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Orijinal araştırma (Original article)

Aphids (Hemiptera: Aphididae) on lettuce in the Eastern Mediterranean Region of Turkey: Incidence, population fluctuations, and flight activities[1]

Doğu Akdeniz Bölgesi marul ekiliş alanlarında zararlı olan Yaprakbiti (Hemiptera: Aphididae) türleri, bulaşıklık oranları, popülasyon gelişmesi ve uçuş aktiviteleri

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Summary

Lettuce is an important crop consumed fresh during winter and spring time. In the past 20 years, aphids have emerged as a major pest problem in lettuce fields of eastern Mediterranean region in Turkey. In this paper, we conducted survey studies to determine aphid species of lettuce and also monitored their population and flight activity during growing season of 2009-2010. Seven aphid species, *Aphis gossypii* Glover, *Aulacorthum solani* (Kaltenbach), *Hyperomyzus lactucae* (L.), *Myzus (Nectarosiphon) persicae* (Sulzer), *Nasonovia ribisnigri* (Mosley), *Rhopalosiphum nymphaeae* (L.) and *Pemphigus bursarius* (L.) (Hemiptera: Aphididae), were determined in the region. *Nasonovia ribisnigri* emerged as the most common among these aphid species. An increase in population was detected in the first plantation lettuce field in November (2009), but another peak was also observed in March (2010) in the second planting period of lettuce during the study which aimed to determine aphid population fluctuations in lettuce fields. In addition, there was no aphid detected during the third planting period of lettuce when milk formation (bitter) occurred and temperature increased. The twelve aphid species that were determined in total were collected by water pan trapping during the study to determine the flight activity of aphids, while six of them were also observed in fields. *Hyperomyzus lactucae* (41%), *N. ribisnigri* (16%), and *M. (N.) persicae* (24%) accounted for 81% of the individuals captured in traps. The flight activity patterns of *N. ribisnigri* in traps were quite similar to those observed in the field.

Key words: *Nasonovia ribisnigri, Myzus persicae,* aphid incidence, population fluctuation, flight activity

Özet

Marul kışın ve ilkbaharda taze olarak tüketilen önemli ürünlerden birisidir. Yaprakbitleri son 20 yılda Akdeniz Bölgesi marul ekim alanlarında en önemli sorun olarak karşımıza çıkmıştır. Bu çalışmada sürvey çalışmaları ile maruldaki yaprakbitleri ve yoğunluklarını belirlenmesi ve de 2009-2010 marul yetiştirme peryodunda da bu yaprakbitlerinin populasyon gelişmesi ile uçuş aktivitelerinin belirlenmesi amaçlanmıştır. Bu çalışma sonucunda bölgede *Aphis gossypii* Glover, *Aulacorthum solani* (Kaltenbach), *Hyperomyzus lactucae* (L.), *Myzus persicae* (Sulzer), *Nasonovia ribisnigri* (Mosley), *Rhopalosiphum nymphaeae* (L.) ve *Pemphigus bursarius* (L.) (Hemiptera: Aphididae) olmak üzere yedi farklı yaprakbiti türü saptanmıştır. Bu yaprakbiti türlerinden *N. ribisnigri* en sık rastlanılan yaprakbiti türü olduğu anlaşılmıştır. Yaprakbitlerinin marul tarlalarında popülasyon dalgalanmalarını belirlemek için yapılan çalışmada I. Ekim marul tarlasında Kasım (2009) ayında bir popülasyon yükselmesine rastlanırken, II. Ekim marulda ise Mart (2010) ayında bir popülasyon artışı görülmüştür. III. ekim marulda ise artan sıcaklıkla birlikte süt oluşumu (acılaşma) olmuştur. Bu marul tarlasında herhangi bir populasyon tespit edilememiştir. Yaprakbitlerinin ucuş aktivitesini belirlemek için yapılan çalışmada toplam 12 tür, su tuzaklarına düşerken bu türlerin 6'sı marulda bulunan türler olmuştur. Su tuzaklarına yakalanan türlerin %81'sini ise *H. lactucae* (%41), *N. ribisnigri* (%16) ve *M. periscae* (%24) oluşturmuştur. *N. ribisnigri'nin* su tuzaklarında tespit tedilen uçuş aktivitesi marul bahçelerindeki populasyon gelişmesi ile bir benzerlik göstermiştir.

Anahtar sözcükler: *Nasonovia ribisnigri, Myzus persicae*, bulaşıklık oranı, popülasyon gelişmesi, uçuş aktivitesi

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Introduction

The East Mediterranean Region of Turkey has significant advantages in terms of agriculture, by means of climate, soil and other ecological conditions. There is intensive polyculture in the region as well as a large vegetable production industry. Vegetables, especially lettuce, grow for four seasons in the region at different altitudes. This vegetable cultivation is done on large pieces of land down to house gardens. Lettuce growing in the East Mediterranean Region of Turkey constitutes 34% of the total production and distribution of this ratio by provinces is 10% for Hatay, 1% for Osmaniye, 17% for Adana and 6% for Mersin (Anonymous, 2008).

Lettuce needs less watering than other types of vegetables due to its growth seasons (fall - spring) but it is rich in A, B, C, D and E vitamins and mineral salts such as iron, calcium and phosphorus. Although this healthy and economically important vegetable has many pests, primary damage is done by aphids. Four different aphid species, *Aphis craccivora* Koch, *Acyrthosiphom lactucae* (Passerini), *Macrosiphum euphorbiae* (Thomas) and *Myzus (N.) persicae* Sulzer were reported on lettuce in Çukurova Region (Zeren, 1989). In another study to determine the overall aphid fauna in the East Mediterranean Region, three aphids species; *A. lactucae*, *M.* (N.) *persicae* and *Nasonovia ribisnigri* (Mosley) were detected (Toros et al., 2002). In addition, fifteen different aphid species *Pemphigus* spp., *Trama* (*Neotrama*) *caudata* Del Guercio, *T. troglodytes* von Heyden, *A. gossypii* Glover, *A. fabae* Scopoli, *Uroleucon formosanus* (Takahashi), *U. cichori* (Koch), *U. ambrosiae* (Thomas), *N. ribisnigri*, *Aulacorthum* (*Neomyzus*) *circumflexum* (Buckton), *A. solani* (Kaltenbach), *A. lactucae*, *M. euphorbiae* and *M.* (*N.*) *persicae* Sulzer (Hemiptera: Aphididae) have been reported on lettuce worldwide (Blackman & Eastop, 1984). Among these species, *N. ribisnigri* is considered as the most critical pest for lettuce in Europe and Canada (Mackenzie & Vernon, 1988; Martin et al., 1995; Rufinger et al., 1997). In addition, various researchers reported *N. ribisnigri* as the most important pest, especially in California and Arizona (USA) since the first time it was identified (Chaney, 1999; Palumbo 2000; Palumbo & Hannan, 2002). *Nasonovia ribisnigri* was recorded in the region of the present study for the first time by Erkılıç et al. (1999) in a survey study to determine the fungal diseases of aphids in the East Mediterranean Region between 1992 and 1996.

Lettuce, consumed especially as a fresh and green vegetable, has not been studied on the basis of pest management. Despite the importance of aphids on lettuce in the East Mediterranean Region, no studies have been reported, except for general surveys (Zeren, 1989; Erkılıç et al., 1999; Toros et al., 2002; Koçak 2010). The aim of the present study was therefore to determine aphid species on lettuce in the East Mediterranean Region, and also their infestation rates, flight activities and population development. These data will help provide a basis to develop effective control methods suitable for integrated control in the Çukurova Region.

Materials and Method

Survey, identification and incidence of aphid species on lettuce

Surveys were conducted in lettuce fields in Hatay, Osmaniye, Adana and Mersin provinces to determine aphid species in lettuce cultivation areas of the East Mediterranean Region of Turkey (Figure 1).

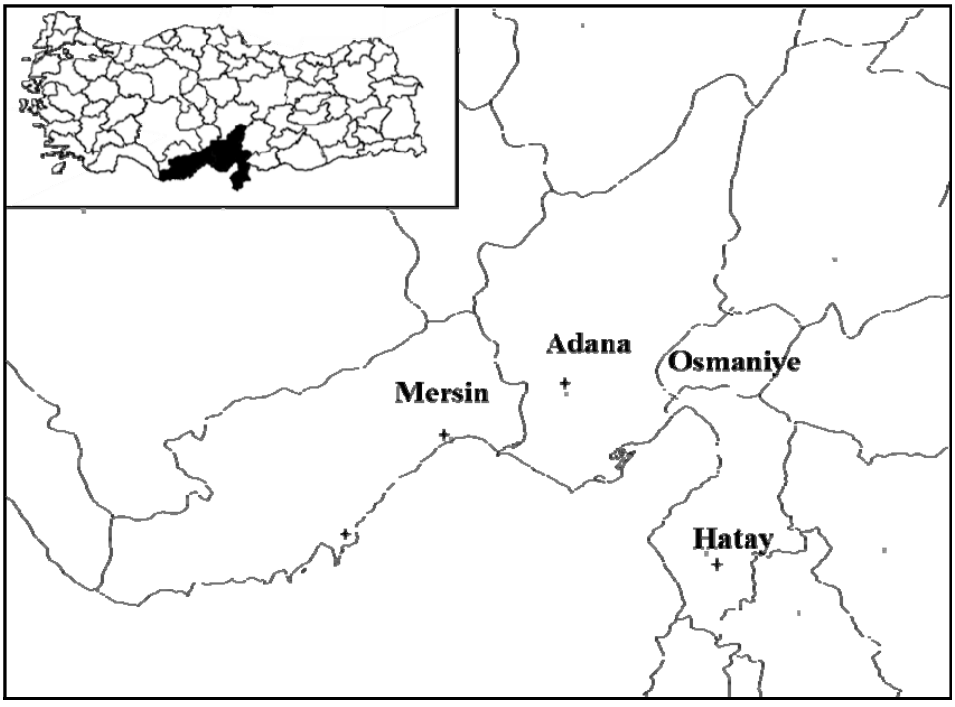

Figure 1. Location of lettuce fields where aphid species were sampled.

Lettuce fields on lower altitudes in the plain were monitored during the growing period between October 2009 and April 2010. Also, lettuce cultivation areas on higher plateaus were monitored in late spring and summer time to identify aphid species in lettuce fields. Sampling was carried out by walking sites from one end to another end in the middle of the field, stopping every 8-10 steps. Lettuce plants in that area were inspected visually and aphid infestation was counted. The infested plants were pulled up from these infested fields according to their infestation rates and size of field (Bora & Karaca 1970). After that, they were examined in laboratory and aphids were preserved in 1.5 ml tubes, containing 70% alcohol, until identification. Label information such as date, place and plant species was also recorded. During monitoring, infested and non-infested lettuce plants were checked to determine the rate of infestation.

Identifications were made by using keys (Bodenheimer & Swirski, 1957; Hille Ris Lambers, 1945; 1947; 1969; Börner & Heinze, 1957; Shaposhnikov 1964; Stroyan 1963; 1977; 1984; Eastop, 1972; Blackman & Eastop 1984). Aphid preparation procedures were applied according to the method of Hille Ris Lambers (1950).

Determination of aphid population fluctuations and flight activities in lettuce fields

To determine population fluctuations of aphids on lettuce plants, lettuce seedlings (*Lactuca sativa* L. var. Velvet®) were planted three times (October 10th, 2009, January 5th, 2010 and April 19th, 2010) in the field at the Research and Implementation Farm of Çukurova University, Faculty of Agriculture, Department of Plant Protection. Seedlings were planted in the soil in double rows on each ridge and 5000 lettuce plants were planted per decare. Fertilizer (N-P-K; 15-15-15) was applied to the soil at 20 kg/decare before each planting period. In addition, 10 kg/decare ammonium nitrate fertilizer was applied before head formation of lettuce. Weed control in lettuce fields was accomplished mechanically during growth trials. Lettuce seedlings were supplied by a private company to whom we had provided seeds of lettuce cultivars. Care was taken to ensure that seedlings were pesticide-free before planting. Planting was done as four parcels in each planting period. Plot size was 15 x 20 m with a 2.5 m wide safety zone between plots.

The numbers of aptera and aleta aphids were counted on ten randomly selected lettuce plants in each plot during each of the three planting periods. Aphid population fluctuation was determined by counting aphids on the leaves of lettuce hearts every week from planting to harvest. A few adult aphids from the plots were transferred into tubes directly with a fine-tipped brush on a weekly basis for the identification of aphid species on lettuce plants. Flight activities of aphids in lettuce fields were monitored with rectangular water pan traps (15 X 25 cm, 6 cm deep) placed on holders 30 cm above the ground. Pans had the color of a fresh lettuce leaf and were placed in two different locations in each of three growing season. For identification purposes, captured aphids were harvested weekly and transferred with a brush into vials containing 70% ethanol. Aphid individuals obtained from both lettuce plants and pan traps were prepared and identified by using a stereo-microscope.

Results and Discussion

Aphid species on lettuce plants

In field surveys, aphid species (6 species in sub-family Aphidinae, 1 species in sub-family Pemphiginae), were identified between 2009 and 2010 in the region (Table 1).

Table 1. Aphid species and their numbers in lettuce cultivation areas of the East Mediterranean Region of Turkey in 2009 and 2010

Subfamily	Species	Number of Infested fields	Incidence rate (%)
Aphidinae	*Aphis gossypii* Glover	3	5.4
	Aulacorthum solani (Kaltenbach)	3	5.4
	Hyperomyzus lactucae (L.)	5	9.1
	Myzus (N.) persicae (Sulzer)	12	21.8
	Nasonovia ribisnigri (Mosley)	27	49.1
	Rhopalosiphum nymphaeae (L.)	3	5.4
Pemphiginae	*Pemphigus bursarius* (L.)	2	3.6

As shown in Table 1, *N. ribisnigri* was the most common aphid species followed by *M. persicae* on lettuce plants. On the other hand, aphids in the subfamily Pemphiginae (*P. bursarius*) were found on lettuce only in Belen, a district of Hatay. Prior of this, research had indicated four different species *A. craccivora*, *A. lactucae*, *Macrosiphum euphorbia*, and *M. persicae*, on lettuce in Çukurova (Zeren, 1989). In addition to this, three aphid species, *A. lactucae*, *M. persicae* and *N. ribisnigri* had been detected in a study to determine the overall aphid fauna in the East Mediterranean Region (Toros et al., 2002). In addition to these species, very common virus vectors such as *A. gossypii*, *A. solani*, *H. lactucae*, *R. nymphaeae*, and *P. bursarius* were added to list by the current study.

Sub-family: *Aphidinae*

Six species of Aphidinae sub-family were identified in this study.

Tribe: Aphidini-Aphidina

Aphis gossypii Glover, 1877

Studied sample: 21/04/2009, Yeşiltepe/Mersin; 20/10/2009, Belen/Hatay.

Tribe: Aphidini-Rhopalosiphina

Rhopalosiphum nymphaeae (Linnaeus, 1761)

Studied sample: 21.04.2009, Mezitli /Mersin.

Tribe: *Macrosiphini*

Four species *Aulocorthum, Hypermyzus, Myzus (Nectarosiphon),* and *Nasonovia* were detected with in four genus.

Aulacorthum solani (Kaltenbach, 1843)

Studied sample: 09/04/2009, Yüreğir/Adana; 14/04/2009, Karalarbucağı/Adana.

Hyperomyzus lactucae (Linnaeus, 1758)

Studied sample: 24/03/2009, Erdemli/Mersin; 14/04/2009, Tarsus/Mersin; 21/04/2009, Mezitli/Mersin; 28/04/2009, Aşağıburnaz/Hatay.

Myzus (Nectarosiphon) persicae (Sulzer, 1776)

Studied sample: 21/04/2010, Mezitli/Mersin; 21/04/2010, Erdemli/Mersin; 28/04/2010, Erzin/Hatay; 28/04/2010, Başlamış/Hatay; 28/04/2010, Madenli/Hatay; 28/04/2010, Aşağıburnaz/Hatay; 28/04/2010, Üçgüllük/Hatay; 28/04/2010, Serinyol/Hatay.

Nasonovia ribisnigri (Mosley, 1841)

Studied sample: 24/03/2009, Erdemli/Mersin; 14/04/2009, Özbek/Mersin; 14/04/2009, Merkez/ Mersin; 14/04/2009, Yenice/Mersin; 14/04/2009, Karalarbucağı/Adana; 14/04/2009, Çamtepe/Mersin; 24/04/2009, Çamtepe/Mersin; 21/04/2009, Yenice/Mersin; 21/04/2009, Yeşiltepe/Mersin; 21/04/2009, Mezitli/Mersin; 21/04/2009, Mantaç Köyü/Mersin; 28/04/2009, Başlamış/Hatay; 28/04/2009, Madenli/Hatay; 20/10/2009, Belen/Hatay; 27/10/2009, Alifakılı/Mersin; 10/11/2009, Geçitli/Adana; 10/11/2009, Ceyhan/Adana; 19/11/2009, Kadirli/Adana; 19/11/2009, Kozan/Adana; 15/01/2010, Balcalı/Adana.

Subfamily: Pemphiginae

Tribe: *Pemphini*

One species of *Pemphigus* Harting 1839 was detected in this study.

Pemphigus bursarius (Linnaeus, 1758)

Studied sample: 20/10/2009, Belen/Hatay.

Aphid incidences in lettuce fields

Lettuce fields were found to be infested at rates ranging from 0% to 100% in lettuce fields in the East Mediterranean Region of Turkey (Table 2).

The highest rates of infestation occurred in Adana province, followed by Hatay and Mersin provinces, respectively. The infestation rate was lower than expected in some districts of Mersin province, especially in Tarsus and Yenice, despite the fact that these districts have 10-100 hectares of commercially planted lettuce. This lower rate of infestation is almost certainly due to elevated levels of insecticide application. According to face to face interviews either with farmers or field workers, some of these commercial fields are sprayed three or four times from seedling to harvest. However, this information is difficult to verify since many owners of these fields will not give permission to survey their fields.

Table 2. Infestation rates (%) in lettuce fields of the East Mediterranean Region of Turkey in 2009 and 2010

Province	District	Number of surveyed field	Infestation rate (%)
Adana	Seyhan	3	13.3
	Yüreğir	1	30.0
	Ceyhan	2	80.0
	Kozan	1	80.0
	Kadirli	1	80.0
	Average		54.6
Mersin	Erdemli	1	10.0
	Center	7	37.1
	Tarsus	9	15.3
	Yenice	3	9.3
	Average		17.9
Hatay	Serinyol	1	2.0
	Dörtyol	3	34.0
	Erzin	3	7.0
	İskenderun	15	25.5
	Average		17.1
	General average	50	32.6

Growers tend to apply insecticides frequently in the East Mediterranean Region, especially in the large lettuce fields in Adana and Hatay provinces. Infestation rate increases to 80% in some parts of the Kozan and Kadirli regions, where commercial cultivation is not common, spraying is minimal, and most lettuce is typically grown in small home gardens (Table 2).

Nasonovia ribisnigri was the sole aphid species found in 24 of the 50 fields surveyed, while in 3 other fields it was found associated with other aphid species. *Nasonovia ribisnigri* was responsible for about 50% of aphid infestation on lettuce by itself. The second most common aphid species, *M. (N.) persicae* was detected in 9 fields alone and in 3 fields with other aphids during the survey. Similarly, *H. lactucae* was detected alone in two lettuce fields, together with *N. ribisnigri* in a field and with *M. (N.) persicae* in another plantation area. Although *A. solani* was found alone in two lettuce fields within the boundaries of Adana province; it was also found with *N. ribisnigri* in a field within the same city. In recent years, *N. ribisnigri* has been recorded as the most important pest for lettuce in many areas such as Europe, Canada and the United States (Mackenzie & Vernon 1988; Martin et al., 1995; Rufingier et al., 1997; Chaney, 1999; Palumbo 2000; Palumbo & Hannan, 2002). *Nasonovia ribisnigri* was detected in a field survey between 1992-1996 (Erkılıç et al, 1999), after that this species became the most common in the area, presumably due to its better adaptation on lettuce and/or its insecticide resistance ability.

Population fluctuations and the flight activities of the aphids

Lettuce plants were found to be susceptible to colonization by *N. ribisnigri* and *M. persicae* throughout their development. These aphids established colonies on all inoculation dates of both fall and spring transplants (Figure 2 and Table 3). Similar results were obtained from previous studies (Mackenzie & Vernon 1988; Liu, 2004).

Three aphid species (*N. ribisnigri*, *M. persicae,* and *H. lactucae*) were obtained from lettuce that was planted to monitor aphid populations. *Nasonovia ribisnigri* had the largest proportion with 65%, followed by *M. persicae* (21%) and *H. lactucae* (14%). Aphid numbers did not increase during October in the first field; however, numbers began to increase at the beginning of November when the weather became cooler and lettuce began to grow (Figure 2). This increase in population lasted through the harvest and until the end of December 2009. In the same month, mosaic virus symptoms were seen in a very low percentage (< 1%) of lettuce planting areas. This virus is transmitted in a non-persistent manner by aphids and leads to significant losses during the autumn months in lettuce growing places such as Spain (Moreno et al., 2007). Numbers of aphids increased between the autumn (first sowing dates) and spring (second sowing dates) months when the temperature was about 15-22 °C (Anonymous, 2010).

A similar result was obtained by Pulambo & Hannan (2002). In their experiment, *N. ribisnigri* had a high population when the temperature was between 18 and 23°C.

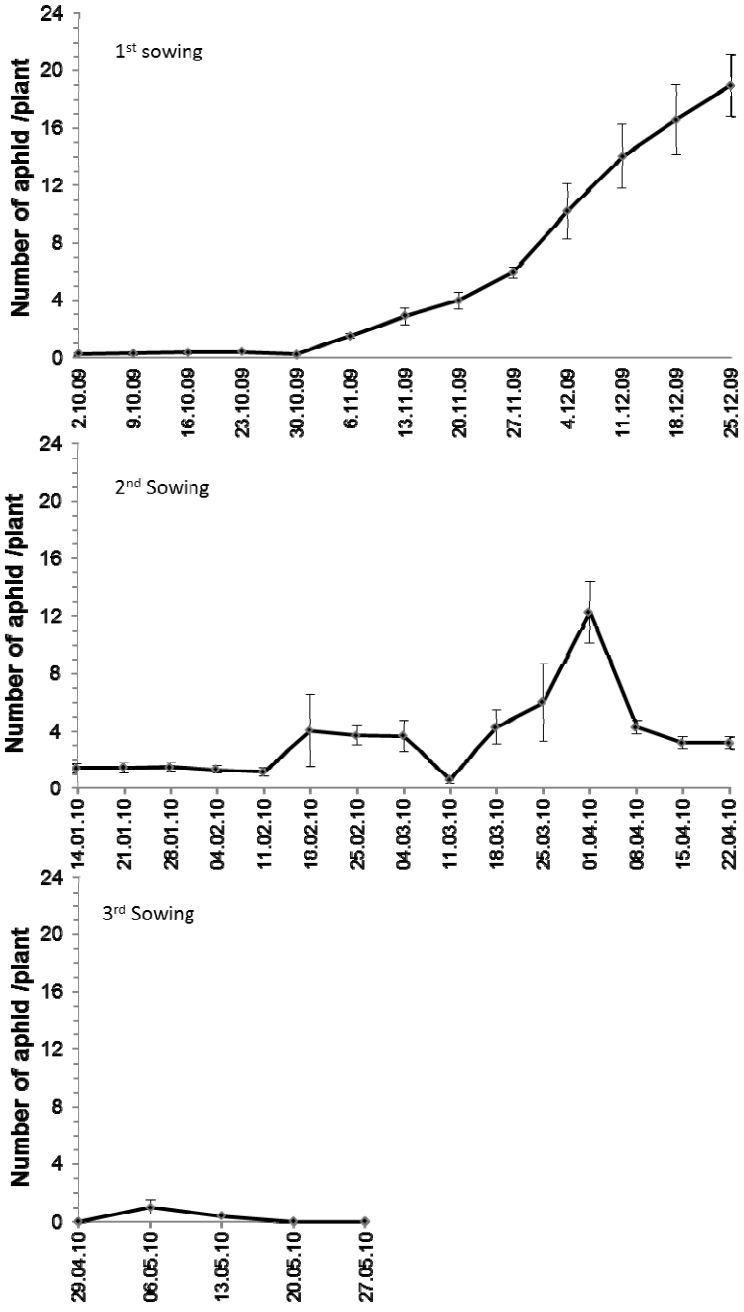

Figure 2. Aphid population fluctuations in three lettuce fields in Balcalı-Adana during 2009 and 2010.

Aphid population levels were not so high in the first experimental field as in the second, which was planted at the beginning of January, but numbers began to increase at the beginning of March when the weather became warmer (Figure 2). This increase was suppressed to an extent by the entomopathogenic fungus, *Fusarium subgulitinans*, which naturally emerged with rains that fell beginning in February (02.02.2010) and lasted until March (02.03.2010). No rain was recorded from the beginning until the end

of March, and the population increased in this month. A significant population decrease occurred upon the bolting of lettuce with increasing air temperatures in April 2010 (Anonymous, 2010). Many individuals were found killed by the entomopathogen during their population observations of both experimental and surveyed fields in the rainy seasons, March-April, (Anonymous, 2010). Consequently, it was understood that this fungus is a natural enemy of this pest and should be further studied. Similar observations were reported by other investigators from their studies in both field and laboratory in the Çukurova Region (Biçer, 1998; Erkılıç et al., 1999; Satar 2004).

There was no specific aphid population growing on lettuce, planted for the third growing season on 30.04.2010, presumably due to increasing temperatures and increased milk formation (bitterness) in the lettuce plants (Figure 2).

Early detection of *N. ribisnigri* infestations is critical for its successful management. One of the methods for early detection of aphids is observation of the flight activity of the pest. Water-pan traps that have the color of young lettuce leaves were used during the study to determine alate aphids flight activities in lettuce fields; numbers and dates of caught individuals are shown in Table 3. The total number of aphids from the 12 species determined that fell into water-pan traps during the eight-month-sampling period was 191. Three species, (*H. lactucae*, 41 %; *N. ribisnigri*, 16 %; and *M. persicae*, 24 %) contributed 81% of total captured individuals. *Pemphigius. bursarius* was not detected in this study, while the other six have already been reported previously. *Macrosiphum euphorbia* was not detected during our field surveys, while it constituted 3 % of total aphids in pan-traps. However, it was identified in an earlier study on lettuce (Zeren, 1989). *Brachycaudus helichrysi* (Kaltenbach), which is known as the stone fruit aphid, was recorded at 1%, *Rhopalosiphoninus latysiphon* (Davidson), which appeared on potato tubers, was 1%, *Aphis fabae* (Koch), a polyphagus species occurring on legumes generally, was 2%, and *Lipaphis* sp. was 1% in the traps (Table 3).

The most aphids were caught in the traps during the second and the third weeks of October 2009 when seasonal flight activity of aphids was monitored. However, the number of aphids captured by traps decreased between November and December when air temperature fell and plant habitus did not grow very well. On the other hand, a significant increase in the flight activities was seen on growing plants due to warming weather and increasing amount of daily rain beginning in February 2010 (Anonymous 2010). Furthermore, this was the time period where most species were caught. This is an expected result for most of the aphids, because their flight activities depend on available host plants and weather (Dixon, 1985). *Nasonovia. ribisnigri*, an important pest of lettuce, was found in traps during the first and second planting and growing cycle of lettuce between October, 2009, and February, 2010. This finding is an indication that this pest prefers lettuce. The most common species caught by traps was *H. lactucae*, which was found throughout the whole period of the study and was caught in the highest numbers in traps during the spring months of 2010. There are 27 recorded host plants of *H. lactucae* in the Palearctic region (Ölmez-Bayhan et al., 2003; Aslan & Uygun 2005; Holman, 2009). These plants generally belong to the plant families Asclepiadaceae, Compositae, Cruciferae and Saxifragaceae. Among host plants, *Cichorium intybus* L., *Cirsium arvense* (L.) Scop., *L. serriola* (L.) Torn., *Reichardia tingitana* (L.) Roth, *Sedum anglicum* Hudson, *Senecio flavus* (Decaisne) Schultz Bip., *Sonchus oleraceus* L. and *Taraxacum officinale* Weber are commonly found in the region of the current study (Uygur et al., 2010). It was reported by Toros et al. (2002) that *H. lactucae* was a common aphid species on *Sonchus* spp. in the

Çukurova region, and a similar observation was made by Tuatay (1990). These reports help to explain why *H. lactucae* was observed in such high numbers in early winter and throughout the spring, as a high number of host plants (e.g., *S. oleraceus*) were common in the region at that time (Uygur et al., 2010).

Table 3. Aphid species and numbers of individuals captured in water-pan traps in lettuce fields in three growing periods from October 2010 through May 2011 in Balcalı, Adana

Date	Total number of Aphid	*Hyperomyzus lactucae*	*Nasonovia ribisnigri*	*Pemphigus bursarius*	*Myzus persicae*	*Macrosiphum euphorbiae*	*Brachycaudus helichrysi*	*Aulacorthum solani*	*Rhopalosiphonim latysiphon*	*Rhopholosiphum.nymphaeae*	*Aphis gossypii*	*Aphis fabae*	*Lipaphis* sp	*Uroleucon cichorii*
14.10.10	17	10	7											
21.10.10	32		12		12			8						
28.10.10	5	2	2		1									
04.11.10	0													
11.11.10	4	2			2									
18.11.10	5		5											
25.11.10														
02.12.10	2					1	1							
09.12.10	5	1			3					1				
16.12.10														
23.12.10	3	2				1								
30.12.10	0													
06.01.11	0													
13.01.11	0													
20.01.11	0													
27.01.11	4	2			2									
03.02.11	2	1			1									
10.02.21	9	1			5			1						2
17.02.11	4	2	1		1									
24.02.11	9	2	3											4
03.03.11	11	4			2				1		1			3
10.03.11	7	3			4									
17.03.11	3	2								1				
24.03.11	6	4				1						1		
31.03.11	11	5			5			1						
07.04.11	8	6				2								
14.04.11	9	7			1	1								
21.04.11	8	5			2								1	
28.04.11	6	3			1							2		
05.05.11	0													
12.05.11	5	3												1
19.05.11	6	5			1									
26.05.11	10	6	1		2						1			
Total	191	78	31	0	45	6	1	10	1	2	2	3	1	10
% of total	100	41	16	0	24	3	1	5	1	1	1	2	1	5.2

One of the important steps in integrated pest management (IPM) in lettuce is the correct determination of the economic pest threshold level to determine the correct spraying time. However, in

lettuce fields, waiting for this economic threshold level results in unsuccessful pest control. This generally happen because of pesticide application time. Near maturation, the typical time for foliar sprays, lettuce leaves are closely packed in the developing heads, providing protected areas for aphids and making them difficult targets in sprays. In addition, all of the leaves are directly connected to the root, creating a barrier for distribution within plants of systemic pesticides applied to soil. As a result, many more applications tend to be needed by harvesting time. In some countries the application of systemic pesticide is done by soil application before the pests reach the economic threshold level (Palumbo & Hannan, 2002; Cantoni et al., 2008). It means that early detection of the pest outbreak is a critical step in the IPM strategy.

The current study, performed in the East Mediterranean Region lettuce cultivation areas of Turkey, reports that aphids are important pests oflettuce fields that are planted in October and January, especially on the plains, and that aphids are more abundant in the first production period of lettuce than the second. Furthermore, there has been a shift to the opinion that *F. subglitinans* may have an important role against lettuce aphids in the future biological control program. Generally, it occurs naturally in lettuce fields which are sown in January and puts serious pressure on lettuce aphid populations in rainy periods. Aphid populations were monitored easily and effectively with water-pan traps. These traps can play an important role in early warning and prediction of aphid populations after detailed studies of the areas where aphids cause severe damage because of their feeding and vector activities. It is suggested that a combination of *F. subglitinans* application and the water-pan trap's early warning may help solve the current problems in aspect of biological control.

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