ACTA AGROBOTANICA Vol. 57, z. 1-2 – 2004 s. 157–167

Aphids (Homoptera, Aphidodea) inhabiting the trees Crataegus x media Bechst. in the urban green area. Part II. Domination and frequency of aphids, their enemies and the damage caused by aphids

ANETA SŁAWIŃSKA, BOŻENNA JAŚKIEWICZ

Department of Entomology, University of Agriculture, ul. Leszczyńskiego 7, 20-069 Lublin, Poland

(Received: 19.11.2003)

Summary

The studies were conducted in Lublin in the years 1999-2001 in two sites (street and park ones) on the trees *Crataegus* x *media* Bechst. The purpose was to determine the domination and frequency of particular aphid species, their effect on the decorative character of plants as well as the occurrence of the aphidophagous in aphid colonies. It was found out that *A. pomi* was the dominating species in both sites. The decorative character of the studied trees was lowered by aphids *A. pomi* and aphids from the genus *Dysaphis*. Aphids from the genus *Dysaphis* also caused changes in the chemical composition of the injured plant parts. The presence of predatory arthropods was observed in aphid colonies occurring on hawthorn. The most numerous of these were the larvae of *Syrphidae* and *Coccinellidae*. The culture of parasitized aphids gave numerous flights of parasitoids and hyperparasitoids. Greater number of both predators and parasitoids of I and II grades were observed in the street site as compared to the park site.

Key words: aphids, domination, frequency, aphid predators, aphid parasitoids

INTRODUCTION

Crataegus x media Bechst. constitutes one of the more precious and beautiful decorative elements of urban green areas. It is characterized by small soil requirements; it grows well in sun-exposed but also half-shaded places. The brushwood and hedges between the fields where all species of hawthorn appear play a big role in soil protection and in landscape decoration (Seneta and Dolatowski 2000).

A lot of pest species occur on hawthorn causing considerable damage to the trees. These pests include the caterpillars from the family *Noctuidae*, *Tortricidae*, *Geometridae*, mining moths, jumping plant lice (*Psyllidae*) and aphids (*Aphidodea*). The latter are especially dangerous due to their high numbers and the damage they cause.

The present work is a continuation of studies on the aphid fauna on the trees of *Crataegus x media* Bechst. (contained in part I). The purpose of this part (part II) was to establish the domination and frequency of particular aphid species and their effect on the decorative character of trees as well as the occurrence of natural enemies in aphid colonies.

MATERIAL AND METHODS

The studied area and the methods of observation concerning the occurrence of aphids on the trees of *Crataegus* x *media* Bechst. in urban conditions are discussed in detail in part I. Besides, in order to determine the qualitative and quantitative relations between particular aphid species occurring on the studied trees, two ecological indexes were used, namely domination and frequency (persistence of occurrence) (Górny and Grüm 1981, Szujecki 1980, Trojan 1977).

The index of domination (D) in other words termed as relative abundance (A_r) determines the percentage of specimens of a given species in the total number of aphids on the studied plant. The index of domination (D) was calculated according to the following formula:

$$D = \frac{n_a}{n} \times 100,$$

where: n_a – number of individuals belonging to a given species in all samples, n – number of individuals of a studied systematic group in all samples.

The following classes of domination were distinguished:

Superdominants >60% Subdominants 10-20% Eudominants 31-60% Recedents 1-9% Dominants 21-30% Subrecedents <1%

The index of frequency (F) shows the relation between the number of all samples where a given species occurred and the number of all samples taken from the studied plant. The constancy of occurrence (C), in other words the index of frequency (F) was calculated according to the following formula:

$$C = \frac{q}{O} \times 100$$

where: q – number of trials when a given species was noted, Q – number of all samples.

Four classes of constancy (frequency) were distinguished:

Class I (euconstants) -0.76-1 (76-100%)Class II (constants) -0.51-0.75 (51-75%)Class III (accessory species) -0.26-0.50 (26-50%)Class IV (accidents) $-\le 0.25 (\le 25\%)$.

RESULTS

Figure 1 presents the percentage of particular species of aphids inhabiting *Crataegus* x *media* Bechst. in both sites during the three years of studies. Table 1 lists the number, domination and frequency of particular aphid species, while Table 2 presents the content of some elements in the leaves of hawthorn damaged as a result of preying aphids from the genus of *Dysaphis* Börn. Table 3, on the other hand, presents the number of aphid enemies, while table 4 the number of parasitoids and hyperparasitoids.

Domination structure and constancy (frequency) of aphids' occurrence

The highest proportion of aphids *Aphis pomi* De Geer was found out in 2000 in site A (99.37%), while the lowest in site B in the same year (60.22%) (Figure 1). Considering the domination, in each year of studies this species was included into superdominants in both sites (Table 1). Taking into account the persistence of their occurrence, in site A it belonged to frequency class II – constant, and only in 1999 it was included into class III – accessory species. In 1999 in site B this species belonged to frequency class IV – accident, while in the other years it belonged to class III – accessory species (Table 1).



Photo 1. Colony of Ovatus crataegarius (Walk.) aphids on Crataegus x media Bechst.

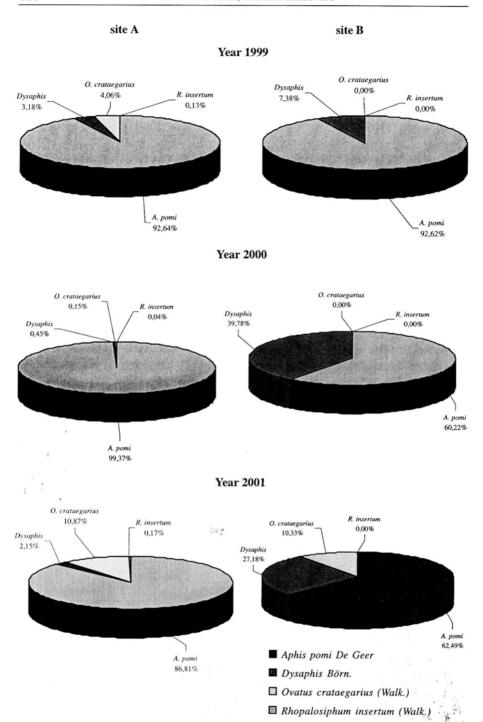


Fig. 1. Percent of particular species of aphids on Crataegus x media Bechst. in the years 1999-2001

Table 1.
The number, domination and frequency of aphid species inhabiting *Crataegus x media* Bechst.

Species of aphids	Year		Site A		Site B						
species of apilius	Tear	N	D	С	N	D	C				
Aphis pomi De Geer	1999	2944	92,63 (SD)	0,476 (III)	1104	92,61 (SD)	0,238 (IV)				
	2000	46215.	99,36 (SD)	0,708 (II)	769	60,21 (SD)	0,417 (III)				
	2001	9470	86,8 (SD)	0,542 (II)	738	62,48 (SD)	0,333 (III)				
	Total	58629	96,75 (SD)	0,58 (II)	2611	71,53 (SD)	0,333 (III)				
	1999	101	3,17(R)	0,143 (IV)	88	7,38 (R)	0,333 (III)				
B 1' B"	2000	209	0,45 (SuR)	0,292 (III)	508	39,78 (E)	0,25 (IV)				
<i>Dysaphis</i> Börn.	2001	235	2,15 (R)	0,333 (III)	321	27,18 (D)	0,333 (III)				
	Total	545	0,89 (SuR)	0,261 (III)	917	25,12 (D)	0,304 (III)				
	1999	129	4,05 (R)	0,286 (III)	0	0	0				
Ovatus	2000	68	0,14 (SuR)	0,333 (III)	0	0	0				
crataegarius (Walk.)	2001	1186	10,87 (SuD)	0,417 (III)	122 10,33 (SuD)		0,125 (IV)				
	Total	1383	2,28 (R)	0,333 (III)	122	3,34 (R)	0,043 (IV)				
Rhopalosiphum insertum (Walk.)	1999	4	0,12 (SuR)	0,143 (IV)	0	0	0				
	2000	17	0,03 (SuR)	0,167 (IV)	0	0	0				
	2001	18	0,16 (SuR)	0,208 (IV)	0	0	0				
	Total	39	0,06 (SuR)	0,174 (IV)	0	0	0				

N – Number (in specimens)

C - Constancy of aphid appearance -

(I) - class I (euconstant)

(II) - class II (constant)

(III) - class III (accessory species)

(IV) - class IV (accident)

D – Domination (in %):

SD - superdominant

E - eudominant

D - dominant

SuD - subdominant

R - recedent

SuR - subrecedent

Ovatus crataegarius (Walk.) (Photo 1) in site A occurred in all the studied years, while in site B its presence was observed only in 2001. The percentage of those aphids ranged from 0% to 10.33%, depending on the year of studies and the site (Figure 1). The highest number of those insects was found out in 2001, when this species was a subdominant. In 1999 it belonged to recedents, while in 2000 to sub-recedents. Considering the persistence of occurrence in site A it belonged to frequency class III – accessory species, while in site B it belonged to frequency class IV – accident (Table 1).

Rhopolosiphum insertum (Walk.) appeared only in site A. The percentage of aphids of this species ranged from 0.04% to 0.17% (Figure 1). In each studied year it was a subrecedent and it belonged to frequency class IV – accident (Table 1).

The number of aphids from the genus *Dysaphis* Börn. in relation to the other species occurring on hawthorn trees was much higher in site B as compared to site A. The lowest percentage of those aphids was found out in site A in 2000 (0.45%), while the highest in that same year in site B (39.78%) (Figure 1). Taking into consideration all the studied years, this aphid was a dominant in site B, while in site A it was a subrecedent. As for the persistence of occurrence in both sites, those aphids most often belonged to frequency class III – accessory species (Table 1).

Symptoms of injuries

Among all the species of aphids occurring on the trees of *Crataegus* x *media* Bechst., only *A. pomi* and aphids from the genus *Dysaphis* clearly lowered their decorative value. Aphids *A. pomi* inhabited mainly the young hawthorn shoots, causing their deformation. In summer, they preyed together with the other individuals of *Psyllidae* on older leaves causing their discoloration and slight deformations. Aphids *O. crataegarius* preyed on the top shoots of host plants but they did not cause any deformation, while aphids *R. insertum* caused slight transverse twisting of the leaves in spring.

In spring, aphids from the genus *Dysaphis* caused the appearance of excrescencies in the form of red protuberances of the leaf blade (Photo 2). The laboratory analyses confirmed the changes in the chemical content of the damaged tissues. As compared to the control, the leaves with excrescencies had a smaller content of photosynthetic pigments (chlorophyll A and B, carotene and xanthophyll) as well as total nitrogen, while the content of reduction sugars increased six times (Table 2).

Table 2.

The effect of preying aphids from the genus *Dysaphis* Börn. on the content of some elements in hawthorn leaves

Leaves	Content										
	Chlorophyll A+B (mg/g d.w.)	Carotene+Xanthophyll (mg/g d.w.)	Total nitrogen (in % d.w.)	Reduction sugars (mg%)							
Control	1,76	0,28	3,03	11,0							
Damaged	1,46	0,22	2,01	64,3							

Aphid predators and parasitoids

In aphid colonies inhabiting the trees of *Crataegus* x *media* Bechst. in both sites the studies found out the presence of the following predators throughout the season: young and adult individuals of *Araneida*; eggs, larvae and adult *Coccinellidae* and *Chryspidae*; larvae of *Cecidomyiidae*; eggs and larvae *Syrphidae* (Table 3). In 2000 in site A and B predators occurred in the greatest numbers (especially young and adult individuals of *Araneida*; eggs and larvae of *Syrphidae*; eggs of *Chrysopidae*). In each year, the studies observed a higher number of predators in site A as compared to site B. This could have been related to high numbers of aphids in site A.



Photo 2. The excrescencies in the form of red protuberances of the leaf blade caused by aphids from the genus *Dysaphis* Börn. on *Crataegus* x *media* Bechst.

 $\label{thm:condition} Table \ 3.$ The number of aphid predators on $\it Crataegus \ x \ \it media \ Bechst.on \ sites \ A \ and \ Bisku \ A \ i \ B$

			Si	te A			Site B							
Pred		Number	r/5 shoo	ts	Number/5 shoots									
	1999	2000	2001	Total	1999	2000	2001	Total						
Araneida	young and adult	1,2	2,8	-	4	-	1,2	0,8	2					
Coccinellidae	eggs	0,4	4,8	121	5,2	-	-	0,4	0,4					
	larvae	0,4	7,2	1,6	9,2	9	0,4	1,6	2					
	adult	-	2,4	-	2,4	0,4	0,4	2,8	3,6					
Dermaptera	larvae and adult	-	0,4		0,4	-		-	-					
Cecidomyiidae	larvae	-	8,8	-	8,8	4	-	-						
Syrphidae	eggs	1,6	20,4	6,8	28,8	-	1,6	*	1,6					
	larvae	-	38,8	1,6	40,4	100	2	-	2					
Chrysopidae	eggs	16,4	19,6	-	36	3,6	26	0,4	30					
	larvae	0,4	1,2	-	1,6	0,4	-	U=	0,4					
	adult	-	0,4	. (e	0,4	112	0,8	794	0,8					

Table 4. The number of aphid parasitoids and hyperparasitoids on *Crataegus* x *media* Bechst.

Parasitoids and hyperparasitoids (family, species)				Number of parasitoids (in specimens)											
		Species of host aphid		19	99		2000				2001				Total
			A		В		A		В		A		В		
				Q	d	Q	d	Ç	d	Q	ď	Q	d	Q	
Parasitoids															
Ichneumonoidae <u>Aphidiidae</u>															
Aphidiinae:	Trioxys angelicae Haliday	Aphis pomi De Geer, Dysaphis Börn.		2		1	17	22		1		2			45
Ephedrinae:	Ephedrus plagiator Nees	Aphis pomi De Geer									2	5	2	4	13
Hyperparasitoids Cynipoidae Cynipidae															
Charpinae:	Charpis victrix Westwood	Aphis pomi De Geer						3							3
Chalcidoidea Pteromalidae															
Pteromalinae:	Pachyneuron aphidis Bouché	Aphis pomi De Geer	1								1	1			3
Asaphinae:	Asaphes vulgaris Walker	Aphis pomi De Geer			1						2	3			6
<u>Encyrtidae</u>															
	Aphidencyrtus ephidivorus Mayr	Aphis pomi De Geer									1	2			3
<u>Megaspilidae</u>															
Megaspilinae: Dendrocerus carpenteri Curtis		Aphis pomi De Geer					1					3			4

The culture of parasitized aphids occurring on hawthorn gave 77 adult individuals from the order *Hymenoptera*, which belonged to parasitoids of I and II grades (Table 4). The parasitic hymenoptera of I grade belonged exclusively to the family *Aphidiidae* and they constituted 75.3% of all the obtained parasitoids. Those are most frequently polyphagous and endoparasitic species that attacked aphids *A. pomi* and the aphids from the genus *Dysaphis* on hawthorn. Hyperparasitoids included 5 species of hymenoptera (Table 4) belonging to the family *Cynipidae*, *Pteromalidae*, *Encyrtidae* and *Megaspilidae*. *Asaphes vulgaris* Walker from the family *Pteromalidae* was the most numerous species and it constituted 31.6% of all the obtained hyperparasitoids. All the parasitic hymenoptera of II grade were obtained only from the parasitoids of *A. pomi* aphids.

DISCUSSION

Among four aphid species observed on the trees *Crataegus* x *media* Bechst., *A. pomi* was the most numerous. During one vegetation season up to 9243 specimens per plant were found out. The percentage of this species was never lower than 60% (superdominant).

The numbers of aphids from the genus *Dysaphis* varied in particular years of studies and due to this fact the species was sometimes eudominant, dominant, recedent or even subrecedent. Similar observations are reported by Tykarska (2001a, 2001b).

The number of O. crataegarius varied in particular years of studies and in each of the sites and therefore the species belonged to subdominants, recedents or subrecedents. This aphid is considered to be a two-home species, migrating from hawthorn onto mint (Cichocka 1980, Szelęgiewicz 1968). However, it follows from the present studies that migration is of facultative nature since part of the aphids remained on hawthorn throughout the season. Similar observations are given in the studies by Tykarska (2001a, 2001b).

The present studies observed scarce aphids *R. insertum* in spring and autumn only in site A (subrecedent and accident).

A. pomi caused the twisting of young shoots, discoloration and deformation of leaves on the studied trees. Similar observations on decorative shrubs are reported by other authors (Jaśkiewicz 1997, 2000, Jaśkiewicz et al. 2001, Łabanowski and Orlikowski 1997). Even with big number of aphids O. crataegarius, the studies observed no visible injuries on the examined plants, which was confirmed by earlier studies (Achremowicz 1990, Müller 1976). Aphids R. insertum occurred in small numbers and for a short period of time; that is the reason why no distinct injuries were observed on the studied plants.

Aphids cause disturbances both outside and inside the plants (Cichocka and Goszczyński 1986). The analysis of leaves with excrescencies caused by aphids from the genus *Dysaphis* showed that the content of chlorophyll and other pigments decreased and the amount of reduction sugars increased. Similar observations on hawthorn inhabited by *Dysaphis crataegi* Kalt. were reported by Goszczyński and Cichocka (1986).

The number of aphids on the studied plants is influenced by the presence of their natural enemies (Cichocka 1996). The predators on the trees *Crataegus* x *media* Bechst. included spiders, earwigs, ladybirds, the larvae of *Cecidomyidae*, *Syrphidae* and *Chamaemyiidae*. They were most numerous in the year 2000.

Numerous parasitoids and hyperparasitoids were obtained from the mummies of aphids occurring on the trees of *Crataegus* x *media* Bechst. The greatest number of parasitic hymenoptera of I and II grades were obtained in 2000 from aphids *A. pomi*. On the other hand, it follows from the studies published by Olszak (1991) that parasitisation of aphids *A. pomi* on apple trees is inconsiderable.

- 1. A. pomi was the species that dominated in both sites in each studied year.
- 2. Out of the four species inhabiting the trees of hawthorn, only *A. pomi* and aphids from the genus *Dysaphis* lowered their decorative values.
- 3. Aphids from the genus *Dysaphis* caused changes in the chemical composition of the damaged plant tissues.
- 4. Greater numbers of predators were observed in site A (street site) as compared to site B (park site) but they had little effect on aphid population due to their low numbers.
- 5. Greater numbers of parasitic hymenoptera were observed in site A (street site) as compared to site B (park site).

REFERENCES

- Achremowicz J., 1990. Z badań nad fauną mszyc Śląska Dolnego i Sudetów. Zesz. Probl. Post. Nauk Rol., 392. 79-94.
- Cichocka E., 1980. Mszyce roślin sadowniczych Polski. PWN, Warszawa, 119pp.
- Cichocka E., 1996. Effect of natural enemies on aphid populations in young apple orchard. Aphids and Other Homopterous Insects, 5, PAS, Skierniewice, 37-45.
- Cichocka E., Goszczyński W., 1986. Biologia odżywiania i bezpośrednia szkodliwość mszyc. Zesz. Probl. Post. Nauk. Rol., 329, 7-23.
- Goszczyński W., Cichocka E., 1986. Szkodliwość mszyc żerujących na korzeniach marchwi. Zesz. Probl. Post. Nauk. Rol., 329, 41-53.
- Górny M., Grüm L., 1981. Metody stosowane w zoologii gleby. PWN, Warszawa, 483pp.
- Jaśkiewicz B. 1997. Skład gatunkowy i dynamika pojawu mszyc na wybranych krzewach ozdobnych w latach 1973 – 1993. Rozprawa habilitacyjna. Wyd. AR w Lublinie s. Rozprawy Naukowe, 183, 93pp.
- Jaśkiewicz B., 2000. Aphids on chosen ornamental shrubs in Lublin. Aphids and Other Homopterous Insects, 7, PAS, Olsztyn, 67-74.
- Jaśkiewicz B., Łagowska B., Gantner M., 2001. Aphids Inhabiting Certain Ornamental shrubs in Urban Conditions. Annales UMCS, EEE., 9, 99-107.
- Łabanowski G., Orlikowski L., 1997. Ochrona roślin iglastych i wrzosowatych. Plantpress Sp. z. o.o., Kraków, 256pp.
- Müller F. P., 1976. Mszyce szkodniki roślin. Terenowy klucz do oznaczania. PWN, 118pp.
- O1szak R. W., 1991. Ocena skuteczności zespołu afidofagów występujących w sadach jabłoniowych. W: Mszyce ich bionomia, szkodliwość i wrogowie naturalni. (red. Cichocka, Goszczyński), PAN, Warszawa, 107-113.

- Seneta W., Dolatowski J., 2000. Dendrologia. Wydawnictwo Naukowe PWN, Warszawa, 559pp.
- Szelęgiewicz H., 1968. Mszyce Aphidoidea. Katalog fauny Polski. XXI, 4, 316, PWN, Warszawa.
- Szujecki A., 1980. Ekologia owadów leśnych. PWN, Warszawa, 603pp.
- Trojan P., 1977. Ekologia ogólna. PWN, Warszawa, 418pp.
- Tykarska K., 2001a. Mszyce i pasożytnicze błonkówki występujące na głogu dwuszyjkowym (*Crataegus laevigata* L.) w Warszawie i Gdańsku. W: Bioróżnorodność i ekologia populacji zwierzęcych w środowiskach zurbanizowanych. [red. Indykiewicz P., Barczak T., Kaczorowski G.], NICE, Bydgoszcz, 38-41.
- Tykarska K., 2001b. Aphids on whitehorn (*Crataegus laevigata* L.) in localities at street and in parks of Gdańsk and Warsaw. Aphids and Other Homopterous Insects, 8, PAS, Siedlee, 231-238.

Mszyce (*Homoptera*, *Aphidodea*) zasiedlające drzewa *Crataegus* x *media* Bechst. na terenie zieleni miejskiej. Część II. Dominacja i frekwencja mszyc, ich wrogowie i powodowane przez mszyce uszkodzenia

Streszczenie

Obserwacje dotyczące określenia dominacji i frekwencji mszyc, ich wpływu na dekoracyjność badanych roślin oraz występowanie afidofagów w koloniach mszyc prowadzono na drzewach Crataegus x media Bechst. na terenie zieleni miejskiej Lublina. Badania wykonywano w latach 1999-2001 na dwóch stanowiskach: przyulicznym – A i parkowym – B. W wyniku przeprowadzonych obserwacji stwierdzono, że gatunkiem dominującym na obydwu stanowiskach był Aphis pomi De Geer. Ustalono, że mszyce A. pomi i mszyce z rodzaju Dysaphis Börn. znacznie obniżały dekoracyjność badanych drzew. Ponadto mszyce z rodzaju Dysaphis powodowały zmiany w składzie chemicznym uszkodzonych organów roślinnych. W koloniach mszyc występujących na drzewach głogu pośredniego stwierdzono obecność licznych afidofagów. Spośród owadów drapieżnych najliczniej występowały larwy Syrphidae i Coccinellidae. Wyższą liczebność drapieżców obserwowano na stanowisku przyulicznym - A. Wszystkie uzyskane parazytoidy i hiperparazytoidy należały do rzędu Hymenoptera. Parazytoidy I stopnia atakowały mszyce A. pomi i mszyce z rodzaju Dysaphis, natomiast pasożytnicze błonkówki II stopnia wyhodowano wyłącznie z parazytoidów mszyc A. pomi. Wyższą liczebność parazytoidów I i II stopnia stwierdzono na stanowisku przyulicznym - A.