

## THE OCCURRENCE OF APHIDS (APHIDIDAE) ON MAIZE (*Zea mays* L.) IN KRZECZOWICE NEAR PRZEWORSK (SOUTH-EASTERN POLAND) IN 2005-2008

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**Abstract.** The dynamics of occurrence, the infested parts of host plants, and the species of aphids (Aphididae) infesting maize were identified in research carried out in Krzeczowice (49°59' N; 22°27' E) near Przeworsk between 2005 and 2008. The research demonstrated three peaks in the development of aphid population size. The first peak (the most abundant) was observed in the latter third of June or in the first half of July. The second peak of population size was observed in early August or in the second half of this month, while the third peak of population size was recorded in the middle or at the end of September. The most important species infesting maize plants during the analyzed period were: *Rhopalosiphum padi* L., *Metopolophium dirhodum* Walk., *Sitobion avenae* L. and *Rhopalosiphum maidis* Fitch. Moreover, in 2007, *Tetraneura ulmi* L. was detected on maize roots in the investigated region for the first time ever.

**Key words:** *Metopolophium dirhodum*, *Rhopalosiphum maidis*, *Rhopalosiphum padi*, *Sitobion avenae*, *Tetraura ulmi*

### INTRODUCTION

Aphids (Aphididae) comprise one of the most important groups of insect pests infesting maize in south-eastern Poland [Lisowicz 2001], and they can cause significant damage to plants when occurring abundantly, especially during periods of water shortage [Mrówczyński et al. 2004]. Hosting aphids does not normally cause direct yield loss. However, by removing sap from the maize's epigeal organs they contribute to the decreased health status of plants [Lisowicz 1996]. Damaged tissues open up an invasive route for penetrating viruses, bacteria and fungi that are responsible for many maize diseases, negatively affecting the quality of the final product or material used for further processing [Lisowicz and Tekielna 2004].

Maximum reduction of aphids' negative effects requires the combined use of many methods preventing the growth of their population, as well as control measures.

However, decisions regarding potential pest control should be based on facts related to pest biology, and the occurrence in each individual year and previous years [Mrówczyński et al. 2007].

The objective of the research was to determine the dynamics of maize aphid occurrence under variable environmental conditions. Additionally, observations of the hosting sites of pests and the determination of species combinations were carried out.

## **MATERIAL AND METHODS**

Research was carried out between 2005 and 2008 on maize cultivar San (FAO 240) in the Plant Cultivation Station in Krzeczowice (49°59' N; 22°27' E) near Przeworsk, Poland. The average number of aphids per plant was determined by counting all the live specimens every 7 days, starting from the stage when the tip of the tassel was visible (BBCH 53) [Adamczewski and Matysiak 2002] on twenty plants, and later, until the end of the maize vegetation season, on ten randomly selected plants harvested from a maize cultivar (diagonally). The search for pests was made on the surface of all epigeal maize organs, inside plants and on the root system.

## **RESULTS AND DISCUSSION**

### **Dynamics of aphid occurrence**

In 2005 aphids occurred with medium abundance. Owing to intensive rainfall and relatively low temperatures in April and the first half of May, the first aphids occurred on plants on 9 June, when maize plants had unfolded the third and fourth leaves (BBCH 13-14). An increase in temperature and improved weather conditions were followed by the rapid development of the pest colony, with three clearly detectable peaks in population size. The first (and the most) highly abundant peak (321.4 individuals per plant) was recorded on 14 July, when maize was at stage BBCH 53, the second peak (104.2 individuals per plant) was recorded on 25 August, when maize was at stage 75, while the third, the lowest peak (41.7 individuals per plant), took place on 30 September, when maize was at stage 87. The last aphid specimens were observed on drying plants on 13 October (Fig. 1).

In 2006 the first aphids were detected on plants unfolding the first and second leaves (BBCH 11-12) on 23 May, i.e. earlier than in the previous year. However, unfavorable weather conditions (intensive rainfall and low temperatures persisting into spring) contributed to the very slow development of pest colonies. Along with improved weather conditions after mid-June, a growth in the population of aphids was observed, and this attained the highest level in the last ten days of June. In the later period high temperatures and periodic lack of rainfall caused drought in the investigated region. This combination of weather factors disturbed the development of pests on maize. Plants demonstrating symptoms of water deficiency were not an attractive source of food for aphids, and therefore the size of the population kept at a low level until the end of the vegetation period. Three small peaks in the development of population size were observed despite the unfavorable weather conditions. The first (and most abundant) peak (45.0 individuals per plant) was recorded on 27 July, when maize was at stage BBCH 18-19, the second peak (18.0 individuals per plant) was recorded on 1 August,

when maize was at stage 71, while the third peak (14.0 individuals per plant) was observed on 19 September, when maize was at stage 87. The last aphids were observed on plants on 10 October (Fig. 2).

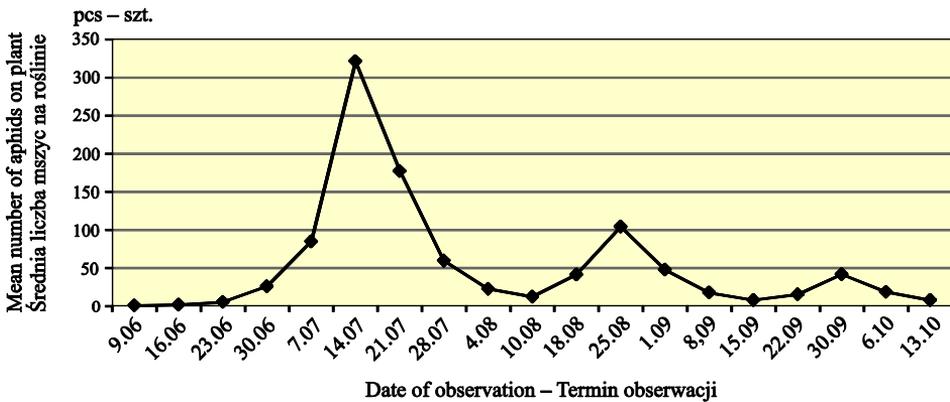


Fig. 1. The dynamics of a mixed-species population of maize aphids in 2005

Rys. 1. Dynamika występowania mieszanej populacji mszyc na kukurydzy w 2005 roku

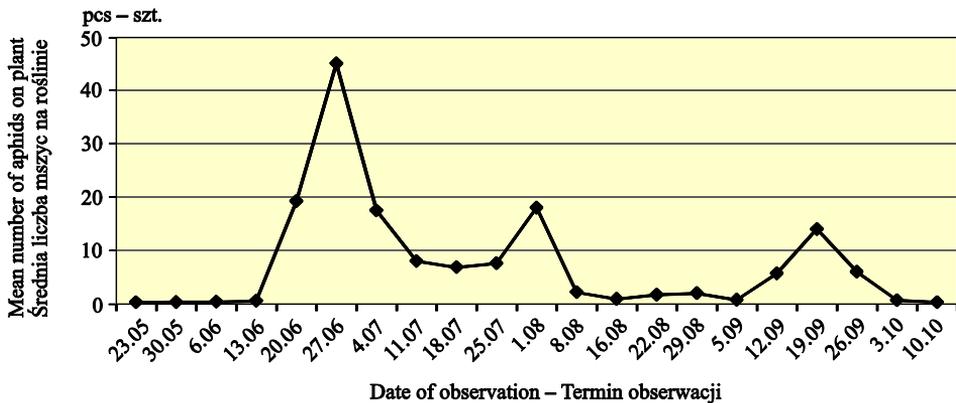


Fig. 2. The dynamics of a mixed-species population of maize aphids in 2006

Rys. 2. Dynamika występowania mieszanej populacji mszyc na kukurydzy w 2006 roku

In 2007 aphids occurred in the maize cultivar on 11 May, when plants were at stage BBCH 11-12, which was the earliest time during the analyzed four year period. Owing to relatively low temperatures during the early vegetation stage the increase in the size of the pest population was slow until June. In the later period high temperatures and moderate humidity were favorable for the development of numerous aphid colonies, as well as accelerated maize growth and ripening. In 2007 aphids occurred with a medium abundance, although it was the highest with respect to all the analyzed years. Three peaks in the size of the aphid population were identified. The first (and most abundant) peak (409.1 individuals per plant) was recorded on 6 July, when maize was at stage BBCH 61, the second peak (127.0 individuals per plant) was recorded on 17 August, when maize was at stage 75, while the third peak (23.4 individuals per plant) took place

on 14 September, when maize was at stage 87. Owing to accelerated maize development the last aphids were observed on plants on 21 September (Fig. 3).

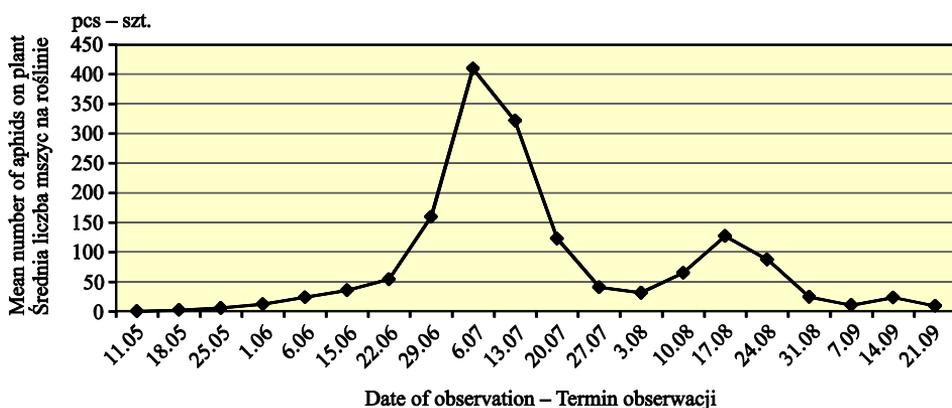


Fig. 3. The dynamics of a mixed-species population of maize aphids in 2007

Rys. 3. Dynamika występowania mieszanej populacji mszyc na kukurydzy w 2007 roku

In 2008 first, few individuals of *R. padi* appeared on maize on 12 May. Weather conditions, especially prolonged rains in June and July, were unfavourable for the development of a colony of those pest. As in past years, there were three peaks in the number of aphids during their development. The first was on 30 June (173.1 individuals per plant), when the plants were on the BBCH 51 stage of development, the second on 12 August (23.2 individuals per plant), with BBCH 73 plants, and the third on 16 September (53.2 individuals per plant), with BBCH 87 plants. Last aphids on plants were observed on 29 September (Fig. 4).

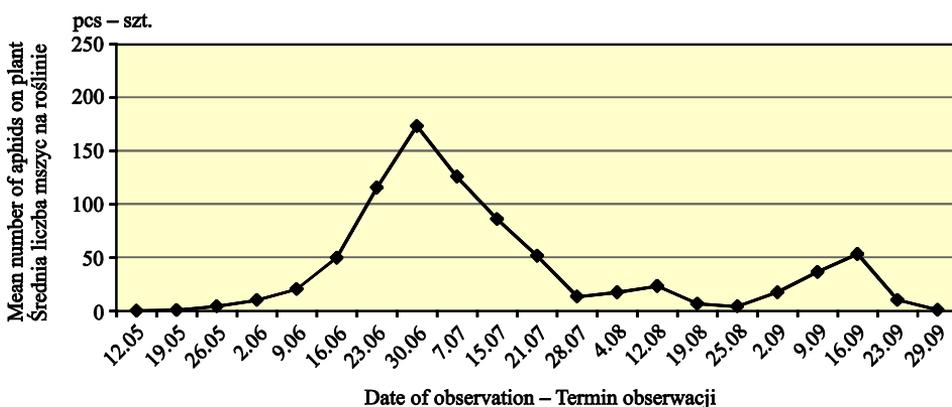


Fig. 4. The dynamics of a mixed-species population of maize aphids in 2008

Rys. 4. Dynamika występowania mieszanej populacji mszyc na kukurydzy w 2008 roku

Results from the observations carried out in this study on the dynamics of aphid occurrence partly contradict observations made by other authors, the main difference being the number of peaks in pest occurrence. In studies carried out in Poland by the

majority of other authors two peaks in the population size of mixed-species aphids infesting maize were recorded [Kania 1962, Plewka and Pankanin-Franczyk 1989, Lisowicz 1992]. Studies by foreign authors have demonstrated two peaks [Leisner et al. 1987, Jürgens 1989, Pons et al. 1989] or one peak in maize aphid population size [Jürgens 1989].

However, the occurrence of three peaks in the size of aphid populations on maize has been confirmed in studies carried out by Lisowicz [2001]. According to this author, the first peak in population size occurs mostly in early July, the second peak in August, and the third peak may occur in August or early October. The last peak in population size was observed in early September, and was related to the fact that the first peak of pest population size is the most abundant. This partly differs from the observations by Lisowicz and Tekiela [2004], who reported the third peak as the most abundant. Custom research showed that it was the first peak that was always the most prominent. During the four years of research, only in 2008 the last peak in aphids numbers was more prominent than the second, but never was it higher than the first one.

Many factors influenced the development of the mixed-species population of aphids on maize over the study period. The most significant factors included the weather conditions, especially the effect of relatively low temperatures in spring, the influence of intense rainfall and strong winds, as well as high temperatures and lack of rainfall, resulting in periodic drought, which was particularly evident in 2006.

The development of mixed-species aphid populations in the analyzed period was considerably affected by their abundant occurrence on other host plants, especially winter cereals growing in the neighborhood of maize cultivars, from which winged forms migrated to maize plants.

Additionally, a strong influence on the dynamics of aphid occurrence on host plants was exerted by the presence of aphidophags, especially ladybird larvae (Coccinellidae), hoverfly larvae (Syrphidae), lacewing larvae (Chrysopidae) and other species whose population size increased together with the development of pest colonies. A high number of aphidophags was observed during the first peak in aphid population size, and their presence was also recorded until the end of the period when pests were present on plants.

The effect of the aforementioned factors on the population of maize aphids has also been observed by other authors, e.g. Lisowicz [1992, 1996], Plewka and Pankanin-Franczyk [1989] and Pons et al. [1989].

### **Aphid species infesting maize and the place of their occurrence**

The species composition of aphids is demonstrated in Figures 5 to 8. The occurrence of the following aphid species was observed on maize plants during the studied period: bird cherry-oat aphid (*Rhopalosiphum padi* L.), rose-grain aphid (*Metopolophium dirhodum* Walk.), cereal aphid (*Sitobion avenae* L.) and corn aphid (*Rhopalosiphum maidis* Fitch.). The occurrence of these aphid species on maize was also recorded by Pons et al. [1989]. Moreover, in September 2007 and July-September 2008 common cecidogenous aphid larvae (*Tetraneura ulmi* L.) were detected on the roots of three maize plants in the marginal strip of cultivar for the first time ever in the investigated region. Additionally, an insignificant number of other aphids was recorded locally on single plants, but they were not determined as species.

The predominant species, and the first occurring on the cultivar between 2005 and 2008, was the cherry-oat aphid. The proportion of *R. padi* in the total number of collected insects in the studied years ranged between 62.5% and 88.9% and determined the level and date of the occurrence of all peaks in the size of the mixed-species aphid population (Fig. 1-4). The obtained results slightly differ from the studies carried out by Plewka and Pankanin-Franczyk [1989] and Lisowicz [1992, 2001], who found that *M. dirhodum* predominated in the first peak of population size, while *R. padi* predominated in the second peak.

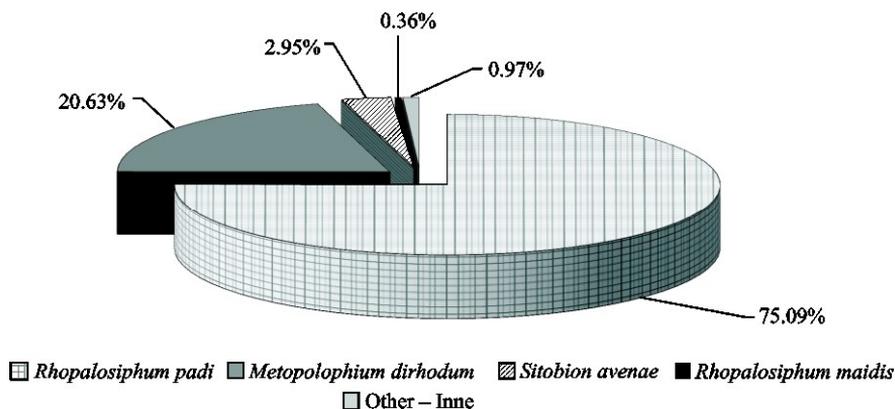


Fig. 5. The proportion of individual species in the total aphid population occurring on maize in 2005, %

Rys. 5. Procentowy udział poszczególnych gatunków w ogólnej populacji mszyc występujących na kukurydzy w 2005 roku

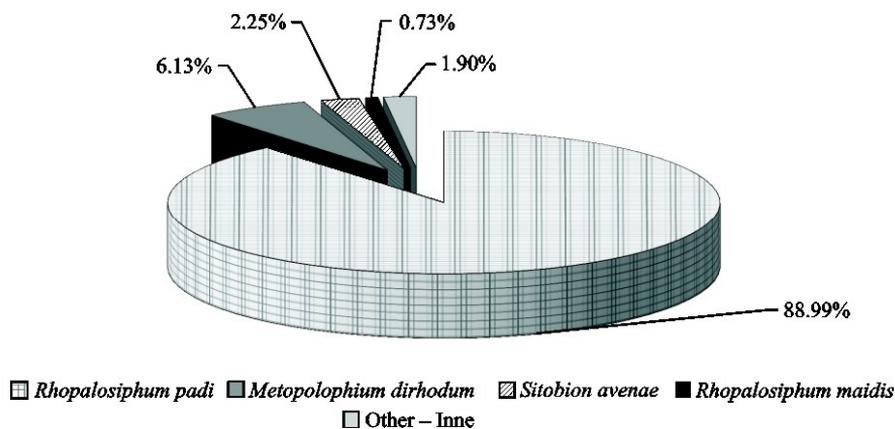


Fig. 6. The proportion of individual species in the total aphid population occurring on maize in 2006, %

Rys. 6. Procentowy udział poszczególnych gatunków w ogólnej populacji mszyc występujących na kukurydzy w 2006 roku

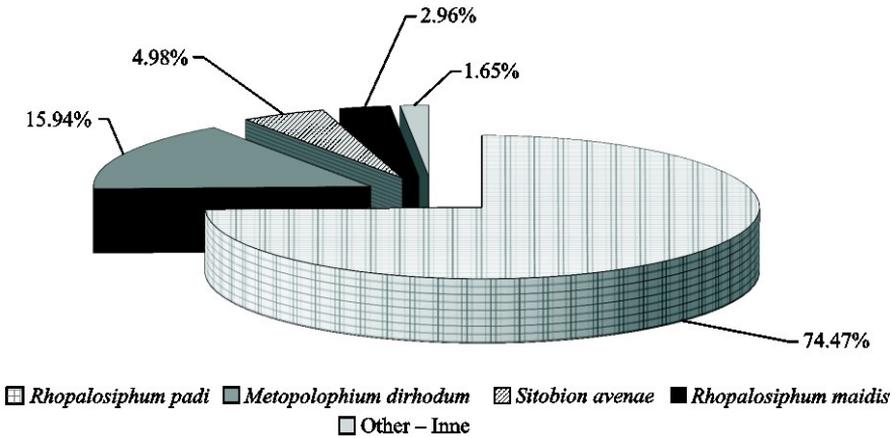


Fig. 7. The proportion of individual species in the total aphid population occurring on maize in 2007, %

Rys. 7. Procentowy udział poszczególnych gatunków w ogólnej populacji mszyc występujących na kukurydzy w 2007 roku

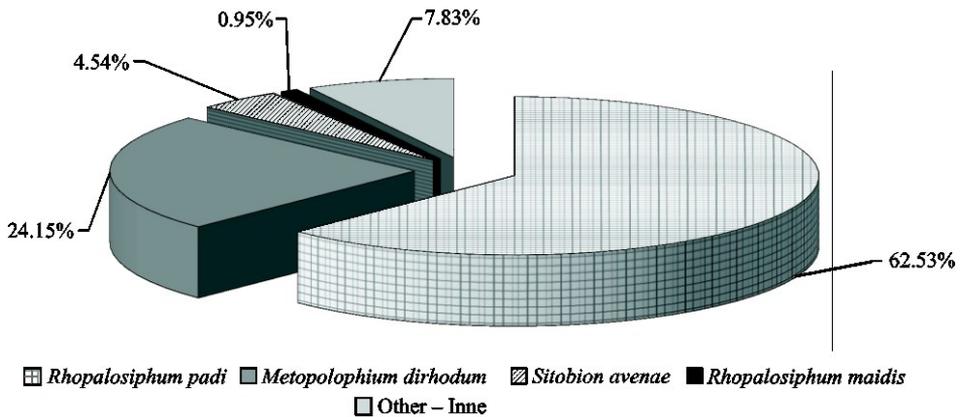


Fig. 8. The proportion of individual species in the total aphid population occurring on maize in 2008, %

Rys. 8. Procentowy udział poszczególnych gatunków w ogólnej populacji mszyc występujących na kukurydzy w 2008 roku

Specimens of *R. padi* initially infested both the bottom surface of leaf blades and unfolded maize leaves. In the later period, when plants were developing tassels and ears, aphids also infested developing tassels, the external surface of leaf sheaths, ear leaves and the fresh silk of the ear. Moreover, from mid-July *R. padi* specimens removed sap from the internal surface of leaf sheaths and husks, and were also detected between soft kernels at the milky stage, and partly from the kernel at the dough stage, especially those unprotected by husks.

The second most abundant species was the rose-grain aphid, whose proportion in the total number of collected insects in the studied three-year period ranged between 6.1% and 24.1%. In the studied period specimens of *M. dirhodum* infested plants between

June and the end of September, and it was only during the very hot summer of 2006 that they fed on maize until the first ten days of August. Initially *M. dirhodum* was most abundant on the bottom surfaces of the maize leaves located lowest above the ground. In the later period aphids of this species infested higher parts of plants, and their colonies were recorded on the bottom and, sporadically, on the top surfaces of leaf blades.

Studies carried out by Lisowicz [1992, 1996], Jürgens [1989] and Pons et al. [1989] confirm the observations made by the author of this paper that the most abundant aphid species occurring on maize are *R. padi* and *M. dirhodum*.

Between 2005 and 2008 cereal aphid early infested an insignificant number of plants from the first half of June, and the period of its occurrence ended in mid-August, except 2006, when it ended on 11 July. Specimens of *S. avenae* infested both bottom and top surfaces of leaf blades and the external surfaces of leaf blades.

Corn aphid was recorded exclusively on the bottom surface of single leaf blades, in colonies of over ten to, rarely, over several dozen specimens. Specimens of *R. maidis* occurred on plants from the first half of August (in 2007 from the latter third of July) until the first half of September.

The common cecidogenous aphid *T. ulmi* has not been recorded on maize in the south-eastern part of Poland so far. Colonies of insignificant numbers of this species feeding on maize roots in the region of Wrocław were first reported in Poland in the 1950s [Kania 1962]. However, according to Zwölfer [1958] this species is not important for commercial cultivars of cereals and maize in Central Europe.

## CONCLUSIONS

1. The abundance of aphids in the studied period ranged from low to moderate. Three peaks in the size of aphid populations were identified during their development.

2. The occurrence of the following aphid species was observed on maize plants during the studied period: *Rhopalosiphum padi* L., *Metopolophium dirhodum* Walk., *Sitobion avenae* L. and *Rhopalosiphum maidis* Fitch. A new species detected on maize roots in the studied region for the first time ever was *Tetraneura ulmi* L. Additionally, single plants were infested by single or small colonies of other aphids, but they were not determined as species.

3. *R. padi*, infesting all epigeal maize organs, was the predominant species during the studied period. *M. dirhodum* occurred with lower abundance and mainly infested the bottom surface of maize leaf blades. The bottom and top surfaces of leaf blades, as well as the leaf sheaths of single plants were infested by *S. avenae*, while *R. maidis* occurred only on the bottom surface of the leaf blades of single plants. *T. ulmi* infested the root system of only three plants growing in the marginal strip of the studied cultivar.

4. During the studied period the chemical control of aphids was only justified in 2005 and 2007. The first half of July was the optimum date for pest control.

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**WYSTĘPOWANIE MSZYC (APHIDIDAE) NA KUKURYDZY (*Zea mays* L.)  
W KRZECZOWICACH KOŁO PRZEWORSKA  
(POŁUDNIOWO-WSCHODNIA POLSKA) W LATACH 2005-2008**

**Streszczenie.** Na podstawie badań wykonanych w latach 2005-2008 w Krzeczowicach (49°59' N; 22°27' E) koło Przeworska określono dynamikę występowania, miejsca przebywania na roślinach oraz skład gatunkowy mszyc (*Aphididae*) żerujących na kukurydzy. Stwierdzono, że w rozwoju mieszanej populacji mszyc występowały trzy maksima liczebności. Pierwsze miało miejsce w trzeciej dekadzie czerwca lub w pierwszej połowie lipca. Drugie wystąpiło na początku sierpnia lub w drugiej połowie

tego miesiąca, natomiast trzeci szczyt liczebności przypadał na połowę lub koniec września. W analizowanym czteroleciu pierwsze maksimum występowania mszyc było najliczniejsze. Najważniejszymi gatunkami występującymi na roślinach w analizowanym okresie były: *Rhopalosiphum padi* L. oraz *Metopolophium dirhodum* Walk. W mniejszym nasileniu wystąpiły ponadto: *Sitobion avenae* L. i *Rhopalosiphum maidis* Fitch. W 2007 roku po raz pierwszy w rejonie badań odnotowano występowanie na korzeniach kukurydzy *Tetraenera ulmi* L.

**Słowa kluczowe:** *Metopolophium dirhodum*, *Rhopalosiphum maidis*, *Rhopalosiphum padi*, *Sitobion avenae*, *Tetraenera ulmi*

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