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Spider biodiversity in connection with the vegetation structure and its surrounding soil

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Abstract:

Spider activity occurred in four ornamental plants was assessed for a whole year using pitfall traps for ground spiders and sweeping net for vegetation or aerial spiders. A total of 456 individuals of ground and aerial spiders were collected. They belonged to 38 species, 38 genera of 7 families. Family Lycosidae was found the dominant recorded 158 individuals (61.9%) of ground spider, while family Salticidae of the aerial spiders recorded 70 individuals (33.3%) of the total aerial collected spiders. By using shannon wiener and simpson indices, results revealed that species diversity were high under Plumbago shrubs for ground spider while the highest diversity of aerial spiders was recorded on red acalypha shrubs. Monthly fluctuation of the total number of spiders should high population between May to August for ground spiders and in August to September for aerial spiders.

Introduction

The Orman garden, which was founded in 1875, is one of the most famous and oldest botanical gardens in Egypt (Diwan *et al.*, 2004) and occupies an area of 28 feddans. Spiders are an important component of most terrestrial ecosystems. They have conquered all environments, they are found in forests, desert regions, and open environments, in bodies of water, under stones and on the ground, on bushes and in burrows or caves. The spiders live in the gardens and even the houses (Bourbia *et al.*, 2018). True spiders are one of the most abundance predatory groups in terrestrial ecosystems.

Spiders have proved to be beneficial in regulation of agricultural pests and their role as natural enemies has recently been more and more stressed (Ghabbour *et al.,* 1999). Few studies have compared differences in the abundance of spiders on foliage of different shrubs and tree species (Souza, 2005). Ghallab (2013) studied the spiders inhabiting two ornamental plants in Orman garden. Hassan *et al.* (2016) studied spiders population inhabiting the ornamental plants at Cairo and Giza Governorates in four public parks, five plants of each park to estimate the effect of different vegetation's on the spiders populations.

El-Hennawy (2017) who listed the Egyptian spider species (405 species, belonging to 204 genera and 41 families) in a checklist which included scientific names of spider species recorded from Egypt, with their distribution localities. Riechert and Lockley (1984) observed associations

between spiders and certain plant species, in a study on the effect of prairie fires on spider distribution. They attributed these associations to structural characteristics of the plants. Habashy *et al*., (2005) indicated that the diversity of the spider fauna in each site is often related to the structural diversity of the habitat.

Indirectly, the surface vegetation affects spider population density and biodiversity, which is influenced by microclimate of the plant. These variations in sun and shade have a marked effect on the horizontal distribution patterns of many pests affected directly on the growth rate of spiders.

The present work study the abundance, spider density and diversity in two different communities of four different evergreen shrubs represented, aerial spiders and ground spiders inhabiting under those shrubs in Orman garden.

Materials and methods

1. Study area:

This work was conducted in Orman garden, Giza, Egypt for a whole year. Four evergreen shrubs were chosen to study the effect of plant structures and compositions on spider biodiversity.

They were red acalypha (*Acalypha wilkesiana marophylla* Mül), twisted acalypha (*Acalypha wilkesiana haffnanni* Mül), single green acalypha (*Acalypha wilkesiana marginata* Mül) and plumbago (*Plumbago auriculate*). Active 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 methods:

2.1. Pitfall trap method:

Spiders were collected by pitfall traps as described by Southwood and Henderson (2000). Three traps/plant/two weeks was regularly applied for each of the four plants chosen.

Seventy eight traps per plant were undertaken for a year of total 312 pitfall collections. The pitfall traps were remained open for 24 hours to obtain both diurnal and nocturnal species. Obtained spiders were preserved in 70 % ethyl alcohol, counted and identified to species level as much as possible and deposited in plant protection research institute collection. We removed the traps between collecting periods, but these were placed in the same locations when sampling again. The recipients were filled with water and a small quantity of detergent added to lower the surface tension. It has been shown that these traps are efficient to assess spider communities (Pearce *et al*., 2005).

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.

3. Identification of spiders:

All the adults and juveniles were determined to species level or morpho species. 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). 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.

4. Data analysis:

4.1. 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).

4.2. Species diversity:

The biodiversity of spiders collected were estimated by using equilibrium. Diversity of collected spiders was determined for samples pooled over one whole year of four 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).

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

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, 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 evergreen shrubs:

1.1. Ground spiders:

Table (1), showed that a total of 45 spiders were collected from red acalypha shrubs. They represented 9 families, 17 genera and 17 species. Juvenile comprised 44.44%; while adults average 55.55%. The sex ratio was 5.25♂:1♀. Of the most abundance species was *Hogna ferox* (13 individuals) followed by *Trochosa urbana* (6 individuals) and *prinerigone vagans* (5 individuals). A total of 50 spiders were collected from twisted acalypha shrubs.

They represented 10 families, 14 genera and 14 species. Juvenile comprised 32%; while adults average 68%. The sex ratio was 2.09♂:1♀. Of the most abundance species was *Hogna ferox*(18 individuals)followed by *Plexippus paykulli* (5 individuals) and *Hasarius adansoni* (6 individuals).We found more spiders at single acalypha of a total of 122 spiders. They represented 7 families, 11 genera and 11 species. Juvenile comprised 80.33%; while adults average 19.67%.

The sex ratio was 1.67♂:1♀. Of the most abundance species was *Trochosa urbana* (65 individuals) followed by *Hogna ferox* (35 individuals).The lowest number of spiders was collected from Plumbago shrubs of a total of 38 spiders. They represented 8 families, 9 genera and 9 species. Juvenile comprised 36.84%; while adults average 63.16%. The sex ratio was 2.4♂:1♀. Of the most abundance species was *Hogna ferox* (14 individuals) followed by *H. adansoni* (8 individuals).

1.2. Leave spiders:

Table (2), showed that a total of 43 spiders were collected from red acalypha shrubs. They represented 5 families, 14 genera and 14 species. Juvenile comprised 72.09%; while adults average 27.91%. The sex ratio was 1♂:1♀. Of the most abundance species was *Philodromes* sp. (11 individuals) followed by *Cheiracanthium* sp. (6 individuals). A total of 40 spiders were collected from twisted acalypha shrubs. They represented 7 families, 9 genera and 12 species. Juvenile comprised 65%; while adults average 35%. The sex ratio was 1♂:1♀. Of the most abundance species was *Cheiracanthium* sp. (10 individuals) followed by *Plexippus* sp. (8 individuals).

But at single green acalypha the total number of spiders decreased to 32 spiders inhabiting, they represented 4 families, 8 genera and 10 species. Juvenile comprised 78.13%; while adults average 21.88%. The sex ratio was 1.33♂:1♀. The most abundant species was *Cheiracanthium* sp. and *Plexippus* sp. (7 individuals) the same number.

The highest numbers of spiders were collected from plumbago shrubs.

A total of 95 spiders were collected from Plumbago, they represented 7 families, 15 genera and 19 species. Juvenile comprised 48.42%; while adults average 51.58%. The sex ratio was 1.58♂:1♀. The most abundant species was *Philodromus* sp. (20); *Thomisus spinifer* (19 individuals) and *Pullchellodrmes glaucinus* (15 individuals).

2. Rank abundance of spider families:

Table (3) was presented by families and showed their abundance. The greatest number of collected ground spiders presented by family Lycosidae 158 (61.96 %) and Salticidae 37 (14.51%) while, those collected from vegetation were family Saiticidae 70 (33.33 %) and Philodromidae 56 (26.67%) followed by Linyphidae 17 (6.67%) of ground spider.

Vegetation spiders were more diverse than ground spiders and their families were mor active. Activity density of families Cheiracanthiidae, Therdiidae and Thomisidae were 29, 25 and 24 individuals of 13.81, 11.90 and 11.43%. Members of Dictynidae were the least presence in both ground and vegetation spiders.

3. Relative abundance-Frequency relationship of spider communities inhabiting ground and leaves:

3.1. Ground spiders:

Table (4) showed that the frequency and abundance values among Weis Fogh of the most abundant spiders in evergreen shrubs (red acalypha, twisted acalypha, single green acalypha and plumbago) during 2018. According Weis Fogh system, members of Family Lycosidae were considered accessory (ac) in red acalypha, twisted acalypha, Plumbago and also members of Salticidae under Plumbago; they recorded 44.44, 48, 36.84 and 31.58% respectively. While members of Lycosidae recorded 81.97 in single green acalypha considered as Constant (C) while all the remaining families were considered accidental.

Members of family Salticidae: *P. paykulli* and *H. adansoni* "dominant" according to Weigmann classification of dominance. Also, family Thridiidae, Thomisidae and Dictynidae were disappeared from Plumbago shrubs. But family Dysderidae, Eutichuridae, Thomisidae and Dictynidae were disappeared from single green acalypha. Also, family Thomisidae and Dictynidae were disappeared from red acalypha. But only one family Philodromidae was disappeared from twisted acalypha. Members of family Lycosidae: *Hogna ferox* ranged between "dominant" and "Eudominant"

according to Weigmann classification of dominance.

According to Weigmann classification, members of Lycosidae were "Eudominant" under the four shrubs investigated, the same family Linyphiidae was "Eudominant" under red acalypha and family Salticidae under Plumbago plant. Members of Gnaphosidae and Salticidae were considered "dominant" under twisted acalypha and plumbago. All the remaining families were "accidental" while their members ranged between "sub-dominant" and "Recedent"

Our results agree with the results which were obtained by (Abd El-Karim *et al.* , 2016) who found that family Lycosidae: *Hogna* sp., *Pardosa* sp. and *Wadicosa fidelis* were dominant and eudominant. Also, Shuang-Lin and Bo-Ping (2006) who indicated that Lycosidae was the dominant family and occupied more than 60% of individuals community.

3.2. Leaves spider:

Table (5) showed that the frequency and abundance values of the most leaves spiders in evergreen shrubs, According "Weis Fogh system" memers of family Salticidae were "Constant" 59.38% on leaves of single green acalypha. Members of Philodromidae and Salticidae were "accessory" while the remaining families were "accidental". Members of families Salticidae: *Thyene imperialis*, *Thyene* sp. and *Bianor* sp. ranged between "Dominant" and "subdominant".

According to weigmann dominance classification, the most dominant species recorded in members of family Salticidae under sigle green acalypha and twisted acalypha considered as "Eudominant" (E). Members of Cheiracanthiidae were "Dominant" (D) under the three species of acalypha and also members of Theridiidae under red and twisted acalypha, in addition members of Thomisidae on leaves of Plumbago.

The remaining families ranged between "sub-dominant" and "Recedent" . This study indicated the influence of vegetation structure on the diversity of resident spider communities. Plumbago shrubs seemed to have a higher amount of diversity than the three types of acalypha, because it had the greatest number of species.

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

Table (6) showed that the total number of spiders collected from ground 255 individuals more than spiders collected from leaves 210 individuals. The most counts of spiders collected from ground were recorded during August 92 individuals decreased to 58 individuals in May. While during August and September the highest numbers of spiders were collected from leaves were 29 individuals for both. No spiders were found by two methods (Pitfall traps and sweeping net) during November and January from ground or leaves.

These results confirmed by Mushtaq *et al.* (2000) , Ghallab (2013) and Abd El-Karim *et al*. (2016) who indicated that total monthly count of spiders collected in early summer during May and the lowest numbers were recorded during February.

Spider diversity: Table (7) compared the biodiversity of collected spiders in different vegetation spider associated with foliage and ground spider by using Shannon-Wiener "H" and Simpson "S" indices of diversity. These results revealed that the highest "H" value recorded on spiders of foliag in red acalypha 2.40 followed by 2.16 in twisted acalypha so red acalypha had a high diversity. The lowest "H" value recorded 1.34 in single green acalypha. Ground spiders revealed that the highest "H" value recorded in

Plumbago 2.4, the lowest value 2.09 in single green acalypha.

Consequently, these values demonstrated that spiders collected from pitfall trap "ground spiders" more than spider associated from 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 0.37 under single green acalypha shrubs and the lowest under red acalypha 0.13. also leaves spider show that the highest value recorded in single green acalypha shrubs 0.15 and the lowest under red acalypha 0.12.

These results revealed that the highest species evenness value recorded on spiders of ground in Plumbago 2.30 and the lowest value in red acalypha 1.67. While leaves spiders revealed that the highest number of Species Evenness recorded in single green acalypha 2.19 and the lowest value in twisted acalypha 1.28.

This result related to the highest content of dropping soil and insects as feeding. Habashy *et al.* (2005) indicated that soil texture may have an important influence on the distribution patterns of spiders that deposit their cocoons in the soil.

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Table (1): Species richness of the collected ground spiders inhabiting evergreen shrubs.

Families and taxa names	Red acalypha			Σ	Total	%	Twisted acalypha			Σ	Total	%	single green acalypha			Σ	Total	%	Plumbago			Σ	Total	%
	♂	♀	J				♂	♀	J				♂	♀	J				♂	♀	J			
Lycosidae																								
Wadicosa fidelis																								
Pardosa sp.	1			1	20	**44.44**	1			1	24	**48.00**					100	**81.97**					14	**36.84**
Hogna ferox	5	2	6	13			7	6 +1▲	5	18			3	1	31	35			7	5	2	14		
Trochosa urbana	2	1	3	6			3	1	1	5				3	62	65								
Gnaphosidae																								
Micaria dives	1			1	3	**6.67**	2	1		3	5	**10.00**	1			1	2	**1.64**	3		1	4	4	**10.53**
Zelotes sp.	1			1					2	2			1			1								
Drassodes	1			1																				
Linyphiidae																								
Erigone dentipalpis	1		2	3	11	**24.44**					2	**4.00**					3	**2.46**					1	**2.63**
Prinerigone vagans	2		3	5									2			2								
Sengletus extricatus	2		1	3			2			2			1			1			1			1		
Salticidae																								
Plexippus paykulli			1	1	2	**4.44**	4		1	5	11	**22.00**	3	1	1	5	12	**9.84**		2	2	4	12	**31.58**
Hasarius adansoni			1	1				2	4	6			1	3	3	7			4		4	8		
Theridiidae																								
Steatoda erigonifomis	1			1	1	**2.22**					1	**2.00**					1	**0.82**						
Kochiura aulica							1			1														
Theridion sp.													1			1								
Philodromidae																								
Philodromus cespitum		1		1	2	**4.44**									1	1	1	**0.82**			3	3	3	**7.89**
Thanatus albini	1			1																				
Oecobiidae					2	**4.44**					2	**4.00**					3	**2.46**					2	**5.26**
Oecobius navus	2			2			1		1	2			2	1		3			2			2		
Dysderidae					1	**2.22**					2	**4.00**											1	**2.63**
Dysdera crocata	1			1			1		1	2											1	1		
Eutichuridae					3	**6.67**					1	**2.00**											1	**2.63**
Cheiracanthium sp.			3	3					1	1											1	1		
Thomisidae											1	**2.00**												
Thomisus spinifer							1			1														
Dictynidae								1		1	1	**2.00**												
Total	**21**	**4**	**20**	**45**			**23**	**11**	**16**	**50**			**15**	**9**	**98**	**122**			**17**	**7**	**14**	**38**		
	45						**50 + 1▲**				**50**		**122**						**38**					

▲: Egg sac

Table (2): Species richness of the collected leaves spiders inhabiting evergreen shrubs.

Families ans taxa names	Spider name	Red acalypha			Total	%	Twisted acalypha			Total	%	Single green acalypha			Total	%	Plumbago			Total	%
		♂	♀	J			♂	♀	J			♂	♀	J			♂	♀	J		
Araneidae	*Araneus* sp.										**2.50**								1	1	**2.11**
	Spiderling								1	1									1	1	
Cheiracanthiidae	*Cheiracanthium* sp.			6	6	**18.60**	1		9	10	**27.50**		1	6	7	**25.00**			2	2	**2.11**
	Cheiracanthium isiacum	1		1	2			1		1			1		1						
Dictynidae	*Dictyna* sp																1			1	**1.05**
Lycosidae	*Trochoa* sp.								1	1	**2.50**										
Philodromidae	*Pulchellodromus glaucinus*		1		1	**30.23**					**5.00**					**12.50**	3	8	4	15	**38.95**
	Philodromus sp.			11	11				2	2				2	2		1	1	18	20	
	Thanatus sp.			1	1									2	2			1	1	2	
Salticidae	*Thyene imperialis*	1	1	1	3	**27.91**		1	2	3	**37.50**					**59.38**	3	1		4	**25.26**
	Thyene sp.			3	3									5	5			1	3	4	
	Heliophanus sp.												1	1	2		2	1	1	4	
	Hasarius adansoni																1			1	
	Plexippus sp.			2	2				8	8		1		6	7						
	Plexippus paykulli						1	1	2	4		2		1	3						
	Bianor sp.			3	3												2	3	2	7	
	Spiderling			1	1									2	2				4	4	
Theridiidae	*Theridion melanostictum*		2		2	**16.28**	2	2		4	**22.50**							1		1	**9.47**
	Theridion sp.	1	1	1	3		1			1									5	5	
	Kochiura aulica		1	1	2		2	2		4							1			1	
	Euryopis episinoides																1		1	2	
Thomisidae	*Thomisus* sp.					**6.98**										**3.13**			1	1	**21.05**
	Thomisus spinifer	3			3							1			1		15	2	2	19	
Uloboridae	*Uloborus* sp.								1	1	**2.50**										
Total		**6**	**6**	**31**	**43**		**7**	**7**	**26**	**40**		**4**	**3**	**25**	**32**		**30**	**19**	**46**	**95**	
		43					**40**					**32**					**95**				

Table (3): Rank abundance of spider families occurred in ground and leaves under different evergreen shrubs

Families	Number of collected ground spiders				Total	%	Number of collected leaves spiders				Total	%
	Red acalypha	Twisted acalypha	Single green acalypha	Plumbago			Red acalypha	Twisted acalypha	Single green acalypha	Plumbago		
Araneidae							0	1	0	2	**3**	**1.43**
Lycosidae	20	24	100	14	**158**	**61.96**	0	1	0	0	**1**	**0.48**
Cheiracanthiidae							8	11	8	2	**29**	**13.81**
Gnaphosidae	3	5	2	4	**14**	**5.49**						
Linyphidae	11	2	3	1	**17**	**6.67**						
Salticidae	2	11	12	12	**37**	**14.51**	12	15	19	24	**70**	**33.33**
Theridiidae	1	1	1	0	**3**	**1.18**	7	9	0	9	**25**	**11.90**
Philodromidae	2	0	1	3	**6**	**2.35**	13	2	4	37	**56**	**26.67**
Oecobiidae	2	2	3	2	**9**	**3.53**						
Dysderidae	1	2	0	1	**4**	**1.57**						
Eutichuridae	3	1	0	1	**5**	**1.96**						
Filistatidae												
Thomisidae	0	1	0	0	**1**	**0.39**						
Uloboridae							0	1	0	0	**1**	**0.48**
Thomisidae							3	0	1	20	**24**	**11.43**
Pholicidae											**0**	**0.00**
Dictynidae	0	1	0	0	**1**	**0.39**	0	0	0	1	**1**	**0.48**
Total	**45**	**50**	**122**	**38**	**255**		**43**	**40**	**32**	**95**	**210**	
	255						**210**					

Table (4) The dominance-frequency relationship of ground spider communities inhabiting evergreen shrubs.

Families and taxa names	Red Acalypha					Twisted acalypha					Single green acalypha					Plumbago				
	No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.
Lycosidae																				
Wadicosa fidelis																				
Pardosa sp.	1	2.22	**R**	**44.44**	**ac**	1	2.00	**R**	**48.00**	**ac**				**81.97**	**C**				**36.84**	**Ac**
Hogna ferox	13	28.89	**D**			18	36.00	**E**			35	28.69	**D**			14	36.84	**E**		
Trochosa urbana	6	13.33	**D**			5	10.00	**Sd**			65	53.28	**E**							
Gnaphosidae																				
Micaria dives	1	2.22	**R**	**6.67**	**A**	3	6.00	**Sd**	**10.00**	**A**	1	0.82	**Sr**	**1.64**	**A**	4	10.53	**D**	**10.53**	**A**
Zelotes sp.	1	2.22	**R**			2	4.00	**R**			1	0.82	**Sr**							
Drassodes	1	2.22	**R**																	
Linyphidae																				
Erigone dentipalpis	3	6.67	**sd**	**24.44**	**A**				**4.00**	**A**				**2.46**	**A**				**2.63**	**A**
Prinerigone vagans	5	11.11	**D**								2	1.64	**R**							
Sengletus extricates	3	6.67	**sd**			2	4.00	**R**			1	0.82	**Sr**			1	2.63	**R**		
Salticidae																				
Plexippus paykulli	1	2.22	**R**	**4.44**	**A**	5	10.00	**Sd**	**22.00**	**A**	5	4.10	**R**	**9.84**	**A**	4	10.53	**D**	**31.58**	**Ac**
Hasarius adansoni	1	2.22	**R**			6	12.00	**D**			7	5.74	**Sd**			8	21.05	**D**		
Thridiidae																				
Steatoda erigoniformis	1	2.22	**R**	**2.22**	**A**				**2.00**	**A**				**0.82**	**A**					
Kochiura aulica						1	2.00	**R**												
Theridion sp.											1	0.82	**Sr**							
Philodromidae																				
Philodromus cespitum	1	2.22	**R**	**4.44**	**A**						1	0.82	**Sr**	**0.82**	**A**	3	7.89	**sd**	**7.89**	**A**
Thanatus albini	1	2.22	**R**																	
Oecobiidae				**4.44**	**A**				**4.00**	**A**				**6.25**	**A**				**5.26**	**A**
Oecobius navs	2	4.44	**R**			2	4.00	**R**			3	2.46	**R**			2	5.26	**sd**		
Dysderidae				**2.22**	**A**				**4.00**	**A**									**2.63**	**A**
Dysdera crocata	1	2.22	**R**			2	4.00	**R**								1	2.63	**R**		
Eutichuridae				**6.67**	**A**				**2.00**	**A**									**2.63**	**A**
Cheiracanthium sp.	3	6.67	**sd**			1	2.00	**R**								1	2.63	**R**		
Thomisidae									**2.00**	**A**										
Thomisus spinifer						1	2.00	**R**												
Dictynidae						1	2.00	**R**	**2.00**	**A**										
Total	**45**					**50**					**122**					**38**				

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)

Table (5) The dominance-frequency relationship of leaves spiders communities inhabiting evergreen shrubs.

Families and taxa names	Spider name	Red acalypha					Twisted acalypha					Single green Acalypha					Plumbago				
		No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.	No.	Sp.%	Dom.	F.%	Freq.
Araneidae	*Araneus* sp.									2.50	**A**						1	1.05	**R**	2.11	**A**
	Spiderling						1	2.50	**R**								1	1.05	**R**		
Cheiracanthiidae	*Cheiracanthium* sp.	6	13.95	**D**	18.60	**A**	10	25.00	**D**	27.50	**ac**	7	16.28	**D**	25.00	**ac**	2	2.11	**R**	2.11	**A**
	Cheiracanthium isiacum	2	4.65	**R**			1	2.50	**R**			1	2.33	**R**							
Dictynidae	*Dictyna* sp																1	1.05	**R**	1.05	**A**
Lycosidae	*Trochosa* sp.						1	2.50	**R**	2.50	**A**										
Philodromidae	*Pulchellodromus glaucinus*	1	2.33	**R**	30.23	**ac**				5.00	**A**				12.50	**A**	15	15.79	**D**	38.95	**Ac**
	Philodromus sp.	11	25.58	**D**			2	5.00	**R**			2	4.65	**R**			20	21.05	**D**		
	Thanatus sp.	1	2.33	**R**								2	4.65	**R**			2	2.11	**R**		
Salticidae	*Thyene imperialis*	3	6.98	**sd**	27.91	**ac**	3	7.50	**Sd**	37.50	**ac**				59.38	**C**	4	4.21	**R**	25.26	**As**
	Thyene sp.	3	6.98	**sd**								5	11.63	**D**			4	4.21	**R**		
	Heliophanus sp.											2	4.65	**R**			4	4.21	**R**		
	Hasarius adansoni																1	1.05	**R**		
	Plexippus sp.	2	4.65	**R**			8	20.00	**D**			7	16.28	**D**							
	Plexippus paykulli						4	10.00	**Sd**			3	6.98	**sd**							
	Bianor sp.	3	6.98	**sd**													7	7.37	**sd**		
	Spiderling	1	2.33	**R**								2	4.65	**R**			4	4.21	**R**		
Theridiidae	*Theridion melanostictum*	2	4.65	**R**	16.28	**A**	4	10.00	**Sd**	22.50	**A**						1	1.05	**R**	9.47	**A**
	Theridion sp.	3	6.98	**sd**			1	2.50	**R**								5	5.26	**sd**		
	Kochiura aulica	2	4.65	**R**			4	10.00	**Sd**								1	1.05	**R**		
	Euryopis episinoides																2	2.11	**R**		
Thomisidae	*Thomisus* sp.				6.98	**A**									3.13	**A**	1	1.05	**R**	21.05	**A**
	Thomisus spinifer	3	6.98	**sd**								1	2.33	**R**			19	20.00	**D**		
Uloboridae	*Uloborus* sp.						1	2.50	**R**	2.50	**A**										
Total		**43**					**40**					**32**					**95**				

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

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

Table (6): Monthly fluctuation of spider population "Catch size" in evergreen shrubs

Month	Pitfall traps (ground spiders)				Total	Leaves (sweepimg net)				Total
	Red acalypha	Twisted acalypha	Single green acalypha	Plumbago		Red acalypha	Twisted acalypha	Single green acalypha	Plumbago	
Jan-18	2	5	0	2	9	0	0	0	0	0
Feb-18	3	2	0	2	7	0	0	0	10	10
Mar-18	3	6	3	2	14	2	0	6	4	12
Apr-18	4	0	2	6	12	3	1	7	1	12
May-18	11	8	36	3	58	2	3	1	5	11
Jun-18	2	10	2	4	18	6	4	2	8	20
Jul-18	3	2	1	4	10	5	7	5	6	23
Aug-18	8	9	68	7	92	6	13	3	7	29
Sep-18	3	1	1	4	9	10	6	4	9	29
Oct-18	1	2	3	2	8	2	3	2	12	19
Nov-18	0	0	0	0	0	2	1	1	18	22
Dec-18	5	5	6	2	18	5	2	1	15	23
Total	45	50	122	38	255	43	40	32	95	210

Table (7): Estimation of shannon-wiener (H), simpson indices (S) and species evenness of spider diversity.

	Ground spider				Leaves spider			
	Red acalypha	Twisted acalypha	Single green acalypha	Plumbago	Red acalypha	Twisted acalypha	Single green acalypha	Plumbago
Shannon-Wiener Index (H)	2.40	2.16	1.34	1.81	2.39	2.16	2.09	2.4
Simpson Index (S)	0.13	0.18	0.37	0.21	0.12	0.14	0.15	0.13
Species Evenness	1.67	1.80	1.83	2.30	1.92	1.28	2.19	1.75

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