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Spider Occurrence in Fields of some Medical and Ornamental Plants in Fayoum - Egypt

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ABSTRACT

Spiders were collected by using ground pitfall trap and shaking method (vegetation beating). Pitfall-traps were practiced once every week in four medicinal and ornamental crops in Fayoum Governorate. A total of 315 spiders of 22 species, 21genera and 15 families were collected, from 320 pitfalls and shaking method collections from of March, 10 to end of August, 2010. The family Lycosidae, was found to be the dominant in the four experimented fields, recording 159 individuals, representing 74.6 % of the total ground collected fauna; followed by the family Philodromidae which represented 20.1 % of the total of aerial collected spiders and being abundant in Red pepper vegetation. The composition of ground collected spider and their densities differed in the four vegetations from that of the aerial collected spiders. The activity densities of ground collected spider communities in the Spearmint, Castor bean, Roselle and Red pepper recorded 34, 64 and 73 and 45 individuals respectively, while those of aerial collected spider were 63, 7 and 29 individuals in Spearmint, Castor bean and Red pepper. No spiders were collected from vegetation of Roselle plant. Community composition of the ground and the aerial collected spiders were determined throughout the period of study using the Shannon-Wiener and Simpson Indices of diversity. Obtained results revealed that species diversity differed in the two communities. Monthly fluctuations of the total number of spiders showed high populations in June.

Key Words: Araneae, Castor bean, Medicinal plants, Ornamental plants, Roselle, Red pepper, Spearmint, Spider.

INTRODUCTION

Plants represent well defined habitats for arthropods. It includes several microhabitats and provides a stable food source for animal dwelling on them (Southwood 1978). The diversity of plants results arthropod assemblages of characteristic species composition (Moran & Southwood 1982), phytophagous organisms, parasitoids, predators and the tourist insects that fly and stay on plant only temporarily.

Medicinal and ornamental plants are important for human health. Thus, some of the famous medicinal plants were selected to be cultivated to measure the influence of their vegetation type on the abundance of different spider species.

Spiders are the most diverse predators in any terrestrial ecosystem (Wise 1993). Its assemblages are highly influenced by variations in plant community structure, ecosystem dynamic such as soil and ambient humidity and temperature (Bonte et *al.*2002). McDonald (2007) illustrated that measures of foliage dwelling spider assemblage are correlated with vegetation cover, thus influenced by factors affecting vegetation structure.

This work was undertaken to study the effect of different vegetations of four medicinal and ornamental plants on spiders' diversity in fayoum, Egypt.

MATERIALS AND METHODS

Study area:

The experiment was conducted at Sennourus village, Fayoum Governorate during the period from March, 10 to the end of August 2010. An area nearly half feddan (2100 m^2) was divided into four plots, each of nearly 420 m^2, and cultivated with a different medicinal and ornamental plant. These plants were: Egyptian spearmint, *Mentha niliaca* Jacq. Castorbean, *Ricinus communis* L., Roselle (Karkadi), *Hibiscus sabdariffa* L. and Red pepper, *Capsicum annuum* L.

Sampling method

Spiders were collected from the study area by two methods:

1-Pitfall trap method:

Spiders were collected as described by Southwood & Henderson (2000). Four traps/week were regularly applied for each of the four plant communities. Sixteen collections per crop community were undertaken each month of total 384 pitfall collections. The pitfall traps were remained open for 24 hours to obtain both diurnal and nocturnal species. Obtained spiders were preserved in 75 % ethyl alcohol, counted and identified to species level as much as possible.

2-Drop-cloth method:

Spiders live on the foliage were collected by shaking the plants on a cloth or a shake sheet (Sallam 2002). Shacking over shaking white cloth (1m×1m) was practiced twice monthly during the surveying period. Collected spiders were kept in glass vials containing 75 % ethyl alcohol and some droplets of glycerin. Identification of female was depending on the epigynum plate, but in case of male the palp anatomy was an important factor.

Frequency and abundance values:

The frequency values of the most abundant species were classified into three classes according to the system adopted by Weis Fogh (1948); "Constant species" more than 50% of the samples, "accessory species" 25-50 % of the samples and "accidental species" less than 25%. On the other hand, the classification of dominance values were done according to (Weigmann, 1973) system in which the species were divided into five groups based on the values of dominance in the sample; Eudominant species (> 30% individuals), dominant species (> 10-30% individuals), subdominant (5-10% individuals) recedent species (1-5% individuals) and subrecedent species (1% individuals).

Statistical analysis:

Analysis of variance was conducted to determine the significance between means of males, females and juvenile structures. The means were compared according to Duncan's multiple range tests (Snedecor and Cochran 1981).

Species diversity

The biodiversity of ground fauna collected were estimated by using equilibrium. Diversity of collected arthropods was determined for samples pooled over one summer season by four different patterns of vegetations. It was measured in each tested vegetation by diversity index that reflected the number of species (richness) in the samples. Two common indices were computed, Shannon-Wiener index "H" and Simpson index "S". They were calculated as described by Ludwig and Reynolds (1988).

$$H' = -\sum (ni / n) \ln (ni/ n) \quad \text{and}$$

$$S = \sum (ni/n)^2$$

Where *ni* 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 number of species and diversity,

"S" is more responsive to changes in the most dominant species (Ludwig & Reynolds 1988).

RESULTS AND DISCUSSION

Spider abundance and species composition:

A-Ground collected spiders:

A total of 315 spiders were collected during the experiment with 52.9 % of them adults. Of this total, 216 spiders were collected from pitfall traps (Table1- A) and 65% were adults. Corresponding values for the aerial collected spiders, (Table 1-B) were 99 spiders and 24.5% of them were adults. A list of identified ground collected spiders was presented (Table1- A); and they belonged to 11 families and 16 species.

Members of Lycosidae were represented by three species: *Wadicosa fidelis*, *Pardosa injucanda* and *Pardosa sp.*; all their developmental structures were collected by pitfall traps below the four plants under investigation. The highest percent of their occurrence was presented by *Pardosa sp.* under Castor bean plant and *Wadicosa fidelis* under Roselle. Members of the Family Gnaphosidae followed Lycosidae in their abundance, *Zelote sp.* was captured by pitfall traps under all the tested plants.

Two families were represented by only a single individual. These were Dictynidae and Titanocidae. Members of the remaining families, Philodromidae, Theridiidae, Linyphidae, Thomisidae, Salticidae and Dysderidae were found in few numbers. The data conformed to the typical pattern of few species were represented by many individuals and many species occurred by few individuals (Preston 1948).

Vegetation type influenced spider abundance. Spearmint received the lowest number of individuals, 34 individuals, belonged to 4 species and 2 families; Roselle received the greatest number of individuals, 73 individuals, 10 families and 14 species followed by Castor bean plant of 64 individuals, 7 families and 12 species; Red pepper recorded 45 individuals, belonged to 10 families and 13 species.

The pitfall traps captured 99 male and 43 female spiders totaled 52.9 % of ground spiders. The sex ratio was 2.3 males: 1 female and the resultant Juveniles comprised 34.25 % Fig. (2). Families Oxyopidae, Miturgidae, Araneidae and Uloboridae were absent from ground spiders.

Statistical analysis proved that no significant differences were observed between means of the developmental structure of spiders collected from spearmint and Red pepper, while a significant difference occurred between males and females' means of individuals collected from Castor bean and Roselle plants.

Table (1-A): Species richness of ground collected spiders inhabiting four medicinal plants between March and August

Families&Species	Spearmint				Castorbean				Roselle				Red pepper				Total
	♂	♀	J	Σ	♂	♀	J	Σ	♂	♀	J	Σ	♂	♀	J	Σ	
								Lycosidae									
Wadicosa fidelis	2	1		3	11	4	2	17	10	5	6	21	3	1		4	45
Pardosa injucanda	6	4	2	12	2		1	3	7	4	6	17		1	7	8	40
Pardosa sp.	4	1	8	13	17	4	10	31	6	3	5	14	7	1	8	16	74
								Philodromidae									
Thanatus albini							1	1	3			3		1		1	5
Philodromus sp.											2	2		.	1	1	3
								Gnaphosidae									
Zelotes sp.	3	3		6	4	3	1	8	1	2	1	4	2	3	2	7	25
								Theridiidae									
Kochura aulica							1	1		1	1	2		1		1	4
Steatoda erigoniformis					1			1	1			1					2
								Linyphiidae									
Erigone dentipalpis									3		1	4			1	1	5
Thomisidae, G1											1	1					2
Thomisus spinifer															1	1	2
								Salticidae									
Plexippus sp.					1		1	2			1	1			2	2	5
Dictynidae, G2									1			1					1
Dysderidae, G3											1	1	1			1	2
Filistatidae, G4									1			1	1			1	2
Titanocidae, G5													1			1	1
Total	15	9	10	34	36	11	17	64	33	15	25	73	15	8	22	45	216
Mean	0.6	0.4	0.45		1.6	0.5	0.7		1.5	0.6	1.1		0.6	0.3	1		
L.S.D. at 5 %		0.6				0.9				0.5				0.7			

Letters G1- G 5: unidentified sp. Mean : The mean of total collected ground and aerial species

Table (1-B): Species richness of aerial collectedspiders inhabiting vegetation of three medicinal plants between March and August

Families&Species	Spearmint				Castorbean				Red pepper				Total
	♂	♀	J	Σ	♂	♀	J	Σ	♂	♀	J	Σ	
Philodromidae													
Thanatus albini	1		1	2							6	6	8
Philodromus sp.			2	2			1	1			9	9	12
Theridiidae													
Kochura aulica	3	2	5	10							2	2	12
Steatoda erigoniformis		1		1									1
Theridion sp..	2	1		3		2		2					5
Linyphiidae													
Erigone dentipalpis			6	6							3	3	9
Gnathonarium dentatum			6	6	1			1			1	1	8
Thomisidae, G1							2	2					2
Thomisus spinifer	1		11	12					1		3	4	16
Salticidae													
Plexippus sp.		3	1	4							4	4	8
Dictynidae, G2	4	2	5	11									11
Oxyopidae, G3			3	3									3
Miturgidae													
Cheiracanthium sp.			1	1			1	1					2
Araneidae, G4			1	1									1
Uloboridae													
Uloborus sp.			1	1									1
Total	11	9	43	63	1	2	4	7	1	0	28	29	99
Mean	0.5	0.4	1.9		0	0.1	0.2		0	0	1.2		
L.S.D. at 5 %		0.9				1.5					0.8		

Letters G1- G 4: unidentified sp. ; Roselle free from areial collected spiders
Mean : The mean of total collected ground and aerial species

Table (2): Estimation of Shannon-Wiener and Simpson Indices of diversity for ground and aerial spiders in different medicinal and ornamental vegetations

Type of index	Ground spiders				Aerial spiders		
	A	B	C	D	A	B	D
Shannon-Wiener Index	1.24	1.4	1.9	2.8	2.1	1.6	1.8
Simpson Index	0.31	0.32	0.2	0.19	0.4	0.22	0.18

A : Spearmint, B : Castor bean, C : Roselle, D : Red pepper

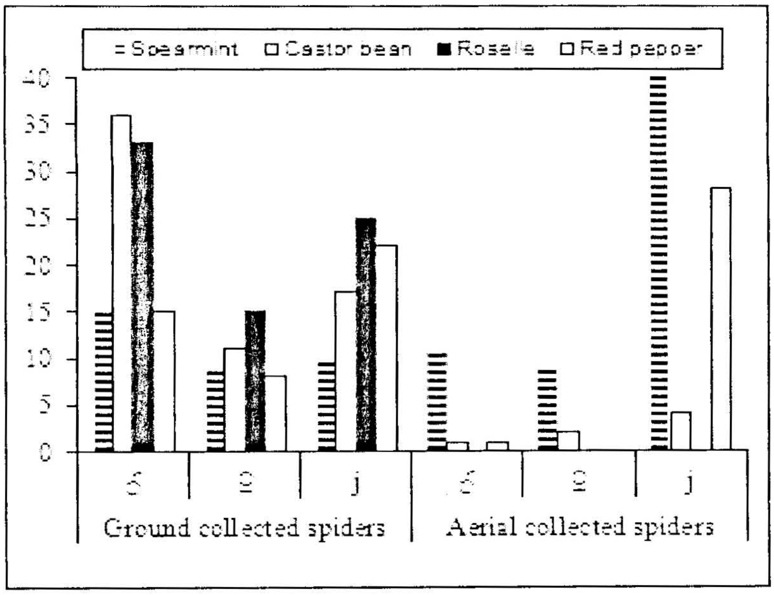

Fig. (1) - Distribution the age structure of ground and aerial collected spiders in different medicinal and ornamental plants.

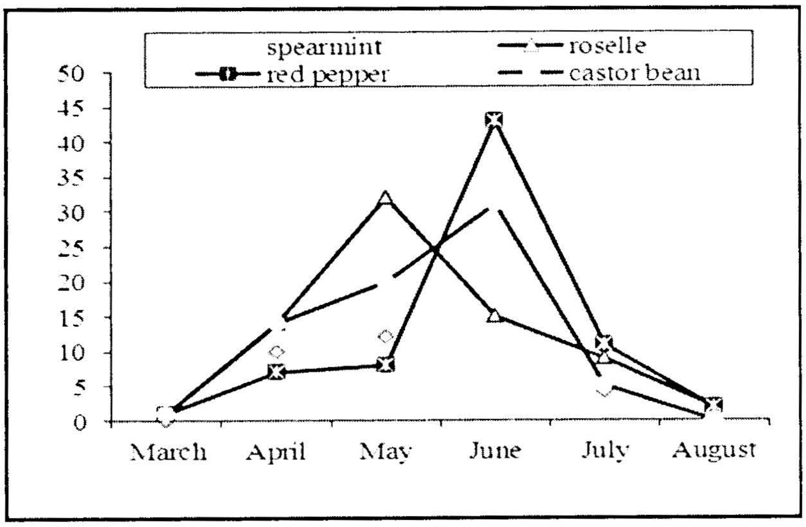

Fig. (2): Monthly fluctuation of spider populations in different medicinal and ornamental plants.

Table (3): The dominance-frequency relationship of spider communities

Families	Spearmint					Castorbean					Roselle					Red pepper				
	Total	sp.%	Dom.	F.%	Freq.	Total	sp.%	Dom.	F.%	Freq.	Total	sp.%	Dom.	F.%	Freq.	Total	sp.%	Dom.	F.%	Freq.
Lycosidae																				
Wadicosa fidelis	4	4.1	R			17	23.9	D			21	28.8	D			4	5.6	Sd		
Pardosa injucanda	12	12.3	D			3	4.2	R			17	23.3	D			8	11.1	D		
Pardosa sp.	18	18.4	D	34.7	ac	31	43.7	ED	71.8	C	14	19.2	D	71.2	C	16	22.2	D	38.9	ac
Philodromidae																				
Thanatus albini	2	2	R			1	1.4	R			3	4.1	R			7	9.7	sd		
Philodromus sp.	2	2	R	4.1	A	1	1.4	R	2.8	A	2	2.7	R	6.8	A	10	13.9	D	23.6	A
Gnaphosidae																				
Zelotes sp.	6	6.1	sd	6.1	A	8	11.3	D	11.3	A	4	5.5	sd	5.5	A	7	9.7	sd	9.7	A
Theridiidae																				
Kochura aulica	10	10.2	D			1	1.4	R			2	2.7	R			3	4.2	R		
Steatoda erigoniformis	1	1	Sr			1	1.4	R			1	1.4	R			0	0			
Theridion sp..	3	3.1	R	14.3	A	2	2.8	R	5.6	A	0	0		4.1	A	0	0		4.2	A
Linyphiidae																				
Erigone dentipalpis	6	6.1	sd			0					4	5.5	sd			4	5.6	sd		
Gnathonarium dentatum	6	6.1	sd	12.3	A	1	1.4	R	1.4	A	0	0		5.5	A	1	1.4	R	6.9	A
Thomisidae						2	2.8	R			1	1	R							
Thomisus spinifer	12	12.3	D	12.3	A	0			2.8	A	0	0		1.4	A	4	5.6	sd	5.6	A
Salticidae																				
Plexippus sp.	4	4.1	R			2	2.8	R			1	1.4	R			6	8.3	sd		
Thyene imperialis	0	0		4.1	A	0	0		2.8	A	0	0		1.4	A	0	0		8.3	A
Dyctinidae, G3	11	11.2	D	11.2	A	0	0				1	1.4	R	1.4	A	0	0			
Oxyopidae, G2	3	3.1	R	3.1	A						1	1.4	R	1.4	A	1	1.4	R	1.4	A
Miturgidae																				
Cheiracanthium sp.	1	1	Sr	1	A	1	1.4	R	1.4	A	0	0		0		0	0			
Dysderidae, G5	0	0									1	1.4	R	1.4	A	1	1.4	R	1.4	A
Araneidae, G1	1	1	Sr	1	A	0	0				0			0		0	0			
Uloboridae																				
Uloborus sp.	1	1	Sr	1	A	0	0				0	0		0		0	0			
Filistatidae, G6	0	0		0		0	0		0		1			1.4	A	0 ·	0			
Titanocidae, G7	0	0				0	0				0	0		0		1	1.4	R	1.4	A
Total	98					71					73					72				

Frequency (abundance), by Weis Fog
> 50 % = Constant (C)
25 - 50 % = Accessory (ac)
> 25 % = Accidental (A)

Dominance, by Weigmann
> 30 % = Eudominant (E)
10 - 30 % = Dominant (D)
5 - 10 % = Subdominant (sd)
1 - 5 % Recedent (R)
> 1 % = Subrecedent (Sr)

B- Aerial collected spiders:

The aerial collected spiders were free from the families Lycosidae, Gnaphosidae, Filistatidae, Titanocidae and Dysderidae. Table (1- B) showed the species richness of spiders collected from leaves by shaking plants. It could be concluded from data recorded that Roselle plants were free from aerial spiders, while Spearmint received the highest spider abundance, of 63 individuals, belonging to 14 species and 10 families. Members of Thomisidae, Dictynidae and Theridiidae were the most frequent taxa on Spearmint plants; they recorded 12, 11 and 10 individuals, respectively.

Experimental study showed that each of the three plantations: Spearmint, Red pepper and Castor bean received five families composed of 63, 29 and 7 individuals, respectively.

The developmental structure of the aerial collected spiders differed from that of the ground ones. The juveniles were more abundant than the adults, recording 75.7 % of the total aerial collected spiders and the resultant sex ratio was 1.1 males : 1 female Fig. (1)

No significant differences were observed between means of males and females but there was a significant difference between Juveniles and adults.

There was, however, a large difference in the composition of spiders and their richness in the two groups. The pitfall method collected more adult spiders and more individual species than did the aerial beating method (Tables 1-A & B).

Species diversity

Table (1-B) compared the biodiversity between ground and aerial collected spiders in different vegetations by using Shannon-Wiener "H" and Simpson "S" Indices of diversity.

The vegetations of different plants varied in their spider richness. The Roselle and Castor bean recorded the highest populations of ground collected spiders of total numbers, 73 and 64 individuals followed by Red pepper. Castor bean obtained small numbers of aerial collected spiders being 5 species and 5 families.

Species richness of aerial groups was 63, 28 and 7 individuals composed of 5 families in each plant of at least 14 species. However vegetation system of Roselle do not received any spider.

By using Shannon Wiener Index, the resulting value of calculation for ground collected spiders was the highest of values (2.8) for Red pepper followed by Spearmint of value (2.1) in the aerial collected spiders, so we can say that those plants had a higher diversity index. Similarly, the values calculated for other cultivation described the different species diversity index for each group.

According to Simpson Index, which reflected the measure of dominance, it was found that the Spearmint plant included the highest number of dominant species in both aerial and ground spiders followed by Castor bean.

Frequency and abundance values:

Table (3) showed the frequency and abundance values of the most abundant spiders. Members of Lycosidae were considered "constant" in Roselle, Castor bean and Red pepper. Members of the families Gnaphosidae and Philodromidae were "dominant" in Castor bean and Red pepper as shown the classification of dominance while the families Theridiidae, Dyctinidae and Thomisidae were "dominant" in spearmint and all were "accidental" according to Weis Fog system.

Our results agreed with Shuang-lin and Bo-ping (2006) who indicated that Lycosidae, Gnaphosidae and Linyphiidae were the three dominant families and they occupied more than 60% of individuals' community.

Monthly fluctuations of spider populations

Fig. (2) showed that spiders appeared in few numbers in early summer on the four different plants. The population density gradually increased showing a peak in June in all plants except for Roselle where the peak observed in May. In general, this data indicated that spiders were active during summer months.

This observation is in accordance with that of Abdel Moneim *et al.* (2003) who found that summer was the season of highest abundance for spiders with no significant differences among locations. Similar results were reported by Uetz (1975) who found that most spiders were captured during summer months.

Thus it could be concluded that the composition and structure of the spiders' assemblage differed between the different types of vegetations. Dense and compact vegetation provides shade and humidity, which composes appropriate conditions especially for small spiders of the families Linyphidae and Theridiidae. These spiders are exposed to loss of water more than larger ones, thus, find hiding places in numerous tiny spaces of such habitats (Duffey, 1975).

Our study showed great differences in dominant family compositions of spider communities. Spiders of the family Thomisidae were of more activity density in Spearmint vegetations followed by Linyphidae and Theridiidae.

The majority of spider abundance, species richness, and evenness were highest in Spearmint vegetations, which might be dependent on type of plant dense vegetation or shade and humidity. Scheidler (1990) and (Wolak, 2000) studied the influence of habitat structure and vegetation architecture on spiders and found higher spider densities on broad plants with many branches than on plants with only few branches and a rather narrow architecture. Also, this result agreed with that of Ghabbour *et al.* (1999) who found the shade of plants and the available humidity expressed as water requirements for each crop in addition to density of plants / acre directly affected abundance of activity density of soil fauna.

Habashy *et al.* (2005) concluded that, indirectly, the area of surface vegetation affected spider population density and biodiversity, which influenced by microclimate of the plant.
This study exposing that plant density, altitude and structures effected spider diversity and activity density.

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