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NUMERICAL STRENGTH DYNAMICS OF *Chromaphis juglandicola* (Kalt. 1843) ON COMMON WALNUT (*Juglans regia* L.) IN LUBLIN TOWN PLANTINGS

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Abstract. Common walnut has gained recognition in Poland as a tree decorating the space around us because of its habit and impressive leaves. More and more frequent use of walnut in the city landscape induced a more thorough analysis of the factor causing a significant decrease in the decorative values of this plant. The aim of this paper was to trace the numerical strength dynamics of *Ch. juglandicola* occupying the *Juglans regia* L. trees, referring to the weather conditions system and to determine the harmfulness degree of the above- mentioned plant louse species. Studies were conducted on walnut trees (*Juglans regia* L.) in Lublin in the years 2006–2008. Three stands in housing estate areas were selected for observation: (A) – a park estate of single-family houses (B) – in the University Campus area, and near the street (C) – at the crossroads of busy streets near the petrol station. The terms of occurrence of this plant louse, as well as the dynamics of its numerical strength were determined against the background of weather conditions. It was established that *Chromaphis juglandicola* (Kalt.) occurs on the *Juglans regia* L. trees growing in Lublin town plantings. It was reported that these plant lice occurred most numerously in the year 2007 on the housing estate post. *Ch. juglandicola* were observed at the bottom side of the leaf blade in dispersion. The terms of spring appearance and autumn disappearance of plant lice were significantly affected by the course of weather conditions. Their development was enhanced by warm spring with not very intense precipitation. However the air temperature above 30ºC and storm-like down pouring rain in summer limited the numerical strength of *Ch. juglandicola.*

Key words: Dusky-veined walnut aphis, walnut, city landscape, meteorological conditions

INTRODUCTION

The origin of walnut (*Juglans regia* L.) has not been throughly recognizwed. It is supposed that its homelands were Central Asia and South-Eastern Europe. The distribution of this tree includes a narrow but quite long strip of land, passing through Asia

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Minor. Persia, Caucasus, along the Himalayas through Tibet, up to China [Bugała 1991, Sękowski 1993, Seneta and Dolatowski 2003, Zdyb 2009].

In Europe walnut is grown first of all as a fruit tree. In Poland it is also one of trees grown for pleasure – e.g. to obtain a shade in the garden, so much looked for in summertime. Due to its habit and large, beautiful, feathery leaves of intense scent, it is regarded as an attractive tree in all seasons of the year. Between April and May its leaves develop together with flowers, enlivening the gardens, parks and urban green areas. In autumn also the walnut fruit is of substantial ornamental value.

This tree is characterized by very low resistance to the contents of sulfur oxides in the air [Jaśkiewicz 2003]. Therefore, it is less frequently used for roadside tree lining. It is sporadically encountered near traffic routes. Most often these are self-sown trees of low decorative value. This tree, well-known in Poland for about 150 years, enjoys increasing popularity nowadays [Pacyniak 1992]. Most often it grows individually, in loose groups, or long rows. It enriches urban, suburban and agrarian (rural) landscapes. It is an element that connects the town to open spaces. More and more frequent use of walnut in the urban landscape creates the need for taking a closer look at this plant from the entomological point of view.

It is settled by a small group of pests, including, among others, a mite – *Aceria tristriatus* and plant louse *Chromaphis juglandicola*, which in the South of Europe is regarded as a dangerous walnut pest [Cichocka 1980]. In more numerous appearances, the above-mentioned pests can substantially decrease the decorative value of walnut tree by decoloration and deformation of leaf blades.

The three year studies were aimed at tracing the numerical strength dynamics of plant louse *Ch. juglandicola* settling the *Juglans regia* L. trees within reference to the weather conditions system.

MATERIAL AND METHODS

The studies were conducted in the area of Lublin in the years 2006–2008. Three research stands were designated:

1. Housing estate stand (A) – it was located in the single-family houses estate (Pułaskiego Street). In this stand 7 walnut trees grew closely together, accompanied by maple trees: ash-leaved (*Acer negundo* L.) and sugar (*Acer saccharinum* L.), European ash (*Fraxinus exelsior* L.), wild plum (*Prunus domestica* L. subsp. syriaca), magnolia (*Magnolia* × *soulangiana* Soul.-Bod.), as well as coniferous trees and shrubs.

2. Park stand (B) was located on the premises of the Casmpus Natural and Mathematical Faculty of the Catholic University of Lublin. It had 8 walnut trees, which were surrounded by small-leaved lime (*Tilia cordata* Mill.), ash-leaved maple (*Acer negundo* L.), sycamore (*Acer pseudoplatanus* L.) and Norway maple (*Acer platanoides* L.)

3. Street-side stand (C) was situated at the crossing of busy streets, near the Statoil petrol station (Kraśnicka Ave. and Warszawska Ave.). On this stand there grew 23 walnut trees, accompanied by orchard trees: apple (*Malus* sp.), pear (*Pyrus* sp.) and ash-leaved maple (*Acer negundo* L.).

In each of the selected stands a sample of 100 leaves and 10 green and lignified 20 cm long sprouts were randomly selected, as well as inflorescences and fruits located on them. Samples were taken every 14 days from May to October. Only in justified cases (in unfavorable weather conditions – during rainfalls, when wind was too strong) the terms of sampling were canceled. We checked the collected material in the laboratory, under a stereoscopic microscope, counting the collected specimens of the examined plant louse species. The identification of this plant louse as to the species was conducted on the basis of durable microscopic preparations. Blackman and Eastop [2000] key was used for marking.

The characterization of meteorological conditions was prepared on the basis of the data obtained from Department of Agrimeteorology of the University of Life Sciences in Lublin and from the website www.weatheronline.pl. The names of arthropods were assumed after Bogdanowicz et al. [2004].

RESULTS

The numerical strength dynamics of plant louse *Ch. Juglandicola* settling *J. regia* trees in a three year study cycle was presented in figure 1, and the weather data were contained in table 1 and 2.

In the examined stands *Ch. juglandicola* occurred irregularly. In the years 2006––2008 plant lice were observed from May to October. In total, during the whole study period 2934 specimens were collected, from which in the housing estate stand (A) – 1394 specimens, in the park stand (B) – 563 specimens and in street-side stand (C) – 977 specimens (tab. 3).

In each study year the dynamics of these hemipterans' numerical strength was differentiated. In the year 2006, with delayed vegetation period and storm-like precipitations, the first, single specimens of *Ch. juglandicola* appeared on stand A in the third decade of May. Moderately warm May and June, with precipitations approaching or below standard, enhanced the development of aphids. The peak of numerical strength of these insects was reported in the first decade of June and it was 164 pieces.·100 leaves^{-1} (fig. 1). During further observations there occurred a slight decrease in the aphid numerical strength. In the 3rd decade of June 148 pcs.·100 leaves^{-1} were reported. The breakdown of aphid numerical strength was significantly affected by drought in July, interchanged with storm-like downpours in August. These pests stayed on the examined trees until mid-September with variable intensity, but their numerical strength was already lower during a single observation and it did not exceed 63 pcs.·100 leaves^{-1}.

On the B stand, like on the A stand, the first single specimens of plant lice appeared in the 3rd decade of May. In June and in the first decade of July the numerical strength of these insects slightly increased. In August no aphids were observed on the examined trees. Probably the reason for such situation was the July heatwave (12 days in the month with temperatures exceeding 30ºC) and torrential rains in August. In the 1st decade of September the examined insects appeared again in the number of 10 pcs. 100 leaves^{-1}, and single specimens were observed as late as in the 1st decade of October.

Table 1. Weather conditions in the years 2006–2008
Tabela 1. Warunki pogodowe w latach 2006–2008

Month Miesiąc	Air temperature Temperatura powietrza °C				Precipitation Opady mm				Relative humidity Wilgotność względna %		
	monthly means średnia miesięczna			multiannual means średnia roczna 1951–2000	monthly totals sumy miesięczne			multiannual monthly totals średnia roczna 1951–2000	monthly means średnia miesięczna		
	2006	2007	2008		2006	2007	2008		2006	2007	2008
January Styczeń	7.5	2.6	0.4	-3.6	15.7	51.5	36.2	21.7	88.0	85.0	78.0
February Luty	-4.3	-1.6	2.3	-2.8	36.7	22.3	17.8	24.8	94.0	89.0	78.0
March Marzec	-1.1	6.2	3.4	1.0	47.0	30.2	64.8	25.8	89.0	81.0	83.0
April Kwiecień	8.7	8.7	9.3	7.5	30.3	17.4	55.8	40.6	77.0	65.0	81.0
May Maj	13.6	15.0	12.8	13.0	59.5	81.5	101.6	58.3	73.0	76.0	85.0
June Czerwiec	16.9	18.1	17.7	16.5	37.9	87.8	25.9	65.8	76.0	78.0	75.0
July Lipiec	21.9	19.2	18.3	17.9	6.8	87.0	77.1	78.0	64.0	76.0	81.0
August Sierpień	17.4	18.4	19.3	17.3	199.2	37.6	45.0	69.7	86.0	80.0	78.0
September Wrzesień	15.7	13.0	12.6	12.9	11.0	129.8	102.9	52.1	83.0	86.0	90.0
October Październik	10.1	7.6	10.1	7.9	14.2	17.3	55.5	40.3	86.0	89.0	90.0
November Listopad	5.3	1.0	4.8	2.5	41.2	31.1	33.1	39.1	94.0	93.0	93.0
December Grudzień	3.0	-1.2	0.9	-1.4	18.6	14.9	43.8	31.5	92.0	95.0	94.0

On the C stand the first aphids appeared after the 20th day of May. A sudden increase, and also the peak of numerical strength of *Ch. juglandicola* were observed in the 2nd decade of June and it was 346 pcs.·100 leaves^{-1}. The aphids remained on the leaves of the examined trees until the 2nd decade of October with variable intensity. However, their numerical strength in single samples did not exceed 65 pcs.·100 leaves^{-1}.

In the year 2007, after mild winter, which contributed to early start of vegetation, the first few specimens of *Ch. juglandicola* were found on the A stand in the first decade of May. That month was relatively warm and despite frequent storm-like precipitations the numerical strength of aphids suddenly increased and the maximum number, which was 200 pcs.·100 leaves was reported in the 3rd decade of May (fig. 1). from the 2nd decade of June to the 3rd decade of July the plant lice occured irregularly. Their numerical strength ranged from 86 to 37 pcs.·100 leaves^{-1}. The weather system (hot July, stormy June and July) at that time probably significantly affected the aphid number strength fluctuations. The observations made between August and September revealed a sudden decrease of this species population, and single specimens of walnut aphis were collected as late as until the 3rd decade of October. It is supposed that such a state might also

result from the weather course – air temperatures above 30ºC in August and frequent precipitations twice exceeding the monthly totals of many years, as well as the accompanying storms in September. In this study period the numerical strength of aphids ranged from 5 to 2 pcs.·100 leaves^{-1}. At the end of October the total disappearance of plant lice was reported.

Table 2. Dates when air temperatures above 30ºC and torrential rains occurred in the years 2006–2007

Tabela 2. Daty występowania temperatur powietrza powyżej 30ºC i opadów typu burzowego w latach 2006–2007

Year Rok	Temperatures above 30ºC Temperatury powyżej 30°C		Torrential rains Opady burzowe	
	month – miesiąc	day – dzień	month – miesiąc	day – dzień
2006	April– kwiecień		April– kwiecień	2, 3
	May – maj		May – maj	16, 28
	June – czerwiec	8, 9, 10, 11, 12, 13, 21	June – czerwiec	1, 23, 27
	July – lipiec	22, 24, 25, 26, 27	July – lipiec	-
	August – sierpień		August – sierpień	7, 18, 20
2007	May – maj		May – maj	9, 11, 15, 23, 26, 27, 28, 29
	June – czerwiec		June – czerwiec	2, 10, 11, 16, 23
	July – lipiec	15, 16, 17, 20, 22, 24	July – lipiec	4, 19, 20, 21, 22
	August – sierpień	22, 23	August – sierpień	21
	September – wrzesień	-	September – wrzesień	5, 6, 28
2008	May – maj		May – maj	1, 4, 18
	June – czerwiec		June – czerwiec	27
	July – lipiec	12, 13	July – lipiec	7, 24, 25
	August – sierpień	15,16	August – sierpień	2, 4, 16
	September – wrzesień	6	September – wrzesień	4
	October – październik	-	October – październik	30

On the B stands the first *Ch. juglandicola* aphids were reported in the 3rd decade of May. The numerical strength of these insects at that time was 96 pcs.·100 leaves^{-1} and approached the highest number in this stand – 104 pcs.·100 leaves^{-1}, which was reported inn the 1st decade of July. In the remaining terms the aphids occurred much less intensely. The last specimens of *Ch. juglandicola* were reported in the 3rd decade of October.

Table 3. Numerical strength of *Chromaphis juglandicola* (Kalt.) settling trees (*Juglans regia* L.) in the years 2006–2008 (pcs.·100 leaves^{-1})

Tabela 3. Liczebność *Chromaphis juglandicola* (Kalt.) zasiedlających drzewa (*Juglans regia* L.) w latach 2006–2008 (szt.·100 liści^{-1})

Year Rok	Stand – Stanowisko		
	housing estate – ogrodowe (A)	park – parkowe (B)	street-side – przyuliczne (C)
2006	437	55	563
2007	636	365	84
2008	321	143	330
Total on stand Łącznie na stanowisku	1394	563	977

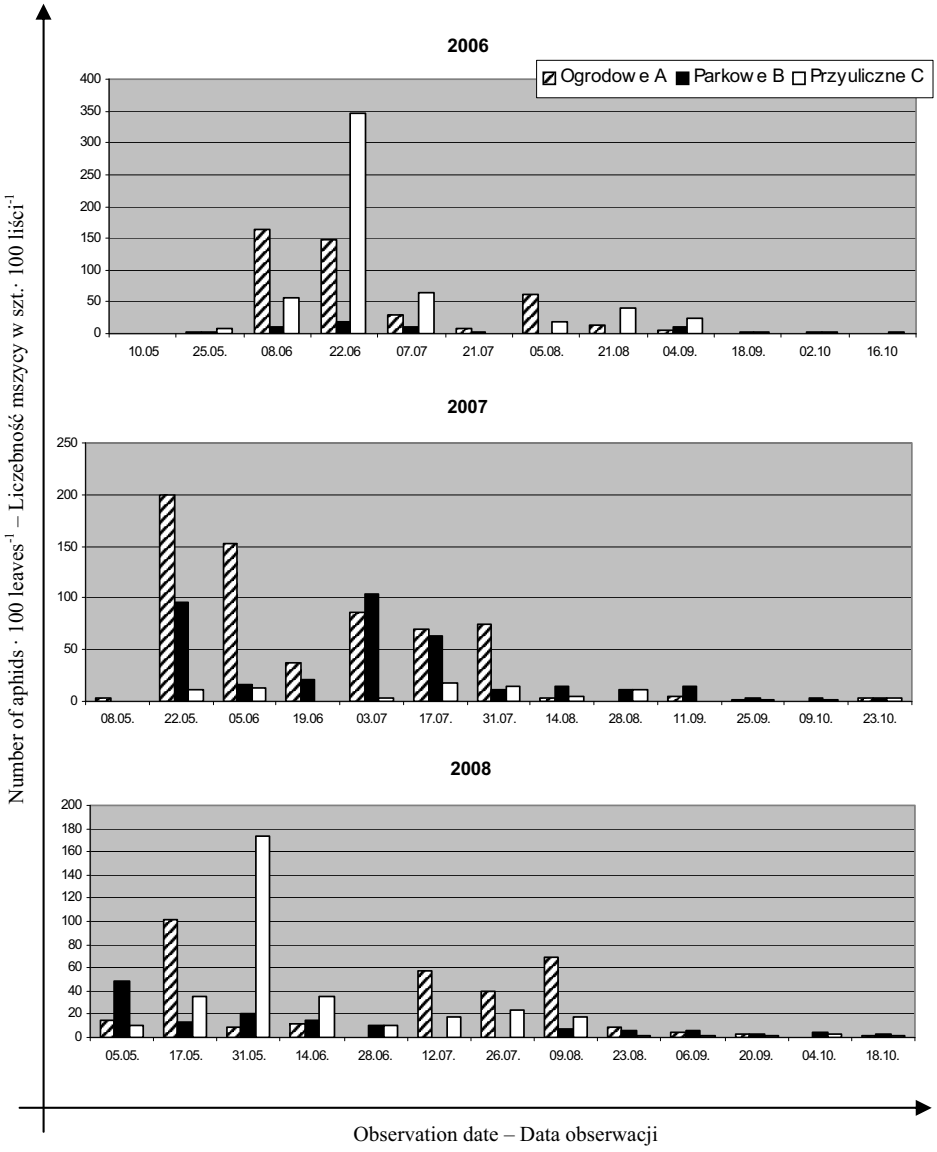

Fig. 1. Dynamics of *Chromaphis juglandicola* (Kalt.) numerical strength on *Juglans regia* L. in the years 2006–2008

Ryc. 1. Dynamika liczebności *Chromaphis juglandicola* (Kalt.) na *Juglans regia* L. w latach 2006–2008

Phot. 1. Larva of the plant louse (aphid) *Chromaphis juglandicola* (Kalt.)
Fot. 1. Larwa mszycy *Chromaphis juglandicola* (Kalt.)

Phot. 2. Plant lice (aphids) *Chromaphis juglandicola* (Kalt.) preying in dispersion on the bottom side of *Juglans regia* L. leaf blade
Fot. 2. Mszyce *Chromaphis juglandicola* (Kalt.) żerujące w rozproszeniu na spodniej stronie blaszki liściowej *Juglans regia* L.

In the C stand the numerical strength of aphids, as compared to the two remaining stands, was significantly lower (tab. 3). The first specimens of the examined plant louse species were collected after the 20th day of May. Its peak number, which was 18 pcs.·100 leaves^{-1}, occurred in the 2nd decade of July, and the last aphids were observed in the 3rd decade of October.

In the year 2008, warm spring enabled us to collect first aphids on the A stand in the first decade of May (tab. 1). The peak number, which was 101 pcs.·100 leaves^{-1} was reported already in the 2nd decade of May. In the subsequent observations the number of plant lice significantly decreased and in the 3rd decade of June no aphids were found to be present on the leaves of *J. regia*. Such state was probably caused by intense storm-like precipitations occurring in that period (the rainfalls exceeded the monthly totals of many years twice). The insects appeared again in July and occurred in quite large numbers until the end of September. Their numerical strength ranged from 69–39 pcs.·100 leaves^{-1}. In subsequent observations the population of this species significantly decreased and systematically lowered (only single specimens were collected), until their total disppearance about the middle of October.

Phot. 3. Damages caused by preting of *Chromaphis juglandicola* on the leaf of *Juglans regia* L.
Fot. 3. Uszkodzenia powodowane żerowaniem *Chromaphis juglandicola* na liściu *Juglans regia* L.

On the B stand first specimens of *Ch. juglandicola* were observed in the 1st decade of May. In the same period the most numerous specimens of aphids were collected (peak number) and their numerical strength equaled 49 pcs.·100 leaves^{-1}. From mid-May to the end of June the plant lice settled *J. regia*, in much smaller numbers and in July the trees were free from aphids. This study period was frequently accompanied by storm-like precipitations and. Additionally, in July – temperatures above 30ºC, which could just as well explain the above-described situation (tab. 2).

In August aphids appeared on the examined plants again, in small numbers. In subsequent observations their numbers gradually decreased, up to complete disappearance in the 2nd decade of October.

On the C stand the first observations of aphids took place, as in the two previous stands, from the 1st decade of May. The most numerous specimens (173 pcs.·100 leaves^{-1}) were collected between May and June. In the remaining observations aphids occurred in much smaller numbers. The last specimens of Dusky-veined walnut aphis were noted about the middle of October.

Ch. juglandicola was preying in dispersion on the bottom side *J. regia* leaf blade, which led to dye penetration and leaf deformation (photos 2 and 3). This caused a significant decrease of the decorative properties of the trees. Besides, the leaves were falling prematurely, which caused weaker winter-hardiness of plants.

DISCUSSION

On the *J. regia* shrubs the occurence of two aphid species has been found so far: *Ch. Juglandicola* and *Callaphis juglandis* (Goetze, 1778). *Ch. juglandicola* is a species that occurs in fewer numbers on this plant. Similar information is given by Jaśkiewicz and Cichocka [2004]. However, the studies conducted in the years 2003–2005 by Jaśkiewicz and Kmieć [2007] indicated predominance of *Ch. juglandicola* on walnut trees in the first study year.

In the present study this aphid occurred in each study year in each stand. It settled in greater numbers in the housing estate stand in the years 2007 and 2008. In the year 2006 however, the aphids occurred in greater numbers in the street-side stand, which is consistent with the conclusions reached by Milwvoj and Kravanij [1999], Wilkaniec [1999], Cichocka et al. [1998], Halbert et al. [1998] and Pisarski [1979], who report that insects with stinging-sucking mouthparts occur in greater numbers in the areas that undergo strong anthropopressure.

As an effect of urbanization pressure an increased soil, air and plant pollution is observed. In the plants that grow near main street tracts a much higher level of pollutants is found: heavy metals and chlorine [Bytnerowicz 1979, Molski and Sitarski 1979]. The defensive mechanisms of such plants are highly weakened. This, in turn, enhances preying of insects with stinging-sucking mouthparts, even more so that they are much more resistant to pollutants as compared to the group of insects with biting mouthparts [Chudzicka 1979]. It was also observed that plants growing in stands with strong accummulation of pollutants containing higher mitrogen levels (protein), and thus they are more attractive for insects. Possible deficits of nitrogen in a p;lant, caused, among others, by air and soil pollutants, are compensated by assimilating nitrates from the soil and nitrogen oxides (NO and NO_2) from the air in amount sufficient to meet the nutrient requirements of the roots and sprouts [Rennenberg *et al.* 1998, Mansfield 2004].

Ch. juglandicola was preying on the examined trees from spring to early autumn. Depending on the study year and the post, its peak number was most often observed in May and June. This is consistent with the previous results, published by Jaśkiewicz and Cichocką [2004]. However, Jaśkiewicz and Kmieć [2007] report that walnut trees were most often and in greatest numbers (the peak number) settled by these aphids between June and July.

The plant lice were preying in dispersion on the bottom side of leaf blade, causing leaf deformation, which was described earlier by: Cichocka [1980], Jaśkiewicz and Cichocka [2004], as well as Jaśkiewicz and Kmieć [2007]. The bottom side of the leaf turned out to be more attractive for the aphids for taking up their food. It was so probably because for these very delicate and small insects (as compared to other aphids) – *Ch. juglandicola* it was easier to insert their mouthparts and suck the juices out of the places where the cells were arranged loosely (spongy parenchyma). Besides, the bottom side of the leaf is deprived of mechanical, cuticle-type protective barriers, which also makes gaining food easier.

The dynamics of aphid population was also significantly affected by the course of weather conditions. The development of these insects was enhanced by warm spring with not very intense precipitations. The numerical strength of aphids in summer time

was low. High air temperatures at that time (about 30ºC) and the accompanying draught caused a significant decrease in plant turgor, which probably made it difficult for insects to take food. Torrential rains in summer also limited the numerical strength of *Ch. juglandicola.* It can be supposed that downpours killed the insects and washed them off the leaves. The obtained data confirm the results of studies performed by Jaśkiewicz and Cichocka [2004] and Kmieć [2007].

CONCLUSIONS

1. *Chromaphis juglandicola* (Kalt.), was preying on *Juglans regia* L. trees in all study years in the housing estate, park and street-side stands.

2. More numerous colonies of *Ch. juglandicola* were observed on trees growing in the housing estate stand.

3. Depending on the study year and stand, the presence of *Ch. juglandicola* was observed throughout the whole vegetation period and the peak number usually fell in May or June.

4. *Ch. juglandicola* settled the bottom part of leaf blade and its preying caused decoloration and deformation of leaves. Leaves fell prematurely from the sprouts which had been invaded more intensely and that caused weaker winter hardiness of these parts of the plant. Preying of *Ch. juglandicola* on *J. regia* trees significantly diminished their decorative values.

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DYNAMIKA LICZEBNOŚCI *Chromaphis juglandicola* (Kalt. 1843) NA ORZECHU WŁOSKIM (*Juglans regia* L.) W MIEJSKICH ZADRZEWIENIACH LUBLINA

Streszczenie. W Polsce orzech włoski ze względu na swój pokrój i okazałe liście zdobył uznanie jako drzewo zdobiące otaczającą nas przestrzeń. Coraz częstsze wykorzystanie orzecha włoskiego w krajobrazie miejskim skłoniło do dokładniejszego przeanalizowania czynnika, który powoduje znaczne obniżenie dekoracyjności tej rośliny. Celem pracy było prześledzenie dynamiki liczebności *Ch. juglandicola* zasiedlającej drzewa *Juglans regia* L. w nawiązaniu do układu warunków pogodowych oraz określenie stopnia szkodliwości wyżej wymienionego gatunku mszycy. Badania prowadzono na orzechu włoskim (*Juglans regia* L.) w Lublinie w latach 2006 – 2008. Do obserwacji wytypowano trzy stanowiska: osiedlowe (A) – osiedle domków jednorodzinnych, parkowe (B) – na terenie Kampusu Uniwersyteckiego oraz przyuliczne (C) – przy skrzyżowaniu ruchliwych ulic obok stacji benzynowej. Określono terminy występowania tej mszycy i dynamikę liczebności na tle warunków meteorologicznych. Ustalono, że *Chromaphis juglandicola* (Kalt.) występuje na drzewach *Juglans regia* L. rosnących w miejskich zadrzewieniach Lublina.

Mszyce te najliczniej notowano w roku 2007 na stanowisku osiedlowym. *Ch. juglandicola* obserwowano na dolnej stronie blaszki liściowej w rozproszeniu. Na terminy wiosennego pojawu oraz jesiennego zaniku mszyc w znaczący sposób wpływał przebieg warunków pogodowych. Ich rozwojowi sprzyjała ciepła wiosna z niezbyt intensywnymi opadami. Natomiast temperatury powietrza powyżej 30ºC i ulewne deszcze typu burzowego latem ograniczały liczebność *Ch. juglandicola.*

Słowa kluczowe: zdobniczka podliściowa, orzech włoski, krajobraz miejski, warunki meteorologiczne

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