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Orijinal araştırma (Original article)

Population dynamics of *Aphis tirucallis* Hille Ris Lambers, 1954 and *Aphis vallei* Hille Ris Lambers & Stroyan, 1959 (Hemiptera: Aphididae) on *Euphorbia* spp. (Euphorbiaceae) in Van, Turkey[1]

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Summary

This study was conducted in Van Province in 2006-2007 years. Samplings were performed in three different locations and aphids were directly counted of those collected from branches of *Euphorbia* spp. *Aphis tirucallis* Hille Ris Lambers, 1954 were found on *Euphorbia heteradena* Jaub. et Spach and *Euphorbia seguieriana* Necker subsp. *seguieriana* Necker while *Aphis vallei* Hille Ris Lambers & Stroyan, 1959 was found on *Euphorbia macroclada* Boiss. These are the first reports for the aphids and their host plants in this area. Population changes of the aphids were observed during two years. It was determined that both of aphids created higher population in the year 2007, which had more proper climate conditions.

Key words: *Euphorbia heteradena, Euphorbia macroclada*, *Euphorbia seguieriana* subsp. *seguieriana*, population dynamic

Anahtar sözcükler: *Euphorbia heteradena, Euphorbia macroclada*, *Euphorbia seguieriana* subsp. *seguieriana*, populasyon değişimi

Introduction

Aphid fauna of Turkey is 410 species among the 4500 aphid species in the world (Remaudière et al., 2006). Aphids feed by sucking the juice out of plants. While this is harmful, they also transmit diseases to plants, which also can be deadly. They are very widespread and an economically important group

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of insects in all part of the world. Besides the culture plants, they reach to higher populations on the annual or perennial plants as the primary or secondary hosts, therefore they constitute a significant step in the food cycle of the living organisms.

The annual or perennial *Euphorbia* species which grows in the culture plant areas and other areas are considerable attractive plants for numerous insects because their milky juice, private color, smell, aroma and flower forms in whole vegetation period.

The *Euphorbia* spp. which are observed as flowery and leafy plants in the same or consecutive periods of the whole vegetation period presents a significant nutrition and sheltering facilities for the predators and parasitoids which feed with pollens in their adult stages.

The cosmopolite *Euphorbiaceae* family includes 300 types and 4500 species. They can be in annual or perennial with different forms (herbaceous, shrubby, ligneous), and nearly all of them have milky juice. In Turkey, there are 91 species of *Euphorbia* type. In the study area (Van and its around), there are 12 species of this type (Davis, 1982).

In this study, the population dynamics of two aphid species, *Aphis tirucallis* Hille Ris Lambers, 1954 and *Aphis vallei* Hille Ris Lambers & Stroyan, 1959 were investigated on *Euphorbia heterodena* Jaub. et Spach*, Euphorbia seguieriana* Necker subsp. *seguieriana* Necker and *Euphorbia macroclada* Boiss. which were widespread in and out of the agricultural areas around in Van Province. It was observed that these species and their hosts were found sequentially in the nature in the whole season.

Material and Methods

This study was conducted in 2006-2007 years, in three different locations (Muradiye, Van centre, Gürpınar-Gevaş) in north-south directions of Van and its around. The ecological differences were considered while choosing these locations (Figure 1). In each location, 3 points were selected with different distances. Samples were taken as 5 repetitions on *E. heteradena, E. seguieriana* subsp. *seguieriana* and *E. macroclada* in two week intervals. Each plant cluster growing on the same root system and composed of different numbers of branches were examined according to their branches, leaves, and flowers and notes were taken by counting their total branches and branches infected with aphids. Among the branches infected with aphids, an infected one was cut from a point near the root and was taken to the plastic bag with paper sack in it and was transferred to the ice box to be counted in the laboratory.

Observations were made in the beginning of April, which was the growing period of the plants in the selected areas, and samplings were taken in the middle of May, which was the first observation of aphid populations in the nature. The samplings were taken with two weeks intervals until September in which plants faded and died. In the study Student's t-test and nonparametric Mann-Whitney U test ($P<0.05$) were applied by using SPSS (version 11.5.0. 2002) statistical software. The analysis of the normally distributed data was conducted by using independent t-test. For the data which did not show normal distribution despite the transformation, non parametric Mann-Whitney U test was applied. In order to test the acceptability of the variables to the normal distribution (normality test), Kolmogorov Smirnov test was used.

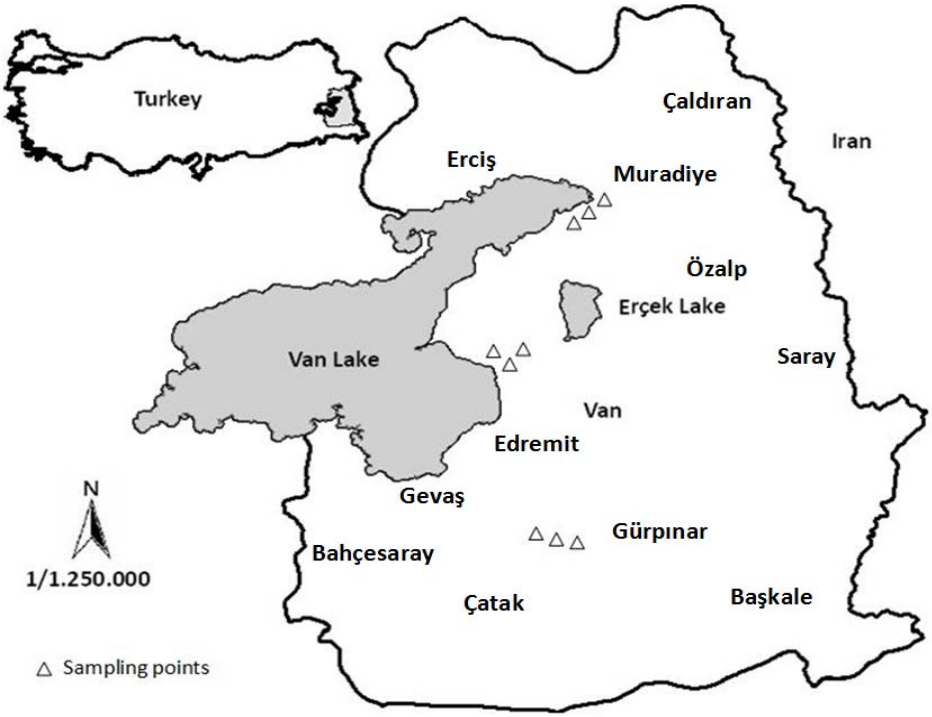

Figure 1. Sampling locations in Van province.

Results and Discussion

Population changes of *Aphis tirucallis* Hille Ris Lambers, 1954

Aphis tirucallis was defined as darkish brown, grayish black because of the waxy liquor on it, and with short conical and dark color in its apteral individuals (Özdemir, 2004). This monoecious species was reported on

Euphorbia sp. in 1978 Kalecik/Ankara firstly according to Düzgüneş et al. (1982) as a new species for Turkey fauna (Özdemir, 2004). According to records, its distribution areas in Turkey were indicated as Diyarbakır (Hazro) (Ölmez, 2000), East Anatolia region (Toros et al., 2002), Malatya (Dilek) (Ölmez et al., 2006) on *Euphorbia* sp. Apart from that, no detailed information was found about its distributions and hosts in Turkey.

Remaudiere et al. (1985) reported that it was Mediterranean origin and found in Ethiopia and Sudan and its host plants were *E. helioscopia* L., *E. hirta, E. prostrata* Ait., *E. pubescens* Vahl, *E. splendens* Boj. ex Hook. and *E. tirucalli* L. In addition to these, Düzgüneş et al. (1982) informed the *E. peplos* as host plant referring to Tanasijtshuk et al. Gonzales-Funes & Michelene (1988) determined *A. tirucallis* on *E. helioscopia* and *E. terracina* in Spain, Peninsula. In Anonymous (1993), it was reported that *E. segetalis*, *E. paralias* and *E. peplus* were host plants of *Aphis tirucallis* in Spain. Gotlin Culjak et al. (2008) declared that it was found on *Prunus amygdalus communis* and *E. helioscopia* in Croatia Gata. Suay-Cano et al. (2002) reported that it was found on *E. terracina* and *E. flavicoma* in Spain, Valencia.

Aphis tirucallis not recorded in Van and its around before. It was found on *E. heteradena* and *E. seguieriana* subsp. *seguieriana* first time in this study. Its population changes were determined in 2006-2007 as mentioned below. In the first observations in the middle of May 2006, it was seen that plant-branch system was developed and first populations of *A. tirucallis* was found on *E. macroclada,* while its first populations were on *E. seguieriana* subsp. *seguieriana* observed at the end of May (Figure 2). In the following samplings, its population increased very fast on *E. heteradena* and reached to the maximum value at the beginning of June, then decreased dramatically in the following weeks, and disappeared completely at the end of July. In 2007, similarly, the first populations were observed on the same host in May. It increased in the following sampling periods with a rapid increase, then reached to the highest value of the two years at the beginning of July and disappeared completely at the end of July. It was thought that climatic factors were one of the probable reasons of these changes. It was seen that the rain periods were less in 2006 summer, especially maximum average temperatures were high in August, and depending on them the moisture levels in the air were less than the 2007. The maximum temperature values were detected as 33.8 ^{o}C and 33.5 ^{o}C in July and August, respectively. These values are too high for the aphids. In 2007, more precipitation was observed in the studied season, temperature was warmer than previous year. The maximum moisture rates of weather were detected as 99% in most times. These factors might have a positive effect on the plant and aphid growth (Figure 3). Thus, the aphid population reached very high values especially at the beginning of July and survived in the nature one month longer when compared with the previous year, 2006.

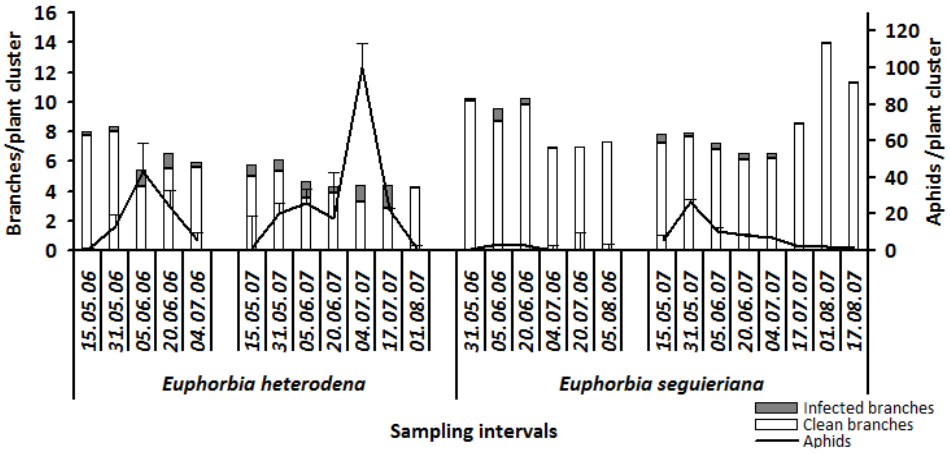

Figure 2. Population densities of *Aphis tirucallis* Hille Ris Lambers, 1954 on *Euphorbia heterodena* Jaub. et Spach and *Euphorbia seguieriana Necker* subsp. *seguieriana Necker* in 2006–2007.

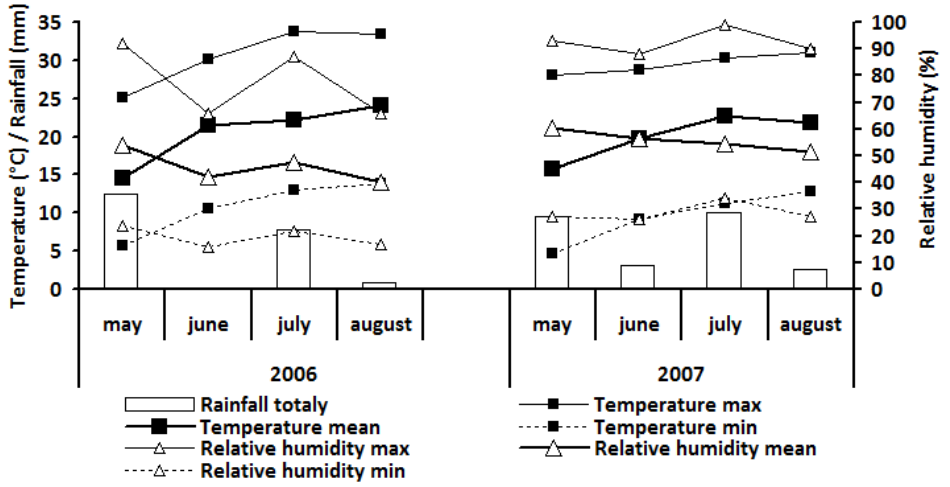

Figure 3. Climatic data of Van province in 2006–2007.

The first populations of *A. tirucallis* on *E. seguieriana* subsp. *seguieriana* were observed at the end of May in 2006 and the populations in the following samplings were detected at low levels. It was observed till the August in that year (it disappeared on *E. heteradena* in those periods).

The aphid's first populations generated earlier in 2007 (in the middle of May) and reached to the highest level at the end of May. In the following samplings, the populations decreased and they were observed at low levels till the end of August. In 2007, higher populations of aphid were observed on this host than the previous year.

Densities of *A. tirucallis* on *E. heteradena* and *E. seguieriana* subsp. *seguieriana* according to sampling intervals, years and hosts were statistically compared and the results were given in Table 1. The standard errors of the means were calculated as high in some observations. Its reason is due to the excess zero observations and the differences between minimum and maximum values of observations. In addition to, some alternate methods are used for these type data analyses (Lambert, 1992, Böhning, 1998, Yeşilova et al., 2010), it was applied Mann-Whitney U test and Kolmogorov Smirnov test for compare of means. The population density of *A. tirucallis* on *E. heteradena* was found high in the 5^{th} sampling of 2007 July and in the mean values of the samples according to years (Table 1; in 5^{th}, 8^{th} rows) ($P<0.05$). Similarly, its population densities were found higher on *E. seguieriana* subsp. *seguieriana* in 2007 in the 4^{th}, 5^{th}, 6^{th} samplings and in mean values of the samples than 2006 (Table 1; 12^{th}, 13^{th}, 14^{th} and 17^{th} rows) ($P<0.05$). According to different hosts, higher populations of *A. tirucallis* were found on *E. heteradena* than *E. seguieriana* subsp. *seguieriana* in 2006 in the 3^{rd}, 4^{th}, 5^{th} sampling intervals and mean (Table 1, in columns) ($P<0.05$). Similarly, in 2007 it had high populations on *E. heteradena* according to the 3^{rd}, 5^{th}, 6^{th} sampling intervals and mean (Table 1, in columns) ($P<0.05$).

Population change of *Aphis vallei* Hille Ris Lambers & Stroyan, 1959

This species was firstly reported in 1964 in Ahlat (Bitlis) by Tuatay & Remaudieri (Remaudieri et. al., 2006). Later, it was determined in Ankara by Çanakçıoğlu (1975) and Özdemir (2004) on *Euphorbia* sp. Özdemir (2004) characterized the morphological definition of this species as black color, dusty in sight, with wide cauda and short cornical, and having a dark stain on the dorsal of the wingless individuals. Its host plant was noted as *Euphorbia peplens* in the East Mediterranean region by Toros et al. (2002).

There is limited information about the worldwide distribution of this species. Ghosh & Nieto Nafria (1994) reported that it was found in the Spain Peninsula Andalusian Mountains on an altitude of 500-1500 without mentioning its host plant. Gonzales-Funes & Michelene (1988) determined *A. vallei* on *Euphorbia characias,* in Spain Peninsula. It was reported that its host plant was *Euphorbia* sp. in Spain (Anonymous, 1993). There is no previous record of this species in Van and its around. During this study, *A. vallei* was determined only on *E. macroclada* in high populations and its population change in 2006-2007 is presented below.

Table 1. Population densities of *Aphis tirucallis* and *Aphis vallei* on *Euphorbia* spp. in 2006−2007

		Aphis tirucallis																			
		2006								**2007**											
Sampling intervals	***rows***	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**mean**	**n**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**mean**
	1	10	1.0±0.56a*A**							5	1.6±1.03aA								
	2	35		13.5±6.34aA						40		20.2±17.46aA							
	3	45			43.0±15.33aA					35			25.9±5.87aA						
Euphorbia heterodena	***4***	44				23.7±9.34aA				25				17.4±7.86aA					
	5	20					5.5±4.37bA			45					100.3±25.32aA				
	6									5						22.2±13.24A			
	7									5							1.7±1.01A		
	8	154							13.2±5.52bA	160									43.7±9.23aA
	9	30	1.0±0.60aA							15	5.4±2.85aA								
	10	40		3.8±1.43aA						45		26.8±9.64aA							
	11	33			2.5±1.13aB					30			10.8±3.35aB						
Euphorbia seguieriana	***12***	39				0.1±0.08bB				25				8.3±3.55aA					
subsp. *seguieriana*	***13***	30					0.0±0.00bB			35					6.9±2.76aB				
	14	40						0.0±0.00b		35						1.8±0.96aB			
	15									15							1.8±1.80A		
	16									25								1.1±1.08	
	17	212							1.3±0.35bB	225									9.7±2.15aB
		Aphis vallei																			
	18	25	3.7±1.76a							45	1.8±1.82b								
	19	33		31.0±13.58a						45		7.3±4.93b							
	20	35			39.3±27.30a					15			35.7±5.95b						
Euphorbia macroclada	***21***	35				6.4±2.17a				30				11.4±5.26a					
	22	30					0.5±0.37b			45					96±21.35a				
	23	40						5.3±3.62a		45						20.4±9.19a			
	24									30							9.6±2.74		
	25									35								13.2±30	
	26	198							15.1±5.44b	290									25.1±4.17a

* Means with the different small letters in the same row are significantly different each others according to Mann-Whitney U test at 5% level.
** Means with the different capital letters in the same column are significantly different each others according to Mann-Whitney U test at 5% level.
n: Number of branches sampled.

In 2006, *A. vallei* generated its first populations on *E. macroclada* at the end of May, then increased regularly and reached to the maximum value in the middle of June. In the following samplings, the population decreased rapidly and disappeared in August. In 2007, it was observed earlier, in the midst of May and increased till the first days of July and the population reached to the higher values than the previous year. In the following weeks, the population decreased, and disappeared completely in the last days of August. When the population intensity of the *A. vallei* was compared according to two years, it was found higher in 2006 in the first three samplings and it was found higher in 2007 in the fifth sampling (Table 1; 18th, 19th, 20th, 22nd rows). When the yearly means are considered, its higher value was detected in 2007 (Table 1; 26th row) ($P<0.05$). The biological cycle and population intensity of *A. vallei* is resembling to *A. tirucallis* population, especially on *E. heterodena* host plant. The climate conditions were more proper especially in the year 2007; therefore its survival period in the nature was longer than *A. tirucallis* populations.

The numbers of branches growing in the same root system in every plant cluster of the *Euphorbia* species and the number of infected branches with aphids were tested for two years according to the sampling intervals and results were given in Tables 2 and 3. Accordingly, the numbers of branches which were grown from a plant cluster of the *E. heteradena* were almost similar for two years samplings, except in 3rd sampling (first days of June), it was higher in the year 2006 ($P<0.05$). In this sampling time, the population of *A. tirucallis* was reached its highest population levell also (Figure 2). The mean numbers of branches were found higher in 2006 ($P<0.05$) (Table 2). The numbers of infected branches with aphids were on this plant were compared according to the years, only the fifth sampling was found high in 2007 ($P<0.05$) (Table 3). This period was also the time in which highest aphid population intensity of the two years was observed in this study (Figure 4).

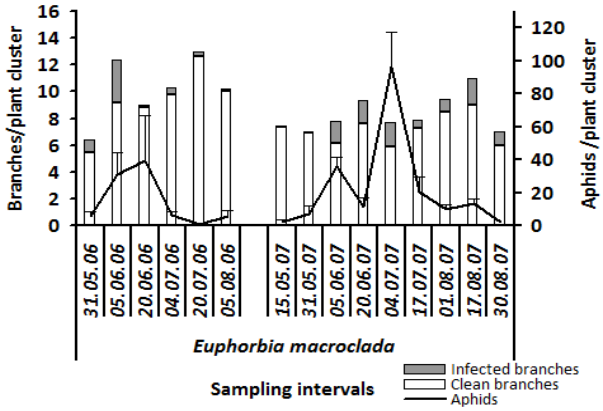

Figure 4. Population densities of *Aphis vallei* Hille Ris Lambers & Stroyan 1959 on *Euphorbia macroclada* Boiss. in 2006–2007.

Table 2. Branches numbers per a plant cluster according to years and sampling intervals

		Branches per a plant cluster																		
		2006								2007										
Sampling intervals	*rows*	n	1	2	3	4	5	6	mean	n	1	2	3	4	5	6	7	8	mean
	1	10	8.0±0.84a*							5	5.8±1.16a								
	2	35		8.4±0.95a						40		6.1±1.09a							
	3	45			5.4±0.50a					35			4.7±0.39b						
Euphorbia heterodena	***4***	44				6.5±0.71a				25				4.3±0.70a					
	5	20					5.9±0.79a			45					4.4±0.43a				
	6									5						4.4±1.03			
	7									5							4.2±0.95		
	8	154							6.6±0.36a	160									4.9±0.34b
	9	30	10.2±1.27a							15	7.9±1.44a								
	10	40		9.6±1.26a						45		8.0±1.08b							
	11	33			10.2±1.04a					30			7.2±0.62b						
Euphorbia seguieriana	***12***	39				7.0±0.73a				25				6.6±0.67a					
subsp. *seguieriana*	***13***	30					6.9±0.64a			35					6.5±0.62a				
	14	40						7.3±0.76a		35						8.6±1.66a			
	15									15							14.0±4.33		
	16									25								11.3±2.77	
	17	212							8.5±0.41a	225									8.4±0.57a
	18	25	5.6±0.83a							45	7.5±0.82a								
	19	33		12.4±1.58a						45		7.0±0.81b							
	20	35			9.0±1.11a					15			7.8±0.98a						
	21	35				10.3±1.07a				30				9.3±0.96a					
Euphorbia macroclada	***22***	30					12.6±2.18a			45					7.7±1.04b				
	23	40						10.2±1.16a		45						7.7±0.76a			
	24									30							9.4±1.19		
	25									35								11±1.07	
	26	198							10.3±0.58a	290									8.3±0.34b

* Means with the different letters in the same row are significantly different each others according to t-student test at 5% level.
n: Number of branches sampled.

Table 3. Infected branch numbers per a plant cluster according to years and sampling intervals

		Infected branches per a plant cluster																		
		2006									2007									
Sampling intervals	*rows*	n	1	2	3	4	5	6	mean		n	1	2	3	4	5	6	7	8	mean
	1	10	0.3±0.15a*								5	0.8±0.58a								
	2	35		0.3±0.16a							40		0.7±0.24a							
	3	45			1.1±0.23a						35			1.1±0.29a						
Euphorbia heterodena	***4***	44				1±0.27a					25				0.4±0.13a					
(Aphis tirucallis)	***5***	20					0.3±0.18b				45					1.0±0.27a				
	6										5						1.6±0.93			
	7										5							0.1±0.03		
	8	154							0.7±0.11a		160									0.9±0.13a
	9	30	0.1±0.06a								15	0.6±0.34a								
	10	40		0.9±0.25a							45		0.3±0.08a							
	11	33			0.5±0.17a						30			0.4±0.11a						
Euphorbia seguieriana	***12***	39				0.1±0.08b					25				0.5±0.19a					
subsp. *seguieriana*	***13***	30					0.0±0.00b				35					0.31±0.09a				
(Aphis tirucallis)	***14***	40						0.0±0.00b			35						0.1±0.07a			
	15										15							0.1±0.07		
	16										25								0.1±0.04	
	17	212							0.2±0.06b		225									0.3±0.04a
	18	25	0.6±0.34a								45	0.1±0.11b								
	19	33		3.2±1.03a							45		0.1±0.06b							
	20	35			0.2±0.13b						15			1.7±0.33a						
Euphorbia macroclada	***21***	35				0.5±0.14a					30				1.7±0.58a					
(Aphis vallei)	***22***	30					0.3±0.21b				45					1.8±0.33a				
	23	40						0.2±0.09a			45						0.6±0.22a			
	24										30							1.0±0.33		
	25										35								2.0±0.49	
	26	198							0.9±0.20b		290									1.0±0.12a

* Means with the different letters in the same row are significantly different each others according to Mann-Whitney U test at 5% level.
n: Number of branches sampled.

The numbers of branches of *E. seguieriana* subsp. *seguieriana* were found high in the 2nd and 3rd sampling intervals in 2006 (Table 2). There were not significant differences in the other sampling intervals and mean values of two years (P<0.05). The differences in the infected branches (Table 3) were not significant in the first three samplings, but in the following samplings and yearly means, higher values were obtained for 2007 (P<0.05). For *E. macroclada,* the numbers of branches (Table 2) according to the yearly means were found higher between the 2nd and 5th sampling intervals in 2006. The number of infected branches (Table 3) in the first two samplings were found higher in 2006, where higher results were obtained in 2007 in the 3rd and 5th samplings and yearly means (P<0.05).

These *Euphorbia* species were not recorded before as host plants of *A. tirucallis* and *A. vallei.* In the presented study, these host plants are new records for the mentioned aphids. Furthermore, these aphids are new records for Van Province also.

It is obviously seen that climatic factors have significant effects on aphid population densities and on plants also. In this study, it was found that, the maximum temperature values had destructive effects on the aphid population rather than the average temperatures in the summer season. Thus, the temperature values of 33.8 °C in July and 33.5 °C in August (2006) are too high for the many aphids. Temperature is an important factor for rapid increase in the aphid population (Trdan & Mileroj, 1999). Temperature ranging from 7.7 to 25.2 is favourable for aphid growth (Chander, 1996), while the optimum temperature for aphid growth is 23.44 °C (Miller & Smith, 1998). In 2007, the temperatures were lower, and the maximum proportional moisture levels were about %99 and %90, and the total rainfalls in summer was higher. Therefore, these factors increased the vegetative growth of the plants and provided more proper climatic conditions for the aphids and the hosts.

Euphorbia species are the undesired plants in the agricultural areas and grasslands because of crop losses and negativities in the animal nutrition. But they have a significant place in the food chain of the ecosystem since they are hosts for numerous beneficial insect species. Especially, their blossom flowers during all vegetation season are very important food source for many pollen feeder beneficial insects. At the samplings, it was observed that highest proportions (29%) of the species determined on these plants were belonging to Hymenoptera which includes numerous pollinators and useful parasitoids (Özgökçe et al., 2008). Besides, so many predators and parasitoids of the Coleoptera (27%), Diptera (26%), Heteroptera (8%) and Neuroptera (2%) were also detected (Özgökçe et al., 2008). In the biological control, it is an important step for the success to provide the sustainability of the natural enemies by growing highly blooming flowery plants in around the agricultural areas. Since

Euphorbia spp. exists naturally in these areas, therefore it constitutes a significant factor to provide the persistence of the natural biological food cycle between the useful and harmful species.

Özet

Van (Türkiye) ve çevresinde *Euphorbia* spp. (Euphorbiaceae) üstünde *Aphis tirucallis* Hille Ris Lambers, 1954 ve *Aphis vallei* Hille Ris Lambers & Stroyan, 1959 (Hemiptera: Aphididae)'nin populasyon değişimi

Çalışma 2006-2007 yıllarında Van ilinde yürütülmüştür. Örneklemeler üç farklı lokasyonda yürütülmüş ve yaprakbitleri *Euphorbia* spp.'nin dalları ile birlikte alınarak doğrudan sayılmıştır. Çalışmada *Aphis tirucallis* Hille Ris Lambers, 1954'in *Euphorbia heterodena* Jaub. et Spach ve *Euphorbia seguieriana* Necker subsp. *seguieriana* Necker üstünde, *Aphis vallei* Hille Ris Lambers & Stroyan 1959'nin de *Euphorbia macroclada* Boiss. üstünde beslenmesi hem yaprakbitlerinin bölge için ve hem de konukçu bitkilerin bu türler için besin bitkileri olması yönünden ilk kayıtlar olma niteliği taşımaktadır. Ayrıca yaprakbitklerinin iki yıllık populasyon değişimleri izlenmiştir. Her iki yaprakbiti türünün iklim faktörlerinin daha uygun olduğu 2007 yılında daha yüksek bir populasyon oluşturduğu saptanmıştır.

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