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Orijinal araştırma (Original article)

Population fluctuations of some important pests and natural enemies found in Oil-bearing rose (*Rosa damascena* Miller) production areas in Isparta province (Turkey)[1]

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Summary

This study was carried out during 2006-2007 in Isparta province, to determine harmful and beneficial species and to reveal important species in Oil-bearing rose production areas. In the study, population fluctuations of economically harmful species known as *Tetranychus urticae* Koch. (Acarina: Tetranychidae), *Rhodococcus perrornatus* Cockerell & Parrott (Hemiptera: Coccidae), *Macrosiphum rosae* (L.) (Hemiptera: Aphididae), *Thrips meridionalis* Priesner (Thysanoptera: Thripidae), *Oxythyrea cinctella* Schaum, *Tropinota hirta* Poda (Coleoptera: Cetoniidae), *Perotis chlorana* Castelnau & Gory (Coleoptera: Buprestidae), *Rhynchites hungaricus* Herbst (Coleoptera: Attelabidae), *Cnaemidophorus rhododactyla* (Denis & Schiffermüller) (Lepidoptera: Pterophoridae), *Syrista parreyssii* Spinola (Hymenoptera: Cephidae) and important natural enemies of these pests known as *Anthribus fasciatus* Forster (Coleoptera: Anthribidae), *Adalia fasciatopunctata revelierei* (Mulsant), *Coccinella septempunctata* (L.), *Exochomus quadripustulatus* (L.), *Hippodamia variegata* Goeze (Coleoptera: Coccinellidae) were determined. The results of this study demonstrate that *R*. *perornatus* and *M*. *rosae* are the two most economically harmful pests at the Oil-bearing rose orchards.

Key words: Oil-bearing rose, pest, natural enemy, Isparta, population fluctuation

Anahtar sözcükler: Yağ gülü, zararlı, doğal düşman, Isparta, populasyon değişimi

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Introduction

Oil-bearing rose (*R*osa *damascena* Miller) (*R*. *gallica* L. and *R*. *phoenicia* Boiss hybrid) is among important aromatic plants from which volatile oils are obtained especially for the production of perfumes, cosmetics, medicines and aromatheraphic products. Oil-bearing rose cultivation in Turkey has been done in the Lakes Region (Isparta, Burdur, Denizli and Afyonkarahisar provinces) since the pre-Republican Period and the sector of Oil-bearing rose cultivation has grown ten-fold in the last 60 years and twice in the last 10 years. In the region, 7.300 tones of rose flower, 1.235 kg of rose oil, 7.750 kg of rose concrete, 1.600 kg of rose absolute and 1000 kg of dry rose production was performed on an area of 20 thousand decares in 2009. Through the exportation of these products a foreign exchange inflow of 10 millions of Euros was performed (Anonymous, 2010). More than 70% of the rose oil production of Turkey is produced in Isparta and the rest in the provinces of Burdur and Afyonkarahisar. The number of papers on the pests, their natural enemies and their control, in Oil-bearing rose areas of Isparta and also of the world (Tuatay, 1963; Nikolova, 1967, 1968, 1969, 1972; Schedl, 1968; Acatay, 1969a, 1969b; Zeki et al., 1999; Ülgentürk et al., 2001; Japoshvili & Karaca, 2002; Karaca et al., 2003; Altınok, 2004; Balevski et al., 2008; Demirözer et al., 2009) is limited. In order to apply a safer control system in the Oil-bearing rose production, it is necessary to analyze the important pests, their natural enemies, their reciprocal relationships and seasonal population fluctuations.

In this paper, population fluctuations of important pests that cause economic losses on Oil-bearing roses produced in the province of Isparta and its districts and important species of their natural enemies were determined.

Materials and Methods

The study was performed between the years 2006 and 2007 on five Oil-bearing rose orchards located 15 km away from Isparta city centre. Three of the orchards are located in Gölcük, and two are located in Yakaören. All five of the orchards are located 1-1.5 km away from each other and have areas of 1–1.5 decares. Neither chemical control nor other control methods have been used against diseases and pests in the orchars and there was no commercial Oil-bearing rose orchards nearby. Population changes of important pests and their natural enemies in the orchards were determined by regular weekly surveys performed between March and October. In each orchard, 100 leaves, 100 shoots (10 cm), 50 two-year twigs (10 cm), 100 rose buds, 50 rose flowers were randomly collected. Besides, strike method (Steiner, 1962) was used and 100 strikes were applied to 50 rose plants randomly selected from each garden. Before each strike, ethyl-acetate impregnated cotton was put into plastic jars located in the middle of Japanese umbrella, and then stickers showing the location and date information were placed in.

The counts for the determination of population fluctuations were made under stereomicroscope as follows:

- On the upper and bottom surfaces of leaves (odd pinnate); Aphididae (winged adult, wingless adult, nypmh, parasitized) and Tetranychidae (adult and nymph),
- On new shoots; Cephidae (egg laid (damaged) shoot),
- On two year twigs; Coccidae (the second instars nymph, male, female, parasitized),
- On rose buds; Pterophoridae (larvae),
- On rose flowers; Thripidae (adult),
- With strike method; Anthribidae, Attelabidae, Buprestidae, Cetoniidae, Coccinellidae (adult).

Insect samples collected during the study were kept in the Isparta Entomology (EMIT) Museum within the body of Süleyman Demirel University, Faculty of Agriculture, Department of Plant Protection.

Results and Discussion

As a result of the literature review and surveys performed, pest species determined to be important in the Oil-bearing rose orchards in Isparta province and its districts were given in Table 1. Besides, beneficial species found to be important were given in Table 2.

Table 1. Important pests species found in Oil-bearing rose areas in Isparta province

Order	Family	Species
ACARINA		
	Tetranychidae	*Tetranychus urticae* Koch
HEMIPTERA		
	Aphididae	*Macrosiphum rosae* (L.)
	Coccidae	*Rhodococcus perornatus* Cockerell & Parrott
THYSANOPTERA		
	Thripidae	*Thrips meridionalis* (Priesner)
COLEOPTERA		
	Cetoniidae	*Tropinota hirta* (Poda)
		Oxythyrea cinctella (Schaum)
	Buprestidae	*Perotis chlorana* Leporte & Gory
	Attelabidae	*Rhynchites hungaricus* Herbst
LEPIDOPTERA		
	Pterophoridae	*Cnaemidophorus rhododactyla* (Denis & Schiffermüller)
HYMENOPTERA		
	Tenthredinidae	*Syrista parreyssii* (Spinola)

Table 2. Important natural enemies found in Oil-bearing rose areas in Isparta province

Order Family	Species
COLEOPTERA	
Anthribidae	*Anthribus fasciatus* Förster
Coccinellidae	*Adalia fasciatopunctata revelierei* (Mulsant)
	Coccinella septempunctata (L.)
	Exochomus quadripustulatus (L.)
	Hippodamia variegata Goeze

Furthermore, climate [average temperature (°C) and average relative humidity (%)] data for Isparta in the years 2006 and 2007 are shown in Figure 1.

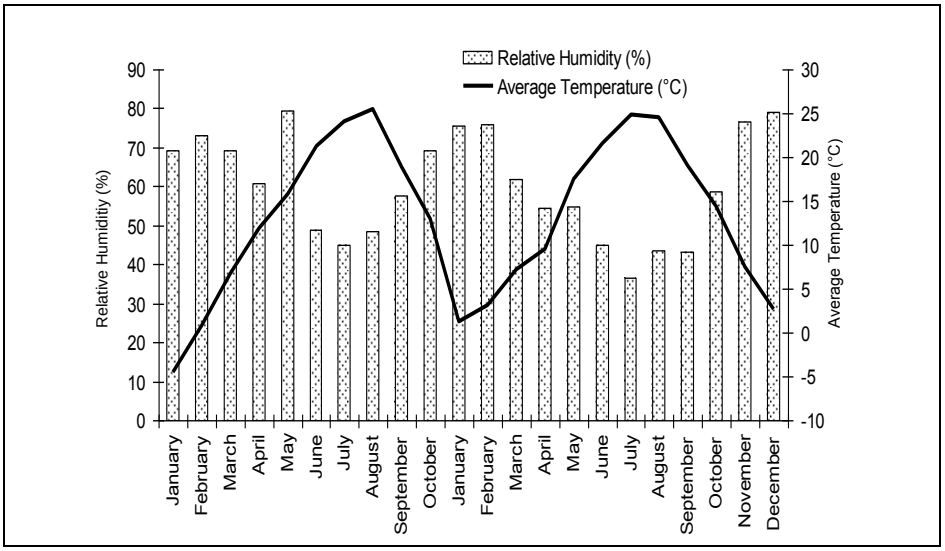

Figure 1. Climate data for Isparta in the years 2006 and 2007.

Population fluctuations of important pest species

Tetranychidae: *Tetranychus urticae* Koch

In order to determine the population fluctuations of *T. urticae,* widely found throughout the Oil-bearing rose orchards in the province of Isparta, the population fluctuations obtained by the counts from five different orchards were given in Figure 2 (a, b).

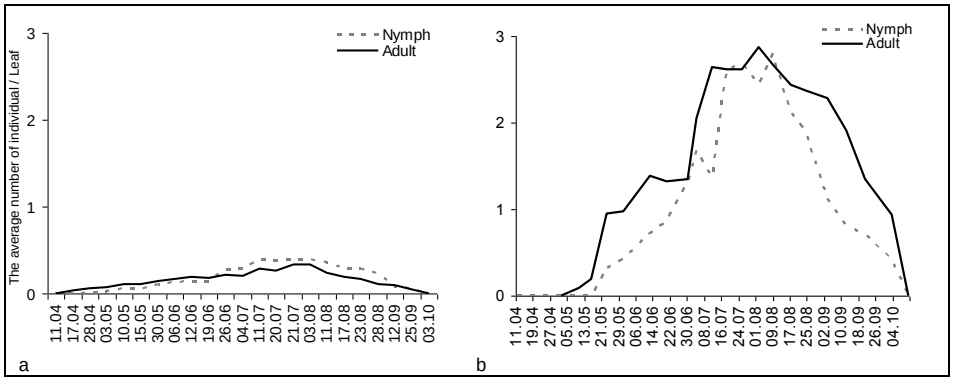

Figure 2. Population fluctuations of *Tetranychus urticae* Koch. on leaves between the years 2006 (a) and 2007 (b).

When the results of the study were analyzed, it was observed in the Oil-bearing rose orchards that *T*. *urticae* was first seen after the second half of April in 2006 and after the first week of May in 2007 and primarily the adult individuals were observed within the initial population. While the initial population of *T*. *urticae* was about 0.3–0.21 in 2006, it was recorded that it was about 0.06–0.8 in the following year. It was found that the maximum levels of the population of adult individuals were at the first week of July both in 2006 and 2007, and the maximum number of adult individuals per leaf was 0.20–0.49 in 2006 and was 1.33–2.86 in 2007. Both in 2006 and in 2007, the minimum average of adult population per leaf was observed to be 0.01–0.15.

Nymphs were observed May onwards both in 2006 and 2007 and the average number of nymph per leaf was recorded to be 0.03–0.08. It was found that the nymph population reached its highest level between the first week of July and almost September and the average numbers per leaf were 0.45–0.51 in 2006 and 2.60–2.96 in 2007. During the period after the second half of September, the level of nymph population started to decrease and reached its minimum at the beginning of October and the level of population was recorded to be 0.04–0.10.

Ecevit (1977) mentioned that *T*. *urticae* emerged in the first week of May onwards, the population reached its maximum level at the mid-August and the population density started to decrease from the end of August onwards, in apple orchards. In their study on the population density of *T*. *urticae* at the plantations in İzmir-Bademli, Bulut & Madanlar (2004) found that the pest emerged at the end of May and at the beginning of June, in some plantations the pest started to emerge at the end of April for the first time and the density of population reached its maximum at July when the temperature is high and the level of humidity was relatively low. Environmental factors directly affect the rate of plant

growth and concordantly cause changes in the pest densities (Park & Lee, 2002). Klubertanz et al. (1990) affirmed that the density of *T*. *urticae* decreased as a result of fertility decrease caused by temperature decrease and the washing of individuals at the leaf surfaces at soppy seasons. It is mentioned by various researches that low level of humidity, high level of temperature and dusty production environments caused increases at the population level of *T*. *urticae* (Helle & Sabelis, 1985; Flint, 1998).

In the study, it was observed that *T*. *urticae* was denser especially at the Oil-bearing rose orchards which were close to gravel roads and/or where weed population was high. In July of both years minimum average yearly humidity and highest average temperature were measured to be 40-45% and 25°C, respectively (Anonymous, 2008). In this period it was determined that *T*. *urticae* population in Oil-bearing rose orchards reached its maximum level.

During the field survey, it was observed that producers did not pay attention to their orchards after harvest, they only applied rejuvenating pruning usually during the last few days of autumn, if they found it necessary, and no other application was done till the following vegetation period. In heavily infested orchards; yellowing, drying and falling of leaves were observed. It is stated that feeding of *T*. *urticae* caused decrease on the chlorophyll rate of the leaves and this in turn caused the weakness of the leaves by the prevention of photosynthesis (Park & Lee, 2002).

Coccidae: *Rhodococcus perornatus* Cockerell & Parrott

The results of the counts, applied in five different orchards in order to determine the population fluctuations of *R*. *perornatus,* detected throughout the Oil-bearing rose orchards in the province of Isparta, were given in Figure 3.

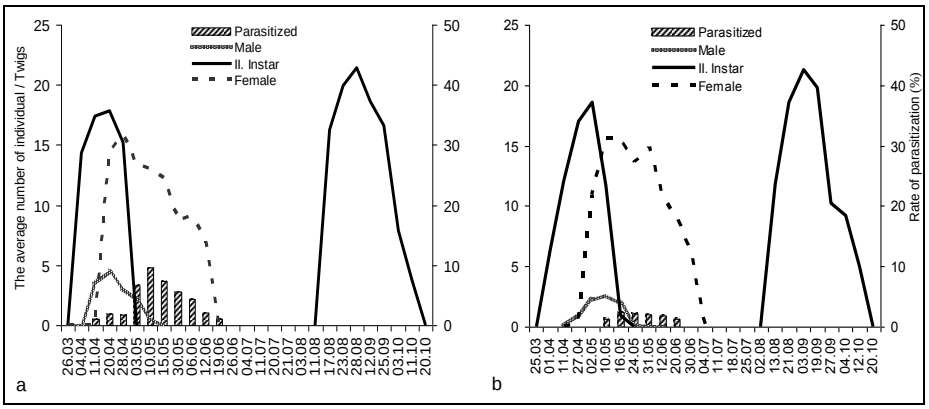

Figure 3. Population fluctuations of *Rhodococcus perornatus* Cock. & Parr. at two year twigs between the years 2006 (a) and 2007 (b).

In this study while the average maximum per twig the second instar nymph population level is determined to be 18.55 at the second half of March 2006, the same figure is recorded as 19.40 for the year 2007. In a study made in previous years, it is stated that in the province of Isparta *R*. *perornatus* overwinters at the second instar nymph diaposes; the second instar nymph initiates just before the transition of the plant to the dormant situation, and the per twig average number of the second instar nymph exiting diaposes is stated to be 20.00 (Altınok, 2004). In both years of the study under consideration adult male individuals occur between the second half of April and first week of May; per twig average individual figure is 4.60 and 3.80 in 2006 and 2007 respectively. Young females of *R*. *perornatus* are observed from the first half of April till the last week of June and per twig average maximum level is determined to be 16.31. In 2007, per twig average maximum level of young females observed between the last week of April and first week of July is determined to be 15.61. In both years of the study, ovipositing female individuals are found in orchards till the last week of June; it is observed that if they are separated from the twigs, more or less pale orange coloured eggs of the individuals spill from their bodies. At his egg count on 50 female individuals, Altınok (2004) states that average egg number is 1,765 ± 504 (minimum 973 and maximum 2,539). In this period of 2006 and 2007, per twig average ovipositing female figure is recorded as 6.1. For both years, the second instar nymph counts are continued following the first week of August, and per twig average maximum figure is recorded as 21.00–23.00.

In this study, it is considered that for the controlling the main pest of Oil-bearing rose, namely *R*. *perornatus,* the timing is very crucial and an application for the second instar nymph population decrease would be very effective. In his study on chemical control of Oil-bearing rose pest in Bulgaria, *R*. *bulgariensis* (Wunn.) (Homoptera: Coccidae), Tsalbukov (1971) succeeds 90-97 % and about the control he suggests that during the long stage (June 11th–July 14th) following the nymph emergence, for an effective control a second pesticide application would be necessary. Under the conditions prevailing in Isparta, it is thought that such a second application for the *R*. *perornatus* individuals that are at the second instar nymph stage would increase the rate of success in pest control.

Aphididae: *Macrosiphum rosae* (L.)

In various studies, it is stated that *M. rosae* prefers *Rosa* spp*.* and it creates problems for the roses cultivated both in open and covered production fields all around the world. *M*. *rosae* is a serious pest of roses the feeding of aphids causes deformation of shoots and leaves on host plants, checking their growth and leading to poorer blooming and fructification and an understanding of its biology and population dynamics strategy. In mostly researches stated that *M*. *rosae*, when found in greater numbers, checked the growth of the shoots, caused deformation and discoloration of the leaves and deformation of

the flower buds and flowers. Besides, the plants were covered with honey-dew, where a saprophytic fungus is essential for developing a reliable management marring the plants developed (Nikolova, 1969; Natskova, 1970; Heie, 1994; Jaskiewicz, 1997, 2004; Blackman & Eastop, 2000; Kmiec, 2007). The population of *M. rosae* that may form crucial losses after reaching dense population levels at Oil-bearing rose orchards in the province of Isparta is given in Figure 4.

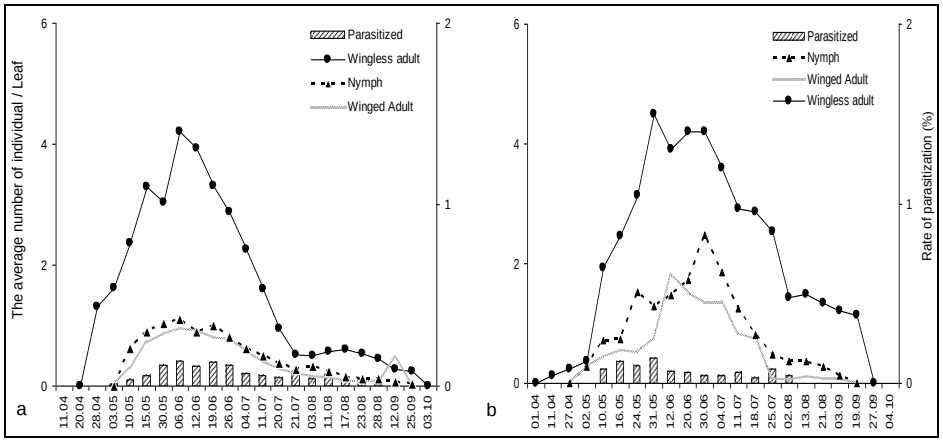

Figure 4. Population fluctuations of *Macrosiphum rosae* (L.) on leaves between the years 2006 (a) and 2007 (b).

In this study, firstly the wingless adult individuals of *M. rosae* are observed form the last days of April onwards both in 2006 and 2007. When the results of the data of 2006 are analyzed, per leaf average emergence population of wingless adult individuals is recorded as 1.13. The same figure is found to be 0.72 in 2007. Wingless adult individuals reach the highest population at the first week of June in 2006 and per leaf average number of individuals are 4.30. In the following year, the average value of the wingless adult population that again increases at the same period is 4.56. The wingless adult population that decreased at the end of September, in 2006, is observed till the first week of October and in this period per leaf average figure is found to be 0.90 – 1.20. In 2007, the decreasing population till the first week of August is observed until the first week of October and per leaf average value is detected to be 1.00 – 1.30. Both in 2006 and 2007, the winged adult individuals are observed as of the end of April, and the highest population values are observed at mid-June. While per leaf average level is 0.42 – 1.00 in 2006, it is 0.42 – 1.18 in 2007. In both years, the nymphs emerge from the first week of May on and their population reaches its highest point in the second half of June. Per leaf maximum average level is recorded to be 1.25 in 2006 and 2.30 in 2007.

In order to be successful in the control of aphids whose population starts to increase especially from mid-May on in Oil-bearing rose orchards.

Thripidae: *Thrips meridionalis* Priesner

Under the climate condition in the province of Isparta the flowering period lasts up to mid-June and in order to determine the population fluctuations of *T*. *meridionalis* adult individuals during this period count is realized and the results of the population changes are given in Figure 5.

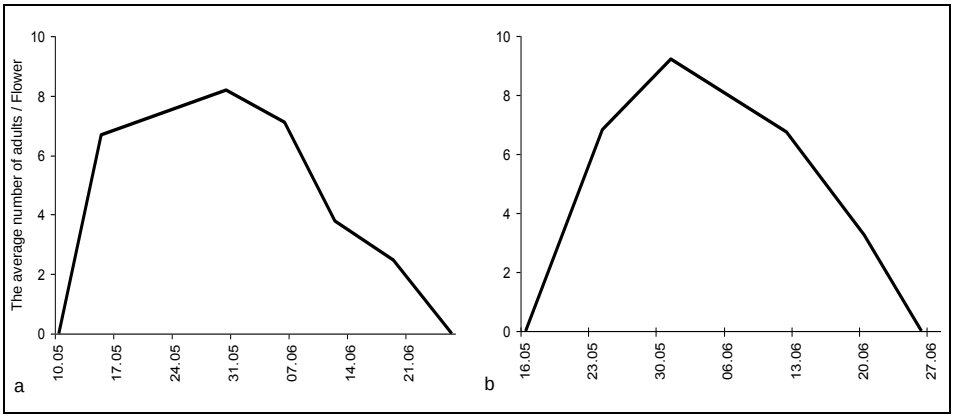

Figure 5. Population fluctuations of *Thrips meridionalis* Priesner on flowers between the years 2006 (a) and 2007 (b).

In the study, it is determined that the adult individuals of *T*. *meridionalis* are observed at the first week of May, just after rose flowers appears. The highest population level of *T*. *meridionalis* on rose flowers is observed at the last days of May and the highest average individual figure is recorded as 8.19 in 2006 and 9.20 in 2007. In both years, flowering initiates to decrease from the second half of June on and in turn, the population of *T*. *meridionalis* diminishes.

No literature could be found on the population fluctuation of Rosa related species of the pest or its presence on foliage plants. In the studies on *Frankliniella occidentalis* (Pergande), one of the flower thrips it is stated that together with the formation of petals the population of thrips appears but it could not be observed during bud period (Pearsall & Myers, 2000; Deligeorgidis et al., 2005). The coincidence of the presence of the pest on the plant and the flowering period limits chemical utilization during the fighting.

Cetoniidae: *Oxythyrea cinctella* Schaum **and *Tropinota hirta*** Poda

In order to determine the population fluctuation of *O*. *cinctella* and *T*. *hirta* that were observed in Oil-bearing rose orchards during flowering period, counts of adult individuals were performed in 2006 and 2007 and the population fluctuations were given in Figure 6.

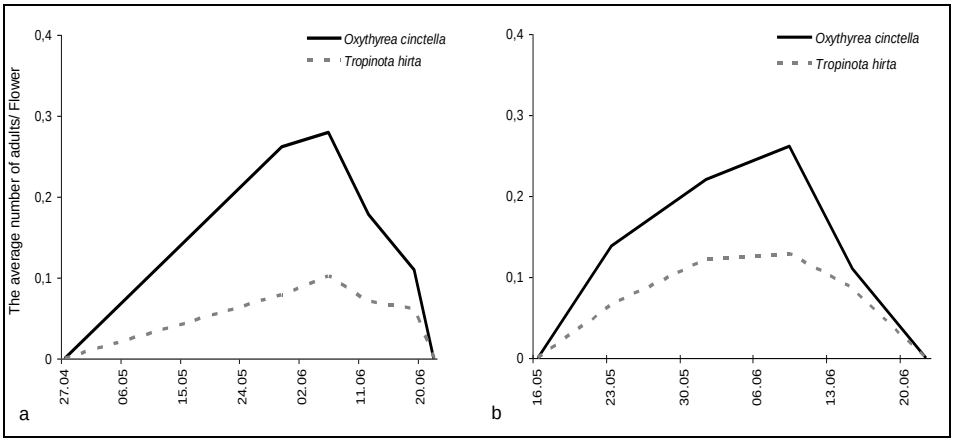

Figure 6. Population fluctuations of *Oxythyrea cinctella* Schaum and *Tropinota hirta* Poda on Oil-bearing rose flowers between the years 2006 (a) and 2007 (b).

In both years of the study, the adult individuals of *O*. *cinctella* and *T*. *hirta* were observed in the flowering period covering the first week of May and the mid-June. In 2006, following the first week of May, the highest population level of *O*. *cinctella* and *T*. *hirta* was observed in the first week of June, and the per strike average maximum number of adult for *O*. *cinctella* was found to be 0.21–0.28 while it was found to be between 0.06 and 0.18 for *T*. *hirta*. In the orchards, the population of *O*. *cinctella* and *T*. *hirta* were observed till the last week of June. In 2007, following the first half of May, adults of *O. cinctella* and *T*. *hirta* were observed in the orchards, and it was determined that their population reached its highest level on the period covering the second half of May till the end of the first week of June. In this period, per strike maximum average number of adult was determined to be 0.20–0.27 for *O*. *cinctella* and 0.12–0.13 for *T*. *hirta*. The populations of both pests started to decrease following the second half of June in 2007 but could be observed at the orchards almost until the end of June.

Buprestidae*: Perotis chlorana* Leporte & Gory

Attelabidae: *Rhynchites hungaricus* Herbst

In order to determine the population fluctuations of *P*. *chlorana* and *R*. *hungaricus* in Oil-bearing rose orchards, counts were performed in 2006 and 2007 and the results were given in Figure 7.

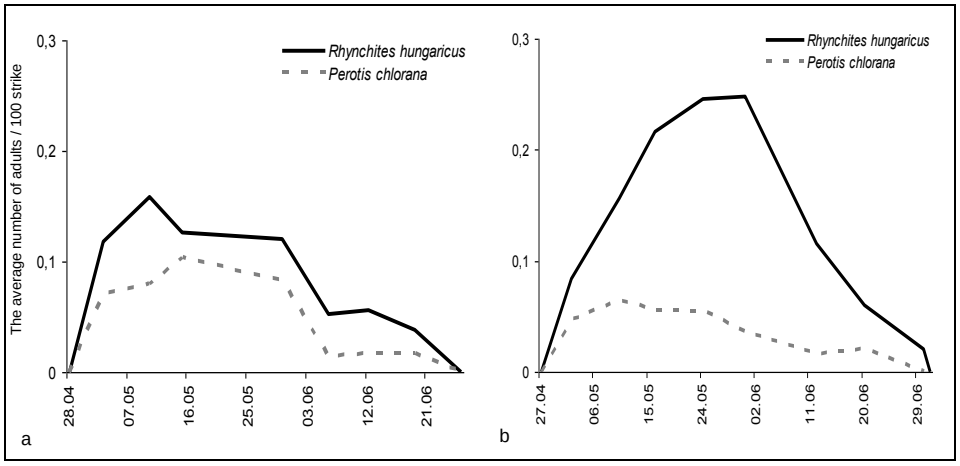

Figure 7. Population fluctuations of *Perotis chlorana* Leporte & Gory and *Rhynchites hungaricus* Herbst on Oil-bearing rose flowers between the years 2006 (a) ve 2007 (b).

In the study, it was determined for the years 2006 and 2007 that adults of *P*. *chlorana* could be observed from the first week of May on and the population reaches its maximum at mid-June. In this period is recorded that per strike average number of adults is 0.11 in 2006, and it is 0.70 in 2007. In both years, adult individuals can be seen up until the last days of June. By the field work, it is observed in the infected orchards, that adults live by cutting the buds and the leaves and larvae live by opening galleries at the roots, and as a result they cause plants to weaken and dry out. It draws attention that infection is much more in the Oil-bearing rose orchards located near forestland. Zeki et al. (1999) stated that both the adult and larvae of *P*. *chlorana* that is complained of are harmful at the Oil-bearing rose production fields, and the species may overwinter either as a adult or a larva. The study also determines that adults bring damage by eating the leaves from the edge inwards, by cutting the stem part of new buds and also by nibbling the stems of green and pink buds before the blooming period.

R. *hungaricus*, another type of the pests that is harmful for the buds of Oil-bearing roses, is observed at the beginning of May in both years and it is determined that the adult population begins to increase following the beginning of May. While per strike average number of adult individual is recorded as 0.13 – 0.16 in 2006, the same figure for 2007 is 0.20 – 0.23. In both years under inspection, no adult individuals can be seen after the second half of June, which is the end of bud vegetation period.

No literature could be found on the population fluctuation of the pest on Rosa related species and foliage plant. In their study on the population change of *R*. *cribripennis* which belongs to the same species and is harmful in olive orchards, Lykouressis et al. (2004) stated that the population of the pest started to increase in May and June and reached it's maximum at mid-June.

Pterophoridae: *Cnaemidophorus rhododactyla* (Denis & Schiffermüller)

In order to determine the population fluctuation of *C*. *rhododactyla* which lives on the buds of Oil-bearing rose, counts were performed in 2006 and 2007 and the result were given in Figure 8.

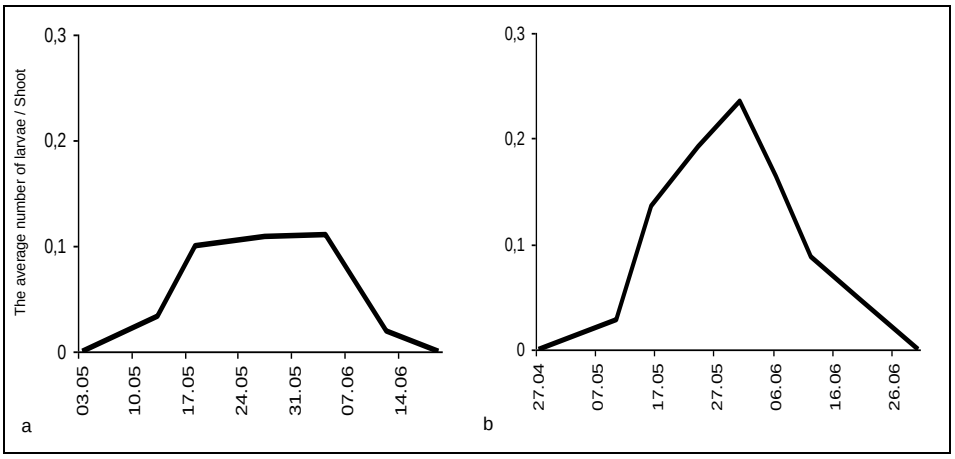

Figure 8. Population fluctuations of *Cnaemidophorus rhododactyla* (Denis&Schiffermüller) between the years 2006 (a) and 2007 (b).

In both years under inspection, it is recorded that the larvae of *C*. *rhododactyla* coincide with period of bud's vegetation, namely the end of April and the first days of May. It is observed that the population of the pest starts to increase from May on and per bud average number of larvae is 0.13–0.15 in 2006 and it is more or less the same in 2007, 0.11 – 0.14. It is recorded that as of May when bud vegetation declines, the population of the pest in the orchards starts to decline but lives till the first week of June. Tuatay (1963) states that those buds harmed by the larvae either do not bloom or partly bloom.

Cephidae: *Syrista parreyssii* Spinola

It is observed during the field study that as the result of the in-branch-downward nourishment of larvaes hatching from the eggs laid to the new shoots of Oil-bearing roses by the female individuals of *S*. *parrayssii*, the branch completely loses its functionality and dries out, and the new bud on which laid eggs are bends downward as the result of turgor pressure loss in a few hours. The population fluctuations gathered through the counts were given in Figure 9.

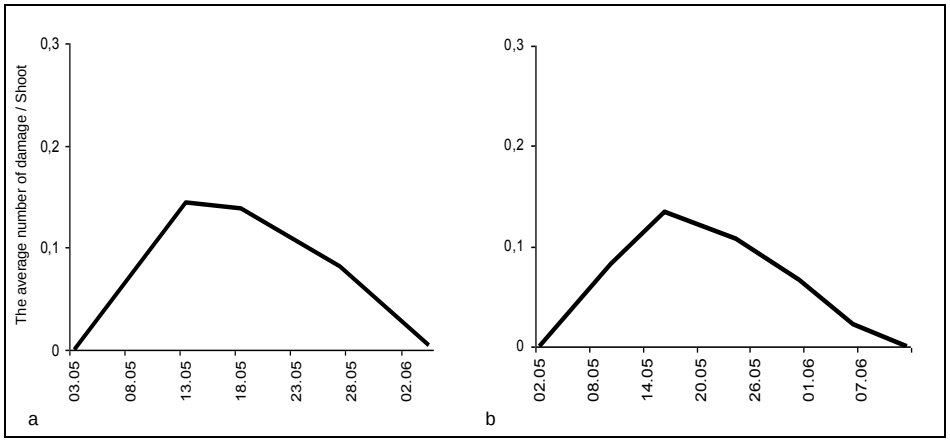

Figure 9. Population fluctuations of *Syrista parreyssii* Spinola between the years 2006 (a) ve 2007 (b).

In both years of the study, it was observed that flying of adults started at the second half of May and damaged (egg laid) shoots could be seen at the last days of May. Tuatay (1963) stated that flying of the adults of *S*. *parreyssii* in the provinces of Isparta and Burdur started at the end of May, the main flies started at June, and females leave each bud only one egg, rarely two. In the studies performed in 2006 and 2007 it is stated that the number of damaged buds reached its maximum at the last days of May. It is recorded that per bud maximum average number of damaged in 2006 and 2007 is 0.14 – 0.16.

At the controlling the pest, it is thought that the land control is very crucial and cutting and removing the egg laid by adult females and downward bended buds off the orchards would decrease the population in the following year.

Population fluctuations of important natural enemies

Anthribidae: *Anthribus fasciatus* Forster

Coccinellidae: *Exochomus quadripustulatus* (L.)

In order to determine the population fluctuations of *A*. *fasciatus* and *E*. *quadripustulatus* that feeds with *R*. *perornatus*, one of the main pests of Oil-bearing roses, counts were performed in 2006 and 2007, and the population fluctuations data is presented in Figure 10.

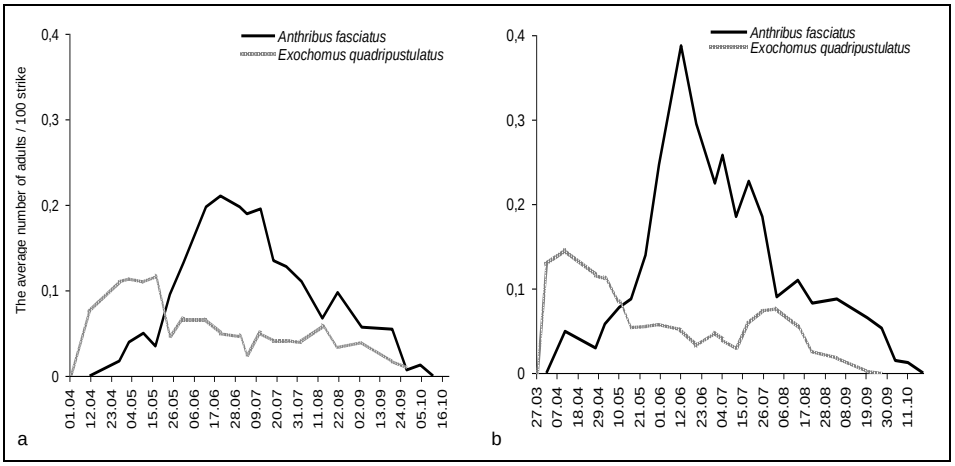

Figure 10. Population fluctuations of *Anthribus fasciatus Forster* and *Exochomus quadripustulatus* (L.) between the years 2006 (a) ve 2007 (b).

It is determined with the study that adults of *A. fasciatus* can be seen in the first week of April and the level of population reaches its maximum towards mid-June. In this period, per strike maximum average figure is recorded as 0.20–0.22 in 2006 and with an increase in population it is 0.39 – 0.41 in 2007. Ülgentürk & Toros (1996) states that predator feed with the eggs of individuals of *Eulecanium tiliae* (L.) on the *Rosa* spp., and states that one larvae is found on each coccid individual. In the observations realized through this study, at the beginning of June individuals of *A. fasciatus* that are at larvae stage are seen among the adult female individuals of *R. perornatus*. It is determined that larvae complete the pupa stage until mid-June and from mid-June on become adult individuals. It is observed that the population that is fallen towards the end of July starts to increase marginally at mid-August. At the pre-laboratory observations for the determination of the feeding characteristics of the predator, it is observed that *A*. *fasciatus* feeds by eating the shells of female individuals of *R*. *perornatus* at the oviposition period.

In the years 2006 and 2007 adult individuals of *E*. *quadripustulatus* could be seen from the end of March on. The population reaches its maximum level in 2006 at the end of the first week of April and it is found that per strike average number of individuals is 0.11 – 0.13 while the figure is 0.13 – 0.16 in 2007. In the field while no adult individual of *E*. *quadripustulatus* could be found from the beginning of June until the end of July, low levels of population are observed at the period covering the end of July and the first half of September. In his study on the Oil-bearing rose production areas in the province of Isparta Altınok (2004) finds adults of *E*. *quadripustulatus* at the first and second instar nypmhs of *R*. *perornatus* at the beginning of spring and summer. In his study on 50 plants from 2 different orchards he records 2.4±1.5 adult individuals at the

village of Deregümü and 3.1±1.3 at Gölcük on average. He states that dense chemical application at Oil-bearing rose orchards causes abnormal declines in the population of predator insects and no *E*. *quadripustulatus* population can be seen at the counts following the chemical applications.

Coccinellidae:

Adalia fasciatopunctata revelierei (Mulsant)

Coccinella septempunctata (L.)

Hippodomia variegata Goeze

Count studies were performed in 2006 and 2007 to determine the population fluctuations of *Adalia fasciatopunctata revelierei* (Mulsant), *Coccinella septempunctata* and *Hippodomia variegata*. The population fluctuations results are given in Figure 11.

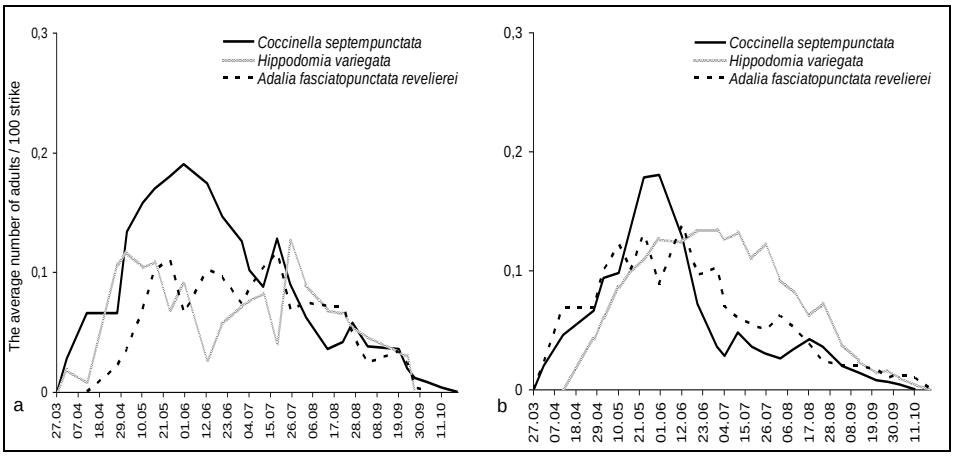

Figure 11. Population fluctuations of *Coccinella septempunctata* (L.), *Adalia fasciatopunctata revelierei* (Mulsant) and *Hippodomia variegata* Goeze between the years 2006 (a) ve 2007 (b).

In both years of the study it has been determined that the first predator species seen in the orchards was *C*. *septempunctata* and adult individuals were seen from the last days of March on. In 2006 and 2007 the population of *C*. *septempunctata* reaches its maximum level at the period starting from the end of April and lasting at the second half of June, and in this period per strike maximum average number of individuals is recorded as 0.18 – 0.21 in 2006 and 0.17 – 0.19 in 2007. In both years adult *C*. *septempunctata* were sampled almost up until September. Ban et al. (2008) states that various factors such as the density of prey, agricultural chemical utilization and the efficiency of other predators affect the population fluctuation of *C*. *septempunctata*. In many studies it is mentioned that *C*. *septempunctata* is generally the dominant type among the aphid-predator species found in the production areas (Ben Halima-

Kamel et al., 1993; Nakata, 1995; Atakan & Özgür, 1996; Ayyıldız & Atlıhan, 2003). In the study it is observed that the population level of *C*. *septempunctata* varies during the summer time and towards the end of summer a certain amount of decrease is experienced at the level of population.

In the years 2006 and 2007 when the study performed, adult *A*. *fasciatopunctata revelierei* seen in the period between the last week of April and the first week of May. Per strike maximum average number of adult *A*. *fasciatopunctata revelierei* which reaches its maximum level in the period covering the first week of June and mid-July is determined to be 0.10 – 0.13 in 2006 and 0.11- 0.14 in 2007. The population starts to diminish from the first half of August on, and until mid-September it may be seen.

Another beneficial species whose population change is observed is *H*. *variegate* and it is determined that it exists in the Oil-bearing rose orchards form the last days of March on in 2006 and 2007. It is observed in the study areas that the population is at its maximum size in the period between the second half of April and the end of August, and during June and July it experiences some increases and decreases. In this period while per strike average number of adult individuals is 0.10 -0.13 in 2006, it is 0.11 – 0.14 for the same period in 2007.

The Oil-bearing rose cultivation that is an important income source for the regional and national economies has regained importance especially in the last few years following the increase in the demand for rose oil. In the studies made it is observed that the Oil-bearing rose producers are trying to enlarge their production fields and accelerate their new plantation construction efforts. This increase in Oil-bearing rose cultivation has caused an increase in the pest and disease control demands in order to avoid economic losses experienced in production fields.

It is determined that the most harmful pest species in economic terms at the Oil-bearing rose orchards is *R*. *perornatus*. It is observed that the period covering the end of March and mid-April is of key importance in the controlling the second stage nymphs settled on two-year twigs is essential. Also a second control application against to the second instar nypmhs belonging to the new population in August would diminish the pest population in the following year and would foster the success in pest control.

It is determined that the second most harmful pest species in economic terms at the Oil-bearing rose orchards is *M*. *rosae*. It is recorded that the pest can be seen in small quantities on fronds from the first week of April on, the population of the pest increases during the period when new buds form, and then it forms colonies on rose buds. It is thought that an application to be realized before this period corresponding to mid-May would prevent flower buds against losses.

Throughout the study, it was determined that most of the Oil-bearing rose producers do not care with their plantations after the harvesting period and no

application against pests whose population increase is made in the post-harvest period. It is observed that in June, that is the post-harvest period, no precaution is taken against *T*. *urticae* whose populations excessively increase, and in the orchards where septic is dense plants substantially get harm.

Özet

Isparta ili Yağ gülü (*Rosa damascena* Miller) üretim alanlarında bulunan bazı önemli zararlı ve doğal düşmanların populasyon değişimleri

Isparta ili Yağ gülü üretim alanlarında bulunan zararlı ve yararlı türlerin belirlenmesi ve önemlilerinin ortaya çıkarılması amacıyla 2006–2007 yıllarında sörvey çalışmaları yapılmıştır. Yağ gülü alanlarında ekonomik açıdan önemli olan zararlı türlerden *Tetranychus urticae* Koch. (Acarina: Tetranychidae), *Rhodococcus perrornatus* Cockerell & Parrott (Homoptera: Coccidae), *Macrosiphum rosae* (L.) (Homoptera: Aphididae), *Thrips meridionalis* Priesner (Thysanoptera: Thripidae), *Oxythyrea cinctella* Schaum, *Tropinota hirta* Poda (Coleoptera: Cetoniidae), *Perotis chlorana* Castelnau & Gory (Coleoptera: Buprestidae), *Rhynchites hungaricus* Herbst (Coleoptera: Attelabidae), *Cnaemidophorus rhododactyla* (Denis & Schiffermüller) (Lepidoptera: Pterophoridae), *Syrista parreyssii* Spinola (Hymenoptera: Cephidae)'nin ve bu zararlılara ait önemli doğal düşmanlardan, *Anthribus fasciatus* Forster (Coleoptera: Anthribidae), *Adalia fasciatopunctata revelierei* (Mulsant), *Coccinella septempunctata* (L.), *Exochomus quadripustulatus* (L.), *Hippodamia variegata* Goeze (Coleoptera: Coccinellidae)'nın populasyon değişimleri belirlenmiştir. Bu çalışmanın sonuçları, *R. perornatus* ve *M. rosae*' nin Yağ gülü bahçelerinde ekonomik açıdan zararlı en önemli iki tür olduğunu göstermiştir.

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References

Acatay, A., 1969a. Gül (*Rosa damascena* L.) ve Gül Yağı. Özaydın Matbaası İstanbul, 63 s.

Acatay, A., 1969b. Schadlinge von *Rosa damascena* Mill. in der Turkei. **Anzeiger fur Schadlingskunde und Pflanzenschutz, (Journal of Pest Science)**, **42** (4): 49-53 (Deutsch).

Altınok, M. A., 2004. Isparta Ili Yağ Güllerinde Zararlı *Rhodococcus perornatus* (Cockrell and Parrott) (Homoptera: Coccidae)'un Biyolojisi Popülasyon Gelişmesi, Yayılışı, Doğal Düşmanları Ve Mücadelesi Üzerine Araştırmalar. Çukurova Üniversitesi Fen Bilimleri Enstitüsü, (Basılmış) Doktora Tezi, Balcalı, Adana, 104 s.

Anonymous, 2008. Isparta Meteoroloji Müdürlüğü Kayıtları (Web page: http://www.isparta.meteor.gov.tr/), (Date accessed: February 2008).

Anonymous, 2010. SDÜ Gül ve Gül Ürünleri Araştırma ve Uygulama Merkezi Araştırma Raporu. (Web page: http://www.gular.sdu.edu.tr/), (Date accessed: February 2010).

Atakan, E. & F. Özgür, 1996. Pamuk tarlasında erken mevsimde *Aphis craccivora* Koch., *Aphis gossypii* Glover (Homoptera, Aphididae) ve bunların doğal düşmanlarının populasyon değişimlerinin araştırılması. **Türkiye Entomoloji Dergisi, 20** (3): 187-197.

Ayyıldız, Y. & R. Atlıhan, 2003. Balıkesir ili sebze alanlarında görülen yaprakbiti türleri ve doğal düşmanları. **Yüzüncü Yıl Üniversitesi, Ziraat Fakültesi, Tarım Bilimleri Dergisi, 16** (1): 1-5.

Balevski, N., S. Simova & S. Draganova, 2008. Biodiversity of beneficial organisms (entomopatogens, predators and parasitoids) in the biocoenoses of oil-bearing rose (Rosa damascena Mill.) in Bulgaria. **Agricultural Academy, Plant Science, 45**: 115-122.

Ban, L., Ahmed, E. Ninkovic, V. Gabriele & D. R. Glinwood, 2008. Infection with an insect virus affects olfactory behaviour and interactions with host plant and natural enemies in an aphid. **Entomologia Experimentalis et Applicata, 127**: 108–117.

Ben Halima-Kamel, M. & M. H. Ben Hamouda, 1993. Aphids in the protected crops and their natural enemies in Tunisia. **Pests of Plants, 11** (2): 50-53.

Blackman, R. L. & V. F. Eastop, 2000. Aphids on the World's Crops: An Identification and Information Guide. 2nd Edition. John Wiley & Sons, Chichester, 466 pp.

Bulut, H. S. & N. Madanlar, 2004. Bademli (Ödemiş, İzmir) Beldesi meyve fidanlıklarında zararlı *Tetranychus urticae* Koch (Acarina: Tetranychidae)'nin populasyon yoğunluğu. **Türkiye Entomoloji Dergisi, 28** (3): 193-203.

Deligeorgidis, P. N., C. G. Ipsilandis, C. Fotiadou, G. Kaltsoudas, L. Giakalis & A. Garsen, 2005. Fluctuation and distribution of *Frankliniella occidentalis* (pergande) and *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) populations in greenhouse cucumber and tomato. **Pakistan Journal of Biological Sciences, 8** (8): 1105-1111.

Demirözer, O., M. B. Kaydan, I. Karaca & Y. Ben-Dov, 2009. First records of armoured scale insects (Hemiptera: Coccoidea: Diaspididae) from the oil-rose, *Rosa damascena*, in Turkey. **Hellenic Plant Protection Journal, 2** (1): 33-35.

Ecevit, O., 1977. *Panonychus ulmi* (Koch) ve *Tetranychus urticae* Koch (Acarina: Tetranychidae)'nin Populasyon Dinamiklerine Etki Eden Bazı Faktörler Üzerinde Araştırmalar. Atatürk Üniversitesi Yayınları No: 449, Erzurum, 164 s.

Flint, M. L., 1998. Pest of The Garden and Small Farm. A Grower's Guide To Using Less Pesticide, 2nd Edition. UC Division of Agriculture Resources and University of California Press. Berkeley, Los Angeles. London, 276 pp.

Heie, O. E., 1994. The Aphidoidea (Hemiptera) of Fennoscandia and Denmark. V. Family Aphididae: Part 2 of Tribe Macrosiphini of Subfamily Aphidinae. Fauna Entomologica Scandinavia, Leiden, Netherlands, 28, 242 pp.

Helle, W. & M. W. Sabelis, 1985. Spider Mites: Their Biology, Natural Enemies and Control. 1B. Elsevier Amsterdam, Netherlands, 458 pp.

Japoshvili, G. & İ. Karaca, 2002. Coccid (Homoptera: Coccoidea) species of Isparta province, and their parasitoids from Turkey and Georgia. **Turkish Journal of Zoology, 26**: 371-376.

Jaskiewicz, B., 1997. Observations on the occurrence of the rose aphid (*Macrosiphum rosae* L.) on bushes of *Rosa rugosa* Thunb. and *R. canina* L. **Folia Horticulturae, 9**: 25-31.

Jaskiewicz, B., 2004. The population dynamics of aphids colonising The shrubs of *Rosa canina* L. in urban conditions of Lublin. 7 (2). (Web page: www.ejpau.media.pl/ volume7/issue2/horticulture/art-05.html), (Date accessed: March 2007).

Karaca, İ., G. Japoshvili & O. Demirözer, 2003. Rose soft scale (Hemiptera: Coccidae) and it's parasitoid in Isparta province (Turkey). **Proceedings of the Georgian Academy Sciences, Biolgical Series B**, **1** (1-2): 77-81.

Klubertanz, T. H., L. P. Pedigo & R. E. Carlson, 1990. Effects of plant moisture stres and rainfall on population dynamics of the twospotted spider mite (Acari: Tetranychidae). **Environmental Entomology**, **19** (6): 1773-1779.

Kmiec, K., 2007. The occurrence of *Macrosiphum rosae* (L.) (Hemiptera: Aphididae) on rose shrubs in Lublin. Electronic Journal of Polish Agricultural Universities (EJPAU), 10 (2). (Web page: www.ejpau.media.pl/volume10 /issue2 /art-12.html), (Date accessed: March 2007).

Lykouressis, D., A. Kapsaskis, D. Perdikis, A. Vatos & A. Fantinou, 2004. Rates of population increase, abundance, and life stage distribution of *Rhynchites cribripennis* (Coleoptera: Attelabidae) on trees and in the soil in an olive grove. **Journal of Economic Entomology, 97** (2): 316-320.

Nakata, T., 1995. Population fluctuations of aphids and their natural enemies on potato in Hokkaido, Japan. **Applied Entomology and Zoology, 30** (1): 129-138.

Natskova, V., 1970. The parasites and predators of aphids on roses. **Rastitelna Zashchita, 19** (11): 19-22.

Nikolova, V., 1967. Entomocaenological and biological studies in *Rosa damascena* Mill. plantations. I. Lepidoptera. **Bulletin de L'institut de Zoologie et Musee, Sofia, 24**: 101-128 (Russian).

Nikolova, V., 1968. Entomocaenological and biological studies in *Rosa damascena* Mill. plantations. II. Coleoptera. **Bulletin de L'institut de Zoologie et Musee, Sofia, 26**: 119-151 (Russian).

Nikolova, V., 1969. Entomocaenological and biological studies in *Rosa damascena* Mill. plantations. III. Homoptera. **Izvestiya Zoologia Institute Sofia, 29**:191-210 (Russian).

Nikolova, V., 1972. Entomocaenological and biological studies in *Rosa damascena* Mill. plantations. IV. Hymenoptera and Diptera. **Bulletin de L'institut de Zoologie et Musee, Sofia, 30**: 107-135 (Russian).

Park, Y. L. & J. H. Lee, 2002. Leaf cell and tissue damage of cucumber caused by twospotted spider mite (Acari: Tetranychidae). **Journal of Economic Entomology, 95**: 952–957.

Pearsall, I. A. & J. H. Myers, 2000. Population dynamics of western flower thrips (Thysanoptera: Thripidae) in nectarine orchards in British Columbia. **Journal of Economic Entomology, 93** (2): 264-275.

Schedl, K. E, 1968. Borkenkäfer aus der Türkei. **Journal of Pest Science, 41** (2): 21-24 (Deutsch).

Steiner, H., 1962. Methoden zur untersuchung der populations dynamik in obstanlagen. **Entomophaga, 7** (13): 207-214.

Tsalbukov, P., 1971. Testing preparations for the control of *Rhodococcus bulgariensis*. **Rastitelna Zashchita, 19** (12): 23-24.

Tuatay, N., 1963. Isparta ve Burdur Bölgesi Yağ Güllerinin Başlıca Zararlıları, Kısa Biyolojileri ve Savaş Metodları Üzerinde Araştırmalar. Tarım Bakanlığı, Ankara Zirai Mücadele Enstitüsü Müdürlüğü, No: 39. Ayyıldız Matbaası, Ankara, 76 s.

Ülgentürk, S. & S. Toros, 1996. "Ankara İlinde *Anthribus fasciatus* Först. (Coleoptera: Anthribidae) üzerinde çalışmalar 668-674.". Türkiye III. Entomoloji Kongresi Bildirileri, (24-28 Eylül 1996, Ankara), 709 s.

Ülgentürk, S., M. B. Kaydan, C. Zeki & S. Toros, 2001. *Rhodococcus perornatus* (Cockerell Parrott) (Homoptera: Coccidae): Yağ güllerinin yeni bir zararlısı. **Türkiye Entomoloji Dergisi, 25** (2): 127-132.

Zeki, H., A. Tamer, K. Ş. Örmeci, M. Ç. Bozkır & S. Toros, 1999. Isparta ilinde yağ güllerinde (*Rosa damascena* Miller) zarar yapan *Perotis chlorana* (Lap. et Gory) (Coleoptera: Buprestidae)'nın biyolojisi ve mücadelesi üzerinde araştırmalar, **Turkish Journal of Agriculture and Forestry, (23)**: 165-182.