptera	124	26	5	2	157
Muscidae	4	41	25	22	92
Hemiptera					
Ahididae					
<i>Aphis</i> sp.	91	35	28		154
Aleyrodidae					
<i>Bemisia argetifolii</i>	11			253	264
Anthocoridae					
<i>Orius</i> sp.	14	31	3	18	66
Hymenoptera					
Braconidae					
<i>Aphidius</i> sp.	27	12	1	1	41
Formicidae					
<i>Monomorium</i> sp.	45	80	2	167	294
Lepidoptera					
Pieridae	4	5	1	1	11
Thysanoptera					
<i>Thrips</i> sp.	20		20		40
Acrididae	7	14		6	27
Orthoptera					
Gryllidae					
<i>Gryllus domesticus</i>	11	7	2	4	24
Psocoptera					
Liposcelididae					
<i>Liposcelis</i> sp.	2		2	7	11

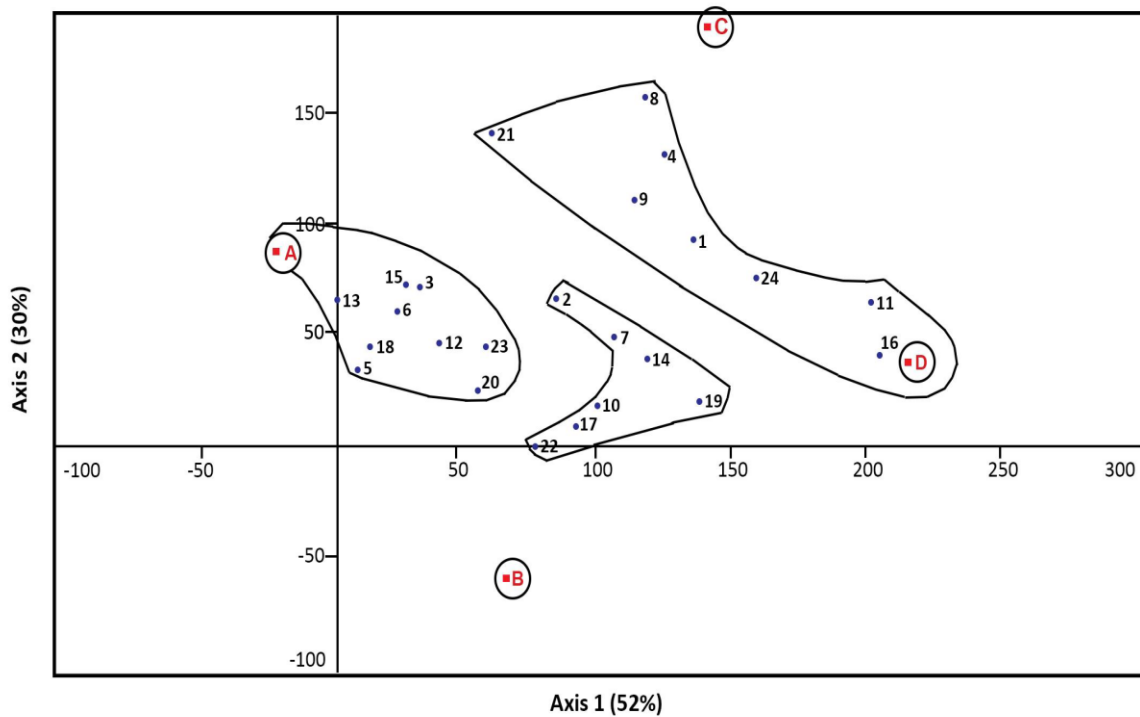


Figure. (1) Graphical representation of the application of CA and AHC methods to data of Table (1). Symbols: Letters A-D are for crops: A, wheat; B, Egyptian clover; C, Strawberries, D, tomato. Numbers 1-24 are for taxa: 1, *Tetranychus urticae*; 2, *Arctoseius magnanalis*; 3, *Macrocheles muscaedomesticae*; 4, *Poecilochirus* sp.; 5, *Friesea clavisetia*; 6, *Isotomurus palustris*; 7, *esentotoma dollfusi*; 8, *Sminthurinus elegans*; 9, Spiders; 10, *Anthicus* sp.; 11, Carabidae; 12, Staphilinidae; 13, Diptera; 14, Muscidae; 15, *Aphis* sp.; 16, *Bemisia argetifolii*; 17, *Orius* sp.; 18, *Aphidius* sp.; 19, *Monomorium* sp.; 20, Pieridae; 21, *Thrips* sp.; 22, Acrididae; 23, *Gryllus domesticus*; 24, *Liposcelis* sp.

Table (2) Total number of species and/or higher taxa, and Simpson and Shannon-Wiener indices of diversity.

Taxa	El-Mahalla El-Kubra		Mahallat Rouh		Total
	Wheat	Clover	Strawberries	Tomato	
	Plot A	Plot B	Plot C	Plot D	
Number of species and/or higher taxa	22	18	19	20	24
Number of individuals	882	719	811	1067	3479
Simpson index of diversity	0.859	0.868	0.679	0.712	0.839
Shannon-Wiener index of diversity	2.347	2.343	1.632	1.663	2.371

Comparisons indicated that higher activity densities of soil fauna taxa were generally associated with no-tillage practices, crop types and, pattern of cultivation (Rizk and Mikhail, 1999; Merlim et al., 2005). The effect of crop density, affect to great extent on the number of species and/or higher taxa in each of plot-A cultivated with wheat and plot-B cultivated with Egyptian clover, in the present study. On the other hand, cultivations of Strawberries in plot-C and tomato in plot-D, support higher activity density of soil fauna taxa than those of either plot-A or plot-B, since spaces in-between each of strawberries and tomato cultivations allow the movement of surface active soil animals taxa. Thus, affect pitfall trap catches and consequently the two indices of diversity.

### CONCLUSION

The study show that the effect of crop density, affect to great extent on the number of species and/or higher taxa in each of plot cultivated with wheat and that cultivated with Egyptian clover, in the present study. On the other hand, cultivations of Strawberries and tomato, support higher activity density of soil fauna taxa than those of either wheat or Egyptian clover, since spaces in-between each of strawberries and tomato cultivations allow the movement of surface active soil animals taxa. Thus, affect pitfall trap catches and consequently the two indices of diversity.

### CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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### AUTHOR CONTRIBUTIONS

All authors contributed equally in all parts of this study.

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### REFERENCES

- Araújo, A. S. F. ; Eisenhauer, N.; Nunes, L. A. P.; Leite, L. F. C. and Cesarz, S. (2015): Soil surface-active fauna in degraded and restored lands of northeast Brazil. *Land Degrad. Develop.*, 26: 1–8.
- Coleman, D. C. and Crossley, D. A. (1996): *Fundamentals of soil Ecology*. Academic Press, New York, 205 pp.
- Hammer, Ø. (2009): *Paleontological Statistic Software Package, Version 1.94b*, Natural History Museum, University of Oslo. 175 pp.
- Kromp, B. (1990): Carabidae Beetles (Coleoptera, Carabidae) as dioindecators in biological and conventional farming in Austrian potato. *Bio. Fert. Soils*, 9: 182- 187.
- Merlim, A. O.; Guerra, J. G. M; Junqueira, R. M. and de Aquino, A. M. (2005): Soil Macrofauna in cover crops of Figs grown under organic management. *Sci. Agric. (Piracicaba, Braz.)*, 62 (1): 57- 61.
- Mikhail, W. Z. A. (1993): Effect of soil structure on soil fauna in a desert wadi in Southern Egypt. *Journal of Arid Environments*. 24: 321-331.
- Rizk, M. A. and Mikhail, W. Z. A. (1999): Impact of no- tillage agriculture on soil fauna diversity. *Zoology in the Middle East*. 113 -120.
- Slingsby, D. and Cook, C. (1986): *Practical Ecology*. – London, 213 pp.
- Wallwork, J. A. (1976): *The Distribution and Abundance of Soil Fauna*. Academic Press, London: 355 pp.

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