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Determination of Pest Insect Species at Pomegranate (*Punica granatum* L.) Orchards in Adıyaman and Siirt Provinces, Turkey

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ABSTRACT

This study was carried out in order to determine the insect pest species found at the orchards of Adıyaman and Siirt provinces. The studies were carried out in the Şirvan district of Siirt and Adıyaman's the Central, Kahta and Samsat districts, where pomegranate production is intensively carried out through the years of 2017 and 2018. Samplings was carried out at the pomegranate orchards at least two weeks interval between April and October. Visual control, knock and insect rearing methods were used to obtain the insect species. According to the results from the study; a total of 42 insect species were obtained from the orders of Orthoptera (1), Thysanoptera (9), Hemiptera (18), Coleoptera (8) Lepidoptera (4) and Diptera (2). Among the identified pest species, *Aphis punicae* Passerini (Hemiptera: Aphididae) and *Apomyelois ceratoniae* Zeller (Lepidoptera: Pyralidae) were determined as the main pest species. *Dioryctria simplicella* Heinemann (Lepidoptera: Pyralidae), *Arcyophora dentula* Lederer (Lepidoptera: Nolidae), *Chrysobothris affinis* (F.), *Acmaeodera wethloi* Obenberger (Coleoptera: Buprestidae) and *Zaprionus indianus* (Gupta) (Diptera: Drosophilidae) were determined for the first time in Turkey's pomegranate production areas.

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Adıyaman ve Siirt İlleri Nar (*Punica granatum* L.) Bahçelerinde Belirlenen Zararlı Böcek Türleri

ÖZET

Bu çalışma, Adıyaman ve Siirt illeri nar üretim alanlarında bulunan zararlı böcek türlerinin belirlenmesi amacıyla yürütülmüştür. Çalışmalar nar üretiminin yoğun bir şekilde yapıldığı Siirt'in Şirvan ilçesi ile Adıyaman'ın Merkez, Kahta ve Samsat ilçelerinde 2017-2018 yıllarında yürütülmüştür. Örneklemeler, Nisan ayı ile ekim ayı arasında tüm örnekleme bölgelerine en az iki haftalık aralıklarla gidilerek gerçekleştirilmiştir. Böcek türlerinin elde edilmesinde gözle kontrol, darbe ve kültüre alma metotları kullanılmıştır. Bu çalışma sonucunda ; Orthoptera takımından 1, Thysanoptera takımından 9, Hemiptera takımından 18, Coleoptera takımından 8, Lepidoptera takımından 4 ve Diptera takımından 2 tür olmak üzere toplamda 42 zararlı böcek türü tespit edilmiştir. Tespit edilen zararlı türlerden, *Aphis punicae* Passerini (Hemiptera: Aphididae) ve *Apomyelois ceratoniae* Zeller (Lepidoptera: Pyralidae) ana zararlı türler olarak belirlenmiştir. *Acmaeodera wethloi* Obenberger (Coleoptera: Buprestidae), *Chrysobothris affinis* (F.) (Coleoptera: Buprestidae), *Arcyophora dentula* Lederer (Lepidoptera: Nolidae), *Dioryctria simplicella* Heinemann (Lepidoptera: Pyralidae), ve *Zaprionus indianus* (Gupta) (Diptera: Drosophilidae) türleri ise Türkiye nar üretim alanlarında ilk kez tespit edilmiştir.

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INTRODUCTION

Although pomegranate is known as a fruit of tropical and subtropical climates, it can also be grown in warm and temperate climates. Pomegranate is consumed fresh as well as used in the food industry as fruit juice, jam and sauce. Due to the growing awareness of healthy nutrition in the world, pomegranate is a preferred fruit type due to its antioxidants, polyphenolic substances and vitamin C content (Zarei et al. 2011; Eyigün 2012).

Official statistics on pomegranate fruit kept regularly by the United Nations Food and Agriculture Organization (FAO) and EUROSTAT are not available. However, when the data of the prominent countries in pomegranate production are examined, it is seen that India, Iran, China and Turkey are the leading countries that produce the most pomegranate production. Besides, Turkey is the most important producer and exporter country in the Middle East after Iran (Kurt and Şahin 2013). According to TurkStat data, Turkey's pomegranate production amount reached 537 847 tons in 2018. 56.53% (304.045 tons) of this production is met in the Mediterranean Region, 30.9% (166.430 tons) in the Aegean Region and 10.69% (57.540 tons) in the Southeastern Anatolia Region. It is seen that among 58 pomegranate cultivation provinces in Turkey, Adıyaman province ranks 10th (10.295 tons) and Siirt province is in 11th (6.788 tons) in terms of production amount (TurkStat, 2020).

The development of extensive pomegranate cultivation in the Southeastern Anatolia Region has not been followed up by adequate strategies of pest control, due to the lack of detailed available data about the pests. The pomegranate has many pest insects which are capable of causing serious crop losses if not well managed (Coccuza et al. 2016).

Pest insects which cause economic losses by inducing various damages on the root, stem, branch, shoot, leaf and flower parts of the plant constitute important problems in pomegranate production areas. In some studies, to determine the pest species in pomegranate production areas in Turkey was indicated that Carob moth [Apomyelois (=Ectomyelois) ceratonia (Zeller) (Lepidoptera: Pyralidae)], Mediterranean fruit fly [Ceratitis capitata (Wied.) (Diptera: Tephritidae)], Pomegranate aphid [Aphis punicae (Passerini) (Hemiptera: Aphididae)], Pomegranate whitefly [Siphoninus phillyreae (Haliday) (Hemiptera: Aleyrodidae)], Citrus mealybug [Planococcus citri (Risso) (Hemiptera: Pseudococcidae)] and Wood

leopard moth [Zeuzera pyrina (L.) (Lepidoptera: Cossidae)] were important pest insects and they caused serious economic losses (Mart and Altın, 1992; Öztop et al., 2002; Öztürk et al., 2005; Öztop et al., 2010; Yıldırım and Başpınar, 2011; Mamay, 2021).

Although studies have been carried out to determine pest species in pomegranate areas of Diyarbakır and Şanlıurfa provinces in the Southeastern Anatolia Region (Mart and Altın, 1992; Mart and Kılınçer, 1993; Mamay and Ünlü, 2013; Mamay et al., 2014a, Mamay et al., 2014b; Mamay et al., 2016; Mamay, 2021), no studies have been carried out within the framework of determining entomological problems in Siirt and Adıyaman. In this paper, the results obtained on the pest species in the pomegranate areas of Adıyaman and Siirt, their distribution areas and types of damage were discussed.

MATERIAL and METHODS

The studies were conducted in the Şirvan district of Siirt, and in the Central, Kahta and Samsat districts of Adıyaman in the years of 2017 and 2018. Sampling was carried out between April and October by visiting all sampling regions at least two weeks interval. The number of sampled trees was not less than 0.1% of the number of trees in study regions (Table 1). The number of trees sampled in the orchards was determined according to Lazarov and Grigorov (1961) (Table 2).

Table 1. Number of trees sampled in the regions

Çizelge 1. Survey alanlarında örneklenen ağaç sayısı			
Province	District	Total number of trees	Number of trees sampled
Adıyaman	Central	262.600	1.341
	Kahta	371.000	1.590
	Samsat	80.100	617
Siirt	Şirvan	116.320	1.986

(TurkStat, 2020)

Rearing method

The rearing method was used to acquire adults of insects which were in the pre-mature life stages. , The insects in pre-mature life stages were placed in appropriate culture containers with the plant parts where they were found in. The samples were placed in a climatic chambers set at 26 ± 1°C temperature , 65 ± 5% humidity and 16: 8 h (light / dark) Photoperiod and nutritional supplements were made in the containers as needed.

Table 2. Number of trees sampled according to the total number of trees in the orchards (Lazarov and Grigorov, 1961)

Çizelge 2. Bahçedeki toplam ağaç sayısına göre örneklenen ağaç sayıları (Lazarov and Grigorov, 1961)

Total number of trees in survey orchard	Number of trees sampled
1-20	All trees
21-70	10-30
71-150	31-40
151-500	41-80
501-1000	%15 of all trees
More than 1000	%5 of all trees

Samples were collected by visual control, knock and rearing methods.

Visual control method

Bud, flower, leaf, shoot, stem and fruit samples were examined visually from four directions of randomly selected trees in the orchards according to the phenology of the tree and the determined insects were taken with hand, forceps or mouth aspirator.

Knock method

The insects were made to fall into the Steiner funnel by striking one branch from each of the four sides of 25 randomly selected trees from each garden. Adult of insects fallen into the Steiner funnel were collected by using mouth aspirator, forceps and soft brush then transferred to killing bottles. The dead insects were placed in petri dishes with the necessary label information and brought to the laboratory for preparation and identification.

RESULTS and DISCUSSION

As a result of the surveys conducted in the pomegranate orchards of Adıyaman and Siirt provinces, 42 pest species belonging to 15 families from 6 orders were obtained. These species and their distribution areas are given in Table 3.

Orthoptera order

Uvarovistia satunini was determined from Tettgoniidae family. The pest was detected only in Şirvan district of Siirt. It was observed that adults and nymphs of the pest directly attacked the flowers and feed greedily. Although the pest has not been reported to cause harm to the pomegranate, İlçin (2015) stated some populations might occur to cause serious economic damages in many agricultural lands. In addition, it was stated that the pest species was detected in the provinces of Muş, Bingöl, Tunceli, Diyarbakır, Batman, Mardin moved as a herd and was harmful to cultivated plants (Doğan, 2014; İlçin, 2015; Ünal, 2018; İlçin et al., 2019)

Thysanoptera order

With this study, *Thrips tabaci*, *T. meridionalis*,

Frankliniella intonsa, *F. occidentalis*, *Neohydathothrips gracilicornis* (Thripidae), *Haplothrips flavitibia*, *H. reuteri* (Phlaeothripidae), *Melanthrips pallidior* and *M. fuscus* (Aeolothripidae) species were determined from Thysanoptera order. The adults and nymphs of the obtained species were observed in the leaves and flowers of the pomegranate. In addition, when the flowers falling on the ground were examined, it was observed thrips species. Mart and Altın (1992), in line with the research findings, stated that thrips species were determined in flowers of pomegranate. Öztıp et al (2002) detected *F. occidentalis* in flowers in pomegranate orchards in Antalya province. Wohlfarter et al (2011) determined thrips species belonging to the families Thripidae, Phlaeothripidae and Aeolothripidae on the leaves, young shoots and flowers in South American pomegranate plantations. Referring to Sheikh (2006), they reported that thrips caused loss of fruit quality due to the damage they cause on flowers.

Hemiptera order

Aphididae family

Two species, *Aphis punicae* and *Brachycaudus helichrysi*, were identified from the Aphididae family.

Brachycaudus helichrysi was seen only in an orchard in Şirvan district and it was not considered to be a significant pest for pomegranate. *Aphis punicae* was detected in all study areas and it was determined that the pest caused to damage with dense populations on leaves, shoots, flowers and fruits. The pest caused fumagine due to the honeydew which occur during feeding. It has been concluded that *A. punicae* is one of the most important pests of pomegranate due to its prevalence, density and the damages which causes on the vegetative and genetic parts of the pomegranate. Yıldırım and Başpınar (2011) was stated that *A. punicae* was a species rarely seen in terms of prevalence and density in Aydın Province, but in other studies conducted in the Mediterranean Region and Southeastern Anatolia, similar to the findings we obtained, was stated that *A. punicae* was one of the important pest species causing yield and quality loss (Mart and Altın, 1992; Öztıp et al., 2002; Öztürk et al., 2005; Mamay 2015). In addition, it has been reported that *A. punicae* caused significant damage to pomegranate in Iran, India, Egypt, Japan, Korea, South Africa and many Mediterranean countries (Ananda et al. 2009; Wohlfarter et al. 2010; Balikai et al. 2011; Sugimoto, 2011; Abd-Ella, 2015; Lee et al., 2015; Cocuzza, 2016).

Aleyrodidae family

Three species belonging to the family Aleyrodidae, *Dialeurolobus rhamni*, *D. pulcher* and *Siphoninus finitimus*, were identified.

Table 3. Pest species identified in pomegranate orchards in Adıyaman and Siirt province and their distribution areas in 2017-2018 years.

Çizelge 3. Adıyaman ve Siirt ili nar bahçelerinde 2017-2018 yıllarında saptanan zararlı türler ve yayılış alanları

Order	Family	Species	Adıyaman			Siirt		
			Central	Kahta	Samsat	Şirvan		
Orthoptera	Tettigoniidae	<i>Uvarovistia satunini</i> (Uvarov)	-	-	-	+		
Thysanoptera	Aeolothripidae	<i>Melanthrips pallidior</i> Priesner	+	-	-	-		
		<i>Melanthrips fuscus</i> (Sulzer)	-	-	+	-		
	Phlaeothripidae	<i>Haplothrips flavitibia</i> Williams	+	+	+	+		
		<i>Haplothrips reuteri</i> Karny	+	+	+	-		
	Thripidae	<i>Thrips tabaci</i> Lindeman	+	+	-	-		
		<i>Thrips meridionalis</i> Priesner	+	-	-	+		
		<i>Frankliniella intonsa</i> (Trybom)	+	+	-	+		
		<i>Frankliniella occidentalis</i> (Pergande)	+	+	+	+		
		<i>Neohydathothrips gracilicornis</i> (Williams)	-	-	-	+		
Hemiptera	Aleyrodidae	<i>*Siphoninus finitimus</i> Silvestri	+	+	+	+		
		<i>Dialeurolobus rhamni</i> Bink-M.	+	+	+	+		
		<i>Dialeurolobus pulcher</i> Dantsig	+	+	+	+		
	Aphididae	<i>*Aphis punicae</i> Passerini	+	+	+	+		
		<i>Brachycaudus helichrysi</i> (Kaltenbach)	-	-	-	+		
	Cicadellidae	<i>Fieberiella gemelina</i> Dlabola	+	+	+	+		
		<i>Euscelis incisus</i> (Kirschbaum)	+	+	+	+		
		<i>Asymmetrasca decedens</i> (Paoli)	+	-	+	-		
		<i>Macrosteles quadripunctulatus</i> (Kirschbaum)	+	-	-	-		
		<i>Anaceratagallia ribauti</i> (Ossiannilsson)	-	-	-	+		
		<i>Eupelix cuspidata</i> (F.)	-	+	-	-		
		<i>Peraglena nervosus</i>	-	-	-	+		
		<i>Zyginidia pullula</i> (Boheman)	-	+	-	-		
		<i>Aphrodes assimilis</i> (Signoret)	-	-	-	+		
		<i>Circulifer haematoceps</i> (Mulsant & Rey)	-	+	-	-		
	Coccidae	<i>Coccus hesperidum</i> L.	+	+	+	+		
		<i>Parthenolecanium corni</i> (Bouché)	-	-	+	+		
	Pseudococcidae	<i>*Planococcus ficus</i> (Signoret)	+	+	+	+		
	Coleoptera	Bostrychidae	<i>Schistocerus bimaculatus</i> (Olivier)	-	-	-	+	
		Buprestidae	<i>Chrysobothris affinis</i> (F.)	-	-	+	-	
			<i>Acmaeodera</i> (s.str.) <i>wethloi</i> Obenberger	-	-	-	+	
		Nitidulidae	<i>Carpophilus nepos</i> Murray	+	+	+	+	
			<i>Carpophilus mutilates</i> Erichson	+	+	-	+	
			<i>Carpophilus hemipterus</i> (L.)	+	+	+	+	
			<i>Urophorus humeralis</i> (F.)	+	+	+	+	
			<i>Carpophilus bifenestratus</i> Murray	+	-	+	+	
		Lepidoptera	Erebidae	<i>Diysonia algira</i> (L.)	+	+	+	+
			Nolidae	<i>Arcyophora dentula</i> Lederer	-	+	-	+
Pyralidae	<i>*Apomyelois ceratoniae</i> (Zeller)		+	+	+	+		
	<i>*Dioryctria simplicella</i> Heinemann		-	-	-	+		
Diptera	Drosophilidae	<i>Drosophila melanogaster</i> Meigen	+	+	+	+		
		<i>Zaprionus indianus</i> (Gupta)	-	-	+	+		

(+): existent, (-): absent, (*): Economically important species

Species belonging to the genus *Dialeurolobus* were generally seen in the lower part of the leaves and rarely in the upper part of the leaf. It was observed that both species could not occur a population in the orchards and cause serious damage. Both species are known to exist in pomegranate areas in Turkey (Öztürk and Ulusoy, 2009). *S. finitimus* individuals were observed only on the lower surface of the leaves and could occur a dense population in some orchards where they were seen. Adults, larvae and pupae of the pest could cover almost completely under the leaf and cause fumagine as a result of intensive feeding. Therefore, *S. finitimus* was detected to be more important than other whitefly species. Öztürk et al. (2005) determined whitefly species as *Acaudaleyrodes rachipora*, *Aleurothrixus floccosus*, *Bemisia argentifolii*, *B. tabaci*, *D. pulcher* and *Siphoninus phillyreae* in the pomegranate areas of the Eastern Mediterranean Region and stated that *S. phillyreae* was among the important pests of pomegranate. Yıldırım and Başpınar (2011) stated that *S. phillyreae* was one of the rare species in their study on pomegranate orchards in Aydın province.

Coccidae family

Pharthenolecanium corni and *Coccus hesperidum* species were determined from Coccidae family. It was observed that *P. corni* was generally seen as one or two individuals on the shoots and branches, *C. hesperidum* was detected rarely on fruit as well as on shoots and branches. Therefore, both pests could not occur an intensive population in the orchards and did not cause an economic damage. Similar to the findings obtained, Öztöp et al. (2002) stated that *C. hesperidum* was among the species detected at low density. In addition, it has been reported that *C. hesperidum* and *P. corni* were detected in some studies conducted in pomegranate areas in the USA, South Africa and Iran (Moghaddam, 2009; Carroll, 2010; Wohlfarter et al., 2010).

Pseudococcidae family

Planococcus ficus species was identified from Pseudococcidae family. It was observed that the pest fed on the fruit crown, at the bottom of the fruit stem and especially in the areas where the fruits touch each other, and caused softening and colour change on the plant parts. In addition, the pest caused fumagine on the fruits due to producing honeydew and decreased the market value of the fruit. It was observed that *P. ficus* was seen more intensely in orchards where pruning was not done well and fruits was not thinning. Although the pest was not very spread in the region, it was evaluated as one of the important pests of pomegranate, as it caused economic losses in the orchards where it was seen. It

has been reported that *Planococcus* sp. and *Planococcus citri* species were determined in the pomegranate areas of Diyarbakır, Şanlıurfa, Antalya and eastern Mediterranean provinces and caused damage during the ripening period of the pomegranate (Mart and Altın, 1992; Öztöp et al., 2002; Öztürk et al., 2005). In other studies, conducted in different parts of the world such as India, South Africa, Spain and Cyprus, it has been stated that *Planococcus* species cause damage to pomegranate and decrease the market value by affecting the quality of pomegranate in particular (Mani and Krishnamoorthy, 200; Wohlfarter et al., 2010; Bartual et al., 2011; Kahramanoğlu and Usanmaz, 2013; Suroshe et al., 2016).

Cicadellidae family

Fieberiella gemelina, *Euscelis incisus*, *Asymmetrasca decedens*, *Macrosteles quadripunctulatus*, *Anaceratagallia ribauti*, *Eupelix cuspidata*, *Peraglena nervosus*, *Zyginidia pullula*, *Aphrodes assimilis* and *Circulifer haemato* were identified from the Cicadellidae family. *F. gemelina* was found to be the most spread among these species. The species obtained could not occur dense populations (2-3 individual at most per 100 knock) and caused no significant damage in orchards. Başpınar and Yıldırım (2011) stated that *Fieberiella anategea* was among the common species in pomegranate orchards and they considered *F. anategea* as a possible vector species, since the *Fieberiella* genus contains vector species that carry many viral diseases. Başpınar et al. (2013) reported that they identified 19 Cicadellid species, including species identified in the study, such as *E. incisus*, *A. decedens*, *M. quadripunctulatus*, *Z. pullula* and *C. haematoceps* in pomegranate orchards.

Coleoptera order

Bostrychidae family

Schistocerus bimaculatus species was obtained from the Bostrychidae family. The pest was detected only in the Şirvan district of Siirt. It was determined that *S. bimaculatus* caused drying of the tree by opening galleries on the branches and trunk of the pomegranate. The pest was detected for the first time in the pomegranate areas of Turkey in Antalya, and it was reported that it could cause significant damages if a good pruning and control was not done (Öztöp et al., 2002). Andreadis et al. (2006) reported that they detected *S. bimaculatus* in their study on pomegranate orchards in Greece, and that the control against the pest depends on preventive measures such as pruning before mating and egg laying.

Nitidulidae family

The species were identified as *Carpophilus nepos*, *C. mutilatus*, *C. hemipterus*, *C. bifenestratus* and *Urophorus humeralis*. The most spread species were *C. nepos* and *C. hemipterus*. It was determined that these species preferred to feed on fruits which be cracked, damaged by birds and primary insects such as carob moth, or mechanically injured. In addition, it was observed that fruits can be infected with saprophyte disease agents by Nitidulidae species and this fruits can be completely decayed. Similar to the findings we obtained, Öztöpe et al. (2002) reported that *Carpophilus* species were detected in pomegranate fruits contaminated with Mediterranean fruit fly and cracked fruits near harvest and *Carpophilus* species were secondary pests in pomegranates. Öztürk et al (2005) stated that Sap beetles fed on pomegranate fruits that are injured naturally, and they caused intense decaying and rotting in pomegranates with the effect of saprophyte fungi during feeding. Mifsud and Audisio (2008) reported that Nitidulidae species caused problems in Central and Southern Italy, especially in pomegranate, fig and peach farming, and Cocuzza et al (2016) reported that damages caused by *Carpophilus* species in Israel.

Buprestidae family

Two species, *Chrysobothris affinis* and *Acmaeodera wethloi* were obtained from the Buprestidae family.

Chrysobothris affinis was found only in the Samsat district of Adıyaman and caused drying on the trunk and thick branches of pomegranate. It was observed that the pest fed on wood tissue, opening galleries and causing spalling in the shells. Although *C. affinis* was determined on European beech, Birch tree, Cherry plum, Nectarine and Almond in different regions of Turkey (Ak, 1998; Tozlu and Özbek, 2000; Bolu and Özgen, 2011), no information was available that the pest caused damage at pomegranate orchard in Turkey. This study was the first to demonstrate that *C. affinis* causes damage at pomegranate plants.

Acmaeodera wethloi was detected in Şirvan district of Siirt. The pest detected only in one orchard was obtained by culturing the drying branches that were heavily attacked by *S. bimaculatus*. It was observed that *A. wethloi* was not a spread pest and did not cause a serious problem. Although the existence of the insect was previously known in Turkey (Ghahari et al., 2015 (referring to Volkovitsh, 2006; Bellamy, 2008), this study was first report about damage of *A. wethloi* on pomegranate plant.

Lepidoptera order

Pyralidae family

Two species, *Apomyelois ceratoniae* and *Dioryctria simplicella* were obtained from the Pyralidae family.

It was determined that *A. ceratoniae* laid eggs in the calix of fruits, hatching larvae entered inside the endocarp and caused to decaying of fruit. Considering both the prevalence and damage type of carob moth, it was the most important pest species identified in the pomegranate production areas of Adıyaman and Siirt provinces. In other studies, conducted in the Mediterranean, Aegean and Southeastern Anatolia regions where pomegranate cultivation is widespread in Turkey have been reported that *A. ceratoniae* is main or important pest species and causes serious damage (Mart and Altın 1992; Öztöpe et al.2002; Öztürk et al.2005; Yıldırım and Başpınar 2011). And these similar findings have been shared from many countries such as Iran, Iraq, Tunisia, Saudi Arabia (Al-Izzi et al.1985; Alrubeai 1987; Norouzi et al 2008, Elsayed and Bazaid 2011; Moawad et al 2011; Braham 2015; Nobakht et al.2015).

Another Lepidoptera species directly causing damage at the fruit was *D. simplicella*. The pest was detected only in Şirvan district of Siirt. Although the pest was observed to be harmful in the calyx of the pomegranate, it could penetrate the inner parts of the fruit (endocarp). Damage of *D. simplicella* in the calyx was quite similar to the Carob moth damage. As a result, although the spread of the pest was limited, it was considered to be one of the important pest species in terms of damage type. There wasn't any study related the damage of *D. simplicella* on pomegranate plants The study results could be accepted as a first report about damage of *D. simplicella* on pomegranate plants.

Erebidae family

Dysgonia algira, from the Erebidae family, was identified and found to cause damage by attacking the leaves. It was observed that the larvae started eating from the edges of the leaves and caused crescent-shaped holes, mature larvae combined leaves and became pupae in them. Öztöpe et al. (2002) reported that *D. algira* did not cause an intense damage in the orchards as parallel with the findings in this study. In Italy, Sannino et al. (1986) stated in their study on *D. algira* that the pest could consume all leaves in dense populations, leaving only shoots.

Nolidae family

Arcyophora dentula species from Nolidae family was determined. It was observed that the pest caused damage by feeding on leaves. The species detected in two orchards in Kahta and one orchard in Şirvan was among the rare pests and did not cause serious damage in the orchards. In Turkey, there is no record that *A. dentula* causes damage to the pomegranate or that the pomegranate is the host of the pest. However, in a study conducted in pomegranate production areas in India was stated that *A. dentula*

caused damage and could leave the plant almost without leaves in some orchards (Mukarjee, 1941).

Diptera Order

Drosophilidae family

Drosophila melanogaster and *Zaprionus indianus* species were recorded from the Drosophilidae family. It was determined that both species preferred fruits that be cracked, attacked by primary pests such as carob moth and became soft and rot, rather than solid fruits. In some studies, and EPPO reports, parallel to this findings, both species have been reported to be secondary pests on pomegranate (Joshi et al., 2014; Braham, 2015; Anonymous, 2016 a, Anonymous, 2016 b). In other studies, conducted in pomegranate areas of Turkey, belonging to the Drosophilidae family, *Drosophila* sp. and *Zaprionus tuberculatus* species have been reported (Öztürk et al., 2005; Kuyulu et al., 2019). Although *Z. indianus* has been detected in fruits such as persimmon, blackberry, fig, cherry, mulberry, peach and plum in Turkey (Özbek-Çatal et al., 2019), no information has been stated that it is detected in pomegranate.

CONCLUSION

In this study, 42 pest insect species belonging to 15 families from 6 orders were obtained from pomegranate orchards. *A. ceratoniae* and *A. punicae* species were the main pest species among the pest species. They were common in Adıyaman and Siirt provinces and could cause significant damages if they were not controlled. Besides, *S. finitimus* and *P. ficus* species were determined as other important pest species on pomegranate. Although both pests were not very common in orchards, it was observed that they could create dense populations in orchards and caused economic losses. *D. Simplicella*, *A. dentula*, *C. affinis*, *A. wethloi* and *Z. indianus* species were determined for the first time in pomegranate production areas of Turkey. The results of this study are important for the determination of the insect fauna of pomegranate and for pomegranate integrated pest management (IPM) studies. In order to solve entomological problems in pomegranate orchards, it will be great benefit to carry out detailed studies on the bioecology and control of the main pest species.

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Contribution of the Authors as Summary

The contribution of the authors is equal

Statement of Conflict of Interest

Authors have declared no conflict of interest

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