

ABUNDANCE AND ACTIVITY - DENSITY OF SOIL FAUNA IN DIFFERENT VEGETABLES, MONOCULTURE AND INTERCROPPING SYSTEMS

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Abstract

In Fayoum, Egypt, the influence of different intercropping systems on population of soil fauna was studied. For this reason, seven vegetations of monoculture and intercropping systems using clover, lettuce and cabbage were applied. Fauna were collected by means of pitfall trap methods and data were analyzed and interpreted. The captured surface soil fauna were listed according to the Ascending Hierarchic Classification (AHC) Roux (1985). Fauna were classified into the six main functional groups, herbivores (agricultural potential pests), detritivores (responsible for soil fertility), carnivores (predators of pests), parasitoids, pollen grain transmitters and vector diseases. The community composition in the period of study was determined using the Shannon-Wiener (1963) and Simpson (1949) Indices of diversity, slight difference in the species diversities among the seven cover of cultivation was observed.

Keywords : Diversity , Functional groups, Intercropping, Monoculture, Shannon-Wiener Index, Simpson Index , Soil fauna, vegetables.

INTRODUCTION

Soil, wherever found is recognized as habitats for much of the biospheres in described diversity. Soil biodiversity could be an indicator of soil health, hence soil productivity. A composite study has been made to investigate the influence of vegetation types on species composition of soil fauna. Arthropods, including insects, spiders, and mites, are integral to crop loss and soil health because they include both beneficial and pest species. The return of arthropods to mined area is influenced by a variety of factors, including plant cover, species richness (Majer *et al.* 1984) and litter cover (Majer *et al.* 1982).

Also, Ramert (2002) concluded that mixed species cropping, particularly row intercropping and strip intercropping, could be an important tool for pest and disease management in organic systems. These benefits are especially likely to include improved techniques for management of soil fertility. However, the benefit occurred from intercropping may vary according to the nature of intercrops and their population management.

In Egypt, many authors studied the effect of intercropping system throughout certain crops combinations such as Metwally (1978) and Shafshak *et al.* (1984). It is a

popular system of cultivation for maximizing yields of crops, the important thing to remember in intercropping is to arrange spacing of different kinds of vegetables in pattern that will permit each to receive maximum light. When leaves of one plant overlap those of another the ones that are shaded will grow less productive.

Several authors have reported that the different cover crops enhance the activity-density of the soil fauna, Hammond (1990) and Rizk & Mikhail (1999). Others indicated that infestation rates and pest populations are reduced in multicultural system than in monoculture of different field crops Altieri *et al.* (1978), Sharaf-El-Din *et al.* (1993), El-Khouly *et al.* (1994), Rizk *et al.* (2002).

Cropping systems must incorporate the relationships between farm practices and the ecosystem to create an equilibrium where farm inputs enhance rather than replace natural processes.

The aim of the present work was carried out to investigate the abundance of soil fauna in different cover crops in various types of vegetable cultivations (monoculture and intercropping systems).

MATERIALS AND METHODS

Study area:

The experiment was conducted in Fayoum Governorate, Egypt, during the period between November 2008 and March 2009. An area of half feddan (2100m²) was divided into seven equal plots. The first plot was cultivated with the Egyptian clover, *Trifolium alexandrianum* L., the second plot with lettuce, *Lactuca sativa* L., the third with cabbage, *Brassica oleracea* L. the fourth was intercropped of lettuce with cabbage in alternating rows at ratio 1:1, the fifth was intercropped of lettuce with cabbage on terraces, the sixth was cultivated with cabbage and surrounded with clover, the seventh was cultivated with lettuce and surrounded with clover.

Method of sampling soil mesofauna

The soil mesofauna was collected in the study area by the pitfall trap method as described by Southwood (1978) and Slingsby & Cook (1986) and Southwood & Henderson (2000), pitfall traps are cups sunk into the ground flush with the soil surface which collect organisms that fall into them. In this method the number of individuals trapped is primarily dependent on their locomotion activity and these are therefore called activity-density rather than population-density, Kromp (1990) and Mikhail (1993). The activity-density cannot be related to the abundance per unit area, Kromp (1990) but, is taken as number per trap, Mikhail (1993).

This experiment continued for five months, ten pitfall traps were distributed in each plot of the mentioned field, samples were taken at weekly intervals from each plot, three week after planting. The contents of the pitfall traps were then transferred to the laboratory where the captured arthropods identified and counted for each treatment.

Treatment of data

The captured surface soil fauna were listed according to the Ascending Hierarchic Classification (AHC) Roux (1985).

Functional groups: The breakdown of trophy group based on feeding strategies and method of locomotion in the soil (Wallwork 1976), as soil arthropods eat their food and mix up the soil .

The abundance: The frequency values of the most abundant species were classified into three classes according to the system adopted by Weis Fogh (1984)," Constant species "were considered as those found in more than 50 % of the sample, "accessory species" were those found in 25-50 % of samples and "accidental species" were those found less than 25% of the samples. On the other hand, the classification of dominance values were done according to Weigmann system (1973), (c.f. El-Shahawy and El-Basheer 1992) in which the species were divided into five groups based on the values of dominance in the samples, eudominant species (>30% individuals), dominant species (>10-30% individuals), subdominant species (5-10% individuals), resident species (1-5% individuals) and sub-resident species (1% individuals).

Species diversity

The biodiversity of soil fauna collected were estimated by using equilibrium. Diversity of collected arthropods was determined for samples pooled over one summer season by seven different patterns of cover cultivation. It was measured by diversity indices that reflect the number of species (richness) in the samples.

Two common indices were computed, the Shannon-Wiener (1963) index "H" and the Simpson (1949) index "S". They were calculated as described by Ludwig and Reynolds (1988) .

$$H' = -\sum (n_i / n) \ln (n_i / n) \quad \text{and} \quad S = \sum (n_i / n)^2$$

Where " n_i " is the number of individuals belonging to the i^{th} of "S" taxa in the sample and " n " is the total number of individuals in the sample , "H" is more sensitive to changes in rare taxa , while "S" is more responsive to changes in the most dominant species (Ludwig & Reynolds 1988)

RESULTS AND DISCUSSION

Population study

In the present study, the activity-density of the surface active soil fauna under seven of covered crops. Different cultivated systems were compared using pitfall traps.

Table (1) lists the soil fauna taxa sampled , the total activity - density of these arthropods was 3664 individuals. They are belong to 13 orders, 33 families and at least 20 recognized species.

Effect of different cultivation on soil arthropod abundance

As shown in Table (1) and Fig.(1) , it was found that the greatest number of individuals was obtained in clover and lettuce monocultures plots , 923 & 673 individuals respectively, then decreased to 506 & 471 individuals for intercropping lettuce with cabbage in alternating rows, and lettuce with cabbage over terraces respectively, while plots cultivated with cabbage and lettuce which, they surrounded by clover received the lowest number of arthropods 346 & 304 individuals respectively.

Table 1. Numbers of surface mesofauna sampled in different patterns of farming system between Nov. 2008 & March 2009 cultivation

Taxa	A	B	C	D	E	F	G	Total
Order : Snail	11	1	2		2	2		18
Order : Acarina	1		1	3		1	1	7
Order : Araneae	14	5	4	3	12	5	11	54
Order : Collembola					6			6
Entomobryidae, <i>Entomobrya sp</i>	202	6	6	2	2	10	4	232
<i>Folsomides parvulus</i>	6	16	24	10	22	33	12	123
Isotomidae, <i>Isotomorus sp.</i>	560	501	315	376	342	155	172	###
Sminthuridae, <i>Sminthurinus sp.</i>			1	2		1		4
Order : Orthoptera								
Acridiidae	1		1		1	1		4
Order : Lepidoptera	1			1	2	5		9
Noctuidae, <i>Autographa gamma</i>	1		1	1	1		1	5
Pieridae, <i>Pieris rapae</i>	1						1	2
Pyralidae			1					1
Myrmelionidae				1				1
Order : Diptera	24	2	5	9	4	12	12	68
Agromyzidae	6	5	4	5	4	7	4	35
Cecidomyiidae	14	7	5	10	4	11	6	57
Chironomidae, <i>Chironomus sp.</i>	6	4	4	2	2	3	3	24
Muscidae	3	4	4	3	3	2	5	24
<i>Musca domestica</i>		1	1	2	1	10	2	17
Sarcophagidae					1		3	4
<i>Sarcophaga dux</i>	1					8		9
Syrphidae		1				1	3	5
<i>Syrphus corollae</i>			2	3	1	7	2	15
Culicidae, <i>Culex sp.</i>	1	1	2	2		9	3	18
Ephedridae	7	5	4	4	3	7	4	34
Faniidae	10	6	8	6	4	8	6	48
Order : Coleoptera	1	2						3
Coccinellidae, <i>Coccinella sp.</i>		1			1	2	1	5
Staphilinidae, <i>Philonthus sp.</i>	1	2	6	4	5	5	2	25
Curculionidae	1				1			2
Scarabaeidae, <i>Tropinota squalida</i>						1		1
Carabiidae	1	2						3
Order : Hymenoptera								
Formicidae	1	3		2				6
<i>Monomorium pharaonis</i>	7	14	4		3	11	2	41
<i>Cataglyphus bicolor</i>	4	1		1	2	3	1	12
<i>Camponotus maculatus</i>	1	4		1	2			8
Apidae		1	2	4		2		9
<i>Apis mellifera</i>	4	1	1	2		3	1	12
Braconidae	4	4	4		7	6	7	32
Chalcididae		1	2	8	1	4	1	17
Sphecidae, <i>Cephix sp.</i>	2							2
Order : Psocoptera, <i>Liposceles sp.</i>	3		2	2	2	1	3	13
Order : Thysanoptera, <i>Thrips sp.</i>	4	32	3	19	7	2	14	81
Order : Homoptera								
Aphidae, <i>Aphids sp.</i>	16	34	22	13	18	6	13	122
Cicadellidae		1	1	3	1			6
<i>Agallia aegyptiacus</i>	3	2	1		2	1	4	13
Order : Hemiptera, Lygaeidae		3			2	1		6
Total	923	673	443	504	471	346	304	###

A : clover

B :Lettuce

C : Cabbage

D : Lettuce intercropped with cabbage in alternated rows (1:1)

E : Lettuce intercropped with cabbage over terraces

F : Cabbage surrounded with clover

G : Lettuce surrounded with clover

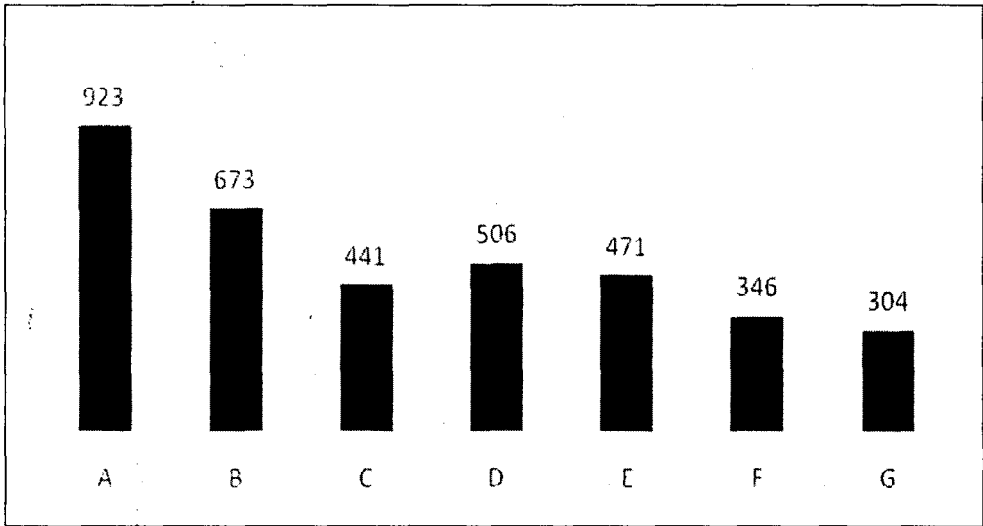


Fig. 1. A comparison between the captured surface soil fauna in different cover of plantation

Species composition, species richness and species abundance

The collected arthropods were summarized by orders in Table (2) and show their abundance, frequency (richness) and dominance. Results indicated that Collembolans, Diptera, Homoptera, Hymenoptera, Thysanoptera and Araneidae are the most frequent taxa among soil fauna recorded in the study, they represented by 97% of the total cached soil fauna. As shown in Table (2), members of Collembola involved the greatest number of soil fauna. The beneficial Collembola represented by three species and two families, they are *Entomobrya* sp. (Entomobryidae) , *Folsomides parvulus* and *Isotomirus* sp. (Isotomidae). Their abundance serve as a good indicators of soil health. They recorded the largest number of collected arthropods and this result is in good accordance with Fountain & Hopken (2004), who showed that collembola (springtails) are abundant and widespread in soil ecosystems and are important members of the decomposer community . Collembola was accounted for 76% and considered as constant species according to system adopted by Weis Fogh (1984), and it was dominant species (>30% individuals) as shown the classification of dominance values which was done by (Weigmann 1973).

The order Diptera followed Collembola in the abundance, accounted for 9.79% of the total captured arthropods. It is represents by nine families, Table (1), Chironomidae , Syrphidae , Cecidomyiidae , Agromyziidae , Muscidae , Fannidae, Culicidae, Sarcophagidae and Ephedridae . Members of the family Agromyziidae known as pest of high frequency in cabbage plots surrounded by clover and clover plots alone, while families Fannidae and Cecidomyiidae live as scavengers in various kinds of decaying matter and were high frequently in the clover plots. Diptera was considered as accidental species (< 25%) and it was subdominant (5-10%).

Table 2. Total number of collected arthropods under different cultivation systems between Nov. 2008 & March 2009 cultivation

Orders	A	B	C	D	E	F	G	Total	Frequency & Dominance %	
Snail	11	1	2		2	2		18	0.49 (a / Sr)	Dominance
Acarina	2		1	3			1	7	0.19 (a / Sr)	> 30 % = Eudominant (E)
Araneae	14	5	4	3	12	6	11	55	1.5 (a / R)	10 - 30 % = Dominant (D)
Collembola	768	523	345	390	372	199	188	2785	76 (C / E)	5 - 10 % = Subdominant (Sd)
Orthoptera	1		1		1	1		4	0.11 (a / Sr)	1 - 5 % Resident (R)
Lepidoptera	5		2	2	3	5	2	19	0.52 (a / Sr)	> 1 % = Subresident (Sr)
Diptera	72	36	40	46	27	85	53	359	9.79 (a / Sd)	
Coleoptera	3	7	6	4	7	8	3	38	1.04 (a / R)	
Hymenoptera	21	29	13	18	15	29	12	137	3.74 (a / R)	Abundance (frequency)
Thysanoptera	4	32	3	19	7	2	14	81	2.21 (a / R)	> 50 % = Constant (C)
Homoptera	19	37	22	18	21	7	17	141	3.85 (a / R)	25 - 50 % = Accessory (A)
Hemiptera		3			2	1		6	0.16 (a / Sr)	> 25 % = Accidental (a)
Neuroptera				1				1	0.03 (a / Sr)	
Psocoptera	3		2	2	2	1	3	13	0.36 (a / Sr)	
Total	923	673	441	506	471	346	304	3664		

A : clover

B : Lettuce

C : Cabbage

D : Lettuce intercropped with cabbage in alternated rows (1:1)

E : Lettuce intercropped with cabbage over Terraces

F : Cabbage surrounded with clover

G : Lettuce surrounded with clover

Order Homoptera ranking the third in the abundance of their individuals, accounted to 3.85 % of the total arthropods, it include the major piercing sucking pests causing economic damage to the plant host , they represented by two species belonging to two families, they are *Agallia aegyptiaca* (Cicadellidae), and *Aphis gossypii* (Aphidae) .

Tables (1) &(2), revealed great differences between cultivation systems, the population density of homopterous members was higher in the monoculture system 37 & 22 individuals for lettuce and cabbage respectively, then decreased in the intercropping system to 18 individuals for lettuce intercropped with cabbage in alternating rows and to 21 individuals for lettuce intercropped with cabbage over terraces. In the last system, the clovers surrounded the lettuce and the cabbage acts as trap and reduce the pest level, the homopterous pests received in these plots were

7& 17 individuals for cabbage and lettuce, respectively. The clover is grown as crop feeding animals and improves soil fertility.

This result indicated that, both, crop vegetation and type of cultivation affected the occurrence of leaf hoppers and aphids.

Order Hymenoptera accounted for 3.74 % of the total captured arthropods. It includes ants , wasps and bees , these insects are important and act as scavengers , parasitoids, predators or pollination potential. They are represented by seven species and five families : *Monomorium pharaonis* , *Cataglyphus bicolor*, *Camponotus maculatus* (Formicidae) , *Cephix* sp. (Sphecidae) *Apis mellifera* (Apidae) , and the parasitoids (Brachonidae) and (Chalcididae) . The largest number of Hymenoptera was obtained in the monoculture 's system (29 individuals). In general ant populations are the highest members of this order, they are responsive to change environmental conditions of soil. The parasitoids were nearly similar in the different cultivation, while the pollen grain transmitters were more abundant in the clover plot.

The frequency of true spider constitute high degree in abundance in the clover plantation (14individuals) while lettuce and cabbage monoculture received (5 & 4 individuals) respectively. Moreover, spider increased in the intercropping system as in lettuce intercropped with cabbage over terraces, 12 individuals. Jogar et al (2004), show that the increase of ground cover density in plant communities could enhance the abundance of spider assemblages. Araneidae, Coleoptera, Homoptera, Hymenoptera and Thysanoptera were accounted for (1.5, 1.04, 3.85, 3.74 and 2.21 %) respectively, and considered as accidental species and they were resident (1-5% individuals) .

The activity-density of snail revealed great differences between different types of cover cultivations that ranges between 11individuals in clover monoculture plantation and 2 individuals in lettuce intercropped with cabbage over terraces and none in lettuce intercropped with cabbage intercropped with for lettuce in alternating rows. Members of Acarina, Hemiptera, Lepidoptera , Neuroptera, Orthoptera, Psocoptera and snails are the lowest frequent taxa among the soil fauna recorded and they were accounted for (0.19, 0.16, 0.52, 0.03, 0.11, 0.36 and 0.49 %) respectively, and considered as accidental species and therefore they were sub-resident (>1% individuals).

Functional group

Table (3) &Fig. (2), show the results of the breakdown of the surface soil fauna in the different cultivation systems into the main functional groups: Herbivores, detrivores, predators, parasites, pollen grain transmitters and vector diseases.

a) Detrivores group ,the Collembolans , ants and dipterous were the main groups of arthropods found in the soil, numbers of these groups were higher on all monoculture plots , while plot of lettuce surrounded by clover received the lowest population, Generally, the detrivores are the most abundant group and recorded 77.32 % of the total pitfall trap catches.

b) Herbivores group , represented by aphids , leaf hoppers, thrips, grasshoppers and locusts, they accounted for 15.04%, the plot of the clover and lettuce (monoculture) received the highest population of herbivores, 108 individuals decreased to 58 individuals in the plot of lettuce intercropped with cabbage over terraces . Perfecto and Sediles (1992) found that the abundance of herbivores on maize would be less in the biculture than in the monoculture and the ant foraging activity would be higher in biculture.

c) Carnivores or predators, recorded 3.66% , and represented by true spiders, robber flies *Syrphus corollae* (Diptera :Syrphidae), *Coccinella sp.*(Coleoptera : Coccinellidae) and *Philonthus sp.*, (Coleoptera : staphyllinidae) and beetles (Coleoptera: Carabidae). The true spiders are the more abundant than other predators. This group was found in high population in the plot cultivated with cabbage surrounded by clover (34 individuals), while plot of lettuce (monoculture) received the lowest population (6 individuals).

d) Parasitoids, recorded by 1.67% found in high population in the plot cultivated with cabbage surrounded by clover (14 individuals), while plot of lettuce (monoculture) received the lowest population (1 individual).

e) The pollen grain transmitters recorded by 0.76% and represented by the bee and collected in few numbers.

f) Vector diseases, recorded by 1.56 and represented by the house fly and found in few numbers..

Scherer- Lorenzen (2005) indicated that the diversity of functional groups in general had more pronounced effects than the number of species, emphasizing the importance of functional traits of species.

Table 3. Breakdown of surface soil fauna into trophic groups in different cover cultivation from November 2008 to March 2009

Functional Group	A	B	C	D	E	F	G	Total	Dominance
									%
Detrivores	783	543	350	392	374	200	191	2833	77.32
Herbivores	108	108	61	79	58	68	69	551	15.04
Parasitoids	5	1	8	8	9	18	14	61	1.67
Predators	19	6	16	14	26	34	19	134	3.66
Poll. Gr.Trans.	4	9	3	6	0	5	1	28	0.76
Vector diseases	4	6	5	7	4	21	10	57	1.56
Total	923	673	441	506	471	346	304	3664	

A :clover

E : Lettuce intercropped with cabbage over Terraces

B :Lettuce

F : Cabbage surrounded with clover

C : Cabbage

G : Lettuce surrounded with clover

D :Lettuce intercropped with cabbage in alternated rows (1:1)

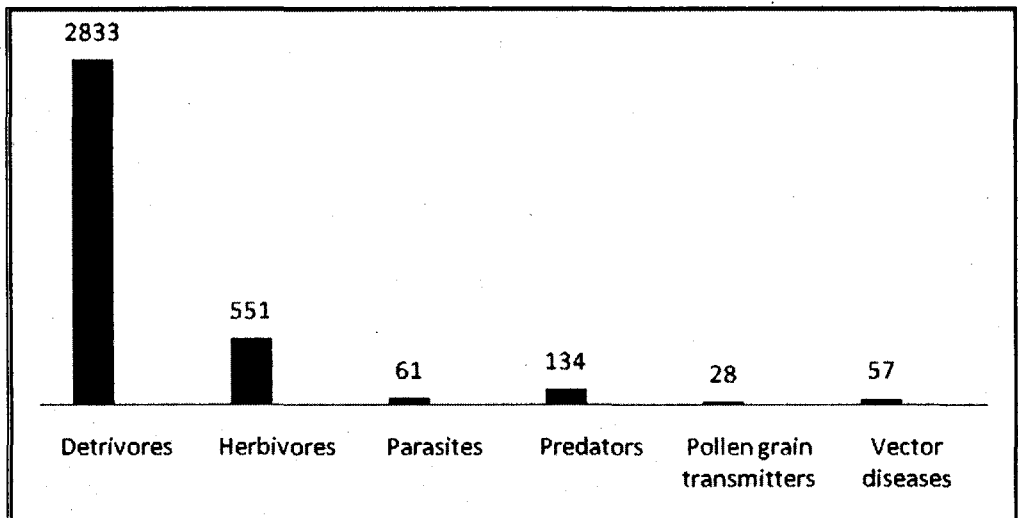


Fig. 2. Breakdown of surface soil fauna into trophic groups in different cover cultivation

Species diversity

Table (4) compares the biodiversity of the soil arthropods in the different cultivation, by using Shannon Wiener (1963) "H" and Simpson (1949) "S" Indices of diversity. The plantation's cover of monoculture plots varies in their species richness

and recorded the highest population of total number 923, 673 & 441 individuals for clover, lettuce and cabbage plots respectively larger than those obtained in the intercropping cultivation and its ecosystem is made up of 9-12 orders and at least 34 sp. , while the species richness of the intercropping were 506 and 471 individuals composed of 11-12 orders and at least 31 sp. , however the vegetation system surrounded by clover received the fewest population of species richness, 346 and 304 individuals of 10&12 orders and at least 35sp.

By using Shannon Wiener Index (1963), (sensitive to changes for rare taxa), the resulting values of calculation for system surrounded by clover were the highest (0.9 &1.1) so, It could be said that this system had higher diversity index. Similarly, the values calculated for other cultivation describe the different species diversity index for each treatment. According to Simpson (1949) Index which, is the measure of dominance (responsive to changes for the most dominant species), it was found that the clover plot include the highest number of dominant species.

Table 4. Estimation of Shannon-Wiener and Simpson Indices of diversity in different cover cultivations

Type of index	A	B	C	D	E	F	G
Shannon-Wiener Index	0.54	0.61	0.75	0.8	0.71	0.9	1.1
Simpson Index	0.73	0.68	0.65	0.62	0.62	0.39	0.46

DISCUSSION

Results indicated that each of the seven cover cropping systems could affect the population of mesofauna. The obtained results reveal that lettuce intercropped with cabbage in alternated rows is suitable for reducing the numbers of aphids and leaf-hoppers to half the number in the monoculture system, whereas, the corresponding number in cabbage surrounded with clover reduced to 1/5 the number of the monoculture system. Previous results are in agreement with the finding of El-khouly et al. (1994) who reported that intercropping of maize with cowpea in different patterns is suitable for lowering the degree of infestation of both crops with the cowpea aphid and the corn leaf aphid.

The major advantage of natural enemies is suppression of phytophagous insect pests at little or no cost and minimal harm to humans or the environment. The activity-density of predators (true spiders) in lettuce intercropped with cabbage over

terraces and lettuce surrounded with clover was greatly high, this is due to the foliage density which ,offers shade, protection and humidity, favorable to spiders.

Also, increasing the number of spiders in clover monoculture system, could be a result of the highest numbers of herbivores and detritivores groups, this deduction is supported with Bardwell & Averill, (1997) and Malony et al.(2003) who showed that spiders preyed upon Collembola and small dipterous larvae located in the ground.

From the previous results it could be concluded that the cover cropping vegetation on one hand and the intercropping system on the other hand are principal factors influencing pest population on plant. Also, Ghabbour *et al.* (1999) found that the shade of plants and the available humidity expressed as water requirements for each crop, in addition to density of plants / acre (1 feddan = 1.038 acre), this directly affects abundance of activity - density of soil fauna.

By using Shannon-Wiener (1963) and Simpson (1949) Indices, the diversity of mesofauna community can be described . The concept of diversity has been utilized by ecologists by combing two distinct aspects of the species composition of communities: number of species and equitability of their abundance, Cox (1996).

The Shannon-Wiener (1963) and Simpson (1949) indices were calculated for each plantation system in the study area to achieve an overview of the surface soil fauna diversity in the seven cover cropping cultivation patterns . It can be concluded from Table (4) that species diversity was nearly similar to some extent in different vegetational types. Similar results have been reported by Al-Assiuty et al. (1993), who determined that species diversity was similar between different vegetational types at the same site (eg. : the numbers of mesofauna in Al-Quanater oranges were nearly similar to that in Al-Quanater banana) , and dissimilar between the the same vegetational types at different sites (eg. : the numbers of mesofauna in Al-Quanater oranges were different than those collected from Rāshid oranges) .

Finally, arthropods are well suited for characterizing the ecosystems that they inhabit, the stable variation in the community among these previous systems throughout the study period may be related to the stable population in the study area . The same result was obtained by Lagerlof & Andren (1988) who traced a low value of species diversity as compared to the greater differences existing between years than between crops .

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توافر و كثافة نشاط حشرات التربة في نظم مختلفة من الغطاء النباتي من الزراعة المنفردة والتحميل

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أجريت هذه الدراسة بمحافظة الفيوم لدراسة كثافة بعض مفصليات الأرجل تحت نظم مختلفة من الغطاء النباتي و الزراعي (التحميل ، والزراعة المنفردة) في مساحة نصف فدان وذلك خلال الفترة بين نوفمبر ٢٠٠٨ حتى نهاية مارس ٢٠٠٩ م . وقد قسمت هذه المساحة إلى سبعة أحواض متساوية تم زراعتها كالاتي :

خصص الحوض الأول والثاني والثالث لزراعة البرسيم ، والخس، والكرنب زراعة منفردة و في الحوض الرابع تم زراعة الخس ومعه الكرنب في صفوف متبادلة بنسبة ١:١، و في الحوض الخامس زرع الخس ومعه الكرنب على مصاطب ، و في الحوض السادس زرع الكرنب وأحيط بحزام من البرسيم وفي الحوض السابع والأخير زرع خس وأحيط أيضاً بحزام من البرسيم . وقد أخذت عينات حيوانات التربة بواسطة مصائد الحفر بعد الزراعة بثلاثة أسابيع، و وزع عدد ١٠ مصائد أرضية في كل حوض على مسافات متباعدة وقد بلغ عدد المصائد ٧٠ مصيدة إسبوعياً.

أظهرت النتائج المتحصل عليها أن تعداد حيوانات التربة كانت أعلى في الزراعة المنفردة وكان البرسيم هو أفضل بيئة أوت إليها عشائر حيوانات التربة حيث بلغ تعدادها ٩٢٣ فرداً ثم تلاه الخس ٦٧٣ فرداً ؛ بينما كان التعداد في نظام التحميل بالصفوف المتبادلة ٥٠٦ فرداً والتحميل على المصاطب ٤٧١ فرداً؛ أما النظام الأخير فكانت أقل النظم جذباً لحيوانات التربة حيث بلغ تعدادها ٣٤٦، و ٣٠٤ فرداً .

قسمت حيوانات التربة إلى ستة مجاميع تبعاً لسلوكها الغذائي : المفترسات، والطفيليات، والعاشبات ، و آكلات النثار ، والناقلة لحبوب اللقاح ، والناقلة للأمراض .

أوضحت الدراسة أن التكوين البيئي وكثافة المجموع الخضري ونظام الزراعة لهم الأثر المباشر في تنوع وكثافة عشائر حيوانات التربة في بيئة ما .

كذلك من دراسة التكوين البيئي للتنوع باستخدام مؤشر شانون فينر ومؤشر سامبسون فقد وجد أن زراعة الخس المحيط بحزام البرسيم أعطى أعلى قيمة للتنوع من المفصليات (١،١) . وباستخدام مؤشر سامبسون وجد أن البرسيم يحتوي على المفصليات الأكثر سيادة حيث أنه أعطى أعلى قيمة (٠،٧٣) .