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SELECTED ISSUES CONCERNING THE ECOLOGY OF GREEN PEACH APHID (*MYZUS PERSICAE* SULZ.) ON POTATO CROPS

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Abstract: It was confirmed that in the north of Poland winged specimens *of Myzus persicae* (Sulz.) start to migrate in spring approximately over three weeks later than in the central and southern regions. It was observed that during the 1981–1990 and 1991–2000 decades, *M. persicae* started its flights approximately over two weeks earlier than during the 1971–1980 decade. With this respect one may conclude that the changes are permanent. There were also changes in quantity. In some places the *M. persicae* share in the entire aphid fauna on potato crops was observed to have decreased as the time passed, which, as it seems, may be associated with a decrease in potato crops area in Poland. Such a correlation can also be confirmed by the fact that in the area where *M. persicae* share increased, the potato crops area also increased extensively.

Key words: *Myzus persicae*, dynamics of occurrence

INTRODUCTION

In Poland, a number of aphid species infest potatoes, and they include three species which appear in large numbers, constituting approximately about 99% of the aphid fauna: buckthorn – potato aphid (*Aphis nasturtii* Kalt.), blackberry aphid (*Aphis frangulae* Kalt.), and green peach aphid *[Myzus persicae* (Sulz.)] (Kostiw 1987). Moreover, these species are major potato virus diseases vectors and thus their economic importance is mainly associated with seed potato crops (Kostiw 2002; Basky 2002).

In Poland, *M. persicae* is the only vector of *Potato leafroll virus* (PLRV), which has an economic importance, and is also a very effective *Potato virus Y* (PVY) vector, as well as of *Potato viruses M* (PVM) and S (PVS) (Kostiw 1987; Gabriel 1989). This aphid species includes a number of forms reproducing permanently parthenogenetically and overwintering anholocyclically on a number of plants in glasshouses and other places which protect them from frost, i.e. flats, or storehouses of agricultural

use, or bisexually with a complete heterogenic alternations of generations in which case the fertilized eggs are laid and they overwinter on a primary host ((Mûller 1976; Szelegiewicz 1968). According to Szelegiewicz, in Poland, the *M. persicae* holocyclic forms lay eggs mainly on peach (*Persica vulgaris* L.) or on *Lycium halimifolium* Mill. Both these plants are more numerous in the central and southern Poland. The former one is to be found in orchards, the latter one is a wild plant growing in the urban area, by fences, on road edges, sometimes being planted intentionally on road slopes or railway embankments. From the *Prunus* L. genus, e.g. *Prunus* devidiana, *P. nana, P. nigra* and *Padus seretina* are other winter primary hosts.

This aphid species is a polyphagous insect whose secondary hosts include over two hundred plant species. It occurs all over the world.

The observations of aphids on potato crops are carried out in order to find out about the conditions of virus disease spread, the warning of virus vectors flight time (aphid alert), destruction of leaves and to determine the expected well-being of seed potatoes prior to harvest in a given year.

The aim of the study was to compare the time of *M. persicae* spring migration in different regions of Poland, their number dynamics, and their share in the entire aphid fauna on potatoes, as well as to determine whether in the many years' period these parameters remained on a similar level or changed.

MATERIAL AND METHODS

The research was carried out in 1971–2000 in five places located in various regions of Poland: Bonin of the West – Pomerania region; Zamarte of the Kujawy-Pomerania region; Szyldak of the Warmia-Mazurian region; Jadwisin of the Mazovia region and Stare Olesno in the Opole region. The monitoring of winged aphids was carried out from May to August with the use of two yellow Moericke's dishes three quarters-water-filled with a few drops of detergent added. The dishes were put in a fallow square–shaped area of 20-m length. The dishes were emptied daily or every second day, with respect to the place. The mean number of aphids of two dishes was analyzed after a logarythmic transformation according to the following formula: lg (n+1) in which "n" equals the number of aphids. Also, in three of the places (Bonin, Jadwisin and Stare Olesno) aphids were counted on 100 leaves with the onset of potato sprouting.

RESULTS AND DISCUSSION

Table 1 represents the mean time of the first yellow dish trapped *M. persicae* specimens in three subsequent decades: 1971–1980, 1981–1990 and 1991–2000 in five places. The places were divided into two groups. The first group included those located in the north of Poland (Bonin, Zamarte, Szyldak), whereas the second one included the two remaining ones, Jadwisin (mid-east Poland) and Stare Olesno (south Poland). The data indicate that in the north of Poland *M. persicae* started its flights approximately on 28 June which is 24 days later than in the two remaining places (Jadwisin and Stare Olesno), where the flights approximately started on 4 June. In all the places the time of migration took place much later during the 1971–1980 decade than in the two other decades, in between which no differences

Table 1. Mean time of the first yellow dish trapped *Myzus persicae* (Sulz.) specimens in three subsequent decades: 1971–1980; 1981–1990 and 1991–2000 in five places

Place	1971–1980	1981–1990	1991–2000	Mean
Bonin	27.06	11.06	8.06	15.06
Zamarte	19.07	23.06	23.06	2.07
Szyldak	5.07	5.07	8.07	6.07
Mean	7.07	23.06	23.06	28.06
Jadwisin	18.06	28.05	4.06	6.06
Stare Olesno	8.06	30.05	1.06	3.06
Mean	13.06	29.05	2.06	4.06

in subsequent places were found. The migration in the northern area in 1971–1980 approximately started on 7 July, i.e. fourteen days later than in the 1981–1990 and 1991–2000 decades, when the first flights were observed at the same time, which is 23 June. Aphids started their flights the earliest in Bonin (approximately on 27 June), then in Szyldak (approximately on 5 July), and the latest in Zamarte (19 July). In 1981–1990 and 1991–2000, also in Bonin aphids started to migrate the earliest (11 and 8 June, respectively). But the latest migration took place not in Zamarte (here, in both decades the flights began in both cases on 23 June), as it had been the case in 1971–1980, but in Szyldak (5 and 8 July, respectively). In Jadwisin and Stare Olesno the first *M. persicae* flights took place on 13 June which is sixteen days later than in 1981–1990 (29 May approximately) and eleven days later than in 1991–2000 (2 June approximately).

The climate and moreover the temperature are the main factors which diversify the aphid spring migration time and its number. In the north of Poland, where the temperature is lower in comparison with the central and southern areas, aphids appeared later. From the data in table 2 one may see that the mean temperature in April – May 1971–1980 and 1981 1990 in this area was 8.5°C and 9.6°C respectively, and was 1.1°C and 1.0°C lower in the two remaining places – Jadwisin and Stare Olesno (Tab. 3), where the temperature was 9.6°C in 1971–1980 and 10.6°C in 1981–1990. In the meantime, the difference in temperatures between the second decade and the third one (1991–2000) was slight and did not exceed 0.4°C in Bonin and in Stare Olesno, and 0.2°C in Jadwisin (Tab. 3), therefore the time of aphid appearance in

Table 2. Mean April – May temperature in: 1971–1980; 1981–1990; 1991–2000 in five places

Place	Years		
	1971–1980	1981–1990	1991–2000
Bonin	8.4	9.4	9.8
Zamarte	8.4	9.6	–
Szyldak	9.7	9.8	–
Mean	8.5	9.6	–
Jadwisin	9.9	10.9	11.1
Stare Olesno	9.3	10.4	10.8
Mean	9.6	10.6	10.9

– no data

Table 3. Mean April – May temperature in: 1971–1980; 1981–1990; 1991–2000 and differences between particular decades in five places

Place	Years								
	1971–1980	1981–1990	difference	1981–1990	1991–2000	difference	1971–1980	1991–2000	difference
Bonin	8.4	9.4	1.0	9.4	9.8	0.4	8.4	9.8	1.4
Zamarte	8.4	9.6	1.2	9.6	–	–	8.4	–	–
Szyldak	8.7	9.8	1.1	9.8	–	–	8.7	–	–
Mean	8.5	9.6	1.1	9.6	–	–	–	–	–
Jadwisin	9.9	10.9	1.0	10.9	11.1	0.2	9.9	11.1	1.2
Stare Olesno	9.3	10.4	1.1	10.4	10.8	0.4	9.3	10.8	1.5
Mean	9.6	10.6	1.0	10.6	10.9	0.3	9.6	10.9	1.3

– no data

these decades was either similar, or the differences did not occur at all. At the present stage of observations one has to bear in mind that the much later *M. persicae* spring migration during the 1971–1980 decade was indeed caused by significantly lower temperature then in the 1981 1990 and 1991–2000 decades. Because of the fact that the presented results were obtained on the basis of many years' observations (30 years) one may observe that there occurred significant changes concerning *M. persicae* spring migration. In the last 20 years, the first *M. persicae* specimens started their spring flights earlier than before that period of time. This is a relevant piece of information with respect to epidemiology of potato virus diseases. Early flights are particularly threatening because aphids settle very young plants which are susceptible to virus infection. In Polish conditions the temperature impact on migration time, and the number of aphids in the Great Valleys region (Kraina Wielkich Dolin) was assessed by Wisłocka (1970) on the basis of the 1962–1967 data, and indirectly also by Gabriel (1965), both of whom found high correlation between cumulated temperatures and the degree of potato virus infection spread by aphids. Such dependence constituted the basis for determination of the PVY and PLRV infection pressure in Poland after considering isothermal lines for mean day temperatures from 1 January to 30 April for PVY, and from 1 January to 10 July for PLRV. The results of researches carried out by Stacherska and Ruszkowska (1978) and Kuroli (1999) also confirmed the dependence of aphid spring migration time on the spring weather conditions.

Table 4 shows the mean data on the share of winged and wingless *M. persicae* specimens of three places (Bonin, Jadwisin and Stare Olesno) in the 1971–1980,

Table 4. The share (%) of wingless and winged *Myzus persicae* (Sulz.) in: 1971–1980; 1981–1990 and 1991–2000. Mean data from five places

Years	Winged*	Winged**	Wingless
1971–1980	35	34	35
1981–1990	32	33	35
1991–2000	32	33	34

*mean of 5 localities
**mean of 3 localities

Table 5. The share (%) of wingless and winged *Myzus persicae* (Sulz.) in: 1971–1980; 1981–1990 and 1991–2000 in five places

Places	Bonin		Zamarte	Szyldak	Jadwisin		Stare Olesno	
Years	winged	wingless	winged	winged	winged	wingless	winged	wingless
1971–1980	33	30	23	49	35	33	35	40
1981–1990	33	36	38	25	33	34	33	34
1991–2000	34	34	39	26	31	33	32	26

1981–1990 and 1991–2000 decades. Only in these places were the observations carried out fully (including yellow dish catches and the counting on leaves). The share remained approximately on a very similar level in case of both morphs, varying slightly 33–35% in subsequent decades. Table 5 shows the share of *M. persicae* in subsequent places. In three of them (Bonin, Jadwisin and Stare Olesno) the data concerning winged and wingless aphids was also taken into account for comparison. With reference to the winged specimens in Bonin this share was usually similar in all decades and varied from 33% in 1971–1980 to 34% in 1991–2000; in Jadwisin it was respectively 35% and 31%, whereas in Stare Olesno it was respectively 35% and 32%. In the last two places a slight decrease could be observed as the years passed. Much greater changes which, however, took on a different direction, occurred in Szyldak. The greatest share of winged aphid specimens was observed in 1971–1980, and it was 49%. Thus, it was 24 or 23% higher than in 1981–1990 and 1991–2000, respectively. Here, also the differences between the 1981–1990 and 1991–2000 decades did not occur. An opposite tendency was observed in Zamarte, where *M. persicae* share increased extensively reaching up to 38% and 39% respectively in 1981–1990 and 1991–2000 in comparison with the 23% share which was observed in 1971–1980, so the difference was 15% and 16%, respectively. In Bonin and Jadwisin the occurrence of winged and wingless aphids remained on a similar level, although in Bonin one could observe a slight increase in the share of wingless aphid number. In the second and third decades of 1981–1990 and 1991–2000 the share was 36% and 34% respectively, and it was 6% greater than in 1971–1980 (30%) and 4% greater than in 1991–2000 (34%).

At the present stage of the research it is impossible to determine explicitly the causes of the changes discussed above. It seems, however, that such phenomena may be locally connected with a decreasing area of potato crops in Poland. In 2000 it was about 1.250 million ha and in comparison to the area of 1962, (the greatest after World War Two) which was more than 2.9 million ha, it was 57% smaller. This dependence is supported by the fact that in Zamarte, where in the last twenty years the area of potato crops has increased seven times, an increase in *M. persicae* numbers was also observed (Kostiw 2000).

Figures 1, 2 and 3 compare the dynamics of winged and wingless *M. persicae* specimens from May to August in 1971–2000 in Bonin (Fig. 1), Jadwisin (Fig. 2) and Stare Olesno (Fig. 3). In Bonin and Stare Olesno there is no similarity between the number of wingless specimens found on leaves and the winged ones caught into yellow dishes, while in Bonin (the north of Poland) the wingless specimens occurred in greater numbers than the winged ones. The evident dominance of winged

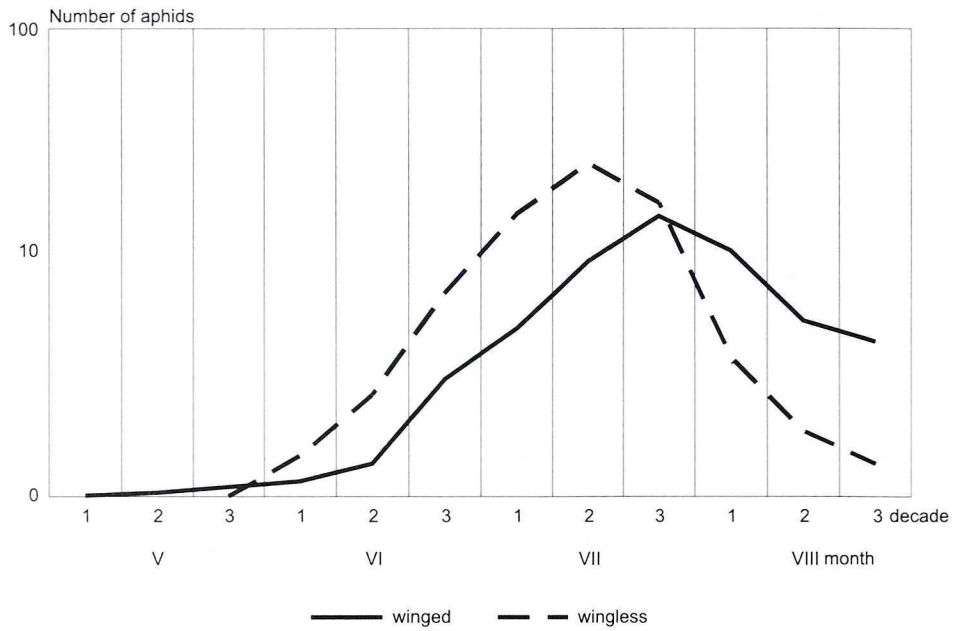

Fig. 1. The dynamics of winged and wingless *Myzus persicae* (Sulz.) occurence in Bonin (mean of 1971–2000)

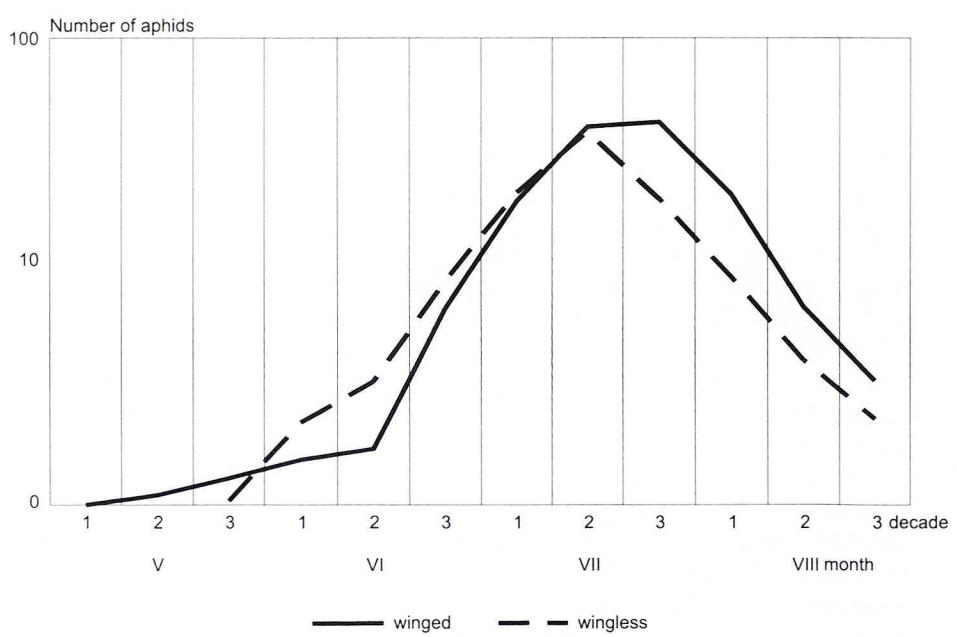

Fig. 2. The dynamics of winged and wingless *Myzus persicae* (Sulz.) occurrence in Jadwisin (mean of 1971–2000)

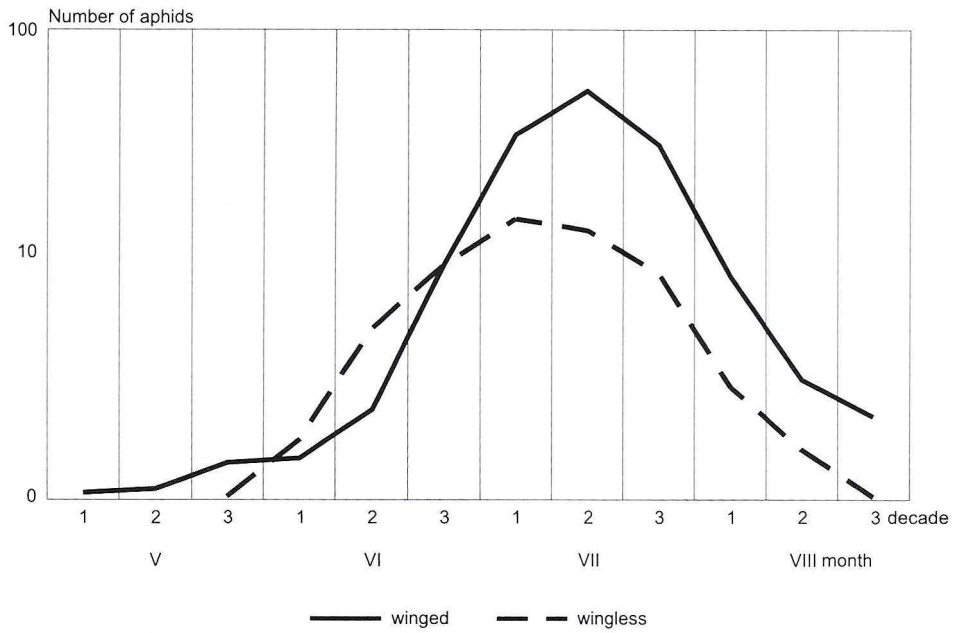

Fig. 3. The dynamics of winged and wingless *Myzus persicae* (Sulz.) occurrence in Stare Olesno (mean of 1971–2000)

aphids in the first, second and third decades of August was a result of a decrease in wingless aphid populations on leaves at that time which is associated with the aging of plants and the consequent lack of food, as well as the shortening of days. A similar phenomenon was observed in all the three places. In Jadwisin, a similarity in the numbers of both morphs occurrence was observed, especially until the wingless aphids reached their highest numbers (second decade of July), whereas in Stare Olesno, from the first decade of July until the end of August the number of winged aphids was much greater than that of the wingless ones. The time of highest gradation of aphids was similar in Bonin and in Jadwisin (the second and third decades of July, wingless and winged forms, respectively). In Stare Olesno their peak was reached earlier, namely in the first (wingless) and the second (winged) decades of July, respectively.

Weather conditions which may have a direct or an indirect impact on aphids are not simultaneously the best for wingless and winged morphs. In places located in the north of Poland, where the temperature is lower in comparison to central of Poland the number of winged aphids was smaller than the number of wingless aphids which were found on leaves. From the comparison of data in three places (Figs. 1, 2, 3) one may see that the best conditions for winged aphids to reproduce were in Stare Olesno, where for most of the vegetation season these morphs dominated over the wingless ones. The worst conditions were in Bonin, where the wingless specimens dominated over the winged ones.

CONCLUSIONS

In the 1981–1990 and 1991–2000 decades the first flights of *M. persicae* began at a similar time which was however 3 weeks earlier than in the 1971–1980 decade. With respect to the fact that the results were obtained on the basis of many years of research (30 years) and observation, one may conclude that the observed differences are significant. They were probably caused by an increase in temperature during the 1981–1990 and 1991–2000 decades respectively by 1,0 and 1,3°C in comparison to the 1971–1980 decade. In some places the percentage of *M. persicae* share decreased as the time passed. It seems that these changes in numbers are locally connected with a decreasing area of potato crops in Poland by 57% in 1962–2000. Such correlation is supported by the fact that in one of the places (Zamarte), where the area of potato crops has increased seven times in the past twenty years, the number of *M. persicae* has also increased.

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POLISH SUMMARY

WYBRANE ZAGADNIENIA EKOLOGII MSZYCY BRZOSKWINIOWEJ (*MYZUS PERSICAE* SULZ.) W UPRAWACH ZIEMNIAKA

Badania przeprowadzono w latach 1971–2000. Ich celem było porównanie terminu migracji wiosennej *Myzus persicae* (Sulz.) w różnych rejonach kraju, dynamiki ich liczebności i udziału tej mszycy w afidofaunie ziemniaka oraz określenie, czy w okresie wieloletnim wielkości te utrzymują się na podobnym poziomie, czy też ulegają zmianie. Monitoring mszyc prowadzono w 5 miejscowościach położonych w różnych rejonach kraju przy użyciu żółtych szalek Moericke'go. Dodatkowo w 3 miejscowościach co 10 dni, począwszy od pełni wschodów ziemniaków liczono owady na liściach roślin. Potwierdzono, że na północy Polski, osob-

niki uskrzydlone rozpoczynały migrację wiosenną w terminie średnio ponad 3 tygodnie późniejszym niż w rejonie centralnym i południowym kraju. Wykazano ponadto, że w dekadach z lat 1981–1990 i 1991–2000 *M. persicae* rozpoczynała loty w terminie średnio ponad 2 tygodnie wcześniejszym niż w dekadzie z lat 1971–1980. Można uważać, że pod tym względem zaszły już istotne zmiany spowodowane prawdopodobnie wzrostem temperatury w dekadach 1981–1990 i 1991–2000 w porównaniu z dekadą z lat 1991–2000. Wystąpiły też zmiany ilościowe. W niektórych miejscowościach stwierdzono zmniejszenie się udziału tej mszycy w całości afidofauny ziemniaka wraz z upływem lat, co jak się wydaje jest lokalnie związane ze zmniejszającym się areałem uprawy tej rośliny w Polsce, a potwierdzeniem tej zależności może być fakt, że w rejonie gdzie nastąpił wzrost udziału *M. persicae*, zwiększyła się również znacznie powierzchnia uprawy ziemniaków.