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# Aphids (*Homoptera, Aphidodea*) Inhabiting the Shrubs of *Spiraea japonica* L. in the City Green Areas. Part II. Domination and frequency of aphids, their predators and injuries caused by aphids

Mszyce (*Homoptera, Aphidodea*) zasiedlające krzewy *Spiraea japonica* L. na terenie zieleni miejskiej. Część II. Dominacja i frekwencja mszyc, ich drapieżcy i powodowane przez mszyce uszkodzenia

**Abstract:** *Aphis spiraephaga* Müll. was the dominating species in both sites on shrubs of *Spiraea japonica* L. every year. All aphid species occurred maximally for two months. Predators (*Coccinellidae*, *Syrphidae*, *Chrysopidae* and spiders) had a minimum influence on aphids population because of their small number and periods of occurrence. *Aphis spiraephaga* and *Aphis fabae* L. lowered the decorative values of shrubs, especially during the blooming period of those plants.

**Key words**: aphids, natural enemies, *Spiraea japonica* L., green areas, domination, frequency

## INTRODUCTION

The shrubs of *Spiraea japonica* L. weakened by unfavourable ecological conditions in the cities are susceptible to the injuries caused by these insects due to the big numbers in their population and poor pressure of their natural enemies. The notion "pest" refers in urbanized settings to those species that caused not only economic losses but also lower the decorative value of ornamental shrubs (Bugała, 1991). Despite uncontested decorative values of *S. japonica*, there is a lack of studies on the occurrence of aphids on these shrubs throughout the whole vegetation period.

This paper is a continuation of studies (contained in Part I) on aphids on *S. japonica*. The purpose of this part was to establish domination and frequency

of particular aphids species, their influence on the decorative value of shrubs and occurrence of their natural enemies in aphids colonies.

## MATERIAL AND METHODS

The basis of research work and methods used to establish the occurrence of aphids on the observed shrubs in city conditions are precisely presented in part I. Additionally, two ecological indexes were used to determine the domination and constancy of occurrence (frequency) (Górny and Grüm 1981; Trojan 1977). The index of domination (D) was calculated according to the following formula:

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

$n_a$ – 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 constancy of occurrence (C) or the index of frequency (F) was calculated according to the following formula:

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

$q$ – number of trials when a given species was noted
$Q$ – number of all samples.

4 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) – ≤0.25 (≤25%)

## RESULTS

The proportion of particular aphid species in the examined sites are shown in fig. 1. Table 1 contains the data on the number and dates of occurrence of aphids: the first occurrence, the maximum and disappearance. Table 2 presents domination and frequency, while table 3 shows the data of predators' occurrence.

**Domination structure and constancy (frequency) of aphids' occurrence.** *Aphis spiraephaga* Müll. was noted on *Spiraea japonica* L. every year and it was the most numerous aphid. Aphids of this species occurred from second 10 day's period of May till third 10 day's period of June in both sites. The maxi-

mum of their occurrence was noted the most often in June and their disappearance at the end of July (only in 2000 in first 10 day's period of August). The number of aphids was repeatedly higher (16 times) in site A than in site B (Tab. 1). It was a superdominant in both sites in all years of studies (Tab. 2). This species constituted from 63.96% to 100% of all aphids feeding on the shrubs of *S. japonica* (Fig. 1).

First individuals of *Aphis fabae* Scop. were observed in site A between May and June, and in site B in the latter half of May. Their maximum was noted in third 10 day's period of May or in June. This species stayed on the shrubs till the middle of July.

The number of individuals of this species in site A was higher and it amounted to 49.4 aphids/shrub, and in site B – 32.2 aphids/shrub (Tab. 1). Depending on the year of studies, *A. fabae* was a subdominant (in site A in 1999 and in site B in 2000), recedent (in site A in the years 2000 and 2001) and eudominant (in site B in the year 2001) (Tab. 2). The species constituted from 1.85% to 35.71% of all the aphids feeding on the shrubs of *S. japonica* (Fig. 1).

Single individuals of *Brachycaudus spiraeae* Börn. were noted only in the years 2000 and 2001. They fed on shrubs about one month, from the end of May till the first 10 day's period of July. Their number was twice higher in site A than in site B (Tab. 1). *B. spiraeae* was observed twice in the course of the three years of studies and then it was a recedent (in site B in the year 2000, and in site A in the year 2001) or a subrecedent (in site A in the year 2000, and in site B in the year 2001) (Tab. 2). This species constituted from 0.03% to 3.81% of all aphids in the years of its occurrence (Fig. 1).

All the aphid species occurred on the shrubs of *S. japonica* for a relatively short time, two months the longest. That is the reason why considering its constancy of occurrence it can be included within IV class of frequency.

Aphid predators. The occurrence of predators was observed on the shrubs of *Spiraea japonica* L. in the aphid colonies. Those predators included young and adult individuals of *Araneida*; the larvae and adults of *Dermaptera*; adults of *Coccinellidae*; the eggs of *Chrysopidae*; the eggs and larvae of *Syrphidae* (Tab. 3). The aphidophagous species were relatively scarce, especially in site B. They appeared in the period of the greatest numbers of aphids or just after the maximum and they probably had no effect on limiting the population.

No parasitoids were found on the examined shrubs; a few empty mummies were observed in site B and those had been probably earlier left by the parasitic hymenoptera.

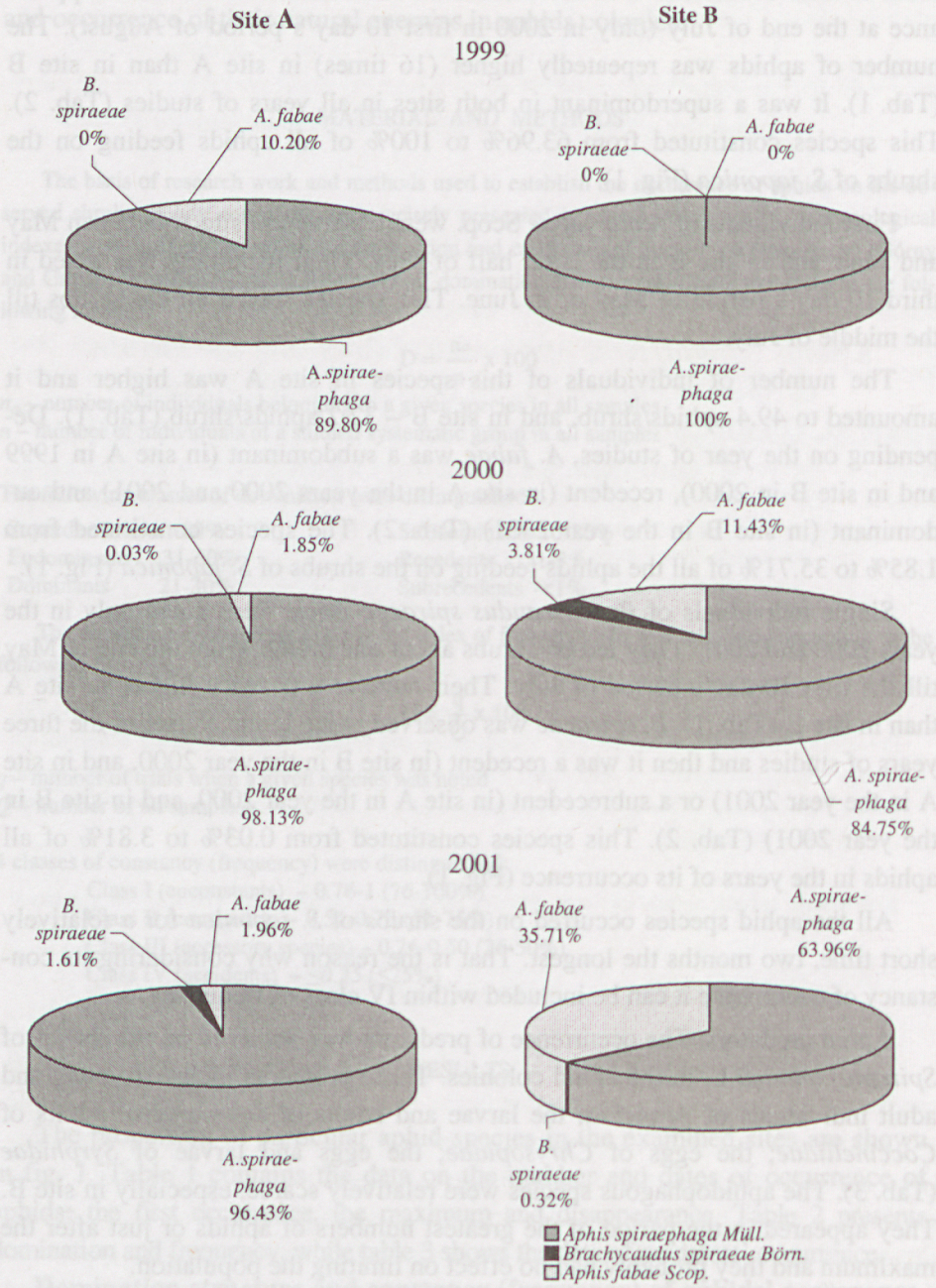


Fig. 1. Percentage contribution of particular aphid species on *Spiraea japonica* L. in the years 1999-2001

Tab. 1. The occurrence of aphids on *Spiraea japonica* L.

| Year | Site | Species | The appearance of aphids (10 day's period/month) | Term of maximum (10 day's period/month) | The disappearance of aphids (10 day's period/month) | Number of aphids | |
|---|---|---|---|---|---|---|---|
| | | | | | | Bs | Us |
| 1999 | A | *Aphis spiraephaga* Müll. | IIdVI | IIIdVI | IIIdVII | 115.6 | 0.6 |
| | | *Aphis fabae* Scop. | IIIdVI | IIIdVI | IIdVII | 13.2 | 0 |
| | | *Brachycaudus spiraeae* Börn. | - | - | - | - | - |
| | B | *Aphis spiraephaga* Müll. | IIIdVI | IdVII | IIIdVII | 6.2 | 1 |
| | | *Aphis fabae* Scop. | - | - | - | - | - |
| | | *Brachycaudus spiraeae* Börn. | - | - | - | - | - |
| 2000 | A | *Aphis spiraephaga* Müll. | IIIdV | IIIdVI | IdVIII | 1424.8 | 20.6 |
| | | *Aphis fabae* Scop. | IdVI | IIdVI | IIdVII | 21.8 | 5.4 |
| | | *Brachycaudus spiraeae* Börn. | IdVII | - | IIdVII | 0.4 | - |
| | B | *Aphis spiraephaga* Müll. | IIdV | IIdVI | IIdVII | 73.2 | 2.4 |
| | | *Aphis fabae* Scop. | IIdV | IdVI | IIdVI | 9.8 | 0.4 |
| | | *Brachycaudus spiraeae* Börn. | IIdV | IIdV | IdVII | 2.8 | 0.6 |
| 2001 | A | *Aphis spiraephaga* Müll. | IIdV | IdVI | IIdVII | 431.6 | 11.6 |
| | | *Aphis fabae* Scop. | IIIdV | IIIdV | IIdVI | 5.6 | 3.4 |
| | | *Brachycaudus spiraeae* Börn. | IIIdV | IIIdV | IIdVI | 7.2 | 0.2 |
| | B | *Aphis spiraephaga* Müll. | IIIdV | IIdVI | IIdVII | 36.4 | 3 |
| | | *Aphis fabae* Scop. | IIIdV | IIdVI | IdVII | 21 | 1 |
| | | *Brachycaudus spiraeae* Börn. | IIdVI | - | IIIdVI | 0.2 | - |
| Total | A | *Aphis spiraephaga* Müll. | IIdV- IIdVI | IdVI- IIIdVI | IIdVII- IdVIII | 1972 | 32.8 |
| | | *Aphis fabae* Scop. | IIIdV-IIIdVI | IIIdV- IIIdVI | IIdVI-IIdVII | 40.6 | 8.8 |
| | | *Brachycaudus spiraeae* Börn. | IIIdV- IdVII | IIIdV | IIdVI- IIdVII | 7.6 | 0.2 |
| | B | *Aphis spiraephaga* Müll. | IIdV- IIIdVI | IIdVI- IdVII | IIdVII- IIIdVII | 115.8 | 6.4 |
| | | *Aphis fabae* Scop. | IIdV-IIIdV | IdVI-IIdVI | IIdVI- IdVII | 30.8 | 1.4 |
| | | *Brachycaudus spiraeae* Börn. | IIdV-IIdVI | IIdV | IIIdVI- IdVII | 3 | 0.6 |

d – 10 day's period, Bs – wingless aphids, Us – winged aphids

Tab. 2. The number, domination and frequency of aphid species inhabiting *Spiraea japonica* L.

| Species | Year | Site A | | | Site B | | |
|---|---|---|---|---|---|---|---|
| | | N | D | C | N | D | C |
| *Aphis spiraephaga* Müll. | 1999 | 581 | 89.80 (SD) | 0.19 (IV) | 36 | 100 (SD) | 0.143 (IV) |
| | 2000 | 7227 | 98.13 (SD) | 0.292 (IV) | 378 | 84.75 (SD) | 0.25 (IV) |
| | 2001 | 2216 | 96.43 (SD) | 0.25 (IV) | 197 | 63.96 (SD) | 0.208 (IV) |
| | Total | 10024 | 97.22 (SD) | 0.246 (IV) | 611 | 77.34 (SD) | 0.203 (IV) |
| *Aphis fabae* Scop. | 1999 | 66 | 10.20 (SuD) | 0.095 (IV) | 0 | 0 | 0 |
| | 2000 | 136 | 1.85 (R) | 0.166 (IV) | 51 | 11.43 (SuD) | 0.125 (IV) |
| | 2001 | 45 | 1.96 (R) | 0.083 (IV) | 110 | 35.71 (E) | 0.166 (IV) |
| | Total | 247 | 2.39 (R) | 0.115 (IV) | 161 | 20.37 (D) | 0.101 (IV) |
| *Brachycaudus spiraeae* Börn. | 1999 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 2000 | 2 | 0.03 (SuR) | 0.042 (IV) | 17 | 3.81 (R) | 0.083 (IV) |
| | 2001 | 37 | 1.61 (R) | 0.083 (IV) | 1 | 0.32 (SuR) | 0.042 (IV) |
| | Total | 39 | 0.37 (SuR) | 0.043 (IV) | 18 | 2.27 (R) | 0.043 (IV) |

N – Number

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

Tab. 3. The occurrence of aphid predators on *Spiraea japonica* L. in sites A and B

| Aphidophags | | Site A | | | | | | | Site B | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Period of occurrence (10 day's period/month) | | | Number/shrub | | | | Period of occurrence (10 day's period/month) | | | Number/shrub | | | |
| | | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 | Total | 1999 | 2000 | 2001 | 1999 | 2000 | 2001 | Total |
| *Araneida* | young and adult | IdVII--IIIdVII | IIdVI | - | 0.8 | 0.4 | - | 1.2 | IIIdVIII | IIdVI | - | 0.4 | 0.4 | - | 0.8 |
| *Coleoptera Coccinellidae* | adult | IIIdVI--IdVIII | - | IIIdVI | 1.2 | - | 0.4 | 1.6 | IIIdVII--IIdIX | IIIdVII | - | 0.8 | 0.4 | - | 1.2 |
| *Dermaptera* | larvae and adult | IIIdVII--IdVIII | - | - | 1.2 | - | - | 1.2 | - | IIIdVI | - | - | 0.4 | - | 0.4 |
| *Diptera Syrphidae* | eggs | - | - | IIdVI | - | - | 2.4 | 2.4 | - | - | - | - | - | - | - |
| | larvae | - | - | IdVI--IIdVI | - | - | 0.8 | 0.8 | - | - | - | - | - | - | - |
| *Neuroptera Chrysopidae* | eggs | IdVIII--IIIdVIII | IIIdVI--IdVIII | - | 1.6 | 2.8 | - | 3.4 | IIdVII | IIIdV--IIIdVII | - | 0.4 | 12.8 | - | 13.2 |

d – 10 day's period

**Symptoms of injuries**. Single individuals of *B. spiraeae* did not cause any clear injuries on the plants. *A. fabae* and *A. spiraephaga* occurred mainly on flower umbels and on the spiraea shoots. The generative parts attacked by aphids dried out earlier and the shoots underwent slight deformation. During the blooming period of those plants, the feeding aphids clearly lowered the their decorative values.

## DISCUSSION

The most numerous species on *S. japonica* in each year of the studies was *Aphis spiraephaga.* The other aphid species, especially *Brachycaudus spiraeae*, occurred in small numbers and not in all years of studies.

Together with growing environmental pollution, the number of insects with the sucking-stinging mouth apparatus began to increase rapidly. In the years of studies, aphids occurred in a much greater number in the street site (A). Similar results, but for trees (maple, linden), are provided from Warsaw by Cichocka and Goszczyński, (1991), from Poznań by Wilkaniec (1994), and also by other authors (Sahajdak et al., 1995). It was also found out that in street sites the rate of the increase of natural enemies is much lower than in the case of aphids (Minoranskij and Wojciechowski 1988).

A small influence on limiting the population of aphids could have been exerted by predatory arthropods: spiders, ladybirds – *Adalia bipunctata* L. and *Coccinella septempunctata* L. as well as larvae *Syrphidae*, which occurred in small number during the maximum number of aphids or just after it. Other authors speak about a considerable effect of natural enemies on the number of aphids in the season of vegetation on other plants (Barczak 1994; Cichocka 1996; Cichocka and Goszczyński, 1997; Olszak and Niemczyk, 1986; Wnuk, 1972).

*Aphis spiraephaga* and *A. fabae* caused slight deformation and inhibition of growing of shoots, tinning and rolling of leaves and earlier drying of umbels. Single individuals of *B. spiraeae* feeding on young shoot caused slight rolling of some leaves along the rib. But *A. spiraephaga* and *A. fabae* determinate low decorative values of spiraea shrubs. Harmfulness of aphids feeding on plants of *Spiraea* sp. was found out by Jaśkiewicz (1997).

## CONCLUSIONS

1. Annually, the species that clearly dominated in sites A and B was *Aphis spiraephaga* Müll.

2. The decorative character of the shrubs during anthesis was lowered by *Aphis spiraephaga* and *Aphis fabae* (the flowers dried out earlier). *Brachy-*

*caudus spiraea* inhibited the plants for a short time and in small numbers, and it did not cause any clear damage.

3. A small influence on limiting the population of aphids was exerted by predatory arthropods because of their small number and period of occurrence.

## REFERENCES

Barczak T., 1994. Naturalni wrogowie mszyc i ich znaczenie w ochronie roślin. Wiad. Entomol. 13, 3: 141-152.

Bugała W., 1991. Drzewa i krzewy dla terenów zieleni. PWRiL, Warszawa, 594 pp.

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., 1991. Mszyce zasiedlające drzewa przyuliczne w Warszawie. w: Mszyce ich bionomia, szkodliwość i wrogowie naturalni. (red. Cichocka E., Goszczyński W.), PAN, Warszawa: 9-18.

Cichocka E., Goszczyński W., 1997. Mszyce i ich wrogowie naturalni w młodym sadzie jabłoniowym. w: Ogólnopol. Konf. Ochrony Roślin Sadowniczych, Skierniewice: 11-12 luty: 54-57.

Górny M., Grüm L., 1981. Metody stosowane w zoologii gleby. PWN, Warszawa, 483 pp.

Jaśkiewicz B. 1997. Skład gatunkowy i dynamika pojawu mszyc na wybranych krzewach ozdobnych w latach 1973–1993. Rozprawa habilitacyjna. Wyd. AR w Lublinie, Rozprawy Naukowe, 183, 93 pp.

Minoranskij V. A., Wojciechowski W., 1988. Wpływ spalin transportu samochodowego na liczebność mszycy *Protaphis artemisiae* Narz., biedronki *Coccinella septempunctata* L. i mrówki *Lasius niger* (L.) w strefie przydrożnej. Acta Biol. Sil., Katowice, 10, 27: 21-27.

Olszak R., Niemczyk E., 1986. The predaceous *Coccinellidae* associated with aphids in apple orchards. Ekol. Pol., 34, 4: 711-721.

Sahajdak A., Boczek J., Cichocka E., Kropczyńska D., 1995. Liczebność mszyc i roztoczy w środowisku skażonym emisjami przemysłowymi. Mat. XXXV Sesji Nauk. IOR, Poznań, cz. 2: 129-132.

Trojan P., 1977. Ekologia ogólna. PWN, Warszawa, 418 pp.

Wilkaniec B., 1994. Afidofauna of selected tree species in the urban area of Poznań. Aphids and Other Homopterous Insects, 4, PAS, Skierniewice: 71-79.

Wnuk A., 1972. Badania nad składem gatunkowym drapieżnych bzygowatych (*Syrphidae, Diptera*) występujących w koloniach mszyc na drzewach i krzewach owocowych. Pol. Pismo Entomol. 42: 235-247.

## STRESZCZENIE

Corocznie dominującym gatunkiem zasiedlającym *Spiraea japonica* L. na obydwu terenach była *Aphis spiraephaga* Müll. Wszystkie gatunki mszyc występowały stosunkowo krótko, maksymalnie przez okres dwóch miesięcy. Minimalny wpływ na ograniczenie populacji mszyc

miały owady drapieżne (biedronki, bzygowate, złotooki) i pająki ze względu na niewielką ich liczebność i okresy występowania (szczyt liczebności mszyc lub po nim). Walory dekoracyjne krzewów, zwłaszcza w okresie kwitnienia, obniżały żerujące dwa gatunki mszyc – *Aphis spiraephaga* i *Aphis fabae* L.