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Distribution of Spiders (Araneae) in Olive Groves in the Eastern Mediterranean and South-Eastern Anatolia Regions of Turkey

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ABSTRACT

In this study, the spider fauna was investigated in olive groves of Adana, Gaziantep, Hatay, Kahramanmaraş, Kilis, Mersin and Osmaniye provinces during 2008-2010. The spider samples were collected using Steiner funnel, hand aspirator and by picked twigs. A total of 1055 specimens were collected consisting of the 699 juveniles and 356 adults identified. The majority of specimens belonged to the Theridiidae family with 291 individuals, followed by Thomisidae with 227 and Salticidae with 187. Collected samples consisted of 66.2% juveniles, 9.7% males and 24.1% females. The sex and the ratios of developmental stages (juvenile and adult) of each family were listed. The female/male ratio was found to be 1:2.4. The 121 spider species were recorded as belonging to 23 families from 94 genera. The dominant families regarding species richness and abundance were identified as 29 species from Salticidae, followed 22 from Thomisidae and 15 from Theridiidae. Among them, *Thomisus* sp. and *Theridion* sp. were found to be the most abundant in 24 locations and identified on trees for 9 and 10 months, respectively.

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GK carried out the study. PAK, MRU helped in the laboratory work. GK analyzed the data and wrote the article.

Key words
Spider fauna, olive trees, Araneae.

INTRODUCTION

Spiders (Araneae) can be found in all types of habitats and ecosystems. They have a large distribution area from the poles to the centre of continents and from sea level to 5000 m elevation (Foelix, 1982; Bolu *et al.*, 2008). They are one of the most important groups in the world. It was reported that spiders play a role as indicators for the quality of the environment in agricultural areas (Clausen, 1986). They feed mostly on insects including Coleoptera, Diptera, Lepidoptera, Heteroptera, Homoptera and Hymenoptera (Edgar, 1969; Nyffeler, 1999). Spiders have been classified with 112 families, 3.905 genera and 44.032 species which including the largest species belonging to Salticidae (5.615 species), Linyphiidae (4.461 species) and Araneidae (3.030 species) in the world (Platnick, 2014).

Karol's (1967) spider list was revised which reported 520 species belonging to 162 genera. In the following years, many faunistic and ecological studies were conducted in different localities in Turkey. Twelve genera and 16 species belonging to Araneidae family were identified in Eskişehir province (Özkütük, 2004). Ninety-nine spider species belonging to 55 genera from 20 families were recorded in Kırıkkale province (Bayram *et al.*, 2005). Among the collected 129 specimens, 21 species belonging to 16 genera and 9 families were recorded in the almond groves at ten localities in the South-eastern region (Bolu *et al.*, 2008). The family Thomisidae was represented by 15 species in 8 genera from Uludağ Mountain, North-West of Turkey (Yılmaz *et al.*, 2009). Seventeen species from Linyphiidae were collected in the Black-sea region (Karabulut, 2011). Sixteen genus and 32 species in Salticidae family were identified in the west Mediterranean region (Bütüner, 2011). Fifty species belonging to nine genera from Lycosidae were identified in the central Anatolia region (Demircan, 2011). One species belonging to Tetragnathidae and two species each belonging to Thomisidae, Philodromidae and Salticidae families of Araneae were found in paddy growing areas of the Karacadağ in the provinces of Diyarbakır and Şanlıurfa (Duman *et al.*, 2013). Additionally, a lot of new records were reported the last decade. The total number of spider species identified were 1.013 belonging to 330 genera and 53 families including the most common 133 species from Gnaphosidae, 116 species from Linyphiidae and 106 species from Salticidae in Turkey (Bayram *et al.*, 2014). Recently, forty-five spider species of 21 families have been recorded on eight fruit varieties in the Eastern Mediterranean and South-Eastern Anatolia Regions of

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Fig. 1. The survey area in the Eastern Mediterranean (EMR) and Southeastern Anatolia (SEAR) regions.

Turkey (Kacar, 2015). Many studies have been carried out on spider fauna in many countries including American, European and Iranian olive groves. Spiders were also found as frequent predators on the pests of olive and the role of spiders was investigated on olive pest control (Morris *et al.*, 1999; Ghavami, 2006; Ghavami *et al.*, 2007; Nieuwenhuys, 2010; Gocalves and Pereira, 2012). In Turkey, researchers have rarely studied the spider species in olive groves.

In the present study, the spider fauna from olive groves was assessed in Adana, Gaziantep, Hatay, Mersin, Kahramanmaraş, Kilis and Osmaniye provinces during 2008-2010. The study area mainly consists of in the olive groves, located at higher elevations and near the forest. The aim of this study is to present the spider fauna in olive groves of the Eastern Mediterranean region (EMR) and South Eastern Anatolia region (SEAR) of Turkey.

MATERIALS AND METHODS

Sampling area

The study was carried out in olive groves in Adana, Hatay, Osmaniye, Kahramanmaraş and Mersin provinces in the EMR, Kilis and Gaziantep provinces of the SEAR (Fig. 1).

Locality descriptions are given below:

I. Adana: centre 37°0'N, 35°19'E, at altitude of approx. 27 m, Hatay: centre 36°15'N, 36°8'E at altitude of about 100 m, Mersin: centre 36°48'N, 34°38'E at altitude of approx. 3 m, Kahramanmaraş: centre 37°35'N, 36°56'E at altitude of about 572 m, and Osmaniye: centre 37°5'N, 36°15'E at altitudes of approx. 99 m provinces.

II. Gaziantep: centre 37°4'N, 37°23'E, at altitude of about 854 m, and Kilis: centre 36°71'N, 37°11'E at altitudes of approx. 649 m provinces.

The locations of sampling species: Adana: Aladağ (1), Ceyhan (2), Feke (3), İmamoğlu (4), Karaisalı (5), Karataş (6), Kozan (7), Sarıçam (8), Seyhan (9), Yumurtalık (10), Yüreğir (11), Gaziantep: Araban (12), İslahiye (13), Karkamış (14), Oğuzeli (15), Nizip (16), Şahinbey (17), Şehitkamil (18), Yavuzeli (19), Hatay: Altınözü (20), Belen (21), Dörtyol (22), Düziçi (23), Erzin (24), Hassa (25), İskenderun (26), Kırıkhan (27), Kumlu (28), Merkez (29), Reyhanlı (30), Samandağ (31), Yayladağ (32), Osmaniye: Bahçe (33), Düziçi (34), Hasanbeyli (35), Kadirli (36), Merkez (37), Toprakkale

(38), Sumbas (39), Mersin: Anamur (40), Aydıncık (41), Bozyazı (42), Çamlıyayla (43), Erdemli (44), Gülnar (45), Merkez (46), Mut (47), Silifke (48), Tarsus (49), Taşucu (50), Kahramanmaraş: Andırın (51), Merkez (52), Türkoğlu (53), Pazarcık (54), Kilis: Elbeyli (55), Merkez (56), Musabeyli (57), Polateli (58) (Fig. 1).

Collecting and identifying spiders

Spiders were sampled once a month from olive groves in different locations of seven provinces between 2008 and 2010. Trees were selected at random; the four cardinal directions for each sample. The samples were collected from different olive orchards belonging to different tree numbers as the number of trees showed variability. For this reason, the Lazarov and Grigorov (1961) method was used to collect the representative data in the sampling areas. For instance, all trees were sampled if tree numbers are less than 20 in the olive orchards (Table I).

Table I.- The number of samples collected varied according to the number of trees available for sampling area, based on sampling progression described by Lazarov and Grigorov (1961).

Numbers of total trees in orchards	The number of sampled trees
1-20	All trees
21-70	10-30
71-150	31-40
151-500	41-80
501-1000	All trees15%
More than 1000	All trees 5%

All specimens were sampled from olive trees by using an aspirator, picked twigs and a Steiner funnel. Most spiders were collected by aspirator and knocking three times the four branches in a 1 m² section of tree foliage into Steiner funnel in each grove. After being placed in the labelled jars, they were brought to the laboratory. Spiders were killed and put into 70% alcohol. Collected adults and nymphs were separated in the laboratory for identification. Samples were labelled and sent for identification. The identified samples were preserved in the museum of Turkish Aracnology Association, Ankara, Turkey.

RESULTS

In the present study, spiders were classified in 121 species belonging to 94 genera and 23 families in 58 localities for three years. The dominant families regarding species richness and abundance were 29 species from Salticidae (23.9%), 22 species from Thomisidae (18.1%) and 15 species from Theridiidae (12.3%) (Fig. 2). Among these, *Thomisus* sp. and *Theridion* sp. were found as the most common species in all 24 locations during 9 and 10 months, respectively.

Some species were found in only one of the provinces surveyed: *Araneus sturmi* and *Monaeses israeliensis* in Gaziantep; *Dictyna pusilla* in Kilis; *Mangora* sp. and *Neottiura bimaculata* in *Kahramanmaraş*; *Araniella cucurbitina, Neoscana adianta, Cicurina cicur, Lathys* sp., *Megalepthyphantes* sp., *Tenuiphantes* sp., *Thanatus atratus, Aelurillus v-insignitus, Euophrys frontalis, Icius hamatus, Episinus truncates* and *Zodarion* sp. in Osmaniye; *Araniella inconspicua, Anyphaena accentuate, Micaria pulicaria, Lepthyphantes* sp., *Thanatus pictus, Heliophanus cupreus, Heliophanus flavipes, Salticus cingulatus, Argyrodes* sp., *Dipoena coracina, Theridion cinereum, Theridiosoma gemmosum, Heriaeus setiger, Runcinia* sp., *Xysticus abditus* and *Hyptiotes* sp. in Mersin; *Cyclosa* sp., *Hypsosinga* sp., *Larinioides* sp., *Singa hamate, Coelotes terrestris, Anyphaena Sabina, Clubiona* sp., *Dictyna arundinacea, Leptonetela* sp., *Microlinyphia pusilla, Neriene cf. furtive, Cheiracanthium canariense, Tibellus macellus, Thanatus formicinus, Thanatus sabulosus, Carrhotus xanthogramma, Heliophanus dubius, Heliophanus simplex, Thyene imperialis, Plexippoides gestroi, Phlegra fasciata, Phintella* sp., *Enoplognatha afrodite, Coriarachne depressa, Coriarachne* sp., *Ozyptila simplex* and *Xysticus kempeleni* in Hatay; *Hypsosinga pygmaea, Neoscona* sp., *Bathyphantes* sp., *Centromerus* sp., *Erigone atra, Maso sundevalli, Philodromus aureoles, Pholcus* sp., *Marpissa radiate, Philaeus chrysops, Enoplognatha caricis, Enoplognatha giladensis, Steatoda bipunctata, Steatoda paykulliana, Cozyptila guseinovorum, Diaea dorsata, Pistius truncates, Thomisus citrinellus, Tetragnatha obtuse, Tetragnatha striata* and *Uloborus plumipes* in Adana (Table II).

Cheiracanthium mildei was identified in Mersin, Hatay, Kahramanmaraş and Kilis, and *Mimetus laevigatus* was found in Osmaniye, Mersin and Adana. The climate of these areas is classified as Mediterranean. While *C. mildei* lives in Holarctic and Argentina, *M. laevigatus* can be seen from Mediterranean to Central Asia. The other species were found in only one or two provinces in this study. In total, 1055 spider specimens were collected consisting of 699 juveniles and 356 adults (102 male and 254 female) (Table II). Most of specimens belonged to the family Theridiidae with 291 individuals (27.6%) including 237 juvenile, 41 female and 13 male, Thomisidae with 227 individuals (21.5%) including 157 juvenile, 53 female and 17 male, Salticidae with 187

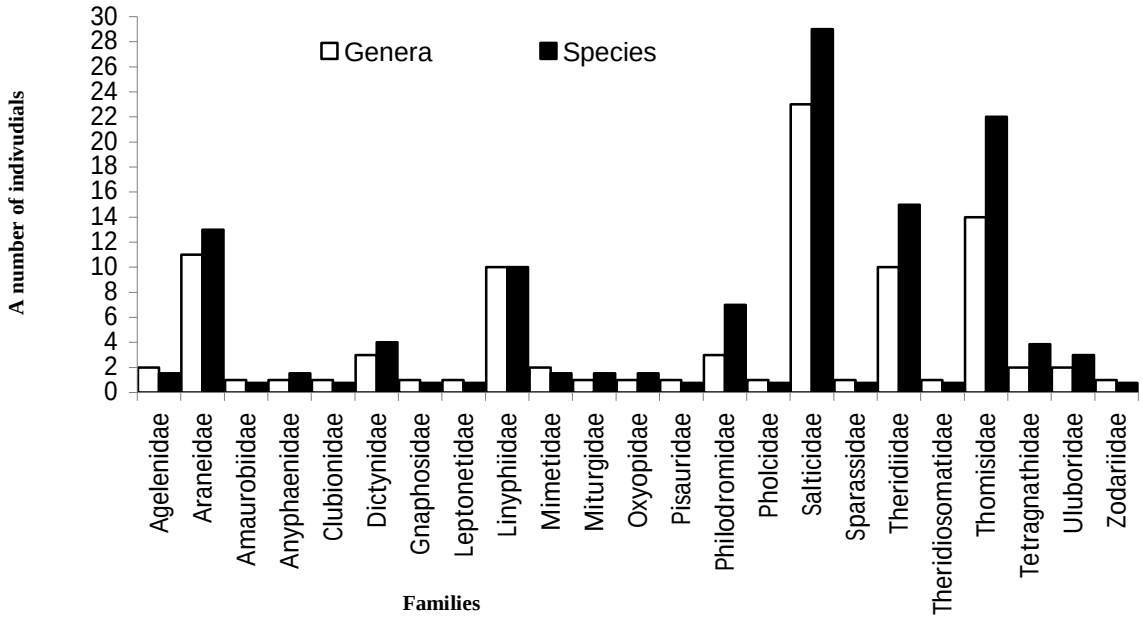

Fig. 2. The percentage of the spider families in olive groves of the eastern Mediterranean (EMR) and south-eastern Anatolia regions (SEAR) of Turkey.

individuals (17.7%) including 130 juvenile, 43 female and 14 male. Collected samples consisted of 66.2% juvenile, 9.7% adult male and 24.1% adult female. The individuals' sex, adult/sub-adult ratios of each family were listed in Table II. The female/male ratio was found to be 1:2.4.

DISCUSSION

Turkey has a rich and diverse fauna with respect to spiders. A few studies on spider fauna were conducted in south of Turkey. Gnaphosidae 17.14% of all records, Thomisidae 16.42%, Lycosidae 9.28%, Salticidae 7.85%, Theridiidae 5.71%, Philodromidae 4.28% and Lyniphiidae 3.57% were determined (Topcu *et al.,* 2005). In Gaziantep, 26 families belonging to the 29 genera and 56 species were determined. The most common family out of the seven families found was Lycosidae (27.2%), followed by Gnaphosidae (22.2%), Theridiidae (12.4%), Thomisidae (6.1%), Philodromidae (3.4%), Liocranidae (3.1%) and Miturgidae (0.3%). To date, a few species were similarly to those found in the previous studies in these regions: *Micrommata virescens, Synema globosum, Heliophanus flavipes, Mimetus laevigatus, Ero aphana, Thanatus formicinus, Ozyptila simplex, Phlegra fasciata, Plexippoides gestroi, Thomisus onustus, Philaeus chrysops, Erigone atra, Steatoda bipunctata, Mimetus laevigatus, Ero aphana, Xysticus kochi, Araneus sturmi, Uloborus walckenaerius, Tetragnatha montana* and *Mimetus laevigatus* were found in the region of Gülek Pass as a parallel recorded by Topcu *et al.* (2005). In Gaziantep, 26 families belonging to the 29 genera and 56 species were determined. The most common family out of the seven families found was Lycosidae (27.2%), followed by Gnaphosidae (22.2%), Theridiidae (12.4%), Thomisidae (6.1%), Philodromidae (3.4%), Liocranidae (3.1%) and Miturgidae (0.3%). It was determined that the male to female ratio in these seven families was 1: 2.93 and 1: 1.34 in adult and sub adult, respectively (Özdemir *et al.,* 2006). *Evarcha michailovi* over annual plants in Hatay and Gaziantep by Yağmur *et al.* (2009) and *Micaria pulicaria* by Seyyar (2009) was recorded. It was similarly determined that *Xysticus* sp., *Runcinia* sp., *Steatoda paykulliana*, *Thyene imperialis*, *Synageles* sp., *Plexippus paykulli*, *Neon* sp., *Hasarius adansoni*, *Tegenaria* sp., *Aelurillus v-insignatus*, *Ero aphana* and *Eros* sp. in pomegranate and *Araneus* sp., *Gibbaranea bituberculata*, *Clubiona* sp., *Salticus cingulatus, Salticus zebraneus, Tmarus piochardi* in olive, and *Philodromus cespitum*, *Cheiracanthium mildei*, *Tetragnatha montana* and *Euryopis* sp. were in two olive and pomegranate of Adana, Mersin and Osmaniye (Öztürk *et al.,* 2013).

Table II.- List of the spider species collected from the olive orchards in the eastern Mediterranean (EMR) and South-eastern Anatolia regions (SEAR) of Turkey.

Family	Species	Location	Months	M	F	J	Total
Agelenidae	*Agelena* sp.	25,49	III,V		3	1	4
	Tegenaria sp.	5,8,11,24,36	IV,VI,XII	1	2	7	10
Araneidae	*Araneus* sp.	2,8,36,47,49,53	VI,VII,X,XII		2	11	13
	Araneus sturmi (Hahn)	17	VII	2			2
	Araniella cucurbitina (Clerck)	34	X		4	4	8
	Araniella inconspicua (Simon)	49	III		2		2
	Araniella sp.	37	VIII			1	1
	Cyclosa sp.	29	IV		2	2	4
	Gibbanea sp.	2,8,26,32,49	IV,V,VIII,X	1		5	6
	Gibbaranea gibbosa (Walckenaer)	11,17	V,XI	1	1		2
	Gibbaranea bituberculata (Walckenaer)	36,49	IV	1	7		8
	Hypsosinga pygmaea (Sundevall)	2	XII		1		1
	Hypsosinga sp.	22	XII			2	2
	Larinioides sp.	24	IV,VII,XII			4	4
	Mangora sp.	53	XI		1	1	2
	Neoscana adianta (Walckenaer)	38	IV	1			1
	Neoscona sp.	8	VII		1	1	2
	Nuctenea umbratica (Clerk)	24,31	IV,VI	2			2
	Singa hamata (Clerck)	31	XI		1		1
	Singa sp.	4	V			3	3
	Zygiella atrica (C.L. Koch)	24,52	IV,XI	2			2
Amaurobiidae	*Coelotes* terrestris (Wider)	22	XI	1		1	2
Anyphaenidae	*Anyphaena accentuata* (Walckenaer)	44	IV	1	1	1	3
	Anyphaena sabina L. Koch	31	VI		1		1
Clubionidae	*Clubiona* sp.	32	VIII			1	1
Dictynidae	*Cicurina cicur* (Fabricius)	38	VIII	1			1
	Dictyna sp.	5,8,19,20,21,25,31	V,VII,VIII,XI,XII	1		14	15
	Dictyna arundinacea (Linneaus)	24	XII	1			1
	Dictyna pusilla Thorell	57	V		1		1
	Lathys sp.	36	VII		1	1	2
Gnaphosidae	*Micaria pulicaria (Sundevall)*	48	V		1		1
Leptonetidae	*Leptonetela* sp.	25	V			1	1
Linyphiidae	*Bathyphantes* sp.	5	VI			1	1
	Centromerus sp.	8	V		2	2	4
	Erigone atra Blackwall	8	VI	1			1
	Erigone sp.	4,8,9,29,49	IV,V,VII,XI		2	8	10
	Lepthyphantes sp.	49	XII		1	1	2
	Linyphia triangularis (Clerck)	24,49	XII		4		4

Continued

Family	*Species*	Location	Months	M	F	J	Total
	Linyphia sp.	27	V			3	3
	Maso sundevalli (Westring)	7	VI		1		1
	Megalepthyphantes sp.	38	VI		1	1	2
	Microlinyphia pusilla (Sundevall)	29	VIII	3			3
	Neriene cf. *furtiva* (O.P.-Cambridge)	24	IV		1		1
	Tenuiphantes sp.	38	VI			1	1
Mimetidae	*Ero aphana* (Walckenaer)	7,8,46	V,VIII	1	2		3
	Ero sp.	57	V		3	3	6
	Mimetus laevigatus (Keyserling)	8,37,46	VI,VIII		3	1	4
	Mimetus sp.	2,8,24,32	IV,V,VIII,XII			6	6
Miturgidae	*Cheiracanthium canariense* Wunderlich	20	VII	1			1
	Cheiracanthium mildei L. Koch	20,24, 29,31,49, 52,57	III,IV, VII,XI,	1	11		12
	Chericanthium sp.	1,5,20,22,27,29, 36, 37	IV,VII,VIII,X,XI,XII	1	9	14	24
Oxyopidae	*Oxyopes* sp.	8,49	VII, XII			5	5
	Oxyopes globifer Simon	47,5	IV,X	2	1	1	4
	Oxyopes lineatus Latreille, 1806	5,11	IV,VII	2	3		5
Pisauridae	*Pisaura* sp.	24,26	IV,VII		3	3	6
Philodromidae	*Philodromus aureolus* (Clerck)	8	VI	1			1
	Philodromus cespitum (Walckenaer)	8,36	V,VIII	2	2		4
	Philodromus sp.	2,7,9,24, 31,58	III,IV,VII,VIII,XI		11	15	26
	Tibellus macellus Simon	20	VII		2		2
	Thanatus atratus Simon	39	X	2	1		3
	Thanatus formicinus (Clerck)	24	VII		2		2
	Thanatus pictus L. Koch	45	X	1	1		2
	Thanatus sabulosus (Menge)	24	XII	3			3
	Thanatus sp.	2,24,33,37,44,47,49, 57	III,IV,VII,,X,XI,XII		4	23	27
Pholcidae	*Pholcus* sp.	5	XI			2	2
Salticidae	*Aelurillus v-insignitus* (Clerck)	37	VIII		1		1
	Ballus sp.	8,20,34, 36,49,	IV,VI, X,XI		1	10	11
	Chalcoscirtus sp.	24	VI			3	3
	Chalcoscirtus nigritus (Thorell)	8,24	IV,VI		2		2
	Carrhotus xanthogramma (Latreille)	22	IV,V	2	2		4
	Cyrba algerina (Lucas)	5,8	IX	1			1
	Cozyptila sp.	2,5	VI,VII	1	1	2	4

Continued

Family	*Species*	Location	Months	M	F	J	Total
	Euophrys frontalis (Walckenaer)	35	VIII		1		1
	Euophrys sp.	16,25,53	IV,XI		1	5	6
	Evarcha falcata (Clerck)	11,20,21	IV,XI		3	1	4
	Evarcha michailovi Logunov	8,24,37	VI,XII	1	3	2	6
	Evarcha sp.	24	VII			3	3
	Hasarius adansoni (Audouin)	30,46	IV,X,XI		3	4	7
	Hasarius sp.	5,13,17, 32,47	VIII,X,XI			9	9
	Heliophanus cupreus (Walckenaer)	49	III		1		1
	Heliophanus flavipes (Hahn)	49	VIII		1		1
	Heliophanus dubius C.L.Koch	29	XI	2	1	1	4
	Heliophanus simplex Simon	21	X		3		3
	Heliophanus sp.	36,37,46	IV,V,VII,VIII		1	6	7
	Icius hamatus (C.L.Koch)	36	VI			1	1
	Icius sp.	27	V			2	2
	Marpissa muscosa (Clerck)	27,29	V	1	1	4	6
	Marpissa radiata (Grube)	8	XII	1			1
	Monaeses sp.	5,11	IV,VI		2	4	6
	Neon sp.	1,51	VIII,X			4	4
	Salticus cingulatus (Panzer)	49	VIII	1			1
	Salticus zebraneaus C.L.Koch)	22,33	VI,X	2		3	5
	Salticus sp.	2,4,5,7,8,17,22,24, 31,40,47,49	IV,V,VI,VII,X,XI,XII		3	36	39
	Sitticus sp.	2,8,20,21,23,24,36, 44	VI,VII,VIII,X,XI,XII		3	16	19
	Synageles sp.	5,23,36	VI,VII,VII			7	7
	Thyene imperialis (Rossi)	23	X		1		1
	Plexippoides gestroi (Dalmas)	24	VII		2		2
	Plexippus paykulli (Audouin)	2,3	IV,XI	2	2	5	9
	Phlegra fasciata (Hahn)	27	IV		3		3
	Philaeus chrysops (Poda)	11	V		1		1
	Phintella sp.	21	V			2	2
Sparassidae	*Micrommata virescens* (Clerck)	1.2.1949	X,XII	4	1		5
	Micrommata sp.	27	V			1	1
Theridiidae	*Argyrodes* sp.	49	III			2	2
	Dipoena coracina (C.L.Koch)	46	VIII	1	2		3
	Dipoena sp.	5,11,25,30,36,37,47, 53,57	V,VII,VIII,X,XI			33	33
	Episinus sp.	51	VIII			1	1
	Episinus angulatus (Blackwall)	7	X	2	1		3
	Episinus truncatus Latreille	38	IV		1		1
	Euryopis sp.	49	IV			3	3
	Enoplognatha afrodite Hippa & Oksala	24	IX	1	3		4
	Enoplognatha caricis (Fickert)	7	IV		1		1
	Enoplognatha giladensis (Levy & Amitai)	8	VI	1			1
	Enoplognatha sp.	54	V			2	2
	Kochiura aulica (C.L.Koch)	15,26	XI,XII		2		2

Continued

Family	Species	Location	Months	M	F	J	Total
	Neottiura bimaculata (Linnaeus)	52	XII	1	1	1	3
	Platnickina tincta (Walckenaer)	2,7,33	V,VII,VIII	1	6		7
	Steatoda bipunctata (Linnaeus)	7	X		4		4
	Steatoda paykulliana (Walckenaer)	2	IV		1		1
	Steatoda sp.	1,24,44,51	IV,X		2	17	19
	Theridion cinereum Thorell	49	IV		2		2
	Theridion varians Hahn	49	VII		1	5	6
	Theridion sp.	1,2,5,7,8,11,20,22,24,25,26,29,30,32,34,36,38,40,44,45,47,49,52,53	III,IV,V,VI,VII,VIII,X,XI,XII	6	14	173	193
Theridiosomatidae	*Theridiosoma gemmosum* (L.Koch)	49	XII	1			1
Thomisidae	*Coriarachne depressa* (C.L.Koch)	24	V		2		2
	Coriarachne sp.	23	X			1	1
	Cozyptila guseinovorum Marusik & Kovblyuk	2	V	1	2		3
	Cozyptila sp.	2	V		1	1	2
	Diaea dorsata (Fabricius)	8	VI		1		1
	Diaea livens Simon	36,49	IV, V	1			1
	Diaea sp.	2,7,17,24,29,31,34,57	IV,V,VI,VII,XII		2	4	6
	Ebrechtella tricuspidata (Fabricius)	24,34	VI,VII	2			2
	Heriaeus setiger (O.P.-Cambridge)	49	IV		1		1
	Heriaeus sp.	16,49	V,XI			3	3
	Misumena sp.	8,9,17,18,24,27,32,47,49,53	III,IV,VI;VII,X,XI,XII		5	25	30
	Monaeses israeliensis Levy	12	XII	1		3	4
	Monaeses sp.	5,8	IV,VI		2	4	6
	Ozyptila rauda Simon	34,3	VI,XI	1		1	2
	Ozyptila simplex (O.P.-Cambridge)	26	XII		1		1
	Ozyptila sp.	20,46,54	IV,VII,			5	5
	Pistius truncatus (Pallas)	8	XII	1	2	4	7
	Pistius sp.	31	XI			1	1
	Runcinia sp.	49	XII			2	2
	Synema globosum (Fabricius)	32,47	VIII		2		2
	Synema sp.	5,32,49	V,VI,VIII,XII		2	4	6
	Thomisus citrinellus Simon	2	V		1		1
	Thomisus onustus Walckenaer	1,2,11,26,34,44	IV,V,VI,X,XI,	1	7	2	10
	Thomisus sp.	2,7,8,9,11,13,16,19,20,22,24,25,26,29,31,32,34,36,37,44,45,46,49,53	III,IV,V,VI,VII,VIII,IX,X,XI,XII		4	53	57
	Tmarus piochardi (Simon)	25,38	XI,XII	1	3	11	15
	Tmarus piger (Walckenaer)	7,26,44	VI,XI,XII	2	5	1	8

Continued

Family	Species	Location	Months	M	F	J	Total
	Tmarus sp.	2,7,15,16,17,29, 49,51	III,IV,X,XI,XII	2		13	15
	Xysticus sp.	9,17,30,34,35,36,38, 44,49,51	III,VI,VII,VIII		3	18	21
	Xysticus abditus Logunov	49	V		1		1
	Xysticus cribratus Simon	11,36	VII, XII	1	2		3
	Xysticus kempeleni Thorell	27	IV		1		1
	Xysticus kochi Thorell	24,56	VII,XI	3		1	4
	Xysticus ninnii Thorell	8,36	X,XII		3		3
Tetragnathidae	*Pachygnatha degeeri* Sundevall	11,22	XII	1	2		3
	Pachygnatha sp.	30,53	XI			3	3
	Tetragnatha montana Simon	7,22,24,27,29	IV,V,VI,VII,XII	9	1		10
	Tetragnatha obtusa C.L. Koch	8	VI	1			1
	Tetragnatha striata L. Koch	5	VII	1			1
	Tetragnatha sp.	5,8,15,24,26,36, 38,49	III,IV,V,VI,	2	8	16	26
Uluboridae	*Uloborus plumipes* Lucas	8	IV		1		1
	Uloborus walckenaerius Latreille	15,29	VI,XI	2			2
	Uloborus sp.	22	VIII			1	1
	Hyptiotes sp.	45	X		2	2	4
Zodariidae	*Zodarion* sp.	37	VI			1	1
Total				102	254	699	1055

M, male; F, female; J, juvenile.

The spiders were one of the most abundant predators and had an important role in olive pest control (Viggiane, 1977). Thaler and Zapparoli (1993) reported that 70 species were found belonging to eight families with the common families being Linyphiidae, Lycosidae, Dysderidae, Gnaphosidae and Theridiidae in Italian olive groves. In another study, Gnaphosidae was mainly collected by cardboard bands, was the family clearly dominant in the three olive groves; it was followed by Zodariidae, collected exclusively by pitfall traps in olive groves of Italy (Loverre *et al.*, 2011). In Salticidae and Philodromidae were the most abundant spider families in olive groves of Spain, and these most frequently caught species were followed by *Salticus* sp., *Icius hamatus* and *Philodromus* sp. that were the main predators on egg and larvae of *Prays oleae* (Bernard) (Lep.: Praydidae) (Morris *et al.*, 1999). Additionally, four families (Thomisidae, Oxyopidae, Salticidae and Theridiidae) comprised more than 83% of the specimens captured, of which Thomisidae and Salticidae declined in abundance between organic and conventional management, whereas the family Oxyopidae was favoured as management disturbance increased on olive trees in Spain (Cardenas *et al.*, 2006). The most abundant group of predators was the order of Araneae in a Spanish olive grove (Pascual *et al.*, 2010). Spiders contributed 42.8% to predators of olive pests. Four spider species: *Frontinellina fruntetorum* (C.L. Koch) (Linyphidae), *Thyene imperialis* (Rossil), *Salticusscenicus* sp. (Clerk) (Salticidae) and *Thomisus onustus*, Walkenaer, (Thomisidae) were determined as the dominant species in olive (Ghavami, 2006). Forty-five species and genera of spiders were identified; most species belonged to the families Linypidae, Oxyopidae, Dictynidae and Scytodidae and most of the species belonged to Araneidae and the least number of species belonged to Linphiidae in olive groves in Iran (Ghavami *et al.*, 2007). Most of the spider populations in European and American olive groves belong to the family of Linyphiidae (Nieuwenhuys, 2010). Both Thomisidae and Salticidae were found as the most abundant families according to the richness of species in our study. Thomisids which are mainly active during the daytime prey on a variety of small invertebrate pest species and may play an important role in the natural control of pests such as aphids, red spider mites and trips (Bogya, 1999). Salticids fed on a variety of pest species such as trips, midges, mites and flies (Bogya, 1999; Carroll, 1980; Dippenaar-Schoeman, 1998).

The any stage spiders prey with olive pests as well as other insects. Spiders are numerous and possibly important components of the predator complex in olive groves. One of the important highlights of this study is that it is the most imperative research on olive groves conducted in seven provinces. Furthermore, this study is the main research to provide a data for future studies in this area. More studies are needed to allow a comparison to the spider fauna of olive groves in other regions of Turkey.

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