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True spiders inhabiting ornamental trees and perennial plants

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Abstract:

Spiders are abundant and widespread in almost all ecosystems and constitute one of the most important components of global biodiversity. The aim of this research work is to clarify the relationship between spider density, diversity and habitat structure. The effects of vegetation structure on communities of spiders by comparing the spider fauna on tree species (Sevrinia, dombeya and feijoa), flowering annuals (Crinum) and evergreen herbs (Pelargonia). The number of collecting spiders found in ground under each tree were 33 and 42 individuals, while those in foliage were 30 and 12, respectively. The number in flowering annuals (Crinum) and evergreen herbs (Pelargonium) was 37 and 45 in ground and 11 and 41 in foliage. The importance of activity density in determining the composition of each group is discussed relative to structural differences of the trees , flowering annuals (Crinum) and evergreen herbs (Pelargonium).

Introduction

Orman botanical garden is rich and high in tree diversity. Orman botanical garden also defined as urban forest (Bahnasy and Khamis, 2019). Spiders are abundant and widespread in almost all ecosystems and constitute one of the most important components of global biodiversity. It is not only found in agriculture field but also considered as the most diverse groups of organisms on earth (Hassan *et al*., 2016).

Few studies have compared differences in the abundance of spiders on foliage of different shrubs and tree species (Souza, 2005). Rizk *et al.* (2012) studied the incidence of medicinal and ornamental plants in Fayoum Governorate. Ghallab (2013) studied the spider fauna associated with lantana and croton in Orman garden and the most abundant families were Miturgidae, Philodromidae, Salticidae, Theridiidae and Araneidae. Hassan *et al.* (2016) found that Zoheria and Orman gardens were the most harbored spider. The most dominant families recorded the largest number of species were Salticidae, Gnaphosidae, Thridiidae and Oonopidae.

Habitat selection in spiders is strongly influenced by physical factors include the structural complexity of the habitat (Turnbull, 1973; Halaj *et al.*, 2000; Rinaldi and Trinca, 2008 and Villanueva-Bonilla *et al.*, 2017). Structural complexity comprises the size, shape, and spatial arrangement of structures in the habitat where the spiders occur (Uetz, 1991 and Ehmann, 1994). For example, differences in the complexity of tree trunks contribute to the structuring of spider communities

(Szinetár and Horváth, 2005). For spiders associated with tree substrates, the bark provides imp ortant niches for resting or locating food resources (Southwood, 1978 and Pinzón and Spence, 2010), as well as appropriate structures for camouflage and to attach webs (Messas *et al*., 2014).

The present study clarifies the relationship between spider density, diversity and habitat structure. The effect of vegetation structure on communities of spiders by comparing the spider fauna on tree species (Sevrinia, dombeya and feijoa), flowering annuals (Crinum) and evergreen herbs (Pelargonium) in Orman garden were discussed.

Materials and methods

1. Study area:

This work was conducted in Orman garden, Giza, Egypt for a whole year (2018). Three trees, one flowering annual and one evergreen herbs were chosen to study the effect of plant structures and compositions on spider biodiversity. They were trees sevrinia (*Severinia monophylla L.);* dombeya (*Dombeya wallichii* Lind.) and feijoa, (*Feijoa sellowiana*), flowering annuals (*Crinum asiaticum* L.) and evergreen herps (*Pelargonium geranium* Bailly). Population density of spiders fauna was measured for one year through four seasons from January to December 2018.

2. Sampling method:

Spiders were collected from the study area by two different collecting techniques were used to get a good representation of spiders:

2.1. Pitfall trap method:

This method was described by Southwood and Henderson (2000). Three traps per plant for two weeks were regularly applied for each of the five presented plants. Seventy eight traps per plant were undertaken for a whole year of total 390 traps. The pitfall traps were remained open for 24 hours to obtain both diurnal and nocturnal species. We removed the traps between collecting periods, but these were placed in the same locations when sampling again. Each trap consisted of a plastic recipient (15×8 cm). The recipients were filled with water and a small quantity of soap to lower the surface tension. Obtained spiders were preserved in 70 % ethyl alcohol, counted and identified to species level as much as possible.

2.2. Sweeping net:

A net with a deep mesh bag is used to collected spiders inhabiting foliage by sweeping over foliage or by shaking the vegetation. Everyone is kept in a vial so that they do not prey on each other; samples were taken every two weeks.

2.3. Identification of spiders:

Voucher specimens were preserved in 70% ethyl alcohol and deposited in an Arachnology Collection in the Plant Protection Research Institute, Giza, Egypt. All the adults and juveniles were determined to species level or morphospecies. Specimens were identified to the family and genus levels according to Ubick *et al*., (2005) and when possible, to the species level with the taxonomic works of various authors. Scientific names were checked in the World spider catalogue (2016). Also, spiders were identified according to Kaston (1978), Roberts (1987), Levi (2002), Oger (2002), Ovtsharenko and Tanasevitch (2002), Prószyński (2003), Huber (2005), El-Hennawy (2017), and Platnick (2012). Juvenile spiders were identified to family or genus level, if possible. Identification of female was depending on the epigynum plate, but in case of male the palp anatomy was an important factor.

3. Data analysis:

3.1. 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).

3.2. Species diversity:

The biodiversity of ground spiders and leaves spiders collected were estimated by using equilibrium. Diversity of collected spiders was determined for samples pooled over one whole year by different patterns of vegetation's. It was measured in each tested vegetation by diversity index that reflected the number of species (richness) in the samples. three common indices were computed, Shannon-Wiener index "H", Simpson index "S" and species Evenness. They were calculated as described by Ludwig and Reynolds (1988).

$H' = -\sum (ni/n) \ln (ni/ n)$ 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, while "S" is more responsive to changes in the most dominant species (Ludwig and Reynolds 1988).

Species evenness = i / Ln((s-1) / Ln(n))

Where, i = Shannon Diversity Index

s = Number of Species Recorded n = Total Number of Individuals in the Sample

Results and discussion

1. Species richness of the collected spiders in ground and leaves inhabiting different plants:

1.1. Ground spiders:

1.1.1. Species richness of the collected ground spiders inhabiting trees:

Table (1) showed that a total of 33 spiders were collected from ground under severinia tree. They represented 8 families, 14 genera and 14 species. Juvenile comprised 39.39%; while adults average 60.61%. The sex ratio was 1.2♂:1♀. Of the most abundance species was *H. ferox* (9 individuals) followed by *H. adansoni* (8 individuals). Also, a total of 42 spiders were collected from dombeya tree. They represented 6 families, 10 genera and 10 species. Juvenile comprised 23.81%; while adults average 76.19%. The sex ratio was 1.67♂:1♀. Of the most abundance species was *H. ferox* (13 individuals) followed by *P. paykulli* (8 individuals). But a total of 42 spiders were collected from feijoa tree; they represented 9 families, 15 genera and 15 species. Juvenile comprised 23.81%; while adults average 76.19%. The sex ratio was 1.13♂:1♀. Of the most abundance species was *H. ferox* (13 individuals)**.**

1.1.2. Species richness of the collected ground spiders inhabiting evergreen herbs:

A total of 45 spiders were collected from pelargonium. They represented 5 families, 8 genera and 8 species. Juvenile comprised 13.33%; while adults average 86.67%. The sex ratio was 0.95♂:1♀. Of the most abundance species was *H. ferox* (19 individuals) followed by *Pardosa* sp. (16 individuals).

1.1.3. Species richness of the collected ground spiders inhabiting flowering annuals:

A total of 37 spiders collected from crinum. They represented 7 families, 10 genera and 10 species. Juvenile comprised 51.35%; while

adults average 48.65%. The sex ratio was 1.6♂:1♀. Of the most abundance species was *H. adansoni* (12 individuals) followed by *H.ferox* (11 individuals).

1.2. Leave spiders:

1.2.1. Species richness of the collected leaves spiders inhabi ting trees:

Table (2) showed that a total of 30 spiders were collected from vegetation of severinia tree. They represented 6 families, 9 genera and 13 species. Juvenile comprised 53.33%; while adults average 46.67%. The sex ratio was 1♂:1♀. The most abundant species was *Theridion* sp. (7 individuals) followed by *Philodromus* sp. (6 individuals).

But number of spiders decreased to 12 individuals from Dombeya tree. They represented 5 families, 8 genera and 9 species. Juvenile comprised 58.33%; while adults average 41.67%. The sex ratio was 1.5♂:1♀. The most abundant species was *Thomisus* sp. (3 individuals)**.**

1.2.2. Species richness of the collected leaves spiders inhabiting evergreen herbs:

A total of 41 spiders were collected from pelargonium (evergreen herbs). They represented 7 families, 14 genera and 16 species. Juvenile comprised 63.41%; while adults average 36.59%. The sex ratio was 1.5♂:1♀. Of the most abundant species was *Philodromus* sp. (10 individuals) followed by *Kuchiur aaulica* (8 individuals).

1.2.3. Species richness of the collected leaves spiders inhabiting flowering annuals:

A total of 11 spiders were collected from crinum (flowering annuals). They represented 4 families, 8 genera and 8 species. Juvenile comprised 81.82%; while adults average 18.18%. The sex ratio was 0♂:2♀. Of the most abundance species was *Philodromus* sp., *Plexippus* sp. and *H. adansoni* (2 individuals) for each species.

2. Rank abundance of spider families occurred in ground and leaves inhabiting tree, evergreen herbs and flowering annuals:

Table (3) was presented by families and showed their abundance. The greatest number of collected ground spiders presented by family Lycosidae 106 indvidiuals (53.27 %) and Salticidae 50 indvidiuals (25.13 %) while, those collected from vegetation were family Philodromidae 25 indvidiuals (26.60%) and followed by Saiticidae and Thridiidae 24 indvidiuals (25.53 %) for each family. Also, a total of 117 spiders inhabiting trees (Severinia, dombeya and feijoa) which collected 33, 42 and 42 individuals, respectively. This number decreased to (30 and 12 individuals) which collected from (Severinia, and dombeya) leaves. The number of spiders was collected from pelargonium (Evergreen herbs) and crinum (Flowering annuals) which collected 82 spiders from soil and 52 spiders from leaves. These results indicated that the various families occurred in soil and leaves peaked at different levels of canopy openness. The type of vegetation acts as a filter for spider families. Ludwig and Reynolds (1988), indicated that the type of vegetation and management are factors that most effect the spider families. Abo-Zaed *et al.* (2019), found that the highest numbers of spider occurrence were collected from rose, Rose geranium, chamomile, sweet basil, neem and *Mentha piperita* composed of 52, 39, 35, 28, 20 and 20 individuals, respectively While marigold and carnation received the lowest number of spider of 10 and 8 individuals, respectively.

3. Relative abundance-frequency relationship of spider communities habiting ground and leaves:

3.1. Ground spiders:

From Table (4), it was indicated that, according Weis Fogh frequency classification, members of Family Lycosidae were considered constant (C) species in abundance under feijoa tree and pelargonium herb which recorded 52.38 and 84.44% respectively. While member Lycosidae was considered as accessory (ac) in severinia tree, dombeya tree, and flowering annual crinum with 39.39, 50 and 32.43, respectively. Members of Salticidae considered as accessory (ac) species under severinia, dombeya trees and the annual flowering annual crinum, the recorded 30.3, 33.33 and 48.65 respectively. Moreover, all the remaining families were recorded as "Accidental" species while their members ranged between "Dominant", "Subdominant" and "Recedent". Members of family Lycoside: *Pardosa* sp. which was "Subdominant" in severinia and feijoa and *Trochosa urbana* which was "Subdominant" in feijoa. Members of family Salticidae: *Plexippus paykulli* which was subdominant in severinia and feijoa but its "Dominant" in dombeya tree. *H. adansoni* family Salticidae was "Dominant" in severinia and dombeya and "Subdominant" in Fejoa. Family Philodromidae, Occobiidae and Filistatidae were disappeared from severinia tree. But family Philodromidae, Occobiidae, Dysderidae and Eutichuridae disappeared from dombeya tree. In feijoa tree only Gnaphosidae family and Filistatidae family was disappeared.

This result indicated that, type of vegetation acts as a filter for spider families and this was also reported by Buchholz (2016) studied spider families in peat areas with different flower composition. He found that the occurrence of larger spiders in correlated with denser vegetation and of smaller spiders with areas where the predominant vegetation was formed by mosses.

Table (4) showed that the frequency and abundance values of the most abundant spiders in evergreen herbs "Pelargonia" and flowering annuals crinum. According to Weis Fogh system family Lycosidae was considered "Constant" 84.44% in pelargonia and "Accessory" 32.43% in crinum. Also, family Salticidae was considered "Accessory" 48.65% in crinum. The same results obtained by Abo-Zaed *et al.* (2019) who recorded eighteen species of spiders belong to nine families and one order (Araneae) was recorded, from Zoheria garden. The dominant spider families recorded with largest number of species. These are: Philodromidae and Theridiidae on jasmine flower, lavender and night-blooming jasmine at Zoheria garden whereas, the same families were dominant on rose, rose geranium and chamomile at Orman garden.

3.2. Spider leaves:

Table (5) showed that the frequency and abundance values of the most abundant leaves spiders in tree, according "Weis Fogh system" family Theridiidae and Philodromidae were considered accessory (40.00% and 26.67%), respectively in Severinia. Also, Family Salticidae and Thomisidae were considered "Accessory" (50.0% and 25.0%) respectively in dombeya. Members of family Theridiidae: *Theridion* sp. and *Kochiuraaulica* were "Dominant" and family Philodromidae: *Philodromus* sp. was "Dominant" on leaves of severinia. Also, members of family Salticidae: *Plexippus* sp. was "Dominant" and all anther species were "subdominant". Members of family Thomisidae: *Thomisis* sp. was "Dominant". Also, the frequency and abundance values of the most abundant spiders in evergreen herbs and flowering annuals. According to Weis Fogh system. Family

Philodromidae and Thrediidae were considered "Accessory" (34.15% and 26.83%), respectively in pelargonium (Evergreen herbs). But family Salticidae was considered "Constant" in Crinum (Flowering annua ls). Members of family Salticidae: *H. adansoni* and *Plexippus* sp. were considered "Dominant" on leaves of Crinum. Abo-Zaed *et al.* (2019) found that the dominant spider families recorded with largest number of species, these are: Philodromidae and Therdiidae on jasmine flower, lavender and night-blooming jasmine at Zoheria garden.

4. Monthly fluctuation of spider population "Catch Size" :

From Table (6), the total monthly count of spider collected in summer during their activity density in May for spiders of trees (33 individuals). While collected from leaves were recorded in June and August (8 individuals). The lowest numbers of individuals were recorded in winter. Table (7), showed that the highest abundance of spiders was found in June and August recorded 15 individuals. These results were recorded in ground spiders under pelargonium herbs and the annual Crinum flower. Spiders were disappeared in November and February and reappeared in few numbers in December and January. Respective numbers of leaves spiders were of highest activity in August (15 individuals), decreased in September to 10 individuals. The lowest numbers of spiders were recorded in November and December 2 and 1 individual ,respectively and disappear in January and February then began to increase in March.

5. Spider diversity:

Table (8) compared the biodiversity of collected spiders in different vegetation between spiders associated with ground or foliage leaves by using Shannon-Wiener "H", Simpson "S" indices and species evenness of diversity. These results revealed that the highest "H" value recorded on spiders of ground in feijoa 2.32 decreased to 2.21 in severinia. But the lowest "H" value recorded 1.44 in pelargonia (Evergreen herbs). But leaves spiders, revealed that the highest "H" value recorded in pelargonia 2.43, decreased to 2.02 in Crinum. Consequently, these values demonstrated that spider collected from pitfall trap "ground spiders" a greater number of spider than spider associated with foliage and diverse also. According to Simpson "S" index, which reflect the measure of dominance, it was found the highest value recorded in ground spider under pelorgonium (Evergreen herbs) 0.31 decreased to 0.14 under feijoa. This result indicated that the, shady and humid conditions at soil incurs to increase number of spiders more than foliage. Also, results revealed that the highest species evenness value recorded on spiders of ground in Pelargonium 2.37 while the lowest value in severinia 1.68. But leaves spiders, revealed that the highest value recorded in severinia 1.96, decreased to 1.74 in Pelargonium. Košulič *et al.* (2016) found that some spiders species of conservation concern dependent on shady and more humid conditions. These results are in accord with findings by Muff *et al.* (2009) that showed importance of habitat variability for spiders even in small spatial scales in forest plantations and alpine timberlines.

Table (1): Species richness of the collected ground spiders inhabiting trees, evergreen shrubs and flowering annuals .

Families and taxa names	Tree															Evergreen herbs						Flowering annuals								
	Severinia			Σ	Total	%	Dombeya			Σ	Total	%	Feijoa			Σ	Total	%	Pelargonia			Σ	Total	%	Crinum			Σ	Total	%	
	♂	♀	J				♂	♀	J				♂	♀	J				♂	♀	J				♂	♀	J				
Lycosidae																															
Wadicosa fidelis			1	1									1			1				2	1	3								
Pardosa sp.	1	2		3	13	**39.39**	1			1	21	**50.00**	3		1	4	22	**52.38**	7	8	1	16	**38**	84.44		1		1	12	**32.43**	
Hogna ferox	3	3	3	9			9	4		13			3	7	3	13			9	7	3	19			3	4+1▲	4	11+▲			
Trochosa urbana							2	3	2	7			3	1		4															
Gnaphosidae																															
Micaria dives			1	1	1	**3.03**			1	1	1	**2.38**							1	1		2	**2**	4.44	2			2	3	**8.11**	
Zelotes sp.																									1			1			
Linyphiidae																															
Prinerigone vagans	1			1									1			1														
Sengletus extricatus	1			1	3	**9.09**					3	**7.14**		1		1	5	**11.90**					**1**	**2.22**					1	**2.70**	
Gnathonarium dentatum		1		1																											
Mermessus denticulatus							1		2	3			1	1	1	3				1		1					1	1			
Salticidae																															
Plexippus paykulli			2	2	10	**30.30**	4	1	3	8	14	**33.33**	1	2		3	7	**16.67**			1	1	**1**	2.22	3	1	2	6	18	**48.65**	
Hasarius adansoni	3	1	4	8			2	2	2	6			1	2	1	4									1	1	10	12			
Theridiidae																															
Steatoda erigoniformis	1	1		2	3	**9.09**		1		1	2	**4.76**	1			1	1	**2.38**	2			2	**3**	6.67							
Kochiura aulica		1		1				1		1										1		1									
Philodromidae																	1	**2.38**													
Philodromus cespitum															1	1															
Oecobiidae																	1	**2.38**											1	**2.70**	
Oecobius navus													1			1									1			1			
Dysderidae					1	**3.03**											2	**4.76**													
Dysdera crocata	1			1									1	1		2															
Eutichuridae					1	**3.03**											2	**4.76**													
Cheiracanthium sp.			1	1											2	2															
Filistatidae											1	**2.38**																			
Filistata sp.							1			1																					
Uloboridae																													1	**2.70**	
Uloborus sp.																											1	1			
Pholicidae																													1	**2.70**	
Pholcus sp.																											1	1			
Dictynidae			1	1	1	**3.03**									1	1	1	**2.38**													
Total	**11**	**9**	**13**				**20**	**12**	**10**				**17**	**15**	**10**				**19**	**20**	**6**				**11**	**7**	**19**				
	33			**33**			**42**			**42**			**42**			**42**			**45**			**45**			**37**			**37**			

▲Egg sac

Table (2): Species richness of the collected leaves spiders inhabiting tree, evergreen herbs and flowering annuals.

Families and taxa names	Spider name	Tree					Evergreen herbs				Flowering annuals			
		Severina			Total	%	Dombeya			Total	%	Pelargonium			Total	%	Crinum			Total	%
		♂	♀	J			♂	♀	J			♂	♀	J			♂	♀	J		
Araneidae	*Neoscona* sp.			1	1	**6.67**						1	1		2	**7.32**					
	Unidendified species			1	1									1	1						
Cheiracanthiidae	*Cheiracanthium* sp.													2	2	**4.88**					
Dictynidae	Unidendified species								1	1	**8.33**										
Gnaphosidae	Unidendified species			1	1	**3.33**								2	2	**4.88**					
Lycosidae	*Pardosa* sp.																		1	1	**9.09**
Philodromidae	*Philodromus* sp.	1	1	4	6	**26.67**			1	1	**8.33**			10	10	**34.15**			2	2	**18.18**
	Philodromus sp.1			1	1																
	Philodromus sp.2			1	1																
	Pulchellodromus glaucinus												1		1						
	Thanatus sp.											1		2	3						
Salticidae	*Thyene imperialis*	1		2	3	**13.33**					**50.00**					**17.07**					**63.64**
	Thyene sp.			1	1									2	2				1	1	
	Plexippus sp.								2	2				2	2				2	2	
	Plexippus paykulli								1	1			1	1	2						
	Bianor sp.								1	1											
	Heliophanus sp.																1		1		
	Hasarius adansoni																1	1	2		
	Hasarius sp.													1	1						
	Spiderling								1	1									1	1	
	Unidendified species							1		1											
Theridiidae	*Theridion* sp.	3	2	2	7	**40.00**					**8.33**		1		1	**26.83**					
	Kochiura aulica	1	3		4							5	1	2	8						
	Euryopis episinoides																				
	Theridion spinitrase	1			1																
	Theridion melanostictum											1	1		2						
	Steatoda erigoniformis						1			1											
Thomisidae	*Thomisus* sp.						2	1		3	**25.00**			1	1	**4.88**					
	Thomisus spinifer											1			1						
Uloboridae	*Uloborus* sp.			1	1	**10.00**													1	1	**9.09**
	Uloborus walckenaerius		1	1	2																
Total		**7**	**7**	**16**	**30**		**3**	**2**	**7**	**12**		**9**	**6**	**26**	**41**		**0**	**2**	**9**	**11**	
		30					**12**					**41**					**11**				

*** Feijoa leaves were unavailable**

Table (3): Rank abundance of spider families occurred in ground and leaves inhabiting tree, evergreen herbs and flowering annuals.

Families	Number of collected ground spiders					Total	%	Number of collected leaves spiders				Total	%
	Trees			Evergreen herbs	Flowering annuals			Trees		Rvergreen herbs	Flowering annuals		
	Severinia	Dombeya	Feijoa	Pelargonium	Crinum			Severinia	Dombeya	Pelargonium	Crinum		
Araneidae	0	0	0	0	0	**0**	**0.00**	2	0	3	0	**5**	**5.32**
Cheiracanthiidae	0	0	0	0	0	**0**	**0.00**	0	0	2	0	**2**	**2.13**
Lycosidae	13	21	22	38	12	**106**	**53.27**	0	0	0	1	**1**	**1.06**
Gnaphosidae	1	1	0	2	3	**7**	**3.52**	1	0	2	0	**3**	**3.19**
Linyphidae	3	3	5	1	1	**13**	**6.53**	0	0	0	0	**0**	**0.00**
Salticidae	10	14	7	1	18	**50**	**25.13**	4	6	7	7	**24**	**25.53**
Theridiidae	3	2	1	3	0	**9**	**4.52**	12	1	11	0	**24**	**25.53**
Philodromidae	0	0	1	0	0	**1**	**0.50**	8	1	14	2	**25**	**26.60**
Oecobiidae	0	0	1	0	1	**2**	**1.01**	0	0	0	0	**0**	**0.00**
Dysderidae	1	0	2	0	0	**3**	**1.51**	0	0	0	0	**0**	**0.00**
Eutichuridae	1	0	2	0	0	**3**	**1.51**	0	0	0	0	**0**	**0.00**
Filistatidae	0	1	0	0	0	**1**	**0.50**	0	0	0	0	**0**	**0.00**
Thomisidae	0	0	0	0	0	**0**		0	3	2	0	**5**	**5.32**
Uloboridae	0	0	0	0	1	**1**	**0.50**	3	0	0	1	**4**	**4.26**
Pholicidae	0	0	0	0	1	**1**	**0.50**	0	0	0	0	**0**	**0.00**
Dictynidae	1	0	1	0	0	**2**	**1.01**	0	1	0	0	**1**	**1.06**
Total	**33**	**42**	**42**	**45**	**37**	**199**		**30**	**12**	**41**	**11**	**94**	
	117			**82**				**42**		**52**			

Leaves of feijoa were unavailable

Table (4): The dominance-frequency relationship of ground spider communities inhabiting trees, evergreen herbs and flowering annuals.

Families and taxa names	Tree															Evergreen herbs					Fowering annuals				
	Severinia					Dombeya					Feijoa					Pelargonia					Crinum				
	No.	sp.%	Dom.	F.%	Freq.	No.	sp.%	Dom.	F.%	Freq.	No.	sp.%	Dom.	F.%	Freq.	No.	sp.%	Dom.	F.%	Freq.	No.	sp.%	Dom.	F.%	Freq.
Lycosidae																									
Wadicosa fidelis	1	3.03	**R**								1	2.38	**R**			3	6.67	**sd**							
Pardosa sp.	3	9.09	**sd**	**39.39**	**Ac**	1	2.38	**R**	**50**	**Ac**	4	9.52	**sd**	**52.38**	**C**	16	35.56	**E**	**84.44**	**C**	1	2.70	**R**	**32.43**	**ac**
Hogna ferox	9	27.27	**D**			13	30.95	**E**			13	30.95	**E**			19	42.22	**E**			11	29.73	**D**		
Trochosa urbana						7	16.67	**D**			4	9.52	**sd**												
Gnaphosidae																									
Micaria dives	1	3.03	**R**	**3.03**	**A**	1	2.38	**R**	**2.38**	**A**						2	4.44	**R**	**4.44**	**A**	2	5.41	**Sd**	**8.11**	**A**
Zelotes sp.																					1	2.70	**R**		
Linyphidae																									
Prinerigone vagans		3.03	**R**								1	2.38	**R**												
Sengletus extricatus	1	3.03	**R**								1	2.38	**R**												
Gnathonarium dentatum	1	3.03	**R**	**9.09**	**A**				**7.14**	**A**				**11.90**	**A**				**2.22**	**A**				**2.70**	**A**
Mermessus denticulatus						3	7.14	**Sd**			3	7.14	**sd**			1	2.22	**R**			1	2.70	**R**		
Salticidae																									
Plexippus paykulli	2	6.06	**sd**	**30.30**	**Ac**	8	19.05	**D**	**33.33**	**ac**	3	7.14	**sd**	**16.67**	**A**	1	2.22	**R**	**2.22**	**A**	6	16.22	**D**	**48.65**	**ac**
Hasarius adansoni	8	24.24	**D**			6	14.29	**D**			4	9.52	**sd**								12	32.43	**E**		
Thridiidae																									
Steatoda erigoniformis	2	6.06	**sd**	**9.09**	**A**	1	2.38	**R**	**4.76**	**A**	1	2.38	**R**	**2.38**	**A**	2	4.44	**R**	**6.67**	**A**					
Kochiura aulica	1	3.03	**R**			1	2.38	**R**								1	2.22	**R**							
Philodromidae																									
Philodromus cespitum											1	2.38	**R**	**2.38**	**A**										
Oecobiidae																									
Oecobius navus											1	2.38	**R**	**2.38**	**A**						1	2.70	**R**	**2.70**	**A**
Dysderidae																									
Dysdera crocata	1	3.03	**R**	**3.03**	**A**						2	4.76	**R**	**4.76**	**A**										
Eutichuridae																									
Cheiracanthium sp.	1	3.03	**R**	**3.03**	**A**						2	4.76	**R**	**4.76**	**A**										
Filistatidae																									
Filistata sp.						1	2.38	**R**	**3.03**	**A**															
Uloboridae																									
Uloborus sp.																					1	2.70	**R**	**2.70**	**A**
Pholicidae																									
Pholcus sp.																					1	2.70	**R**	**2.70**	**A**
Dictynidae	1	3.03	**R**	**3.03**	**A**						1	2.38	**R**	**2.38**	**A**										
Total	**33**					**42**					**42**					**45**					**37**				

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

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

Table (5): The dominance-frequency relationship of leaves spider communities inhabiting tree, evergreen herbs and flowering annuals.

Families and taxa names	spider name	Tree										Evergreen herbs					Flowering annuals				
		Severina					Dombeya					Pelargonium					Crinum				
		No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.
Araneidae	*Neoscona* sp.	1	3.33	**R**	6.67	**A**						2	4.88	**R**	7.32	**A**					
	unidendified species	1	3.33	**R**								1	2.44	**R**							
Cheiracanthiidae	*Cheiracanthium* sp.											2	4.88	**R**	4.88	**A**					
Dictynidae	unidendified species						1	8.33	**sd**	8.33	**A**										
Gnaphosidae	unidendified species	1	3.33	**R**	3.33	**A**						2	4.88	**R**	4.88	**A**					
Lycosidae	*Pardosa* sp.																1	9.09	**sd**	9.09	**A**
Philodromidae	*Philodromus* sp.	6	20.00	**D**	26.67	**Ac**	1	8.33	**sd**	8.33	**A**	10	24.39	**D**	34.15	**ac**	2	18.18	**D**	18.18	**A**
	Philodromus sp.1	1	3.33	**R**																	
	Philodromus sp.2	1	3.33	**R**																	
	Pulchellodromus glaucinus											1	2.44	**R**							
	Thanatus sp.											3	7.32	**Sd**							
Salticidae	*Thyene imperialis*	3	10.00	**Sd**	13.33	**A**				50.00	**ac**				17.07	**A**				63.64	**C**
	Thyene sp.	1	3.33	**R**								2	4.88	**R**			1	9.09	**sd**		
	Plexippus sp.						2	16.67	**D**			2	4.88	**R**			2	18.18	**D**		
	Plexippus paykulli						1	8.33	**sd**			2	4.88	**R**							
	Bianor sp.						1	8.33	**sd**												
	Heliophanus sp.																1	9.09	**sd**		
	Hasarius adansoni																2	18.18	**D**		
	Hasarius sp.											1	2.44	**R**							
	Spiderling						1	8.33	**sd**								1	9.09	**sd**		
	unidendified species						1	8.33	**sd**												
Theridiidae	*Theridion sp.*	7	23.33	**D**	40.00	**Ac**				8.33	**A**	1	2.44	**R**	26.83	**ac**					
	Kochiura aulica	4	13.33	**D**								8	19.51	**D**							
	Euryopis episinoides																				
	Theridion spinitrase	1	3.33	**R**																	
	Theridion melanostictum											2	4.88	**R**							
	Steatoda erigoniformis						1	8.33	**sd**												
Thomisidae	*Thomisus* sp.						3	25.00	**D**	25.00	**ac**	1	2.44	**R**	4.88	**A**					
	Thomisus spinifer											1	2.44	**R**							
Uloboridae	*Uloborus* sp.	1	3.33	**R**	10.00	**A**											1	9.09	**sd**	9.09	**A**
	Uloborus walckenaerius	2	6.67	**Sd**																	
Total		**30**					**12**					**41**					**11**				

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)

*** Feijoa leaves were unavailable**

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Table (6): Monthly fluctuation of ground spider population "Catch size" in trees.

Month	Ground spiders			Total	Leaves spiders			Total
	Severina	Dombeya	Feijoa		Severina monophyla	Dombeya	Feijoa	
Jan-18	1	2	1	**4**	0	1	-	**1**
Feb-18	1	3	0	**4**	2	0	-	**2**
Mar-18	1	1	2	**4**	0	0	-	**0**
Apr-18	1	0	1	**2**	0	1	-	**1**
May-18	5	8	20	**33**	2	1	-	**3**
Jun-18	6	3	4	**13**	6	2	-	**8**
Jul-18	7	9	5	**21**	3	3	-	**6**
Aug-18	4	9	1	**14**	8	0	-	**8**
Sep-18	2	3	2	**7**	3	1	-	**4**
Oct-18	2	1	4	**7**	4	2	-	**6**
Nov-18	2	1	1	**4**	2	0	-	**2**
Dec-18	1	2	1	**4**	0	1	-	**1**
Total	**33**	**42**	**42**	**117**	**30**	**12**	-	**42**

Table (7): Monthly fluctuation of leaves spider population "Catch size" in flowering annuals and evergreen herbs

Month	Ground spiders		Total	Leaves spiders		Total
	Pelargonia	Crinum		Pelargonia	Crinum	
Jan-17	1	1	**2**	0	0	**0**
Feb-17	1	0	**1**	0	0	**0**
Mar-17	5	1	**6**	2	0	**2**
Apr-17	1	0	**1**	3	0	**3**
May-17	2	6	**8**	3	0	**3**
Jun-17	5	10	**15**	2	0	**2**
Jul-17	1	8	**9**	5	0	**5**
Aug-17	9	6	**15**	11	4	**15**
Sep-17	12	1	**13**	9	1	**10**
Oct-17	6	3	**9**	3	6	**9**
Nov-17	0	0	**0**	2	0	**2**
Dec-17	2	1	**3**	1	0	**1**
Total	**45**	**37**	**82**	**41**	**11**	**52**

Table (8) Estimation of shannon-wiener (H), simpson indices (S) and species evenness of spider diversity

	Ground spider					Leaves spider			
	Severinia	Dombeya	Feijoa	Pelargonium	Crinum	Severinia	Dombeya	Pelargonium	Crinum
Shannon-Wiener Index (H)	2.21	1.89	2.32	1.44	1.76	2.13	2.09	2.43	2.02
Simpson Index (S)	0.16	0.19	0.14	0.31	0.23	0.14	0.14	0.12	0.14
Species Evenness	1.68	2.15	1.76	2.37	1.93	1.96	1.79	1.74	1.89

Leaves of feijoa were unavailable

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References

Abo-Zaed, A. E.; Hassan, M. I. and Mansour, A. M. (2019): Survey of insect pests and spiders infesting medicinal and aromatic plants. Egypt. J. Plant Prot. Res. Inst., 2 (2): 368 – 377.

Bahnasy, M. I. and Khamis, M. H. (2019): Distribution pattern of trees diversity in Orman Botanical Garden. Middle East Journal of Agriculture Research, 8(1):1-11.

Buchholz, L. (2016): Causal Explanation in Global Analysis: A Critical Realist Rapprochement. Critical Realism Network, December. Published, 2016, 1-5 pp http://criticalrealismnetwork.org.

Ehmann, W. (1994): Spider habitat selection: an experimental field test of the role of substrate diameter. J. Arachnol., 22:77–81.

El-Hennawy, H. K. (2017): A list of Egyptian spiders (revised in 2017). Serket. 15(4): 167-183.

Ghallab, M. M. A. (2013): Preliminary study of the spiders inhabiting ornamental plants in Orman Garden Egypt (Arachnida: Araneae). Acarines, 7(2): 85-92.

Halaj, J.; Cady, A. and Uetz, G., (2000): Modular habitat refugia enhance enhance generalist predators and lower plant damage in soybeans. Environ. Entomol., 29: 383-393.

Hassan, M. F.; El-Bishlawy, S. M. O.; Sallam, G. M. and Sawers, M. A. (2016): Incidence of spiders in Cairo and Giza Governorates, Egypt. Acarines, 10:81-87.

Huber, B. A. (2005): Key to families adapted from "SpinnenMitteleuropas" Museum Koenig Bonn. http://www. Uni-bonn.de/-bhuber1/spider-key/ARANEAE.html.

Kaston, B.J. (1978): How to know the spider. W.C. Brown Co., Dubuque, lowa, U.S.A., pp 272.

Košulič, O.; Michalko, R. and Hula, V. (2016): Impact of Canopy Openness on Spider Communities: Implications for Conservation Management of Formerly Coppiced Oak Forests. . PLoS ONE 11(2): e0148585. doi:10.1371/journal.pone.0148585.

Levi, H. W. (2002): Keys to the genera of araneidorb weavers (Araneae, Araneidae) of the Americas, J. Arachnol., 30(3): 527-562.

Ludwig, J. A. and Reynolds, J. F. (1988): Statistical ecology: A primary method and computing. New York, pp.337.

Messas, Y.; Souza, H.; Gonzaga, M. and Vasconcellos-Neto, J. (2014): Spatial distribution and substrate selection by the orb-weaver spider Eustalaperfida Mello-Leitao, 1947 (Araneae: Araneidae). J. Nat. Hist., 48:2645-2660.

Muff, S.; Signer, J. and Fieberg, J. (2009): Accounting for individual-specific variation in habitat-selection studies: Efficient estimation of mixed-effects models using Bayesian or frequentist computation. DOI: 10.1101/411801.

Oger, P. (2002): Les Araignées de Belgiqueet de France, on-line at http://arachno. Piwigo.com/index.PhD/categories.

Ovtsharenko, V. and Tanasevitch, A. (2002): A key to spider families. American museum of natural history. Online at http://research.amnh.org/iz//blackrock2/key.htm**.**

Pinzón, J. and Spence, J. (2010): Bark-dwelling spider assemblages (Araneae) in the boreal forest: Dominance, diversity, composition and life-histories. Journal of Insect Conservation., 14(5):439-458.

Platnick, N. I. (2012): The world spider catalog, version 12.S. American museum of natural history, on-line at http://research.amnh.org/iz//spiders/catalog.

Prószyński, J. (2003): Salticidae genera of Levant (Israel and Neighboring Countries) http://salticidae.org/salticid/diagnost/keys-sal/levant.htm.

Rinaldi,I. and Trinca,L. (2008): Spider assemblages in widely separated patches of cerrado in Sao Paulo State, Brazil.Acta Biol. Parana. 37, 165-180.

Rizk, M. A.; Sallam, G. M. E.; Abdel-Azim, N. A. I. and Ghallab, M. M. (2012): Spider occurrence in fields of some medicinal and ornamental plants in Fayoum, Egypt. Acarines, 6: 41-47.

Roberts, M. J. (1987): The spiders of Great Britain and Ireland. Volume 2: The Linyphiidae. Harley Books, Colchester.

Southwood, T.R.E. (1978): Ecological Methods with particular reference to the study of insect population.Chapman and Hall, London. Pp 524.

Southwood, T. R. E. and Henderson, P. A. (2000): Ecological Methods. Blackwell Science Ltd., Oxford: pp 574.

Souza, A.L.T. de Martins (2005): Foliage Density of Branches and Distribution of Plant-Dwelling Spiders. Biotrotrpica., 37(3): 416–420.

Szinetár, C. and Horváth, R. (2005): A review of spiders on tree trunks in Europe (Araneae). Acta Zool.Bulg., 1:221-257.

Turnbull , A. (1973): Ecology of the true spiders. Annu. Rev. Entomol., 18:305-348.

Uetz, G.W. (1991): Habitat structure and spider foraging. Pp. 325–348. In Habitat Structure: The Physical Arrangement of Objects in Space. (S.S. Bell, E.D. McCoy & H.R. Mushinsky, eds.)., Chapman and Hall, London, U.K.

Ubick, D.; Paquin, P.; Cushing, P. E. and Roth, V. (2005): Spiders of North America : An Identification Manual. (eds) Published by American Arachnological Society.

Villanueva-Bonillaa, G. A.; Adriana Trevizoli Salomãob and JoãoVasconcellos-Neto (2017): Trunk structural traits explain habitat use of a tree-dwelling spider (Selenopidae) in a tropical forest. Acta Oecologica, 85:108-115.

Weigmann, G. (1973): Zur Ökologie der Collemolen und Oribatiden in griechisch Land-Meer (Collembola, Insecta; Oribatei, Acari). Z. Wiss. Zool., Leipzig, 186(3/4): 291-295.

Weis Fogh, T. (1948): Ecological Investigation on mites and collembolan in the soil. Nat. Jutlant , 1: 135-270.

World Spider Catalog (2016): Natural History Museum Bern. http:// wsc.nmbe.ch, version 17.0 [accessed 24 May 2016].