

BIODIVERSITY OF SOIL MITES ASSOCIATED WITH WHEAT AND SOYBEAN CROPS IN SHARKEIA AND BEHEIRA GOVERNORATES

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Abstract

Biodiversity of different soil mite associated with both wheat and soybean crops surveyed in Sharkeia and Beheira governorates during two successive seasons 2016 and 2017. Fifty-seven mite species belonging to 41 genera under 22 families belonging to four sub-orders; Mesostigmata, Prostigmata, Cryptostigmata and Astigmata were identified. The total numbers of the collected mite groups recorded 69, 295, 533 and 602 individuals for Astigmata, Mesostigmata, Cryptostigmata and Prostigmata in Sharkeia, while the number of mites recorded 104, 378, 282 and 405 individuals for the previous groups in Beheira, respectively. Soil mites associated with wheat crop were higher numbers than soil mites of soybean. The oribatid and mesostigmatid mite species exhibit the higher number of soil mites in soil wheat followed by prostigmatid and astigmatid, while the low number of mites were recorded in soil cultivated by soybean plants.

Keywords: Biodiversity, soil mites, wheat, soybean.

INTRODUCTION

Mites are widespread in every sort of aquatic, arboreal, terrestrial and parasitic habitat, which accounting for as much as 80 % of all soil arthropods commuting living in the soil (Peterson and Luxton, 1982; Minor and Norton, 2004). They are not passive inhabitants of ecosystem. In fact, they are strong interactors with other organisms. In a similar way they are important indicators of disturbance in both aquatic and terrestrial systems and they are a major component of biological diversity. Functionally, they are classified as engineers of soil structure, indicators of the health of soil systems and major interactors with nematodes and microbes in decomposition (Walter and Proctor, 1999). Soil is an important component for monitoring of sustainability of land use in relation to both the conservation of natural resources and biodiversity of ecosystems. So, it has been growing awareness of species diversity and growing interest in understanding the factors influencing soil biodiversity (Ducarme and Lebrun, 2004). However plants play a dominant role as the foundation of the food web, so, it has been suggested that plant litter quality, quantity and timing, the soil water balance and microclimate in the surface layer and root

activity can determine the functioning of the belowground ecosystem (Hairiah *et al.*, 2001). The mesostigmatid mites play important role as predators of other soil microarthropods and both free-living and plant parasitic nematodes (Koehler, 1999; Beaulieu and Walter, 2007). They play a vital role in regulating the pest population in the soil.

So, the objective of this study is to survey the soil mites associated with wheat and soybean crops in Sharkeia and Beheira governorates during two successive seasons 2016 and 2017.

MATERIALS AND METHODS

Survey of soil mites associated with wheat and soybean plants:

The present investigation was conducted at two locations in diameter from Sharkeia and Beheira governorates during seasons 2016 and 2017.

To survey the soil mites inhabiting soil cultivated by wheat and soybean crops, 500 g of soil with three replicates were fortnightly taken using iron cylinder of one cubic liter at depth of 10-cm under the two crops (Gilyarov, 1975). Soil samples were kept in paper bags and transferred to the laboratory, soil samples were extracted using modified Tullgren's funnels (Lasebikan, 1974), allowed to mites fall into small jar containing 75% ethyl alcohol+ 5% glycerol. Then extracted mites mounted on glass slides in Hoyer's medium for identification. The identification of mites was based on illustrated to the world references keys Krantz and Walter (2009); Zaher (1986) and Evans (1992).

Data analysis:

The community structure of soil mites was analyzed using abundance and dominance percentage. Species diversity was expressed by the Shannon-Wiener Index (H') and the evenness (J') was calculated by Pielous (J') according to Pielou (1984):

$$H' = - \sum_{j=1}^S p_j \ln p_j$$

H, Shannon's diversity index

S, total number of species in the community (richness)

P_i, proportion of S made up of the *i*th species

E_H, equitability (evenness)

RESULTS AND DISCUSSION

Survey of soil mites associated with wheat and soybean plants:

At the present study, 57 mite species belonging to 41 genera under 22 families from four mite sub-orders were collected, (Table 1). Sub-order Mesostigmata

was represented by nine families namely: Ascidae was represented by two species; *Arectoseius butleri* Hughes and *Gamasellodes bicolor* Athias-Henriot; family Melicharidae was represented by five species: *Proctolaelaps orientalis* Naser, *P. scolyti* Evans, *P. holovertris* Moraes, Britto, Mineiro & Halliday, *P. pygmaeus* (Müller) and *P. aegyptiacus* Naser; family Pachylaelapidae was represented by only mite species namely *Pachylaelaps reticulatus* Berlese; family Blattisociidae represented by eight species: *Lasioseius lindquisti* Naser and Abou-Awad., *L. parberlesei* Bhattacharyya, *L. aegypticus* Afifi, *L. africanus* Naser, *L. pencillinger* Naser, *Blattisoeius tarsalis* Berlese, *B. keegani* Fox and *Blattisoeius mali* Oudemans; family Macrochelidae represented by two species: *Macrocheles muscadomesticae* (Scopoli) and *M. africanus* Hafez, El-Badry & Naser; whereas family Laelapidae represented by six species: *Ololaelaps bregetovae* Shereef and Soliman, *Androlaelaps casalis* (Berlese), *Hypoaspis sardoa* Berlese, *H. baloghi* Shereef and Afifi, *H. lubrica* Voigts & Oudemans and *Pneumolaelaps lubricus* (Oudemans & Voigts); family Uropodidae represented by two species, *Uroobovells (Fuscuropoda)* sp. Krantz and *Chiropturopoda bakeri* Zaher & Afifi, family Digamasellidae and Haemogamasidae were represented by a single species for both of them namely: *Digamasellus presepum* Berlese and *Haemogamasus pontiger* (Berlese), respectively.

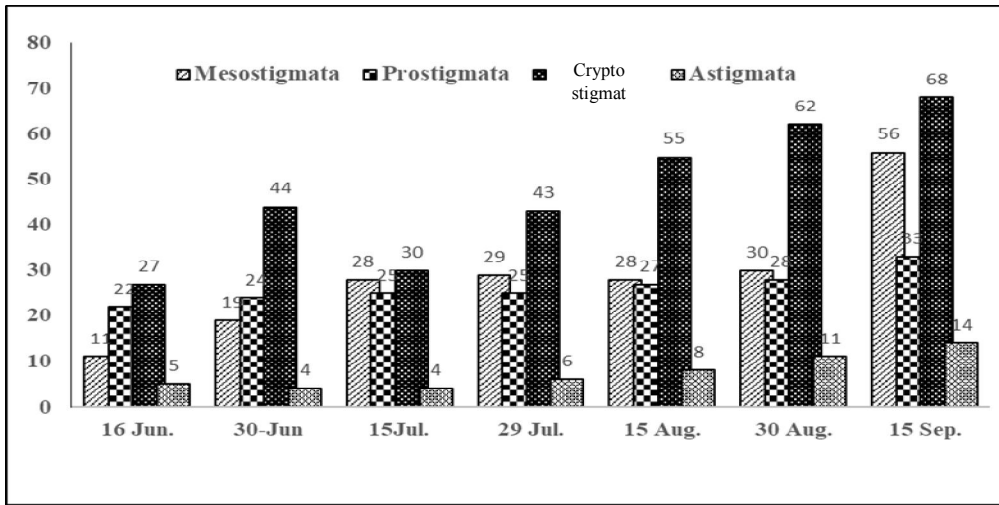
Sub-order Prostigmata was represented by nine families: Eupodidae was represented by three species: *Cocceupodes trandtmanni* Abou-Awad and El-Bagoury, *Eupodes momeni* Abou-Awad and *Eupodes voxencollinus* Sig Thor; family Rhagiidae was represented by two species: *Neothoria niloticus* Abou-Awad and El-Bagoury and *Roubustocheles mucronata* Zacharda; family Badellidae was represented by two species namely *Bdellodes longirostris* (L.) and *Cyta latirostris* (Hermann); family Cunaxidae was represented by three species: *Cunaxa* spp., *C. potchensis* Den Heyer and *Doctyloscirus dolichosctosus* Den Heyer; family Chyletidae represented by two species namely: *Chyletogenus ornatus* (Can. & Fanz.) and *Cheyletus badryi* Zaher and Hassan; family Raphignathidae represented by two species: *Raphignathus gracilis* (Rack) and *Raphignathus bakeri* Zaher & Gomaa; family Samarididae was represented by a single species namely *Tichosmaris jacoti* (Southcot); family Stigmaeidae represented by six species: *Apostigmaeus navicella* Grandjean, *Ledermuelleriopsis dendrites* Willmann, *Mediolata aegyptiaca* Zaher & Soliman, *M. pentascuta* Zaher & Gomaa, *Agistemus banksi* Gomaa & Hassan and *A. vulgaris* Soliman & Gomaa; family Tydeidae represented by three species namely *Tydeius* sp, *Paralorryia gizai* El Bagoury and *Lorryia reticulata* Oudemans.

Table 1. A partial taxonomic list of mites inhabiting soil of soybean plants in Sharkeia and Beheira Governorates throughout 2016 season.

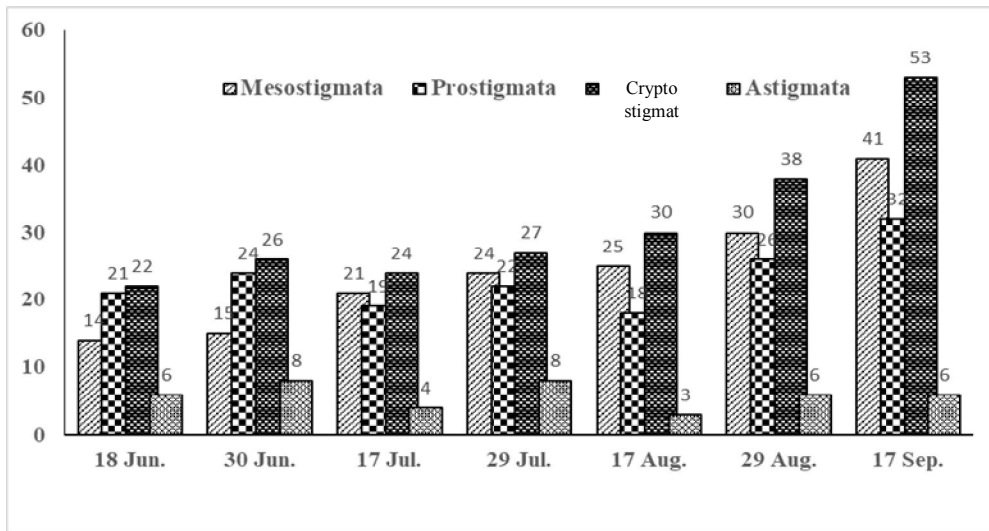
Acari Sub – order	Family	Mite species	Dominance of mite species	
			Sharkeia	Beheira
Mesostigmata	Ascidae	<i>Arectoseius butleri</i> Hughes	7.79*	2.91*
		<i>Gamasellodes bicolor</i> A. - H.	3.05	1.85
	Melicharidae Hirschmann	<i>Poctolaelaps orientalis</i> Naser	4.75	1.06
		<i>P. scolyti</i> Evans	8.14	5.03
		<i>P. holovertris</i> Moraes, Britto, Mineiro & Halliday	3.73	1.59
		<i>P. pygmaeus</i> (Müller)	0.68	1.85
		<i>P. aegyptiacus</i> Nasr	1.36	1.59
	Pachylaelapidae	<i>Pachylaelaps reticulatus</i> Berlese	3.73	0.26
	Blattisociidae German	<i>Lasioseius lindquisti</i> Nasr and Abou- Awad	7.79	4.23
		<i>L. parberlesei</i> Bhattacharyya	1.69	3.17
		<i>L. egypticus</i> Afifi	1.69	1.06
		<i>L. africanus</i> Nasr	2.71	1.06
		<i>L. pencilliger</i> Nasr	1.36	1.06
		<i>Blattisocius tarsalis</i> Berlese	3.39	0.26
		<i>B. keegani</i> Fox	0.34	3.17
		<i>B. mali</i> Oudemans	4.07	2.65
	Macrochelidae Vitzthum	<i>Macrocheles muscaedomesticae</i> (Scopoli)	2.37	0.26
		<i>M. africanus</i> Hafez, El-Badry & Nasr	2.71	0.53
	Laelapidae Berlese	<i>Ololaelaps bregetovae</i> Shereef and Soliman	2.03	0.00
		<i>Androlaelaps casalis</i> (Berlese)	5.42	6.08
		<i>Hypoaspis sardoa</i> Berlese	0.68	2.91
		<i>Hypoaspis baloghi</i> Shereef and Afifi	6.44	5.29
		<i>Hypoaspis lubrica</i> Voigts & Oudemans	6.77	3.70
		<i>Pneumolaelaps lubricus</i> (Oudemans & Voights)	0	2.65
	UropodidaeBerlese	<i>Urobovells (Fuscuropoda) Krantzi</i>	2.71	0.79
		<i>Chiropturopoda bakeri</i> Zaher&Afifi	10.51	24.34
	Digamasellidae Evans	<i>Digamasellus presepeum</i> Berlese	4.07	0.79
Haemogamasidae Oudemans	<i>Haemogamasus pontiger</i> (Berlese)	9.83	30.69	

Table 1. Cont.

Acari Sub – orders	Family	Mite species	Dominance of mite species	
			Sharkei a	Beheir a
Prostigmata	Eupodidae Koch	<i>Cocceupodes strandtmanni</i> Abou-Awad and El-Bagoury	3.32	1.23
		<i>Eupodes momeni</i> Abou-Awad	1.83	2.96
		<i>Eupodes voxencollinus</i> Sig Thor	0.83	0.99
	Rhagidiidae Oüdemans	<i>Neothoria niloticus</i> Abou-Awad and El-Bagoury	7.64	10.86
		<i>Roubustocheles mucronata</i> Zacharda	0.33	3.46
	Bdellidae Duges	<i>Bdellodes longirostris</i> (L.)	0.33	2.22
		<i>Cyta latirostris</i> (Hermann)	0.17	2.72
	Cunaxidae Thor	<i>Cunaxa</i> spp.	0.66	1.98
		<i>C. potchensis</i> Den Heyer	1.00	1.48
		<i>Doctyloscirusdolichosctosus</i> Den Heyer	0.17	3.46
	Chyletidae leach	<i>Chyletogenus ornatus</i> (Can. &Fanz.)	0.17	4.44
		<i>Cheyletus badryi</i> Zaher and Hassan	1.02	3.46
	Raphignathidae Kramer	<i>Raphignathus gracilis</i> (Rack)	1.49	0.26
		<i>R. bakeri</i> Zaher & Gomaa	3.49	2.47
	Smarididae Kramer	<i>Tichosmaris jacoti</i> (Southcot)	1.01	2.22
	Stigmaeidae Oüdemans	<i>Apostigmaeus navicella</i> Grandjean	8.80	18.27
		<i>Ledermuelleriopsis dendritus</i> Willmann	6.31	8.39
		<i>Mediolata aegyptiaca</i> Zaher & Soliman	9.97	8.88
		<i>M. pentascuta</i> Zaher & Gomaa	6.31	2.22
		<i>Agistemus banksi</i> Gomaa & Hassan	2.99	9.38
<i>Agistemus vulgaris</i> Soliman & Gomaa		6.81	7.41	
Tydeidae Kramer	<i>Tydeius</i> sp.	2.66	0.74	
	<i>Paralorryia gizai</i> El Bagoury	2.49	3.95	
	<i>Lorryia reticulate</i> Oudemans	1.83	2.22	
Crypto stigmata	Oribatulidae Thor	<i>Schelorbates laevigatus</i> (Koch)	50.47	191.49
	Oppiidae Grandjean	<i>Oppia sticta</i> Popp	1.13	0.00
Astigmata	Acaridae Leach	<i>Tyrophagus putrescentiae</i> (Schrank)	46.38	28.85
		<i>Rhizoglyphus robini</i> Claparede	26.09	33.65
	Pyroglyphidae	<i>Dermatophagoides farina</i> (Hughes)	27.54	37.5

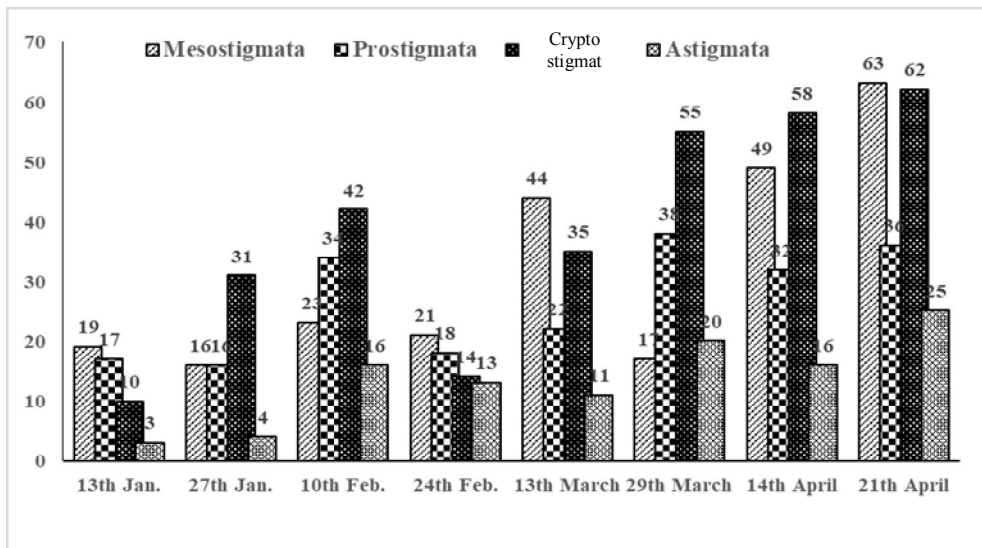


a. Sharkeia

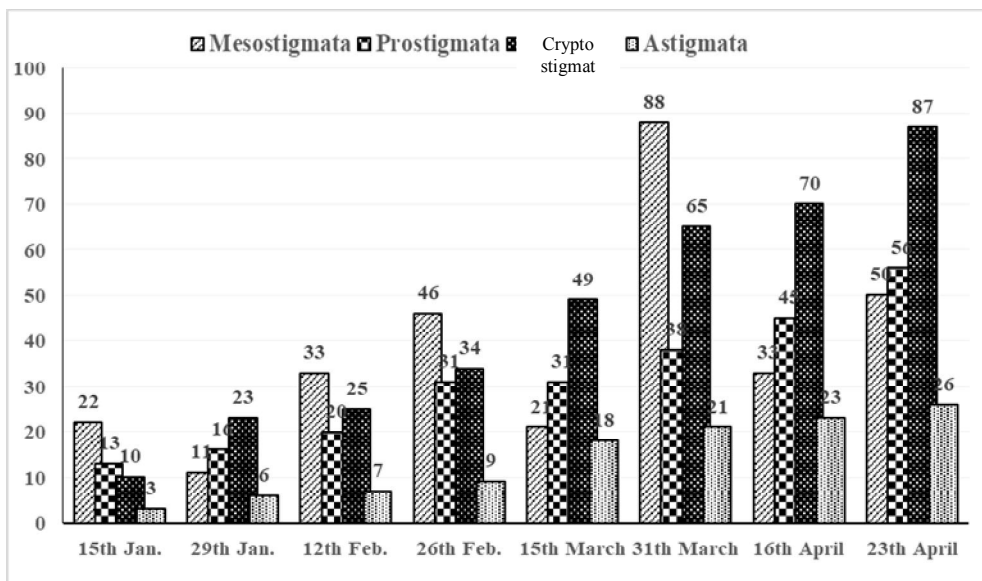


b. Beheira

Fig. (1, a-b): Total numbers of the collected soil mites associated with soybean plants in Sharkeia and Beheira Governorates.



a- Sharkeia



b- Beheira

Fig. (2, a-b): Total numbers of the collected soil mites associated with wheat plant in Sharkeia and Beheira Governorates.

Sub-order Cryptosstigmata was represented by two families Oribatulidae and Oppiidae which were represented by a single mite species namely: *Schelorbates laevigatus* (Koch) and *Oppia sticta* Popp, respectively. While, sub - order Astigmata was represented by two families; Acaridae which represented by two mite species namely; *Tyrophagus putrescentiae* (Schrank) and *Rhizoglyphus robini* Claparede and family Pyroglyphidae was represented by a single mite species namely *Dermatophagoides farina* (Hughes). The obtained data revealed that oribatid mite,

Scheloribates laevigatus (Koch) was the most dominant mite species recorded 191.49 and 40.47 % in Beheira and Sharkeia, respectively, followed by astigmatid mite, *Tyrophagus putrescentiae* recorded 46.38% at Sharkeia and *Rhizoglyphus robini* recorded 33.65 % in Beheira and mesostigmatic mite *Haemogamasus pontiger* recorded 24.34% recorded with 30.69% for for *Chiropturopoda bakeri* in Sharkeia Governorate, while the low dominance mite species recorded with Prostigmatid with 18.27% for *Apostigmaeus navicella* in Beheira Governorate. Thus, author detected that Cryptostigmatid and Mesostigmatid mite species exhibited the higher number at wheat crop followed by Prostigmatid and Astigmatid mite species, while the low numbers of mite species were recorded at soybean crop and these may be related to crop rotation and biodiversity of ecosystem.

Data in Tables (2 & 3) revealed that the number of soil mites inhabiting soil in Sharkeia was more than that recorded in Beheira represented by 56 and 55 mite species, respectively. The diversity of soil mites expressed by Shannon index (H'), while richness by Evenness (J'), soil in Sharkeia recorded 2.99 and 0.74 respectively, were higher than those obtained in Beheira soil, 2.66 and 0.66 respectively. In despite of the number of soil mites, observed at wheat and soybean soil gave the same value (four sub-orders), the total mite individuals recorded in wheat soil (1345 individuals) was more than in soybean soil (1315 individuals) resulting the increase in diversity and Evenness (0.366 and 0.264, respectively), in case of wheat than in soybean soil (0.299 and 0.216, respectively), (Table 3).

As general trend, both diversity and Evenness were positively correlated with number of mite species.

Table 2. Number of species (S), species diversity (Shannon index, H') and evenness (J') of soil mites inhibited soybean and wheat under different habitats in Sharkeia and Beheira Governorates

Parameters	Habitats	
	Sharkeia	Beheira
Species Richness (S)	56	55
Number of Individuals (N)	1105	1494
Shannon Index (H')	2.99	2.66
Evenness ($H'/\ln(S)$)	0.74	0.66

Table 3. Number of species (S), species diversity (Shannon index, H') and evenness (J') of soil mites inhabited under different habitats

Parameters	Habitats	
	Wheat	Soybean
Species Richness (S)	4	4
Number of Individuals (N)	1345	1315
Shannon Index (H')	0.366	0.299
Evenness (H'/ln(S))	0.264	0.216

The authors Wasyluk, 1975 and Abo-Korah & Osman, 1979 mentioned that different mite species of soil differ in their response to certain plants under which they live and carry out their activities. The obtained results are in agreement with Walia and Mathur (1994) who found that cryptostigmatid mites were the most frequent and abundant followed by Astigmata, Mesostigmata and Prostigmata in survey of soil samples under field crops, vegetable plants, fruit trees and forest plantation. Also, Banerjee (1986); Krantz and Walter 2009; El-Kady and Bahgat 2000; Embarak and Abou El-Saad (2010), reported that cryptostigmatid mites were the most predominant over other groups of mites such as Mesostigmata, Prostigmata and Astigmata, these may be based on host plant. In addition, El-Kawas *et al.*, (2011) investigated the occurrence and distribution of soil mites inhabiting onion and garlic plants in Sharkeia governorate. Twenty-three mite species belonging to four sub-orders were recorded. Results cleared that actinedid and oribatid mites were the most dominant in onion and garlic soils contributing by 35.16 and 41.38 % of the total collected mites, respectively.

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التنوع البيولوجي لأكاروسات التربة المرتبطة لمحصولي القمح وفول الصويا بمحافظتي الشرقية والبحيرة

فاطمة شحاته قلموش ، عصام محمد عبد السلام ياسين

قسم بحوث أكاروس القطن و المحاصيل - معهد بحوث وقاية النباتات- مركز البحوث الزراعية -
الدقى - جيزة - مصر

تم حصر ودراسة أكاروسات التربة المصاحبة لنباتات القمح و فول الصويا بمحافظتي
الشرقية و البحيرة خلال عامي ٢٠١٦ و ٢٠١٧ . حيث تم تسجيل ٥٧ نوعا أكاروسيا تابعة لـ ٤١
جنسا تنتمي الي ٢٢ فصيلة تتبع أربعة تحت رتبة.
ولقد أظهرت الدراسة أن إجمالي الاعداد التي تم تسجيلها بلغ ٦٩ و ٢٩٥ و ٥٣٣ و ٦٠٢
لكل من الأكاروسات عديمة الثغر و ذات الثغر المتوسط و خافية الثغور و ذات الثغر الأمامي
بمحافظة الشرقية ، علي الترتيب ، و ١٠٤ و ٣٧٨ و ٢٨٢ و ٤٠٥ فردا بمحافظة البحيرة، علي
الترتيب.

وأوضحت الدراسة أن أعلي تعداد من أكاروسات التربة في محصول القمح مقارنة بفول
الصويا، حيث أظهرت أن تعداد مجموعة الحلم خافية الثغور و مجموعة ذات الثغر المتوسط عالية
في محصول القمح مقارنة بالحلم ذات الثغر الأمامي و عديم الثغر . وقد سجل أقل عدد من
اكاروسات التربة مصاحبة لمحصول فول الصويا.

