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First Record of *Rhopalosiphum maidis* (Fitch) (Homoptera: Aphididae) in Slovakia

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During the autumn of 1999, an outbreak of *Rhopalosiphum maidis* (Fitch) was observed on barley volunteers at locality Nitra-Malanta (48° 19′ N, 18° 09′ E) in Slovakia. Barley plantation arose from dropped grain of spring barley harvested on July 20, 1999. The soil was not cultivated after the harvest. During the observation, in October, nearly 80% of tillers were in growth stage of heading and nearly 20% of tillers were in growth stage of booting. The abundance of *R. maidis* reached 61.13 and 67.37 individuals per main and lateral tiller respectively. *R. maidis* was not observed on maize fields in the vicinity of the infested barley plantation. The highest percentage of populations constituted larvae and nymphs. Alate females formed 6.7% of the *R. maidis* population. From 2116 aphids observed on 30 main tillers 97 (4.58%) and from 2283 aphids observed on 30 lateral tillers 153 (6.70%) were infected by entomophthoralean fungi *Entomophthora planchoniana* Cornu or *Erynia neoaphidis* Remaudière et Hennebert.

Keywords: *Rhopalosiphum maidis, Entomophthora planchoniana, Erynia neoaphidis.*

Rhopalosiphum maidis (Fitch) is a common aphid on maize in many countries of the world. It is usual on maize in the USA (Irwin and Thresh, 1988), south European countries like Portugal (De-Gouveia, 1984), France (Breniaux et al., 1976), or Spain (Pons et al., 1989; Fereres et al., 1990) and in Africa (Darwish and Ali, 1991). *R. maidis* was common on maize in Bulgaria (Grigorov, 1982) and Turkey (Bremer and Raatikainen, 1975).

Because *R. maidis* develops only partenogenetically, and it is not able to overwinter by eggs (Müller, 1961), it does not occur in colder regions of Europe. Its distribution in Europe is limited from 40° N to 45° N, accidentally up to 50° N (Knechtel and Manolache, 1944). In 1960, *R. maidis* was recorded for the first time in eastern Germany (Müller and Freitag, 1960). In England, *R. maidis* was first found in 1955 (Stroyan, 1955). *R. maidis* was also observed in Sweden (Ossiannilsson, 1959), Poland (Kania, 1962), Hungary (Milinkó et al., 1983; Mészáros et al., 1984) and Romania (Knechtel and Manolache, 1944; Manolache et al., 1968). Three main aphid species were found on maize at Rennes (northwest of France). The fourth species, *R. maidis,* was observed only once (Henry and Dedryver, 1989).

From 1997–1999, the population dynamics of aphids on maize plants was studied at Nitra-Malanta (48° 19′ N, 18° 09′ E) in Slovakia. The aim of the study was to explain how entomophthoralean fungi influence cereal aphid populations on maize. The results from the years 1997 and 1998 have already been published (Štalmachová and Cagáň, 1999). In October 1999, a new aphid species, *R. maidis,* was found on barley volunteers near the Nitra-Malanta locality.

Up to now, there has been no information about the occurrence of *R. maidis* in Slovakia. In this paper, circumstances surrounding the appearance of *R. maidis* in Slovakia are discussed.

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Materials and Methods

The field with barley volunteers, where *R. maidis* was found in 1999, was situated at Nitra-Malanta locality at altitude of 230 m, 1 km east of the experimental base of the Slovak Agricultural University in Nitra.

Barley volunteers rose from lost grains of spring barley harvested on July 20, 1999. The soil was not cultivated after the harvest. During the observation, in October, nearly 80% of barley tillers were in the growth stage of heading and nearly 20% of tillers were in growth stage of booting

At the barley volunteer field (variety Sladko, 0.5 hectare) where *R. maidis* was found, 30 plants were analysed for the occurrence of aphids. The main tiller and the first lateral tiller were taken for analysis from each plant. The alatae and apterous individuals of each aphid species were counted. The number of aphids infected by entomophthoralean fungi and parasitized aphids was recorded as well. The same procedure was conducted on 60 maize plants on maize field about 1 km distant from examined barley field.

Additional five maize fields were examined to find out if *R. maidis* occurs there, too.

To show if the population of *R. maidis* can well develop in Slovakia, the demographic structure of aphid population was investigated. Although, the demographic structure of other species found on barley volunteer field was made for comparison. Ten barley plants infested by aphids were put into the freezer for 5 hours. Then, aphids were collected from the plants by shaking, put in 70% alcohol and counted. Aphids of each species were sorted out into four groups; larvae, nymphs, apterous females and alate females.

The spectrum of entomopathogens infecting aphids on barley volunteers was identified by using the method of Papierok (1989). Each infected aphid was placed to a piece of damp cellulose inside a small Petri dish lid (diameter 35 mm). Then, the Petri dish lid was placed over a microscope slide. The damp conditions initiated the sporulation of fungus and the conidia were collected on microscope slide. After, the conidia were mounted in lactophenol-cotton blue. The fungal species was identified from the shape and size of conidia.

Results and Discussion

In 1999, the population dynamics of aphids on maize included two peaks. The first peak occurred during the second half of June and *Metopolophium dirhodum* (Walker) was the dominant species. The second peak was recorded at the beginning of September but aphid populations were much less numerous than in June. *M. dirhodum* was the dominant species again and 14% of the aphid population constituted *R. padi.*

The same aphid species were found at 5 other maize fields surveyed at different localities 15 kilometres around the locality Nitra-Malanta. *R. maidis* was found on maize plants neither during the growing season, nor in autumn.

This species was not usual on maize at colder localities. In Hampshire, England, on the maize crop, *M. dirhodum* and *R. padi* were found at densities that exceeded those

found on small-grain cereals and grasses at the same time of year. *Sitobion avenae* (F.), and *Macrosiphon euphorbiae* (Thomas) were found at relatively low densities, and *R. maidis* and *Macrosiphon festucae* (Theo.) were observed rarely (Hand and Carrillo, 1982). On the other hand, four aphid species, including *R. maidis, R. padi, S. avenae* and *M. dirhodum* were observed on barley plants during October 1999 in Slovakia. *Table 1* shows the numbers of individuals from each species. The average number of aphids per main and lateral tiller was 61.13 and 67.37 *(R. maidis),* 7.50 and 7.43 *(R. padi),* 1.67 and 1.30 *(S. avenae),* or 0.23 and 0.10 *(M. dirhodum),* respectively. The difference between numbers of aphids on the main and lateral tiller was insignificant (analysis of variance, Tukey test). The table shows that *R. maidis* had higher capacity to develop on barley plant than *R. padi. S. avenae* and *M. dirhodum* do not seem have any importance in autumnal damage of barley.

Table 1

Number of aphids (x±s) per main tiller and per lateral tiller of barley plant on October 13, 1999 (variety Sladko) and maize plants on September 30.
Locality Nitra-Malanta (48° 19′ N, 18° 09′ E). Altitude 230 m

	barley volunteers				maize	
	main tiller		lateral tiller			
	alatae	apterous	alatae	apterous	alatae	apterous
Rhopalosiphum maidis	1.3±1.92	59.83±59.80	0.6 ±0.95	66.7±48.58	0±0	0±0
Rhopalosiphum padi	0.1±0.40	7.40±10.47	0.03±0.18	7.40±6.72	0.03±0.18	0.13±0.78
Sitobion avenae	0±0	1.67±3.94	0.03±0.18	1.27±3.30	0±0	0±0
Metopolophium dirhodum	0±0	0.23±1.26	0±0	0.1±0	0±0	0.05±0.28

Data from bioassays of aphids collected from wheat and barley fields near Prosser, Washington State, showed that *R. maidis* reached high population densities only on late autumn barley (Halbert and Pike, 1985).

In studies on field populations of cereal aphids attacking small spring grains in South Dakota, *Schizaphis graminum* (Rond.), *S. avenae* and *R. padi* commonly attacked wheat, barley and oats, while *R. maidis* occurred only on barley (Kieckhefer, 1975). Infestation of barley with *R. maidis* occurred also in Magdeburg county, Germany (Dubnik and Thormeier, 1988). In the UK, 5 species of aphid commonly occurred on cereals between April and September. These species were *R. padi, M. dirhodum, S. avenae, Sitobion fragariae* (Wlk.) and *M. festucae. R. maidis* has been occasionally recorded on barley leaves (George and Plumb, 1982).

All information mentioned above supports the conclusion that in many countries, *R. maidis,* in spite of its name, develops much better on barley than on maize.

Several species of cereal aphids, including *R. maidis,* persist and reproduce parthenogenetically throughout the year in the southern areas of the USA. They persist less readily or not at all in the northern states and Canada where winters are cold and these areas are reinvaded annually by migrants from the south (Irwin and Thresh, 1988). Reports

from the USA show that the first migrants of *R. maidis* were observed during the first half of June (Post and Olson, 1961; Robinson and Hsu, 1963). The summer and autumn flight activity of cereal aphids was monitored in South Dakota, by operating a large suction trap continuously from 1 June to mid-November. *R. maidis* occurred in early August and in mid-September (Kieckhefer and Lytle, 1976). In southwestern Ontario the largest emigration of alatae from the maize plants was found in August and from about mid-September to mid-October (Foot, 1977). A similar situation occurs in Europe, only the migration of insects is relatively more limited by mountains. Mountain edges in America are oriented in the direction south-north and mountain edges in Europe are oriented in the direction east-west. Migrating insects need a suitable host plant for their next reproduction in new areas. In Slovakia, spring cereals are already harvested in July and maize is past flowering at the end of July. Except for maize or young cereals from seeds dropped during the harvest, other possible host plants should be grasses. *R. maidis* did not fare well on any of 12 species of grasses tested (Stoner and Kieckhefer, 1979). But, *R. maidis* was found on spring barley, *Echinochloa crus-galli* (L.) Beauv., *Festuca pratensis* Huds., and winter barley in eastern Germany (Geissler and Karl, 1987). *R. maidis* overwinters in a milder climate and is regularly reintroduced to central Hungary where it occurred on *Echinochloa cruss-galli* (Basky and Eastop, 1995). Matured maize plants in late summer and in autumn are probably not very suitable hosts for any aphid except for *R. padi* which is known as a species well developing on the oldest plant leaves (Pons et al., 1989). In Slovakia, winter cereals are usually sown during September–October. During the same months, young plants of winter cereals are emerging. In October it is probably too late to develop a new population of *R. maidis* on these plantations. But, we should mention that the weather in September and at the beginning of October was much warmer then usually. So, it seems that in a regular situation, without the summer development of barley plants, there is a little chance for the development of a strong *R. maidis* population in Slovakia.

The demographic structure of aphid populations on barley during autumn is shown in *Table 2*. Larvae and nymphs formed the highest percentage of populations. Alate females formed 6.7% of *R. maidis* population but only 0.6% of *R. padi* population. A

Table 2

Demographic structure of aphid population on barley plants on October 13, 1999 (variety Sladko). Aphids were collected from 10 randomly chosen plants. Locality Nitra-Malanta. Altitude 230 m

	n	Larvae % (n)	Nymphs % (n)	Alate females % (n)	Apterous females % (n)
Rhopalosiphum maidis	1472	52.6 (774)	38.2 (562)	6.7 (99)	2.5 (37)
Rhopalosiphum padi	342	59.9 (205)	34.5 (118)	0.6 (2)	5.0 (17)
Sitobion avenae	59	57.6 (34)	22.0 (13)	6.9 (4)	13.6 (8)
Metopolophium dirhodum	13	69.2 (9)	30.8 (4)	0.0 (0)	0.0 (0)

higher number of apterous females occurred in the population of *R. padi.* Females accounted for more than 20% of individuals of the *S. avenae* population. The results suggest that *R. padi* is more adapted to colder temperatures in autumn than *R. maidis.* The *R. padi* population still did not produce high number of alate females in October. This is not very surprising because *R. maidis* is the aphid of warm areas, whereas *R. padi* is usual pest of cereals especially in the countries of northern Europe (Andersson, 1977; Chiverton, 1986).

A higher ratio between females and immature forms in the population of *S. avenae* should indicate that production of young larvae is smaller than it is in the population of the other two species. The conditions for the development of *S. avenae* were probably less suitable than for both *Rhopalosiphum* species. Similarly, when *R. maidis* and *R. padi* were fed on resistant maize varieties, an increase was observed in the migration of apterous and in the incidence of alatae (Vereshchagina and Gandrabur, 1988).

From 2116 aphids observed on 30 main tillers, 97 (4.58%) and from 2283 aphids observed on 30 lateral tillers, 153 individuals (6.70%) were infected by entomophthoralean fungi. From the sample of 95 infected aphids, 70 were infected by *Entomophthora planchoniana* Cornu and 24 were infected by *Erynia neoaphidis* Remaudière et Hennebert (= *Entomophthora aphidis* Hoffmann). Mixed infection caused by both entomophthoralean species was found in one case. It seems that the same fungus species infect the aphid in different climatic conditions. *E. neoaphidis* caused the infection of *R. maidis* in Israel (Kenneth and Olmert, 1975) or Canada (Remaudière et al., 1978), *E. planchoniana* in Israel (Kenneth and Olmert, 1975).

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