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**Aphids Inhabiting Certain Ornamental Shrubs
in Urban Conditions**

Mszyce zasiedlające niektóre krzewy ozdobne w warunkach miejskich

INTRODUCTION

Ornamental shrubs constitute a valuable element of vegetation in urban conditions. They perform many positive functions; they favourably affect the microclimate through regulating the amount of oxygen and carbon dioxide and through increasing air humidity; they absorb the dust and harmful gases, muffle the noise, protect the soil against erosion (Wysocki, 1993; Grysiewicz, 1989). Worse and worse ecological conditions in cities affect the plants increasing their susceptibility to disease and pests. The most numerous phytophags in the polluted cities are arthropods with a stinging-sucking mouth apparatus, which include the aphids (Cichocka and Goszczyński, 1991; Wilkaniec, 1994). Despite the unquestionable practical and aesthetic valours of ornamental bushes, there are few thorough studies which would discuss the aphids and their harmful effect (Halbert and Voegtlin, 1992; Jaśkiewicz, 1995, 1996 a, b, 2000).

The purpose of the present paper was to establish the species composition, numbers and population dynamics of aphids on selected ornamental plants.

MATERIAL AND METHODS

Observations were held in Lublin in the years 1995-1997, on the green area in front of the Rector's Office of the University of Agriculture and its neighbourhood (A), and in the housing estate "Czechów" (B). Area A can be treated as a street site (heavy traffic), whereas area B is

localised in the centre of a housing estate (no traffic), hence it can be treated as a park site. The shrubs in area A and B were not subjected to any protective treatments.

Observations were performed on the following ornamental shrubs: barberry – *Berberis vulgaris* L.; garland spirea – *Spiraea arguta* Zabel., and white dogwood – *Cornus alba* L. Five shrubs from each examined species growing close to each other were analysed. Aphids were counted on five shoots of each shrub. The plants were monitored from early spring to late autumn, with approximately 10-days' intervals. When the weather was unfavourable (showers of rain), observations were postponed till the following days. To mark the aphids, the keys of Šapošnikov (1964), Rupajs (1969) and Müller (1976) were used. Meteorological data were obtained from the Institute of Agrometeorology of the University of Agriculture in Lublin.

RESULTS

In the period when observations were held, the presence of three aphid species from *Aphididae* family was established. The studies found out one species from sub-family *Thelaxinae*, namely *Anoecia corni* F, two species from sub-family *Aphidinae*: *Liosomaphis berberidis* Kalt. and *Aphis spiraephaga* Müll. The paper adopts the newest Polish designation of aphids according to Szeleğiewicz and Cichocka (1990). Information on the numbers, dates of appearance of the first aphids, population maximum, and disappearance of colonies on the examined shrubs is presented in Tab.1, while Tab. 2 presents the course of the weather in the studied years. Observations in areas A and B found out the occurrence of different aphid species on the examined shrubs.

The presence of *Liosomaphis berberidis* was found out on *Berberis vulgaris*. They were most numerous in 1995, both in area A – 1156.2, and in area B – 819.2 aphids/shrub, and least numerous in 1997, especially in area B – 133.8 aphids/shrub.

In 1995 in area A the first aphids appeared in the middle of April, the first colonies were found in the third 10-days' period, while in area B they were observed in the first 10-days' period of May, settling the bottom part of the leaf blade. Due to low temperatures in April and May the population growth was slow. In June, after considerable warming, the number of aphids grew rapidly. The maximum numbers were observed in the second 10-days' period of June: in area A – 183 aphids/shrub, and B – 107.2 aphids/shrub. The following observations showed a drop of population on all shrubs, which was probably affected by July and August heat waves, with minimum rainfalls. After the shower rains and a considerable drop of temperature in September, the colonies disappeared at the turn of September and October.

In 1996, the beginning of the vegetative period was delayed by four weeks. The first yellow-green aphids in colonies were observed in the second (area A) and third (area B) 10-days' periods of May. Warm May, especially its second

Table 1. Species composition, dates of their occurrence and number of aphids/shrub in areas A (Rector's Office) and B (Czechów housing estate) in the years 1995-1997

Aphis species on shrubs	Area of studies	Appearance of the first colonies		Maximum numbers		Disappearance of aphids		The number of aphids/shrub			Totally 1995-1997
		from	to	from	to	from	to	1995	1996	1997	
<i>Liosomaphis berberidis</i> on <i>Berberis vulgaris</i>	A	IIIId IV	IIId V	IIIId V	IIId VI	IIIId IX	IIIId X	1156.2	612.2	581.2	2349.6
	B	Id V	IIIId V	Id VI	IIIId VI	IIIId IX	IIIId X	819.2	382.4	133.8	1335.4
	Totally							1975.4	994.6	715.0	3685.0
<i>Aphis spiraephaga</i> on <i>Spiraea arguta</i>	A	Id V	IIId V	Id VI	IIIId VI	IIIId IX	Id X	1002.2	403.8	691.4	2097.4
	B	Id V	IIIId V	Id VI	IIIId VI	IIId IX	IIIId IX	908.2	418.2	603.4	1929.8
	Totally							1910.4	822.0	1294.8	4027.2
<i>Anoecia corni</i> on <i>Cornus alba</i>	A	Id V	IIIId V	Id VI	IIId VI	IIId IX	IIIId IX	1302.4	677.2	196.6	2176.2
	B	Id V	IIIId V	Id VI	IIId VI	IIIId IX	Id XI	1012.6	689.4	162.2	1864.2
	Totally							2315.0	1366.6	358.8	4040.4

Table 2. Temperature and rainfall in 1995-1997 vegetation seasons

Month	Temperature (°C)							Rainfall (mm)						
	mean for years		monthly mean			deviation from multi-year (mean)		mean for years		monthly rainfall			standard percentage	
	1951-1995	1995	1996	1997	1995	1996	1997	1951-1995	1995	1996	1997	1995	1996	1997
III	1.1	2.3	-3.0	1.8	+1.2	-1.9	+0.7	25.4	43.7	24.6	16.2	172.0	96.8	63.8
IV	7.4	7.4	7.3	3.9	0.0	-0.1	-3.5	39.1	40.0	15.4	40.8	102.3	39.4	104.3
V	13.0	12.2	15.5	13.9	-0.8	+2.5	+0.9	57.2	32.8	115.5	83.1	57.3	201.9	145.3
VI	16.4	17.1	16.5	16.8	+0.7	+0.1	+0.4	65.9	70.3	28.0	36.2	106.7	42.5	54.9
VII	17.9	19.8	16.4	17.6	+1.9	-1.5	-0.3	73.6	25.5	80.2	183.8	34.6	109.0	249.7
VIII	17.2	18.1	17.7	18.2	+0.9	+0.5	+1.0	71.1	62.1	90.3	33.8	87.3	127.0	47.5
IX	12.9	12.9	9.6	12.5	0.0	-3.3	-0.4	51.4	113.2	83.3	47.4	220.2	162.1	92.2
X	7.9	9.6	8.4	5.5	+1.7	+0.5	-2.4	40.5	11.0	57.0	35.0	27.2	140.7	86.4
XI	2.5	-0.9	5.5	2.3	-1.6	+3.0	-0.2	38.7	24.1	62.1	34.8	62.3	160.5	89.9

10-days' period favoured a dynamic development of aphids, which changed their feeding place moving to the top shoots. The maximum number was observed in area A – 101 aphids/shrub in the first, and in area B – 64.2 aphids/shrub in the third 10-days' periods of June. After heavy rains in the first 10-days period of July, the aphid population decreased, and following the heat waves in the first 10 days of August, only singular individuals were observed. In September again the number of aphids grew, especially in area A, though with variable intensity. The disappearance of aphids in both areas took place on the final days of October.

In 1997, after cold winter, the first scarce colonies appeared in areas A and B in the second 10-days' period of May. In subsequent observations the number of aphids grew, reaching the maximum in area A – 103 aphids/shrub in the second 10-days' period of June, and in area B – 20.2 aphids/shrub in the third 10-days' period. Beginning with July, a drop in the number of aphids was observed, in area B only singular individuals were noted till the end of August. Small colonies were observed from September, and they disappeared in area B in the third 10-days' period of September, and in area A in the second 10-days' period of October.

It was found out that in June the aphids often changed their feeding place, moving to the young leaves of the top parts of shoots. They most frequently inhabited the bottom part of the leaves, along the main nerve. In the period of maximum numbers of aphids the shoots were covered with the feeding aphids, which brought about the twisting of leaves, inhibition of their growth and discoloration; the leaves got scrolled and fell down earlier. Honey-dew allowed for the growth of saprophytic fungi from the genera *Alternaria sp.* and *Cladosporium sp.* causing a dark-coloured coating; the leaves looked as if covered with a dust layer. Aphids of this species definitely lowered the ornamental value of barberry shrubs.

On *Spiraea arguta* the studies found out the presence of *Aphis spiraeophaga*, which were most numerous in 1995 in area A – 1002.2 aphids/shrub, and in area B – 908.2 aphids/shrub. In 1996 the number of aphids was the lowest – (more than doubled) in area A – 403.8 aphids/shrub, in area B – 418.2 aphids/shrub.

In 1995 the first colonies of this aphid on the bottom part of the leaves were observed in areas A and B in the first 10-days' period of May. The maximum number in area A – 141 aphids/shrub, and B – 108 aphids/shrub took place a month after their appearance – in the first 10-days' period of June. Colonies of these insects sustained to the second 10-days' period of August. From August 21 (after a storm) the number of aphids in colonies dropped rapidly, in area B only singular individuals were observed. Disappearance of aphids after September showers of rain and a considerable drop of temperature was noted in area A in the first 10-days' period of October, and in area B in the third 10-days' period of September.

In 1996, despite a considerably delayed vegetative period, the first colonies were observed in area A in the second, and in area B in the third 10-days' period of May. Subsequent observations showed that the numbers of aphids grew till the end of June. In the third 10-days' period of June the studies found out the maximum appearance in both areas (A – 93.2 aphids/ shrub, B – 79.4 aphids/shrub). The aphids changed their feeding place moving to the top shoots. Beginning with July the numbers dropped. After August heat waves and September showers, the disappearance of aphids was observed in the second (A) and third (B) 10-days' periods of September.

In 1997 dark brown aphids appeared in the second 10-days' period of May. Their maximum was observed in both areas in the second 10-days' period of June (A – 101 aphids/shrub, B – 88.8 aphids/shrub). Due to the heavy rains in July and dry weather in August, aphids occurred with changeable intensity. Their disappearance took place in both areas, A and B, in the third 10-days' period of September.

Aphids of this species inhabited the top shoots and the bottom part of the leaves, forming abundant colonies. Their feeding caused that the shoots stopped to grow, they were deformed, while the leaves were smaller. Because these shrubs grow intensively, after the aphids flew away the newly appearing shoots and leaves were not deformed. In the period when aphids appeared in big numbers, honey-dew excreted by them, which is good basis for the growth of saprophytic fungi from the genera *Alternaria* sp. and *Cladosporium* sp. causing a dark-coloured coating, affected the ornamental value of *Spiraea arguta* Zabel. The dark coat of the developing mycelium made it difficult for the infected organs to breathe, and marred the plants.

Anoecia corni was found on the bushes of *Cornus alba*. The highest numbers were observed in 1995 in area A – 1302.4 aphids/shrub, and in area B – 1012.6 aphids/shrub, and the lowest in 1997 (almost ten times lower) in area A – 196.6 aphids/shrub, and in area B – 162.2 aphids/shrub.

In 1995 aphids appeared in both areas on the first 10 days of May. After considerable warming, the number of aphids radically grew to 13.2 aphids/shrub on the first 10 days of June. Subsequent observations showed a drop of their numbers, probably due to the heat waves in July and August, with little rain. Beginning with the end of the second 10-days' period the number of aphids grew very fast. The second, and much higher maximum was observed in area A – 172 aphids/shrub in the second, and in area B – 127.2 aphids/shrub in the third 10-days' periods of September. Warm first 20 days of October allowed for considerable numbers of aphids to appear; in area A they disappeared on the last days of the month, while in area B on the first 10 days of November, after the leaves had fallen.

In 1996 the beginning of the vegetative period was delayed, aphids appeared in the third 10-days' period of May. The following observations found out only a few of them. A small spring peak occurred in both areas in the second 10-days' period of June – about 20 aphids/shrub. Most frequently aphids settled the flower umbells and the young shoots. After July showers aphids were only scarce, on two shrubs in area A none were observed. Beginning with August the number of aphids grew, reaching the maximum in area A – 121 aphids/shrub, and area B – 138.4 aphids/shrub in the second 10-days' periods of September. The colonies disappeared in the second and third 10-days' period of October, respectively.

In 1997 the first aphids appeared in the second 10-days' period of May. In area B a few individuals were noticed on one shrub, whereas the other plants were free from aphids. In areas A and B (one shrub) a slight maximum of the population was observed – about 10 aphids/shrub – in the second 10-days' period of June. Between July and the middle of August the studies found out, though not on all shrubs, small colonies and singular individuals. August 24 was the beginning of a dynamic growth of aphids. Except for yellow-brown wingless individuals the colonies included big black winged ones with dark stigmas on their wings. The second maximum of population was observed in area A – 18.2 aphids/shrub, and area B – 21.2 aphids/shrub in the second 10-days' period of September, while the colonies disappeared in both areas in the second 10-days' period of October.

In spring aphids inhabited the flower umbells and the young shoots, which slightly lowered the aesthetic value of the shrubs. In summer and autumn the fact that aphids fed on leaf blades caused overcolouring and the leaves fell down earlier, which, however, did not affect the ornamental valours of the shrubs, because the most important include the dark red shoots.

DISCUSSION

Analysing the three years of studies it was found out that each of the three shrub species was settled by one aphid species. Barberry shrubs were host plants for *L. berberidis*, garland spirea for *A. spiraephaga*, and white dogwood for *A. corni*. The presence of only one aphid species – *A. spiraephaga* on garland spirea was confirmed by other authors (Achremowicz, 1986; Müller, 1976; Szelegiewicz, 1968). Lampel (1968) also reports it on weeds – *Capsella bursapastoris*, while Vereshchagin, Vereshchagin (1990) on *Valeriana officinalis*. Achremowicz (1986), Szelegiewicz (1968) and Jaśkiewicz (1995) report one aphid species – *L. berberidis* – on barberry shrubs, which is confirmed by the present studies. Despite numerous observations, the aphids enumerated by Szelegiewicz (1968), namely *Anoecia vagans* and *Aphis corniella*, were not found. Only the presence of *A. corni* was stated.

Comparing the numbers of aphids in the street site (A) with the park site (B), more numerous populations were found in area A; it was only in 1996 that the number of *A. spiraephaga* and *A. corni* was slightly higher in area B. Comparable results on trees (linden, maple) in urban conditions of Warsaw were achieved by Cichocka and Goszczyński (1991), and in Poznań by Wilkaniec (1994).

The most numerous aphid populations on all the examined shrubs in both areas were observed in 1995, while the smallest numbers on barberry and dogwood were found out in 1997, and on garland spirea in 1996. The first spring colonies of aphids in both areas appeared in May, exceptionally in 1995 they were found in area A (barberry) from the third 10-days' period of April. The maximum numbers were observed in June; on dogwood shrubs the second peak, and much more numerous, occurred from the middle to the end of September. The disappearance of colonies was found out between the third 10-days' period of September to the third 10-days' period of October, and in 1995 in area B (dogwood) it was on the first 10 days of November.

Annually, at the end of May and in June *L. berberidis* and *A. spiraephaga* formed colonies made up of numerous individuals on the shoots and leaves. The same information is provided in the studies by Vereshchagin and Vereshchagin (1990), Jaśkiewicz (1995, 1996 a, b, 2000).

The weather in spring and summer affected the number of all aphid species. Delayed vegetative period, drought, high temperatures over 30°C, and stormy rains considerably inhibited the population of these delicate insects. After early and sunny spring with rainfalls within the norm differently affected pathological changes of leaves, shoots and flowers. The harmful effect of *A. spiraephaga* in Kiszyniów is discussed by Vereshchagin, Vereshchagin (1990), and in Lublin by Jaśkiewicz (1996a, 2000). Information on the numbers and harmfulness of *A. corni* in Lublin in the years 1989-1991 is provided by Jaśkiewicz (1996 b); Achremowicz (1986) and Lampel (1968) discuss the harmful effect of *L. berberidis*, while Jaśkiewicz (1995, 1996 b) studies its numbers and population dynamics. Injuries caused by the feeding aphids clearly lowered the ornamental value of barberry shrubs.

CONCLUSIONS

1. Each of the discussed species of shrubs was inhabited by one aphid species.
2. The most numerous populations of aphids on shrubs were found out in the street site (A).
3. The highest numbers of aphids were observed in 1995 after mild winter and cold spring with average rainfalls, while in 1997 their numbers were the

lowest due to the delayed vegetative period, the drought in May and June, and heavy showers of rain.

4. Considering all the examined shrub species, the aphid which most clearly lowered their ornamental valours was *L. berberidis*.

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SUMMARY

The studies conducted in the years 1995-1997 concerned the occurrence of aphids on the shrubs of barberry, garland spirea and white dogwood. They were carried out in the green area of two sites; a street site (A) and a park site (B). Three aphid species were found out, namely *Liosomaphis berberidis* Kalt. on barberry, *Aphis spiraeophaga* Müll. on garland spirea, and *Anoecia corni* F. on dogwood. On all the examined shrubs aphids were most numerous in 1995, while

being the least numerous on barberry and dogwood in 1997, and on garland spirea in 1996. The studies found out differentiated numbers of aphids in the examined places: they were most numerous in area A (street site); only in 1996 the number of aphids *A. spiraephaga* Müll. and *A. corni* F. was slightly higher than in area B. In both areas the first spring colonies of aphids were observed in May, 1995 was an exception since in area A (on barberry) aphids were observed beginning with the third 10-days' period of April. The maximum numbers were usually found out in June, while on dogwood shrubs the second peak, and much more numerous, took place between the middle and the end of September. The disappearance of colonies was observed between the third 10-days' period of September and the third 10-days' period of October, while in 1995 in area B (on dogwood) it was on the first 10 days of November. Weather conditions in spring and summer affected the numbers of all aphid species. Delayed vegetative period, drought, high temperatures of over 30°C and stormy rainfalls considerably inhibited the population of these delicate insects. The injuries caused by their feeding clearly lowered the ornamental value of barberry shrubs.

STRESZCZENIE

Tematem badań przeprowadzonych w latach 1995-1997 były obserwacje nad występowaniem mszyc na krzewach berberysu zwyczajnego, tawuły wczesnej i derenia białego. Badania prowadzono na terenie zieleni miejskiej w dwu punktach: na stanowisku przyulicznym (A) i stanowisku parkowym (B). Ustalono obecność trzech gatunków mszyc: *Liosomaphis berberidis* Kalt. na berberysie, *Aphis spiraephaga* Müll. na tawule i *Anoecia corni* F. na dereniu. Najliczniej mszyce na wszystkich badanych krzewach wystąpiły w roku 1995, najniższą ich liczebność na berberysie i dereniu notowano w roku 1997, a na tawule w roku 1996. Stwierdzono zróżnicowanie liczebności mszyc na badanych terenach, liczniej mszyce występowały na terenie A (stanowisko przyuliczne), jedynie w roku 1996 liczebność mszyc *A. spiraephaga* Müll. i *A. corni* F. była nieznacznie wyższa na terenie B. Pierwsze wiosenne kolonie mszyc na obydwu terenach pojawiały się w maju, wyjątkowo w roku 1995 na terenie A (na berberysie) notowano ich obecność od III dekady kwietnia. Szczyt ich liczebności najczęściej obserwowano w czerwcu, na krzewach derenia drugi szczyt, i to znacznie liczniejszy, wystąpił od połowy do końca września. Zanik kolonii notowano od III dekady września do III dekady października, a w roku 1995 na terenie B (na dereniu) w I dekadzie listopada. Na obniżenie lub wzrost liczebności wszystkich gatunków mszyc miały wpływ warunki pogody wiosną i latem. Spóźniony okres wegetacji, susza, wysokie temperatury powyżej 30°C oraz ulewy typu burzowego znacznie ograniczały populacje tych delikatnych owadów. Po wczesnej i pogodnej wiosnie z opadami w granicach normy mszyce występowały liczniej. Uszkodzenia powodowane w wyniku żerowania mszyc najwyraźniej obniżały dekoracyjność krzewów berberysu.