Türk. entomol. derg., 2007, **31** (2): 83-95
ISSN 1010-6960

The diversity and abundance of mites in agrochemical-free and conventional deciduous fruit orchards of Bursa, Turkey*

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Summary

A survey was conducted in Bursa, during 2003-2004 to evaluate the impact of conventional growing on the mite diversity and abundance in 6 deciduous fruit trees, apple, pear, peach, plum, quince and cherry. In this aim, the differences between conventional and agrochemical-free sites were observed. Additionally, an evaluation was performed in terms of mite species diversity and abundance among deciduous fruit tree species in this study. As a result of this study, pear, cherry, quince and peach were less preferred than apple and plum, respectively, for mite colonization and diversity. Among a total of 36 species, in conventional sites, ***Panonychus ulmi*** (Koch) (Acari: Tetranychidae), ***Tetranychus urticae*** Koch (Acari: Tetranychidae) and ***Typhlodromus athiasae*** P. & S. (Acari: Phytoseiidae) and, in agrochemical-free sites, ***Amblyseius potentillae*** (Garman) (Acari: Phytoseiidae), ***Bryobia rubrioculus*** (Scheuten) (Acari: Tetranychidae), ***Amphitetranychus viennensis*** (Z.) (Acari: Tetranychidae) and ***Tydeus californicus*** (Banks) (Acari: Tydeidae) were predominant species and formed more than 66% of the mite specimens collected during two-years. The mite abundance did not significantly differ between conventional and agrochemical-free sites, despite the less species diversity in conventional sites. This suggests that the predatory and neutral fauna may be more affected by agrochemicals than spider mites, such as ***P. ulmi***, ***T. urticae***, and a phytoseiid mite, ***T. athiasae***. On the other hand, this study demonstrated that the mite diversity in conventional sites was decreased by agricultural practices as the high number of unique species was found. Furthermore, based on Sorenson similarity index, the analysis of species similarity brought up that the species composition was quite changed by human activity in conventional sites.

Key words: Mites, deciduous fruit trees, species diversity, species richness.

Anahtar sözcükler: Akarlar, ılıman iklim meyve ağaçları, tür çeşitliliği, tür zenginliği.

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* This study was supported by TUBITAK (The number of Project: TOGTAG-3164 and is part of a PhD thesis

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Alınış (Received): 20.11.2007

Introduction

Bursa has soil and climate conditions suitable for the growing of deciduous fruit trees such as apple, pear, peach, quince, cherry and plum. The deciduous fruit trees are hosts to extensive and diverse mite faunas; as long-term perennial plants they provide stable ecological habitats. Rasmy et al. (1972) recorded over 44 mite species in agrochemical-free deciduous fruit trees in Egypt. Applications of broad-spectrum insecticides, such as organochlorine, organophosphates, carbamate or pyrethroid pesticides, against some fruit moths, aphids and spider mites in conventional orchards, have a profound impact on the range and relative abundance of mites on the trees. The application of these pesticides, and to some extend also fungicides, has contributed to the spider mite problem on deciduous fruit trees by suppressing natural enemies and increasing the abundance of food. Most mite species are highly sensitive to insecticides and are virtually eliminated by a single application (Van de Vrie, 1985; Solomon et al. 2000). However, others (especially those with cryptic habits or those that are dispersive, have alternative hosts, or have developed insecticide-resistant strains) thrive as important pests including ***Panonychus ulmi*** (Koch) (Acari: Tetranychidae) (European spider mite) and ***Tetranychus urticae*** Koch (Acari: Tetranychidae) (Two spotted spider mite) (Solomon et al., 2000; Kumral & Kovanci, 2007). Eventually, the indiscriminate use of pesticides disrupts the ecological balance and enables pests to increase in economically damaging levels.

Several studies have reported that the diversity, population fluctuation and abundance of mites on deciduous fruit trees, especially apple, pear, cherry and peach (Rasmy et al., 1972; Zaher et al., 1974; Castagnoli et al, 1985; Zaki, 1992; Villaronga et al., 1993; Çobanoğlu & Kazmierski, 1999; Kishimoto, 2002; Barbosa et al., 2003; Rodriguez-Navarro et al., 2003; Kasap et al., 2004; Yanar & Ecevit, 2004, 2005). But, the available information related to the diversity and abundance of mites on apple, pear, peach, quince, cherry and plum tress in Bursa province is limited. Only the survey study is the determination of phytoseiid species on apple orchards of Bursa (Çobanoğlu, 1993). Moreover, there is no study about comparing diversity and abundance of mites on the six plant species.

The aims proposed for this work were to compare the diversities and abundances of mites found in deciduous fruit trees in conventional orchards where chemical fertilizers and pesticides were excessively used, and in agrochemical-free orchards of Bursa in two consecutive years (2003-2004) using monthly samplings.

Material and Method

Sampling sites and plant species

This study was conducted in six conventional sites, Ağaköy (AK), Arabayatağı (AY), Çeltik (ÇE), Dudaklı (DU), Hasanköy (HS) and İznik (İZ) and six agrochemical-free sites, Yenice (YE), Görükle (GO), Epçeler (EP), Osmaniye (OS), Hüseyinalan (HU) and Göynükbelen (GB), in six districts, Gürsu, Osmangazi, Nilüfer, Kestel, Orhaneli and İznik, located at Bursa northwestern Turkey. For survey studies, six deciduous fruit orchards (0.1-ha plots), apple ***Malus communis*** L., pear ***Pyrus communis*** L., peach ***Prunus persica***, plum ***Prunus domestica*** L., quince ***Cydonia oblonga*** Miller. and cherry ***Prunus avium*** L., were selected from each site. Conventional sites are located at 90-150 m above sea level in Bursa Plain. The sites in terms of climate, vegetation, physiographic, soil type and other microclimatic parameters were very similar. They intensively sprayed with pesticides and fertilized with synthetic manures. The natural vegetation around the sites was mostly destroyed. The agrochemical-free sites are distributed at altitudes of 100 to 250 m on Bursa Plain and the northern and southern foothills of Mount Uludag. The deciduous fruit orchards of the agrochemical-free sites were grown without agricultural practices such as spraying, fertilizing, plowing etc. Although there are natural vegetation variations due to a great diversity among sites, climatically conditions and soil type are similar in these sites.

Mite survey

Ten deciduous fruit trees were selected randomly in each orchard from above mentioned sites. The twenty twigs, each containing 5 leaves, collected monthly at random from two direction and two heights of 1 and 1.8 m of each tree early May to early October for two consecutive years (2003-2004). After collection, the samples were examined directly under a binocular microscope or extracted in Berlese funnels. The slides of mites were made according to Gutierrez (1985). Species identifications were confirmed by Prof. Dr. S. Çobanoğlu (Department of Plant Protection, Ankara University, Turkey); Prof. Dr. M. Khanjani (Department of Plant Protection, University of Bu-Ali Sina, Iran) and Prof. Dr. A. Saboori (Department of Plant Protection, Tahran University, Iran).

Statistical analysis

The statistical variation in mite abundance between plant species were analyzed using a one-way analysis of variance (ANOVA), following a mean separation a Student-Newman-Keuls test (SAS Institute, 2002). Estimation of species richness was computed by Chao method of Colwell (2005). The Sørensen Similarity Indexes (L) of twelve sampling sites were compared, using the equation given by Chao et al. (2005):

$$L = 2S_{12}/S_1 + S_2$$

Where S_1 is number of species in site 1, S_2 is number of species in site 2 and, S_{12} is number of shared species in site 1 and 2.

Results

In total, 36 different mite species, a total of 2032 individuals, were collected from conventional and agrochemical-free orchards of deciduous fruit trees during two consecutive seasons. Collected species from six deciduous fruit trees and their abundances are given in Table 1. Thirty-six species from sixteen families found, of which twenty-one belong to Phytoseiidae, Bdellidae, Cunaxidae, Tydeidae [only one species, ***Pronematus ubiquitus*** (McGregor)], Cheyletidae, Stigmaeidae, Anystidae and Erythraeidae were predatory and eight belong to Tetranychidae, Tenuipalpidae and Eriophyidae were phytophagous. The food habits of the seven remaining species belong to Machrochelidae, Ascidae, Laelapidae, Tydeidae, Tarsonemidae and Acaridae were identified as neutral fauna. Among all families, Phytoseiidae and Tetranychidae had the greatest richness (six and eleven species, respectively) and abundant (47.61% and 23.21%, respectively). Thus, ***Amblyseius bicaudus*** Wainstein (Acari: Phytoseiidae), ***Typhlodromus athiasae*** P. & S. (Acari: Phytoseiidae), ***Amblyseius potentillae*** (Garman) (Acari: Phytoseiidae), ***Euseius finlandicus*** (Oudemans) (Acari: Phytoseiidae), ***Bryobia rubrioculus*** (Scheuten), ***P. ulmi***, ***T. urticae*** and ***Amphitetranychus viennensis*** (Z.) (Acari: Tetranychidae) were the most abundant species belong to the two families.

The mean number of mite collected differed significantly among the deciduous fruit trees ($F_{5,151} = 4.54$; $p = 0.001$). Overall for two seasons, the mean number of individuals collected was significantly higher from trees of apple (36.97%) and followed by trees of plum (23.52%) (Table 1). Similarly, the species richness was higher on leaves and foliages of apple and plum (26 species and 27 species, respectively) than for the other deciduous fruit trees.

The species richness and abundance of mites in respect to site differences is shown separately for conventional orchards and agrochemical-free orchards in Figure 1. The species richness in many agrochemical-free apple, pear, cherry and plum orchards were higher than those of conventional orchards (Figure 1). However, figures also indicated that species richness of conventional orchards of apple and plum trees lower than those of agrochemical-free orchards. But there was no difference between conventional and agrochemical-free orchards of quince and peach. In addition, Figure 1 pointed out that there were not differences between conventional and agrochemical-free sites in terms of sample abundance indicating that the populations of certain mite species in conventional orchards were significantly more abundant compared to those in agrochemical-free orchards, despite of the less species diversity. These mite species were, a predator mite, ***T. athiasae*** (9.5% abundance) and two phyto-phytophagous mite, ***P. ulmi*** (11.1% abundance) and ***T. urticae*** (15.5% abundance) (Table 1). In addition, the species diversity of conventional sites changed compared to agrochemical-free sites. For example, the dominant species of agrochemical-free sites, ***E. finlandicus***, ***A. viennensis***, ***B. rubrioculus***, ***Cenopalpus pulcher*** (Can.&Fan.) and ***Tydeus californicus*** (Banks), were rarely found in conventional sites (Table 1).

Table 1. Numerical summary of mite species collected among different deciduous fruit trees and locations during the 2003-2004 growing season

Family	Species	Species abundance (%)													
		Apple		Pear		Cherry		Plum		Quince		Peach		All plant species	
		AS	CS	AS	CS	AS	CS	AS	CS	AS	CS	AS	CS	AS	CS
Phytoseiidae	*Euseius finlandicus* (Oudemans)	0.29	0.00	0.00	0.00	1.27	0.44	1.03	0.15	0.05	0.05	0.05	0.10	2.69	0.73
	Kampimodromus aberrans (Oud.)	0.68	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.49	0.00	0.00	0.00	1.27	0.00
	Amblyseius bicaudus Wainstein	0.20	0.73	0.00	0.00	0.05	0.24	0.00	0.20	0.00	0.10	0.00	0.78	0.24	2.05
	Amblyseius potentillae (Garman)	1.71	0.05	0.05	0.00	0.00	0.00	0.68	0.00	0.59	0.00	0.10	0.00	3.13	0.05
	Paraseiulus triporus (Ch. &Yos.)	0.00	0.00	0.00	0.00	0.05	0.00	0.20	0.00	0.00	0.00	0.10	0.00	0.34	0.00
	Anthoseius recki (Wainstein)	0.98	0.05	0.10	0.00	0.15	0.05	0.20	0.00	0.20	0.00	0.00	0.00	1.61	0.10
	Phytoseius plumifer (Can.&Fan.)	0.00	0.20	0.10	0.00	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.29	0.20
	Phytoseius echinus Wain.& Ar.	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.39	0.00
	Typhlodromus athiasae P.&S.	0.98	2.05	0.15	0.24	0.00	0.73	0.59	1.47	0.15	2.00	0.00	0.98	1.86	7.48
	Typhlodromus tiliae Oud.	0.20	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00
	Typhloctonus tiliarum Muma	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.39	0.00
Macrochelidae	*Macrocheles penicilliger* (Berlese)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.10	0.00
Ascidae	*Arctoseius semiscissus* (Berlese)	0.10	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00
Laelapidae	*Hypoaspis laevis* (Micheal)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.10
Bdellidae	*Spinibdella* sp.	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.39	0.00
Cunaxidae	*Cunaxa setirostris* (Hermann)	0.20	0.00	0.05	0.00	0.00	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.44	0.00
Tydeidae	*Tydeus californicus* (Banks)	2.40	0.15	0.54	0.00	2.10	0.00	1.91	0.15	0.00	0.10	0.29	0.29	7.24	0.68
	Tydeus caudatus (Dugés)	0.20	0.00	0.10	0.00	0.24	0.00	0.78	0.00	0.10	0.00	0.00	0.00	1.42	0.00
	Pronematus ubiquitus (McGregor)	0.05	0.05	0.00	0.00	0.15	0.00	0.29	0.20	0.10	0.39	0.00	0.10	0.59	0.73
Cheyletidae	*Cheletogenes ornatus* (Can&Fan.)	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.10	0.10
Tetranychidae	*Bryobia rubrioculus* (Scheuten)	2.64	0.00	0.10	0.00	1.37	0.00	2.00	0.05	0.00	0.00	0.00	0.00	6.11	0.05
	Panonychus ulmi (Koch)	1.47	6.65	0.15	1.37	0.05	0.00	0.10	0.00	0.78	0.29	0.00	0.29	2.54	8.61
	Eotetranychus pruni (Oudemans)	0.00	0.00	0.00	0.00	0.00	0.00	0.78	0.00	0.00	0.00	0.00	0.00	0.78	0.00
	Tetranychus atlanticus McGregor	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.05	0.00	0.00	0.00	0.00	0.24	0.05
	Tetranychus urticae Koch	0.73	2.00	0.24	2.69	0.73	1.42	1.61	3.96	0.00	0.29	0.49	1.56	3.81	11.93
	Amphitetranychus viennensis (Z.)	2.84	1.17	1.08	0.10	3.28	0.29	3.28	0.88	0.15	0.05	0.39	0.00	11.00	2.49
Tenuipalpidae	*Cenopalpus pulcher* (Can.&Fan.)	3.13	0.10	0.10	0.10	0.34	0.00	0.10	0.00	1.66	0.00	0.00	0.00	5.33	0.20
Stigmaeidae	*Zetzellia mali* (Ewing)	2.20	0.44	0.10	0.05	0.00	0.05	0.44	0.05	0.44	0.15	0.00	0.00	3.18	0.73
Anystidae	*Anystis* sp.	0.00	0.00	0.00	0.00	0.15	0.00	0.10	0.00	0.10	0.00	0.00	0.00	0.34	0.00
Erythraeidae	*Abrolophus* sp.	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15
	Balaustium sp.	0.39	0.00	0.44	0.00	0.20	0.00	0.00	0.00	0.00	0.05	0.00	0.00	1.03	0.05
	Allothrombium sp.	0.00	0.00	0.05	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.15	0.00
	Erythraeus sp.	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Tarsonemidae	*Tarsonemus sp.*	0.73	0.05	0.44	0.00	0.54	0.00	0.59	0.00	0.20	0.10	0.05	0.20	2.54	0.34
Eriophyidae	*Aculus schlectendali* (Nalepa)	0.49	0.00	0.68	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	1.17	0.73
Acaridae	*Tyrophagous purescentiae* (Sch.)	0.20	0.00	0.10	0.00	0.05	0.15	0.20	0.10	0.15	0.05	0.10	0.10	0.78	0.39
	All mite species	23.28	13.69	4.55	4.79	10.95	3.52	16.28	7.24	5.33	3.81	1.66	4.89	62.05	37.95

AS, Agrochemical-free sites; CS, Conventional sites

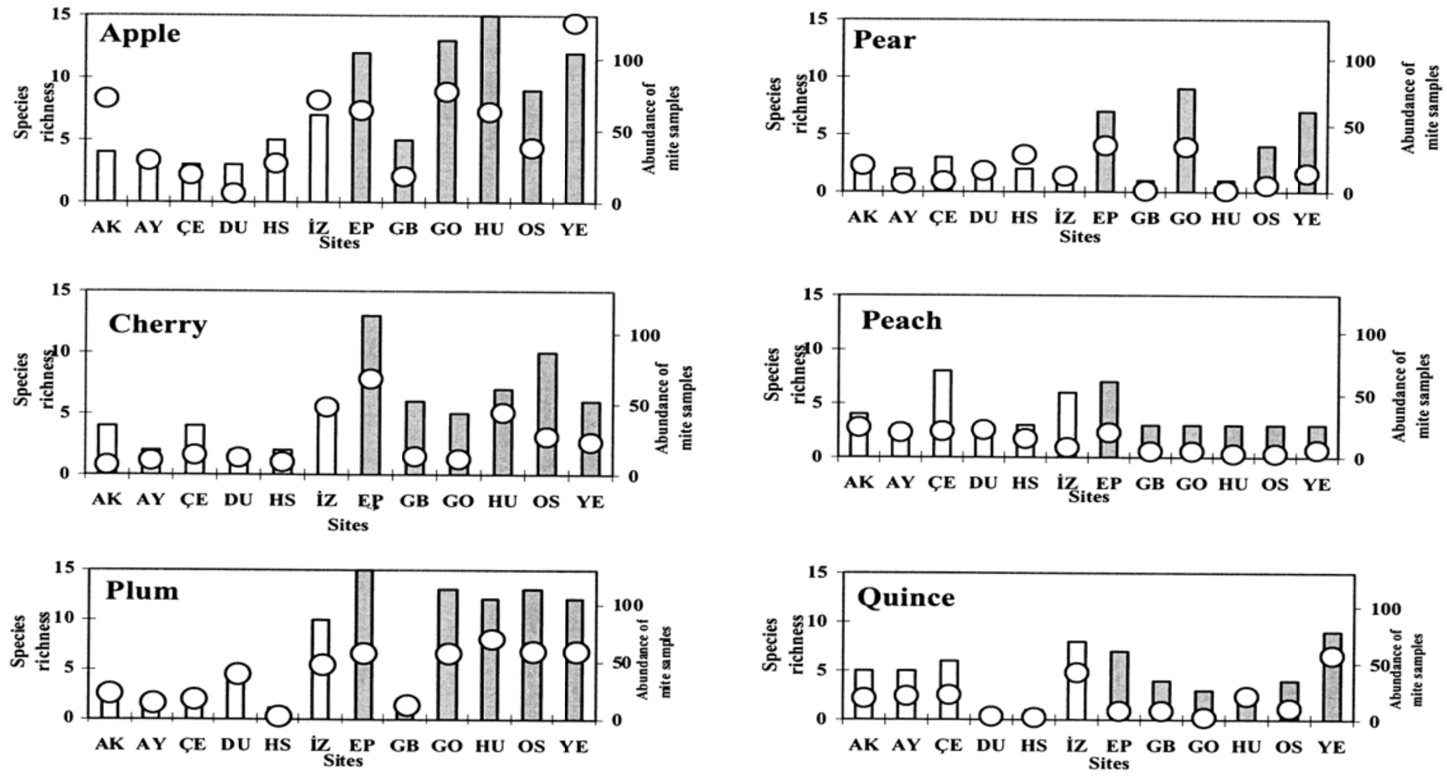

Figure 1. The white dots represent the abundance of mite samples, white and grey bars represent the species richness collected from conventional and agrochemical - free sites, respectively, apple, pear, plum, cherry, peach, quince orchards during 2003-2004 years.

Chao's species richness analysis and the observed number of species indicated that there were plenty of species in agrochemical-free sites compared with conventional sites (Table 2). Furthermore, the analysis showed that the number of unique species in conventional sites quince was (9) followed by apple (6), plum and peach (5), pear (4) and cherry (3). This result pointed out that it was found less species in conventional sites than that of agrochemical-free sites and many of them are unique species, in other words, the number of individuals of these mite species were 1 or 2 samples. Considering all deciduous trees, the total mite fauna in conventional sites were determined 43% less than that in agrochemical-free sites and unique species occurred 20% of total fauna of conventional sites (Table 2).

Table 2. Result obtained from Chao's estimation for species richness of each tree and all plants

Analysis	Sites	Observed number of species	Estimated species richness	SD of species richness	95% confidence	Number of unique species
Apple	AS	25	26.56	2.09	25.21 – 36.41	5
	CS	13	16.00	4.18	13.39 – 35.99	6
Pear	AS	18	18.37	0.82	18.02 – 23.08	8
	CS	7	9.79	3.88	7.35 – 28.41	4
Cherry	AS	18	23.00	7.22	17.93 – 55.37	7
	CS	9	9.88	1.64	9.08 – 18.71	3
Plum	AS	26	28.93	2.95	26.57 – 41.13	8
	CS	11	12.88	2.45	11.26 – 24.29	5
Quince	AS	16	16.00	0.08	16.00 – 16.27	6
	CS	14	15.00	1.58	14.11 – 22.96	9
Peach	AS	9	9.20	0.62	9.00 – 13.07	6
	CS	10	10.00	0.02	10.00 – 10.04	5
All plants	AS	33	34.04	1.50	33.13 – 41.35	5
	CS	21	21.80	1.33	21.08 – 28.63	4

AS, Agrochemical-free sites; CS, Conventional sites

The similarity index suggested that except for İZ site, conventional sites only weakly resembled to the agrochemical-free sites in terms of mite diversity (Table 3). Although there were medium few similarity in distribution of mite fauna, similarity among conventional and agrochemical-free sites generally ranged from 0.08 to 0.59. In addition, strong and medium relations among agrochemical-free sites were found (0.59-0.78). Similarly, conventional sites were exhibited medium and strong similarities in distribution of mite fauna (0.50-0.78) except for four relations between conventional sites (İZ/AY, AK/ÇE, DU/AY, AY/ÇE).

Table 3. Species similarity index between agrochemical-free and conventional sites across all deciduous trees using Sørenson's similarity index

	Sites	AS						CS					
		YE	GO	HU	OS	EP	GU	İZ	AK	DU	ÇE	HS	AY
AS	YE	1.00											
	GO	0.78	1.00										
	HU	0.73	0.74	1.00									
	OS	0.77	0.63	0.73	1.00								
	EP	0.72	0.59	0.86	0.78	1.00							
	GU	0.75	0.59	0.60	0.63	0.63	1.00						
CS	İZ	0.79	0.63	0.58	0.67	0.50	0.62	1.00					
	AK	0.48	0.52	0.35	0.35	0.25	0.56	0.62	1.00				
	DU	0.59	0.55	0.50	0.52	0.40	0.61	0.64	0.50	1.00			
	ÇE	0.56	0.59	0.54	0.50	0.40	0.50	0.78	0.42	0.56	1.00		
	HS	0.56	0.52	0.47	0.48	0.36	0.48	0.74	0.56	0.53	0.57	1.00	
	AY	0.27	0.25	0.22	0.18	0.08	0.44	0.42	0.53	0.46	0.44	0.55	1.00

AS, Agrochemical-free sites; CS, Conventional sites

Discussion

Our results showed that the mite diversity and abundance varied among deciduous fruit tree species. Pear, cherry, quince and peach were the least preferred plants for mites, respectively. It is difficult to tell why species richness and abundance of certain species differed between host plants. This may be related to host plant selection by phytophagous species. Each phytophagous species does not accept all plants to the same degree, because of the plant's nutritional value, physical characteristics (thick cuticle, leaf trichome density, glandular and non-glandular hairs) and the quantity and nature of secondary metabolites which may function as toxins, deterrents and digestibility reducers to herbivores (Sabelis et al. 1999; Van Den Boom 2003). Predator fauna, especially some phytoseiid species, ***A. bicaudus***, ***A. potentillae***, ***T. athiasae*** and ***E. finlandicus***, were also commonly found on each host plant species in our study. This may be a result of predator species, which are a diet generalist or diet specialist. Several authors have reported that many phytoseiid mite species of the genara ***Thyphlodromus***, ***Amblyseius*** and ***Euseius*** are classified as diet generalists (Overmeer, 1985; Schausberger & Croft, 2000; Toyoshima & Amano, 2006). The species of the genera prey on eriophyid mites, tydeid mites and tarsonemid mites as well as tetranychid mites and also reproduce well when it feeds on pollen and the spores and hyphae of the powdery mildew. Furthermore, some plant species offer shelter as well as alternative food to predators and thus create an enemy dense environment, while other plants constitute a relatively more enemy free space (Van Den Boom, 2003). Among the species belong to neutral fauna, ***Tydeus*** spp., ***Tarsonemus*** sp. (Acari: Tarsonemidae) and ***Tyrophagous putrescentiae*** (Sch.) (Acari: Acaridae) were found as very common on deciduous fruit trees in this study. Many authors reported that abundances of these species are related to food resources such as Homoptrean honeydew and resultant sootymold fungi, on other epiphytes, pollen and the various debris of plant (Hughes, 1976; Liguori et al., 2002).

In this study, ***T. urticae***, ***P. ulmi*** and ***T. athiasae*** were the predominant species on deciduous fruit trees and abundantly collected from conventional sites compared with agrochemical-free sites throughout the two seasons. Yet, ***E. finlandicus***, ***A. viennensis***, ***B. rubrioculus***, ***C. pulcher*** and ***T. californicus*** were the dominant species in the agrochemical-free sites. Empirical observations by acarologists and growers strongly suggest that the economically important mite species on some deciduous fruit trees have been shifting for about 40 years: ***A. viennensis*** and ***B. rubrioculus***, which were dominant until 1960s, were replaced by other species such as ***T. urticae***, and ***P. ulmi*** (Kishimoto, 2002). Mite pests on deciduous fruit trees may be considered as man-made pests as a result of cultural practice. Although this shift in species composition is thought to be caused by several factors such as the introduction of fertilizers, pruning and irrigation systems which have stimulated abundance of tetranychid mite populations, changes in the pesticide spray program most likely to be the main reason. Increased use of pesticides, not only insecticides but also some fungicides, has been shown to change species composition, decrease species diversity, and have caused out breaks of tetranychid mites (Van De Vrie, 1985; Kishimoto, 2002). Similar to our results, many authors from different regions reported that ***T. urticae*** and ***P. ulmi*** had dominated in the complex of tetranychid mites on the deciduous fruit trees, when pesticides were applied intensively during a period (Van De Vrie, 1985; Solomon et al., 2000; Kishimoto, 2002; Manko & Vlasova, 2003). Furthermore, many studies have shown that ***T. urticae*** and ***P. ulmi*** possess the ability to rapidly develop resistance to various pesticides (Van De Vrie, 1985; Song et al., 1995; Nauen et al., 2001; Kumral & Kovanci, 2007). On the other hand, this study demonstrated that the dominant phytoseiid species, changed with agricultural practices e.g. ***T. athiasae*** and ***A. bicaudus*** have replaced ***E. finlandicus*** and ***A. potentillae***. This probably was a result of combination of the 2 main reasons: (1) Pesticide resistance and (2) Diet generalist predators. Many current results concerning resistance phytoseiid mites, particularly ***Typhlodromus*** and ***Amblyseius*** species, are found to be similar to those observed in tetranychid mites, despite the pesticide resistance can rarely be observed in predators (Fournier et al., 1985; Auger et al., 2005; Bonafos et al., 2005; Khan et al., 2005). The diet generalist phytoseiid mites can survivor dispersing alternative food sources such as reservoirs (ground cover and edge plants) in the surrounding areas or feeding on other alternative foods such as different mites, pollens, spores and hyphaes on same plant, when the density of tetranychids is low (Overmeer, 1985; Solomon et al., 2000; Van Den Boom, 2003).

In this study, the high number of unique species and the low observed number of species in conventional sites were pointed to been eliminated of some species by effecting agricultural practices. The applications of pesticides have contributed to the tetranychid mite problem on deciduous fruit trees, especially apple, plum, pear and cherry, by suppressing predator species and increasing the abundance of food for tetranychid species (Van De Vrie, 1985; Kreiter et al., 2000). Although mite predators of the families Bdellidae, Cheyletidae, Cunaxidae, Erythraeidae, Stigmaeidae and Anystidae are relatively important controlling agents of carnivore mites on fruit trees (Solomon et al., 2000), we observed a few individuals of these natural enemies. However, there is no evidence about the development of resistance or tolerance to pesticides in these predaceous mites (Cranham & Helle, 1985). Consequently, predaceous species which are highly sensitive to pesticides were virtually eliminated by frequently applications. Additionally, the reservoir plants have been destroyed effect by weed control and monoculture growing that has been the reducing factor of mite diversity (Shimoda & Takabayashi, 2001; Gyorffy, 2006). These activates have inhibited predator movement from the reservoirs into the orchard due to the phytoseiid mites in the orchards may partially come from the reservoirs (Gyorffy, 2006; Toyoshima & Amano, 2006).

Analysis of mite species similarity based on Sorenson quantitative index, showed that there were lower or non- similarity between conventional and agrochemical-free sites. Moreover, the strongly similarity among conventional sites indicated that some species, which are highly adapted to agricultural practices and toxic chemical compounds, were commonly found. There were some unexpected results in conventional sites, probably due to ecological differences in the experimental sites or varying exposure levels to pesticides. Similarly, the environmental factors such as the altitude, the natural vegetation in the surrounding area and non-homogeneous experimental sites in terms of vegetation patterns of deciduous fruit tree species, may have influenced similarity among conventional or agrochemical-free sites (Toyoshima & Amano, 2006).

In conclusion, increasing phytophagous mite populations and decreasing mite diversity on deciduous fruit trees, especially apple, pear, plum and cherry which were extensively sprayed, are obvious showed in this study. The unconscious use of agrochemicals, particularly pesticides, had negative impact on mite diversity and abundance of predator species, besides promoting resistance of spider mites to these compounds in Bursa (Kumral & Kovancı, 2007).

Acknowledgements

This study was funded by The Scientific and Technical Research Council of Turkey - TUBITAK (Projects Grant No.TOGTAG-3164). We are grateful to Prof. Dr. S. Çobanoğlu, Department of Plant Protection, Ankara University, Turkey; Prof. Dr. M. Khanjani, Department of Plant Protection, University of Bu-Ali Sina, Iran; Prof. Dr. A. Saboori, Department of Plant Protection, Tahran University, Iran for identification of mite fauna.

Özet

Bursa (Türkiye)'nın konvansiyonel ve zirai kimyasal kullanılmayan ılıman iklim meyve bahçelerindeki akarların çeşitliliği ve zenginliği

Bursa'da elma, armut, şeftali, erik, ayva ve kiraz olmak üzere 6 ılıman iklim meyve ağacındaki akar çeşitliliği ve bolluğuna konvansiyonel yetiştiriciliğin etkisini değerlendirmek için 2003 ve 2004 yılları boyunca bir sürvey çalışması yürütülmüştür. Bu amaçla, konvansiyonel yetiştiricilik yapılan alanlar ve zirai kimyasallar kullanılmayan yani kendi halindeki alanlar arasındaki farklılıklar saptanmıştır. Ayrıca bu çalışmada ılıman iklim meyve ağacı türleri arasındaki akar tür çeşitliliği ve bolluğu açısından bir değerlendirme yapılmıştır. Sonuç olarak, armut, kiraz, ayva ve şeftali akar bolluğu ve çeşitliliği bakımından sırasıyla elma ve eriğe göre daha az tercih edilmişlerdir. Saptanan 36 tür arasından, ***Panonychus ulmi*** (Koch) (Acari: Tetranychidae), ***Tetranychus urticae*** Koch (Acari: Tetranychidae) ve ***Typhlodromus athiasae*** P.&S. (Acari: Phytoseiidae) konvansiyonel bahçelerde; ***Amblyseius potentillae*** (Garman) (Acari: Phytoseiidae), ***Bryobia rubrioculus*** (Scheuten) (Acari: Tetranychidae), ***Amphitetranychus viennensis*** (Z.) (Acari: Tetranychidae) ve ***Tydeus californicus*** (Banks) (Acari: Tydeidae) kimyasal kullanılmayan bahçelerde baskın türler olarak tespit edilmiştir ve iki yıl boyunca toplanan akar örneklerinin %66'dan fazlasını oluşturmuşlardır. Konvansiyonel bahçelerde daha az tür çeşitliliği olmasına rağmen, akar bolluğu açısından kimyasal kullanılmayan bahçelerle aralarındaki farklılık önemli değildir. Bu, predatör ve neutral faunanın tarım kimyasallarından ***P. ulmi*** ve ***T. urticae*** gibi kırmızıörümcekler ve phytoseiid akar ***T. athiasae***'ye göre daha fazla etkilenmiş olabileceğini akla getirmiştir. Diğer taraftan, bu çalışma konvansiyonel bahçelerde yüksek sayıda eşsiz tür bulunması, buralarda zirai uygulamalardan dolayı akar çeşitliliğinin azaldığını göstermiştir. Daha da fazlası, Sorenson benzerlik indeksine göre tür benzerliği analizi konvansiyonel bahçelerde insan aktiviteleri sonucunda akar tür çeşitliliğinin oldukça değiştiğini ortaya koymuştur.

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