

Determination of Pests and Beneficial Species in Avocado Orchards in Antalya Province

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Abstract

This study was conducted to determine the pests and beneficial species found in Avocado orchards in Antalya province, Turkey. Survey studies were carried out between the years of 2018-2020 in Alanya, Aksu, Finike, Gazipaşa, Kemer, Manavgat, Muratpaşa, Serik and Kumluca districts of Antalya that have avocado production. In the surveys, visual examination, counting of the branch, knock down, and trapping methods were used. As a result of the study, 18 pest species belonging to 13 families and 6 orders and 15 beneficial species belonging to 4 orders and 5 families were determined.

1. Introduction

Avocado (*Persea americana* Mill.), is a subtropical plant that spreads over large areas of the world and stands out with its increase in production every year. Avocado, which is in high demand in international markets with its nutritious properties and distinctive taste, entered to Turkey in the early 1970s and spread along the Mediterranean coastline. Mexico ranks first in terms of avocado production in the world, while Indonesia, Peru, the Dominican Republic, and Colombia follow that respectively (FAOSTAT, 2018). In Turkey, it is grown in the coastline of Muğla, Antalya, Adana, Hatay and Mersin provinces (Table 1). The total avocado production area, which was 556 ha in 2018, has almost doubled, reaching 950 ha as of 2019 (TUIK, 2018; 2019). Antalya province in Turkey leads the avocado production at the highest rate. Antalya accounts for 70% of the avocado production area in Turkey. In Antalya, Alanya district constitutes the highest production area with 62% (TUIK, 2019). As avocado production increases over time, it is exported from Antalya province to 25 countries, including Germany, Ukraine, Bulgaria, and Greece (BAİB, 2019). Studies on the

adaptation of avocado cultivars in Turkey have been conducted in Batı Akdeniz Agricultural Research Institute (BATEM) in Antalya for many years and it has been determined that Bacon, Fuerte, Hass, Zutano, and Ettinger cultivars are suitable for the region (Bayram et al., 2006). These data clearly show the importance of Antalya province in avocado production. In parallel with the intensive demand day by day, the number of avocado trees is increasing and it is thought that avocado will be as important as citrus and pomegranate in the following years.

It is estimated that pests and beneficial species are intense due to the increase of production areas of Avocado, the suitability of the climate conditions of Antalya province for insect populations, and the lack of chemical control yet. Bayram (2010) reported that the Mediterranean medfly, thrips, scale insects, mealybugs, and lemon rat are among the common pests. However, there is no detailed study on this issue in Turkey. The aim of this study was to identify pests and beneficial species as the first step in the control of avocado pests. Most species obtained as a result of the research will be the first record for the avocado fauna of Turkey.

Table 1. Avocado presence and production in Turkey by provinces (TUİK, 2019)

Province	Number of trees at fruiting age	The number of trees in not fruiting	Total area of orchards (ha)	Production amount (tons)
Adana	-	2180	6.7	-
Antalya	60986	52455	659.5	3409
Hatay	293	-	0.8	23
Mersin	9230	77682	276.9	699
Muğla	2010	1050	5.2	78

Table 2. Number of trees examined according to orchard size (Lazarov and Grigorov, 1961)

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

In this study, it was aimed to identify pests and beneficial species in avocado orchards by conducting surveys during 2018-2020, spreading Alanya, Aksu, Finike, Gazipaşa, Kemer, Manavgat, Muratpaşa, Serik and Kumluca districts of Antalya province in Turkey. The data obtained from the study, can be used as preliminary information both in the pest control and in the use of biological control factors.

2. Material and Methods

The material of the study consists of avocado orchards in Alanya, Aksu, Finike, Gazipaşa, Kemer, Manavgat, Muratpaşa, Serik, and Kumluca districts in Antalya province, the tools used in the survey studies, culture containers, labels, pests and beneficial species, traps, chemicals and consumables used in preparing insects for diagnosis, and equipment.

2.1. Survey studies

The studies were conducted between March and November in avocado production areas in Alanya, Aksu, Finike, Gazipaşa, Kemer, Manavgat, Muratpaşa, Serik and Kumluca districts in Antalya province between the years of 2018 and 2020. Surveys were carried out at non-periodic intervals and it was noted that no pesticide was applied out in the selected orchards. In the survey studies, 0.01% of the total avocado area was included and studies were carried out in a total of 30 orchards. The number of trees to be examined according to the size of the orchard was determined according to the method of Lazarov and Grigorov (1961) (Table 2).

2.2. Determination of pests and beneficial species

Taking into account the phenology of the plants in the survey areas and labour force, sampling was carried out at non-periodic intervals between March

and November by visual inspection, knock down, counting of branch, and trapping method (Anonymous, 2017).

Visual examination method: According to the phenological period of the plant, a total of 100 plant parts, consisting of 10 parts (buds, flowers, leaves, and fruits) from 10 trees, were randomly selected and the pests and beneficial species were collected and recorded.

Knock down method: This method was used with Steiner funnel (Steiner, 1960). The branches, which in the different directions of the trees randomly selected to represent the avocado orchard, were hit twice with a stick with a rubber tube on the end and hit 100 times in total and the pests and beneficial species that fell on the Steiner funnel were collected with an aspirator and recorded.

Branch counting method: 20-25 cm long branches and shoots were collected from different sides of five trees to identify scale insects.

Trapping method: The delta type trap containing the Mediterranean fruit fly pheromone and yellow and blue sticky traps were hung in the orchard in the south direction of the trees and at a height of about 1.5-2.0 m from the ground, and the insects caught in the traps were brought to the laboratory.

2.3. Laboratory studies

Adults were collected and brought to the laboratory in an icebox, prepared for diagnosis and sent to subject experts. Pre-adult periods were cultured in the laboratory and sent to the diagnosis in the same way when they became adult. Furthermore, parasitized individuals were brought to the laboratory and cultured for parasitoid emergence and sent for diagnosis.

3. Results and Discussion

As a result of surveys, 18 pest species belonging to 13 families and 6 orders and 15 beneficial species belonging to 5 families and 4 orders were identified.

Table 3. Pests found in avocado orchards

Order	Family	Species
Hemiptera	Aphididae	<i>Aphis (Toxoptera) aurantii</i> (Boyer de Fonscolombe)
	Diaspididae	<i>Myzus (Nectarosiphon) persicae</i> (Sulzer)
		<i>Chrysomphalus dictyospermi</i> (Morgan)
	Coccidae	<i>Chrysomphalus aonidum</i> (Linnaeus)
		<i>Coccus hesperidum</i> (Linnaeus)
	Cicadellidae	<i>Ceroplastes floridensis</i> (Comstock)
		<i>Fiebertiella oenderi</i> (Dlabola)
		<i>Balclutha frontalis</i> (Ferrari)
<i>Agalmatium bilobum</i> (Fieber)		
<i>Icerya purchasi</i> Mask.		
Margarodidae	<i>Pseudococcus viburni</i> (Signoret)	
Pseudococcidae	<i>Pseudococcus viburni</i> (Signoret)	
Aleyrodidae	<i>Trialeurodes vaporariorum</i> (Westwood)	
Coleoptera	Cerambycidae	<i>Batocera rufomaculata</i> (De Geer)
Thysanoptera	Thripidae	<i>Thrips pillichii</i> (Priesner)
		<i>Heliothrips haemorrhoidalis</i> (Bouché)
Diptera	Tephritidae	<i>Ceratitis capitata</i> (Wiedemann)
Acarina	Acaridae	<i>Tyrophagus putrescentiae</i> (Schrank)
Epulmonata	Helicidae	<i>Eobania vermiculata</i> (Müller)

Table 4. Beneficial species found in avocado orchards

Order	Family	Species
Coleoptera	Coccinellidae	<i>Stethorus punctillum</i> Weise
		<i>Serangium parcesetosum</i> Sicard
		<i>Scymnus rubromaculatus</i> (Goeze)
		<i>Oenopia conglobata</i> (Linnaeus)
		<i>Scymnus auritus</i> (Thunberg)
		<i>Nephus nigricans</i> (Weise)
		<i>Adalia bipunctata</i> (Linnaeus)
		<i>Chilocorus bipustulatus</i> (L.)
		<i>Hippodamia variegata</i> (Goeze)
		<i>Coccinella septempunctata</i> (Linnaeus)
Neuroptera	Chrysopidae	<i>Chrysoperla carnea</i> (Stephens)
	Coniopterygidae	<i>Conwentzia pineticola</i> (Enderlein)
Hymenoptera	Braconidae	<i>Bracon (Habrobracon) hebetor</i> (Say)
Acarina	Phytoseiidae	<i>Neoseiulus californicus</i> (McGregor)
		<i>Phytoseiulus persimilis</i> (Athias Henriot)

Thrips pillichii Priesner, 1924, (Thysanoptera: Thripidae), *Fiebertiella oenderi* Dlabola, 1985, *Balclutha frontalis* Ferrari, 1882 (Hemiptera: Cicadellidae), *Agalmatium bilobum* Fieber, 1877 (Hemiptera: Issidae), *Eobania vermiculata* (Müller) (Eupulmonata: Helicidae) and *Pseudococcus viburni* (Hemiptera: Pseudococcidae) species were recorded as the first record of avocado in the world, while all species except *Ceratitis capitata* in Turkey were recorded as the first record for avocado cultivation.

Pests and beneficial species found in avocado orchards of Antalya province are given in Table 3 and 4. *Myzus persicae* and *Aphis aurantii* species, which are two aphid species determined in avocado orchards in Antalya province, are widely found in many cultivated plants in Turkey (Sarac et al., 2015). Furthermore, they are among the known avocado pests in the world (CABI, 2019).

The most common pest group in avocado orchards are scale insects. *Chrysomphalus dictyospermi* and *Chrysomphalus aonidum* are avocado pests identified as in the world (Kondo and Muñoz, 2016). In Turkey, it has been detected in a large number of hosts in the Mediterranean,

Aegean, Marmara, and Black Sea regions (Kaydan et al., 2013; Çalışkan Keçe and Ulusoy, 2017; Yaşar and Erözmen, 2018). *C. hesperidum*, *Ceroplastes floridensis* and *Icerya purchasi* (cottony cushion scale) are known as common citrus pests in Antalya (Göl and Karaca, 2016). In a study conducted in Colombia, it was reported that these pests were identified in avocado areas as well (Kondo and Muñoz, 2016). Moreover, whiteflies are among the important pests that have a wide host range in Turkey. *Trialeurodes vaporariorum* species was found in the study carried out and this species is among the avocado pests known in the world (CABI, 2019; García-Palacios et al., 2020).

Fiebertiella oenderi, *B. frontalis* and *A. bilobum* species belong to Cicadellidae and Issidae families were found in Antalya and Turkey fauna (Demir, 2008). In the world, no information has been reached that these species, which are harmful to different hosts and avocados.

Pseudococcus viburni is an important pest species in orchards in the Black Sea Region, Istanbul and Ankara provinces in Turkey (Telli and Yiğit, 2019). However, this species has not been determined in avocado orchards.

Doğanlar and Yiğit (2002) found that black vine thrips, *Retithrips syriacus* (Mayet) (Thysanoptera: Thripidae), a fruit and vineyard pest detected in Hatay, were fed and reproduced in avocado fruits as a result of laboratory studies. In our study, two different thrips species, *T. pillichii* and *Heliethrips haemorrhoidalis*, were found. Moreover, *H. haemorrhoidalis* species is known as an important thrips species in avocado in the world (Stevens et al., 1999; Larral and Lipa, 2007; Denmark and Fasulo, 2010). In Turkey, this species was first recorded as an important kiwi pest in a study conducted in Rize province in 2009-2010 (Ülgentürk et al., 2011). Similarly, *T. pillichii* is found in the fauna of Turkey and is not known as an avocado pest in the world (Nickle, 2008; Tunç and Hastenpflug - Vesmanis, 2016).

Furthermore, *Batocera rufomaculata*, which was detected in avocado orchards in Gazipaşa district in 2020, entered Turkey as a fig pest in 2000 (Tozlu and Özbek, 2000). In the world, it is one of the hosts of avocado trees (Mane and Gaikwad, 2018).

Tiring and Satar (2017) stated that in their study to determine the population fluctuation of the *C. capitata* species in avocado, peach, and fig orchards, *C. capitata* has been identified with the culturing of infected fruits from the avocado orchard. In the present study, *C. capitata* was found in traps in avocado orchards in Serik and Alanya districts. Besides, it is included among avocado pests in the world (De Graaf, 2009; EPPO, 2011).

Tyrophagus putrescentiae mite has been identified in stored products in Turkey, and no information has been found on its detection in avocado areas. Moreover, it was detected in avocado orchards in a study conducted in Mexico in 2017 (Genç and Özar, 1986; Sandoval-Cornejo et al., 2019).

Eobania vermiculata (Müller) (Eupulmonata: Helicidae) has been found to cause damage in peach and nectarine orchards in Adana and Mersin provinces (Hazır and Ulusoy, 2012). This pest is generally found in coastal areas, dry vegetation, vineyards, and agricultural areas in the world (Ronsmans and Van den Neucker, 2016). As for the beneficial species found in avocado orchards during the surveys, all detected species are widely found in the Turkish fauna.

4. Conclusion

Among the pests identified in the surveys, it was observed that the population of most pests is low. Hence, it is believed that the presence of predators and parasitoids found in nature keeps these pests in balance. Considering that there is no licensed plant protection product in avocado, it is thought that many pests will fall below the economic loss threshold if natural enemies are protected. However, for pests that have a high population and require to be controlled, different controlling

techniques should be studied within the scope of an integrated pest management (IPM) program. These controlling methods should be the least harmful to the environment and natural enemies.

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