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A study on the incidence of woolly poplar aphid, *Phloemyzus passerinii* (Hom.: Aphididae) on poplar species and clones in Hamedan province, Iran

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Abstract

Woolly poplar aphid, *Phloeomyzus passerinii* (Signoret), is considered as an important and serious pest of poplar in Iran and many countries. During 2002-2003, resistance and susceptibility of 12 poplar clones to *P. passerinii* were evaluated in Hamedan province of Iran. Number of formed aphid colonies found in a surface unit was counted three times during a growing season. The clones *Populus alba* 58/57, *P. deltoides* 72/51, *P. deltoides missoriensis*, *P. x. euramericana* 214, *P. nigra* 62/72, *P. nigra* 62/140 and *P. nigra* 62/149 were immune to the insect pest, but the remaining of *P. nigra* clones were infested variously. Analysis of variance conducted on obtained data, revealed a significant difference (α = 1%) between the clones. Mean infestation of *P. nigra* 56/72 was significantly higher than other studied clones in all sampling dates. Mean infestation of branches (at four main geographical directions of tree) was significantly different in the first sampling date, but not in two other dates. Natural enemies of the aphid collected in this region were *Exochomus nigromaculatus* (Goeze), *Chilocorus bipustulatus* L., *Sympherobius pygmaeus* (Rambur), *Anthocoris* sp., *Orius* sp. and *Chiracanthium* sp. The species, *E. nigromaculatus* and *S. pygmaeus* are reported for the first time on *P. passerinii*. The two parasitoid species, *Thaumatomyia elongatula* (Becker) and *Pachyneuron* sp., are reported for the first time on this pest from Iran. Mean density of *T. elongatula* and *S. pygmaeus* were higher than other natural enemy species and placed in same LSD test class. Mean density of the parasitoid wasp, *Pachyneuron* sp., was less than other natural enemies.

Key words: poplar, resistance, *Ploemyzus passerinii*, natural enemies, Hamedan, Iran

چکیده

شته‌ی مومی صنوبر، *Phloeomyzus passerinii* (Signoret)، در ایران و بسیاری از کشورهای جهان از آفات مهم صنوبر به شمار می‌رود. طی سال‌های ۱۳۸۲-۱۳۸۱، مقاومت و حساسیت دوازده کلن صنوبر نسبت به شته‌ی *P. passerinii* در استان همدان مورد بررسی قرار گرفت. تعداد کلنی‌های شته‌ی تشکیل شده در واحد سطح شاخه در طول فصل رشد در سه نوبت اندازه‌گیری شد. کلن‌های *Populus alba* 58/57، *P. deltoides* 72/51، *P. deltoides missiriensis*، *P. x. euramericacana* 214، *P. nigra* 62/72، *P. nigra* 62/140 و *P. nigra* 62/149 نسبت به آفت مقاوم بودند، ولی بقیه‌ی کلن‌های *P. nigra* درجات مختلفی از آلودگی را نشان دادند. تجزیه‌ی واریانس انجام شده روی داده‌های بدست‌آمده تفاوت معنی‌داری را در سطح یک درصد (۱٪ = α) بین داده‌ها نشان داد. میانگین آلودگی کلن *P. nigra* 56/72 در تمام تاریخ‌های نمونه‌برداری از سایر کلن‌های مورد مطالعه بالاتر بود. میانگین آلودگی شاخه‌ها (در چهار جهت جغرافیایی درخت) در اولین نمونه‌برداری اختلاف معنی‌داری داشت، ولی در دو تاریخ دیگر اختلافی را نشان نداد. دشمنان طبیعی شته‌ی مومی که در این منطقه جمع‌آوری شدند، عبارتند از: *Exochomus nigromaculatus* (Goeze)، *Chilocorus bipustulatus* L.، *Sympherobius pygmaeus* (Rambur)، *Anthocoris* sp.، *Orius* sp. و *Chiracanthium* sp.. گونه‌های *E. nigromaculatus* و *S. pygmaeus* برای اولین بار از روی *P. passerinii* گزارش می‌شوند. دو گونه‌ی پارازیتوئید *Thaumatomia elongatula* (Becker) و *Pachyneuron* sp. برای اولین بار در ایران از روی این آفت گزارش می‌شوند.

میانگین تراکم *T. elongatula* و *S. pygmaeus* از سایر گونه‌های دشمنان طبیعی بالاتر بود و با آزمون LSD در رده‌ی مشابهی قرار گرفتند. میانگین تراکم زنبور پارازیتوئید *Pachyneuron* sp. پایین‌تر از سایر دشمنان طبیعی بود.
واژگان کلیدی: صنوبر، مقاومت، *Phloeomyzus passerinii*، دشمنان طبیعی، همدان، ایران

Introduction

Increasing need of our country to wood and cellulose resources and scarcity of natural forest resources to answer this need, has given a great importance to forestation with fast-growing species and clones. Poplar is among the fast-growing species that because of its adaptability to different climates and existence of suitable fields for developing poplar plantation has been planted in Iran from early ages. By the time of Iran's membership in International Poplar Commission, a scientific approach has been started to qualitative and quantitative development of poplar plantation by studying adaptability of native and exotic poplar species and clones and also their resistance and susceptibility to important pests and diseases in different ecological regions of Iran. Woolly poplar aphid, *Phloeomyzus passerinii* (Signoret), is one of the serious and most important pests of poplar trees in Iran. Feeding of the aphid on the sap of host trees causes decrease of tree growth and, consequently, highly infested trees will die (Allegro *et al.*, 1996; Shojai *et al.*, 1998). The aphid has been reported from several European, Asian and American countries (Arru, 1967; Habib & Ghani, 1970; Arru, 1971; Sekawin, 1971; Arru & Lapietra, 1979; Arzone & Vidano, 1984; Lapietra & Allegro, 1986; Lapietra & Allegro, 1990a, 1990b; Frison, 1991; Allegro & Cagelli, 1996; Allegro *et al*., 1996; Raspi, 1996; Shojai *et al*., 1998; Dordai *et al*., 2000).

Except northern provinces of Iran, which are adjacent to Caspian Sea (Guilan and Mazandaran), all other suitable regions for poplar plantation in Iran have been infested to the aphid (Shojai *et al.*, 1998; Rezwani, 2001; Sadeghi *et al*., 2002a; Rajabi-Mazhar *et al*., 2003; Moharramipour *et al*., 2004).

So far, many researchers have studied several aspects of resistance of poplar species and clones to woolly poplar aphid. Arru (1971) studied the reaction of cuts of some poplar clones to the pest in laboratory conditions. These studies have been followed by testing 411 genotypes of *Populus deltoides* (Arru & Lapietra, 1979) and afterwards on 244 genotypes of *P. nigra* (Allegro & Cagelli, 1996). Resistance behaviour of some poplar clones to woolly poplar aphid, which had already been tested for their wood yield and their reaction to some important fungi diseases, was evaluated in laboratory and field conditions (Lapietra &

Allegro, 1986; Lapietra & Allegro, 1990b; Shojai *et al*., 1998; Sadeghi *et al.*, 2002a; Rajabi-Mazhar *et al.*, 2003).

The poplar species, *Populus nigra*, *P. x. euramericana* and *P. deltoides* have been reported as hosts of this aphid in Iran. Based on the report of Shojai *et al.* (1998), all native *P. nigra* stands distributed in Iran are more or less severely infested with the pest. While *P. deltoides* had the least infestation rate, the infestation rate of *P. x. euramericana* clones to the pest was variable (Shojai *et al*., 1998). Studying resistance and susceptibility of eleven *P. nigra* clones to poplar aphid in Zanjan province of Iran showed that the clone, *P. nigra* 62/154 (originated from Turkey), was completely resistant to woolly poplar aphid compared to other tested clones (Sadeghi *et al.*, 2002a).

Several natural enemies belonging to the families Hemerobiidae, Anthocoridae, Miridae, Acaridae, Coccinellidae, Syrphidae and Chrysopidae feed on the pest (Raspi, 1996). *Chilochorus bipustulatus*, however, is the only reported natural enemy of the pest in Iran. In the present study, natural enemy community of woolly poplar aphid and their densities on different poplar clones were studied. The objectives of the present study were: (1) finding poplar stands possessing resistance genes to the pest and diseases that may be later used in poplar breeding and (2) preparing the essential data for providing a successful and sustainable integrated pest management program with attention to ecological aspects involving the three trophic levels (poplar clones, woolly poplar aphid and its associated natural enemies). Therefore, the present study may be useful for the two mentioned aims and is complementary to previous researches (Rajabi-Mazhar *et al*., 2003; Moharramipour *et al.*, 2004).

Materials and methods

Geographical characteristics of the sampling site: field studies were conducted in research farm of Research Center of Agricultural and Natural Resources of Hamedan province. Hamedan province is located in western part of Iran with 1780 m altitude, 48º 32' 30" longitudes and 36º 47' 12" latitude. It has dry summers and cold snowy winters. The texture of soil is sandy-loam to loam with a pH of 7.7.

Poplar clones: twelve native and exotic poplar clones[1] belonging to *P. nigra*, *P. alba*, *P. x. euramericana* and *P. deltoides* were selected for the study. Names and origins of the tested clones are shown in table 1. In the year 1999, ten stands of each clone were planted with a 1.5

1- Clones are stands that are propagated from a particular stand by asexual methods and contain all genetic characteristics of the mother stand.

m interval distance from each other. At the time of experiments during the years 2002-2003, these poplar trees were 3 and 4 years old, respectively. During the growing season of these years, number of woolly poplar aphid colonies formed on tree trunks and branches was counted in three different dates, in mid July, mid August and mid September. In each sampling time, four branches of each poplar stand were randomly selected at four main geographical directions of the trees. Then, the length of infested areas in the sampled branches was measured and aphid colony numbers formed till that sampling time were counted and the number of aphid colonies per each centimetre was calculated.

Natural enemies: for collecting natural enemies of the insect pest, 10 cm of the tree trunks located in the height of 80-90 cm from earth were covered with a fine mesh cloth. Before covering, all present aphid colonies on the covered area were counted. The traps were opened every 15 days once and trapped natural enemies were collected and their numbers were recorded.

Data analysis: data of clone infestation to the pest was computed by repeated measurement analysis using SPSS 11.0 software. Square-transformed data was used for analysis of variance and least significant difference test (LSD) at $\alpha = 5\%$ was used to compare means.

Table 1. Name and origin of studied poplar clones.

Name	Origin
Populus alba 58/57	Italy
P. deltoides 72/51	America
P. deltoides missoriensis	America
P. nigra 47/13	Iran (Miandoab)
P. nigra 56/32	Turkey
P. nigra 56/72	Turkey
P. nigra 62/72	Turkey
P. nigra 62/140	Turkey
P. nigra 62/149	Turkey
P. nigra 74/1	Iran (Hamedan)
P. nigra 75/2	Iran (Hamedan)
P. x. euramericana 214	Italy

Results

Clone infestations to woolly poplar aphid

In the natural condition of Hamedan province, the seven following clones, *P. alba* 58/57, *P. deltoides* 72/51, *P. deltoides missoriensis*, *P. x. euramericana* 214, *P. nigra* 62/72, *P. nigra*

62/140, *P. nigra* 62/149 were not at all infested to the aphid, so statistical analysis were only carried out on the data obtained from five remained *P. nigra* clones. There was a significant difference between clones with respect to the number of woolly poplar aphid colonies at α = 1% (table 2).

In the first sampling date, mid July, *P. nigra* 56/72 and *P. nigra* 47/13 clones were more infested compared to the other three clones. Moreover, in the second sampling date, mid August, these two clones were still more infested compared to the other clones. In the second sampling date, however, these two clones were ranked in two different groups. In the third sampling date, *P. nigra* 47/13 and *P. nigra* 56/72 were more infected than the other clones. It can be seen in table 3 that the infestation rate of the clone, *P. nigra* 56/72, to the aphid in all of the three sampling dates was higher than the other clones and significantly different with them. The mean number of aphid colonies per cm registered at the first, second and third sampling dates were 1.89, 7.27 and 9.94, respectively. Mean of infestation in the clone, *P. nigra* 75/2, was lower than the others.

Effect of geographical directions on infestations rates

Only in the first sampling date, geographical directions had a significant effect on infestation rates of woolly poplar aphid, while in the second and third sampling dates, no significant difference was observed. In the first sampling date, tree trunks were more infested to the aphid than the branches and a significant difference was found between trunk and branch infestations. Also, the branches situated in northern and southern directions of tree trunks, were significantly more infested to the aphid compared to the branches situated in western or eastern directions.

Interactions between mean number of woolly poplar aphid, geographical directions and sampling dates showed no significant difference (table 2). This indicates that during the time, progress of infestation process on trunks and branches did not significantly differ, while total infestation progress on the branches in different directions increased during the season.

Natural enemies

Predators: *Chilocorus bipustulatus* L. and *Exochomus nigromaculatus* (Goeze) (Col.: Coccinellidae), *Sympherobius pygmaeus* (Rambur) (Neur.: Hemerobiidae), *Orius* sp. and *Anthocoris* sp. (Hem.: Anthocoridae), and a spider belonging to the genus *Chiracanthium*

were collected on woolly poplar aphid in the region. *E. nigromaculatus* and *S. pygmaeus* are reported as predators of *P. passerinii* for the first time.

Table 2. Two way analysis of variance (clone/branch direction) of woolly poplar aphid density on five *P. nigra* clones.

	11.7.2002		16.8.2002		16.9.2002	
Variation sources	**df**	**MS**	**df**	**MS**	**df**	**MS**
Clone	4	8.73**	4	21.62**	4	31.66**
Direction of branches	4	1.04*	4	1.03 ns	4	1.75 ns
Clone × direction	16	0.35 ns	16	0.58 ns	16	0.90 ns
Error	177	0.41	184	0.58	182	0.75

ns: non significant difference
*: significant difference at α = 5%
**: significant difference at α = 1%

Table 3. Mean number of woolly poplar aphid colonies on *P. nigra* clones during summer of 2002.

	Mean number of aphid colony in each cm ± SE		
Poplar clones	**11.7.2002**	**16.8.2002**	**16.9.2002**
P. nigra 74/1	0.26 ± 0.05b	0.75 ± 0.11c	1.05 ± 0.13b
P. nigra 47/13	1.65 ± 0.26a	3.01 ± 0.37b	5.07 ± 0.63a
P. nigra 75/2	0.04 ± 0.02b	0.09 ± 0.04d	0.17 ± 0.06c
P. nigra 56/32	0.30 ± 0.08b	1.06 ± 0.16c	1.89 ± 0.28b
P. nigra 56/72	1.89 ± 0.59a	7.27 ± 0.99a	9.94 ± 0.81a

*: Means with similar letters in each column are not significantly different (α = 5%).

Table 4. Mean number of woolly poplar aphid colonies on trunk and branches in different directions of poplar trees.

	Mean number of aphid colony in each cm ± SE		
Branch direction	**11.7.2002**	**16.8.2002**	**16.9.2002**
Trunk	1.28 ± 0.35a	2.24 ± 0.51a	3.09 ± 0.57a
Northern part	0.85 ± 0.32ab	3.18 ± 1.21a	4.34 ± 1.66a
Southern part	0.68 ± 0.22ab	2.00 ± 0.68a	3.70 ± 1.61a
Eastern part	0.50 ± 0.12b	1.41 ± 0.26a	2.16 ± 0.42a
Western part	0.37 ± 0.08b	1.28 ± 0.27a	1.95 ± 0.48a

*: Means with the similar letters in each column are not significantly different (α = 5%).

Parasitoids: *Thaumatomyia elongatula* (Becker) (Dip.: Chloropidae) and *Pachyneuron* sp. (Hym.: Pteromalidae) were collected on woolly poplar aphid in Hamedan province. The first parasitoid is reported for the first time from Iran and the second is reported on the aphid for the first time.

Natural enemy densities

Mean densities of the natural enemies collected in 2003 are shown in table 5. Mean densities of *T. elongatula* and *S. pygmaeus* were higher than the other natural enemies, while the parasitoid wasp, *Pachyneuron* sp., had the lowest density. The mean densities of the predator bugs, ladybeetles and the spider were placed in intermediate classes between the former ones (table 5).

Table 5. Means comparison of the number of woolly poplar aphid natural enemies captured on poplar clones.

Natural enemies[1]	Mean number of natural enemies ± SE
Thaumatomyia elongatula (Becker)	0.89 ± 0.14a*
Sympherobius pygmaeus (Rambur)	0.79 ± 0.09a
Orius sp.	0.70 ± 0.009ab
Chilocorus bipustulatus L.	0.52 ± 0.07bc
Anthocoris sp.	0.37 ± 0.05cd
Exochomus nigromaculatus (Goeze)	0.27 ± 0.04de
Chiracanthium sp.	0.19 ± 0.04de
Pachyneuron sp.	0.15 ± 0.04e

1. Unit = Number in ten cm of infected trunks covered with a fine mesh cloth.
*: Means with similar letters are not significantly different (α = 5%).

Effect of clones on natural enemy densities

Based on three way analysis of variance (table 6), number of natural enemies (E) on different tested clones (C) was significantly different. A significant difference was also found between natural enemies, in different sampling dates (T). The interactions between clone/sampling dates (C×T), natural enemies/sampling dates (E×T) and clones/natural enemies/sampling dates (C×E×T) were statistically significant (α = 1%).

Table 6. Three way analysis of variance (poplar clones/natural enemies/sampling dates).

Variation sources	Df	MS	F	Pr > F
Clone (C)	4	7.49	48.45*	0.0001
Natural enemy	7	1.68	10.89*	0.0001
E×C	28	0.52	3.35*	0.0001
Error	360	0.52	3.16*	0.0001
Time (T)	2	4.07	83.25*	0.0001
C×T	8	0.57	11.71*	0.0001
E×T	14	0.35	7.21*	0.0001
C×E×T	56	0.14	2.80*	0.0001
Experimental error	720	0.05		

*: significant at α = 1%.

The mean number of natural enemies on *P. nigra* 56/72 clone was 112.40 that was significantly different from other clones (α = 5%) (table 7). The mean of *T. elongatula* on *P. nigra* 56/72 and *P. nigra* 56/32 were significantly higher compared to other natural enemies on the clones. Comparing means of natural enemies' densities on the clones showed that mean densities of *T. elongatula* and *S. pygmaeus* were 0.89 and 0.79, respectively and were significantly higher compared to other collected natural enemies. For the parasitoid wasp, *Pachyneuron* sp., the mean density was 0.15. Table 8 shows that poplar clones had a significant effect on density of natural enemies of the pest. In other words, there was a significant interaction between clones and natural enemies, so that on *P. nigra* 56/72, mean densities of *T. elongatula*, *C. bipustulatus* and *S. pygmaeus* were 2.33, 1.60 and 1.60, respectively, and were placed in the same class, but densities of other natural enemies on this clone were significantly different from the other clones (α = 5%).

The number of natural enemies increased from the first to the third sampling date. The number of *T. elangatula* on *P. nigra* 56/72 and *P. nigra* 56/23 increased more intensively compared to *E. nigromaculatus*, *C. bipustulatus*, *Orius* sp., *Anthocoris* sp. and *S. pygmaeus* that increased less intensively; while the number of *Chiracathium* sp. and *Pachyneurom* sp. decreased during the sampling dates.

Table 7. Mean comparison of the numbers of natural enemies collected on different poplar clones using LSD test (α = 5%).

Poplar clones	Mean number of natural enemies[1] ± SE
P. nigra 47/13	14.20 ± 3.36c
P. nigra 56/32	14.20 ± 5.0b
P. nigra 56/72	112.40 ± 16.12a
P. nigra 74/1	5.50 ± 1.67c
P. nigra 75/2	1.20 ± 1.09d

1. Unit = Number in ten cm of infected trunks fenced with lace tissue.
*: Means with similar letter are not significantly different (α = 5%).

Discussion

Based on the previous studies carried out in Iran (Khial & Sadraee, 1984; Shojai *et al*., 1998; Sadeghi *et al*., 2002a), *P. alba* was completely resistant to woolly poplar aphid, while this poplar species was reported as a susceptible host for the pest in some European countries (Vivani, 1955). In the present study, *P. alba* 58/57 clone was completely immune to the pest. Susceptibility of *P. alba* clones in European countries and resistance of its Iranian clones to

the pest is likely to be related to the strain of the aphid (Vivani, 1955; Shojai *et al*., 1998). Therefore, we used a *P. alba* clone originating from Italy as control in our experiments to ensure that the aphid strain is pure. The lack of infestation in this clone with the pest showed that we had only one strain of aphid in our experimental site. This confirmed the results of the previous study executed in Zanjan province of Iran (Sadeghi *et al.*, 2002a), i.e. there is a strain of *P. passerinii* in Iran that can not infest *P. alba* clones. However, Shojai *et al*. (1998) observed a *P. alba* stand in Sabzevar (Khorasan province of Iran) that was infested to *P. passerinii.*

P. deltoides and *P. x. euamericana* clones used in the study were not infested to the pest in field, while Shojai *et al*. (1998) reported *P. deltoides* and *P. x. euamericana* as host plants of the aphid. They mentioned that *P. deltoides* was less infected, but *P. x. euamericana* clones were more or less infested to the pest.

Shojai *et al*. (1998) did not find any *P. nigra* resistant clone against the pest while in the present study *P. nigra* 62/72, *P. nigra* 62/140 and *P. nigra* 62/149 were completely resistant to the pest in field conditions. The result of this study confirms the previous results obtained in Zanjan province, where a clone of *P. nigra* resistant to *P. passerinii* was introduced (Sadeghi *et al.*, 2002a).

All *P. nigra* clones showing resistance to the pest in Zanjan or Hamedan provinces were native to Turkey, while susceptible or partially resistant clones were native to Iran. Resistance of exotic *P. nigra* clones to woolly poplar aphid could be justified by two reasons. First, the aphid strain in Iran is different from that of Turkey. Second, the exotic *P. nigra* clones introduced to Iran are resistant to the pest. The *P. nigra* 62/140, *P. nigra* 62/72 and *P. nigra* 62/149 clones were completely resistant to woolly poplar aphid in Hamedan province. In the previous studies in laboratory conditions (Rajabi-Mazaher *et al*., 2003), first nymphal instars of the pest were not be able to establish on cuts of these clones. In addition, calculated intrinsic rate of increase (r_m) and net reproductive rate (nymph per female, Ro) on the mentioned clones were zero (Moharramipour *et al*., 2004). Therefore, these two clones could be considered as immune or non host plants for the aphid. The result of the present study rejects the results of Shojai *et al*. (1998) that could not be able to find a *P. nigra* resistant clone to the pest, and supports the previous results obtained in Zanjan province (Sadeghi *et al.*, 2002a).

Table 8. Mean comparison of interaction effects between different poplar clones and natural enemies of woolly poplar aphid.

	Natural enemies (number in 10 cm length of the tree trunk)							
Poplar clones	***E. n.*[1]**	***C. b.*[2]**	***T. e.*[3]**	***P.* sp.[4]**	***C.* sp.[5]**	***S. p.*[6]**	***O.* sp.[7]**	***A.* sp.[8]**
P. nigra 47/13	0.03 ± 0.08^{ijklmn}	0.57 ± 0.13^{fghij}	0.20 ± 0.1^{klmn}	0.03 ± 0.03^{mn}	0.17 ± 0.07^{klmn}	0.73 ± 0.19^{efghi}	0.50 ± 0.11^{ghijkl}	0.30 ± 0.08^{ijklmn}
P. nigra 56/32	0.23 ± 0.08^{jklmn}	0.33 ± 0.11^{ijklmn}	1.77 ± 0.45^{bcd}	0.00^{n}	0.17 ± 0.07^{klmn}	1.30 ± 0.32^{cde}	1.07 ± 0.28^{defg}	0.60 ± 0.16^{fghijk}
P. nigra 56/72	0.67 ± 0.13^{efghi}	1.60 ± 0.19^{ab}	2.33 ± 0.35^{a}	0.63 ± 0.14^{efghi}	0.50 ± 0.13^{ghijkl}	1.60 ± 0.20^{abc}	1.03 ± 0.18^{def}	0.50 ± 0.11^{ghijkl}
P. nigra 74/1	$0.13 \pm 0.06^{lmn*}$	0.1 ± 0.06^{lmn}	0.27 ± 0.11^{ijklmn}	0.13 ± 0.05^{mn}	0.13 ± 0.06^{lmn}	0.33 ± 0.09^{ijklmn}	0.9 ± 0.25^{efgh}	0.43 ± 0.12^{hijklm}
P. nigra 75/2	0.00 ± 0.00^{n}	0.00 ± 0.00^{n}	0.00 ± 0.00^{n}	0.00 ± 0.00^{n}	0.00 ± 0.00^{n}	0.00 ± 0.00^{n}	0.00 ± 0.00^{n}	0.00^{n}

*: Means with similar letters are not significantly different using LSD test ($\alpha = 5\%$).
1- *Exochomus nigromaculatus* (Goeze) (Col.: Coccinellidae)
2- *Chilocorus bipustulatus* L. (Col.: Coccinellidae)
3- *Thaumatomyia elongatula* (Becker) (Dip.: Chloropidae)
4- *Pachyneuron* sp. (Hym.: Pteromalidae)
5- *Chiracanthium* sp. (Araneae: Clubionidae)
6- *Sympherobius* **pygmaeus* (Rambur) (Neu.: Hemerobidae)
7- *Orius* sp. (Hem.: Anthocoridae)
8- *Anthocoris* sp. (Hem.: Anthocoridae)

Establishment and growth of aphid colonies on different geographical directions of the tree trunks and branches were significantly different in the first sampling date. Mean of aphid colonies established on tree trunks in the first sampling date were significantly higher than mean of aphid colonies on tree branches in different geographical directions. The mean of aphid colony numbers on northern and southern branches were higher compared to these on eastern and western branches. These results could be justified by the fact that the aphids hibernate in bark crevices and collars of host trees. Therefore, at the beginning of aphid activities, they establish near their hibernating site on tree collars and then trunks. When the aphid population starts to increase, newly emerged nymphs infest other parts of the trees and establish new colonies particularly on branches of northern and southern directions which are warmer than eastern and western branches.

Natural enemies of woolly poplar aphid are rich in the region (table 5), but their numbers on different poplar clones are not the same. The highest mean number of natural enemies (112.40) were found on *P. nigra* 56/72 clone, which was significantly different from other clones (α = 5%). This clone was infested to the aphid more than other clones, being more susceptible to the aphid. It indicates that a poplar clone with highly susceptibility to the pest shows richness in natural enemies' biodiversity. Inversely, *P. nigra* 75/2 clone with a mean number of 1.20 natural enemies had the least infestation rate to the aphid. Although, resistant clones to the pest provide an economically suitable strategy for pest control, these resistant clones can decrease natural enemy densities. On the other hand, it is possible that the resistant clones lose their resistance against the pest when a new strain of the aphid rises or is introduced to the region. Therefore, it seems to be better and more suitable to use partially resistant clones rather than the highly resistant ones. Because in the latter case, the pest will be managed by integrated pest management tools and natural enemies of the pest populations will be regulated by conserved natural enemies.

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