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STUDY OF APHID POPULATION IN SEED POTATO CROP

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ABSTRACT

This paper presents the results of aphid species monitoring in the seed potato crop during the growing season using Moerike aphids trap in 2020 and 2021 at INCDCSZ Braşov. Aphids control as direct pests is rarely justified in potato crop but absolutely necessary to prevent indirect damages caused by infecting potato plants with viruses transmitted by aphids. The aphids monitoring in seed potato crops is absolutely necessary to reduce the risk of the appearance and development of aphid populations, implicitly to decrease the incidence of viral contamination. During the two years of study, winged aphids were collected using yellow water traps¸ The vector aphid species were identified from the total of collected aphids. The identification resulted in a number of 20 vector species (682 - total number of individuals) in 2020 and 24 vector species (1843 - total number of individuals) in 2021.

INTRODUCTION

The main geographical regions of the world are characterized by a specific aphidofauna. In most cases, agricultural crops are not indigenous to the countries where they are grown; the aphids that infest these crops are exotic or recently introduced. Some of the largest genera of aphids (Pemphigus, Chaitophorus, Cinara, Aphis, Uroleucon and Macrosiphum) are well represented in the northern hemisphere (especially in North America) but also in Europe. Compared to the northern hemisphere, the aphidofauna of the southern continents is much poorer. The main aphid species harmful to agricultural crops were introduced to Europe from North America, with the exception of *Macrosiphum euphorbiae*.

Aphids cause a significant amount of damage to host plants. The direct damage related to the removal of nutrient sap from the tissues, the development of soot on the honeydew removed by aphids can go unnoticed if the populations are kept at a low level. Quite rarely the need to fight against aphids as direct pests is justified. The greatest damage caused by aphids in potato crops is indirect damage. The systemic infection of plants with viruses transmitted by aphids is the main cause of potato yield reduction and hence the need to cultivate virus-free plants in areas where the vector pressure is lower. In the feeding process some species of aphids circulate a large number of phytopathogenic viruses (Kostiw 1979). The structure and size of aphid vector populations largely determine the level of spread of viruses. Viruses are the main cause of the progressive decrease in potato plant vigor, the reduction of the yield of chlorophyll assimilation, the viral degeneration of the potato. Infected potato tubers are sources of viruses for other plants and subsequent crops. Transmission of potato viruses (from one field to another) is attributed to the activity

of winged aphids. They are also largely responsible for the transmission of viruses within a crop from one plant to another.

The winged aphids role in the transmission of viruses must be seen from the point of view of seasonal activity, which can be determined by different methods and especially using several types of traps. For example, yellow water traps are used for monitoring of flight activities in the fields but olso for the studies of biodiversity of aphids (Vučetic et al. 2013).

Vector species possess a certain efficiency of virus transmission. Some 40 virus species are known to infect potato, and of these, 13 are aphid-transmitted (Salazar 1996 cited by Radcliffe & Lagnaoui 2007). Monitoring of aphids in seed potato crops helps to determine the risk of virus spread, establishing the optimal moment for interrupting the potato crop vegetation (Milošević et al. 2014). Seed production can be maximizing without the risk of seed potato infection. Monitoring helps also to make decisions regarding the need for intervention with chemical treatments and to reduce the number of interventions against aphids, thus contributing to the increase in the population level of natural predators. Reducing the risk of the appearance and development of aphid populations resistant to certain active substances is another goal of this activity.

MATERIAL AND METHODS

In order to evaluate the structure of aphid populations in the potato crop at INCDCSZ Brașov, the monitoring of the flight of aphids (viral vectors from potato crops) was carried out during the potato vegetation period, in 2020 and 2021. To capture the aphids in flight they were used the Moerike traps which consist in vessels colored in a very bright yellow shade, also called Canary Yellow which corresponds to Munsell Color 5.0Y 9/14 and R.H.S. Coour Chart Yellow Group 9A, color that does not reflect UV light. As a capture medium, water with addition of liquid detergent was used in order to reduce tension on the surface of the water, preventing the insects from flying out of the vessel. The yellow plastic pots had a diameter of approx. 30 cm and a height of 8 cm. Samples were collected daily until 8 am. The captured entomological material was sorted and the aphid species were analyzed and determined. The following morphological characters were used to determine the captured aphid species: the degree of sclerotization, the nature of the cuticular surface, the color of the aphids, the size and shape of hairs or setae, the body length and shape, the head, thorax, abdomen and its appendages particular characters. For the precise determination of the species, the works of Taylor (1981), Blakman & Eastop (1984), Remaudiere & Fernandez (1990) and Remaudierre & Remaudiere (1997) were consulted.

The activity of aphid species was analyzed using analytical indices: number (abundance – A) and relative dominance (D) according to Bodenhaimer (1955) and Balog (1958) cited by Varvara, 1989.

- abundance (A) represents the number of individuals of a species captured in a time interval.

- relative dominance is expressed as a percentage and represents the ratio of a species to the number of individuals of all captured species. An abundant species is also dominant, influencing the activity of other species in the biocenosis. The obtained percentages are divided into 5 classes, corresponding to the species dominance: subreceding species (0–1%); receding species (1.1–2%); subdominant species (2.1–5%); dominant species (5.1–10%); eudominant species (>10%).

RESULTS AND DISCUSSIONS

During the two years of the study, using yellow water traps, the winged aphids present in the potato crop were collected during the potato vegetation period (May - August) (table 1). From the total collected aphids, a number of 682 individuals from 20 vector aphid species were identified in 2020, while in 2021, 24 vector aphid species were identified, totaling a number of 1843 individuals. It is observed that in 2021 the abundance of vector aphids collected was much higher than in 2020.

Table 1

The abundence of vector aphid species (Brașov 2020, 2021)

	Vector aphid species	**2020**	**2021**
1	*Acyrthosiphon pisum*	8	56
2	*Aphis craccivora*	52	244
3	*Aphis fabae*	167	574
4	*Aphis frangulae*	48	146
5	*Aphis gossypii*	19	13
6	*Aphis nasturtii*	11	20
7	*Aphis pomi*	3	51
8	*Aphis sambuci*	65	358
9	*Aphis* spp.	54	219
10	*Brachycaudus cardui*	0	5
11	*Brachycaudus helichrysi*	50	4
12	*Brevicoryne brassicae*	4	0
13	*Capitophorus elaeagni*	0	2
14	*Cavariella aegopodii*	13	8
15	*Cavariella pastinacae*	0	1
16	*Cryptomyzus ribis*	0	5
17	*Hyalopterus pruni*	19	22
18	*Hyperomyzus lactucae*	1	5
19	*Metopolophium dirhodum*	4	14
20	*Myzus persicae*	141	50
21	*Phorodon humuli*	11	11
22	*Rhopalosiphum insertum*	0	2
23	*Rhopalosiphum padi*	4	18
24	*Sitobion avenae*	6	13
25	*Sitobion fragariae*	2	2
	Total aphid vector abundence	682	1843
	Total aphid vector species	20	24

Colonising species are the main vectors of plant pathogenic viruses. In this study among the aphid species that colonise the potato were identified *Myzus persicae* (Sulzer) (green peach aphid) and *Aphis nasturtii* Kaltenbach (buckthorn aphid). Although the number of colonising species on potato was small, non-colonizing species with high abundance during the potato growing season were identified in 2020 and 2021: *Acyrthosiphon pisum* (Harris), *Aphis craccivora* Koch,

Aphis fabae Scopoli, *Aphis frangulae* Kaltenbach, *Aphis sambuci* (L.), *Brachycaudus helichrysi* (Kaltenbach), *Cavariella aegopodii* Scopoli, *Cryptomyzus ribis* (L.), *Hyalopterus pruni* (Geoffroy), *Hyperomyzus lactucae* (L.), *Rhopalosiphum padi* L; *Phorodon humuli* Koch, *Sitobion avenae (*Fabricius), *Sitobion fragariae* (Walker). (Bokx & der Want, 1987, Kostiw, 1980, Sigvald, 1987; Piron, 1986, Milošević et al., 2014, Fox et al., 2017).

For the biological material identified, the dominance of each species was calculated (Table 2). Analyzing the dominance of the species identified in the two years of study, the following were found:

Table 2

The dominance of vector aphid species (Brașov 2020, 2021)

Vector aphid species (2020)	**%**	**Vector aphid species (2021)**	**%**
Eudominant species (>10%)		Eudominant species (>10%)	
Aphis fabae	24.5	*Aphis fabae*	31.1
Myzus persicae	20.7	*Aphis sambuci*	19.4
Dominant species (5.1-10%)		*Aphis craccivora*	13.2
Aphis sambuci	9.5	*Aphis* spp.	11.9
Aphis spp.	7.9	Dominant species (5.1-10%)	
Aphis craccivora	7.6	*Aphis frangulae*	7.9
Brachycaudus helichrysi	7.3	Subdominant species (2.1-5%)	
Aphis frangulae	7.0	*Acyrthosiphon pisum*	3.0
Subdominant species (2.1-5%)		*Aphis pomi*	2.8
Aphis gossypii	2.8	*Myzus persicae*	2.7
Hyalopterus pruni	2.8	Receding species (1.1-2%)	
Receding species (1.1-2%)		*Hyalopterus pruni*	1.2
Cavariella aegopodii	1.9	*Aphis nasturtii*	1.1
Aphis nasturtii	1.6	Subrecedent species (0-1%)	
Phorodon humuli	1.6	*Rhopalosiphum padi*	1.0
Acyrthosiphon pisum	1.2	*Metopolophium dirhodum*	0.8
Subrecedent species (0-1%)		*Aphis gossypii*	0.7
Sitobion avenae	0.9	*Sitobion avenae*	0.7
Brevicoryne brassicae	0.6	*Phorodon humuli*	0.6
Metopolophium dirhodum	0.6	*Cavariella aegopodii*	0.4
Rhopalosiphum padi	0.6	*Brachycaudus cardui*	0.3
Aphis pomi	0.4	*Cryptomyzus ribis*	0.3
Sitobion fragariae	0.3	*Hyperomyzus lactucae*	0.3
Hyperomyzus lactucae	0.1	*Brachycaudus helichrysi*	0.2
		Capitophorus elaeagni	0.1
		Cavariella pastinacae	0.1
		Rhopalosiphum insertum	0.1
		Sitobion fragariae	0.1

- in 2020 the eudominant species that exceeded 10% of the total vector aphids were: *A. fabae* (24.5%) and *Myzus persicae* (20.7%); in 2021 *A. fabae* (31.1%), *A. sambuci* (19.4%), *A. craccivora* (13.2%), *Aphis* spp. (11.9%). The species with the greatest dominance in both years being *Aphis fabae*;

- in 2020, five dominant species were recorded: *A. sambuci* (9.5%), *Aphis* spp. (7.9%), *A. craccivora* (7.6%), *Brachycaudus helichrysi* (7.3%), *A. frangulae* (7.0%); the only dominant species in 2021 was *A. frangule* (7.9%);

- in the subdominant species category in 2020, two species fell with 2.8% *A. gossypii* and *Hyalopterus pruni* and in 2021 three species*: Acyrthosiphon pisum* (3.0%), *A. pomi* (2.8%), *M. persicae* (2.7%);

- there were four receding species in 2020, and two species in 2021;

- most vector aphids species were subrecedent: seven species in 2020 and 14 species in 2021.

Analyzing the activity of vector aphid species, it was observed that the main virus vector species of potato showed different abundance in Brașov in 2020 and 2021 (figure 1), species recording higher abundance in 2021. Of the most abundant species, most belong to the genus *Aphis*, followed by *Myzus persicae* and *Brachycaudus helichrysi*. Of all the species listed, the most abundant and present in the yellow traps over the two years of monitoring was *A. fabae* with 167 specimens in 2020 and 547 specimens in 2021.

The most virulent species, *Myzus persicae,* had a high population during 2020 (141 specimens) and a much lower population during 2021 with only 50 specimens.

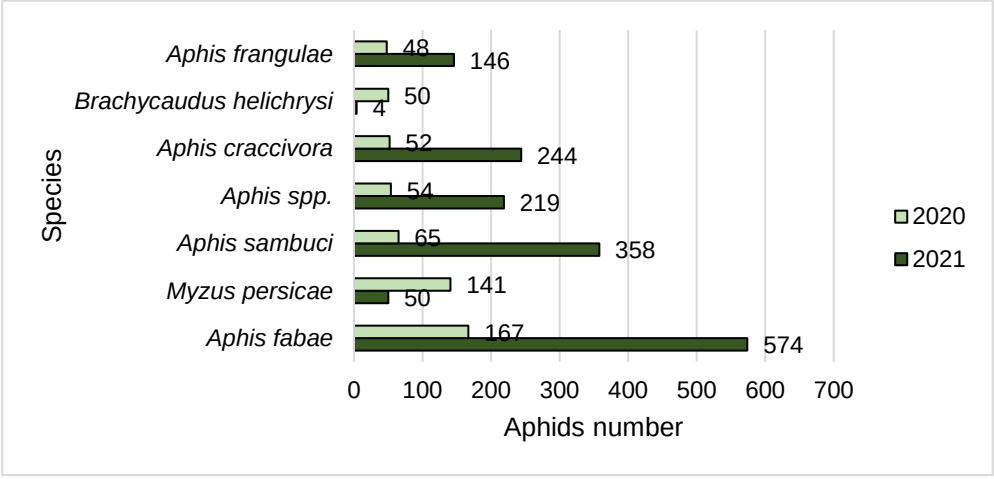

Figure 1. The main vector aphid species colected (Brașov - 2020, 2021)

CONCLUSIONS

This viral vectors monitoring in a seed potato field allowed the knowledge of the abundance and dominance of aphid species at the plot level. The data are punctual and represent the local situation at field level.

The abundance of vector aphid species was different in the two years of the study, with a higher number of aphids recorded in 2021 comparing with 2020.

In the two years the dominant species was *Aphis fabae*. *Myzus persicae*, the main vector of all potato viruses had a different evolution, with a much lower number of individuals recorded in 2021 compared to 2020.

Due to difference in aphid behavior, the number of aphids and the species composition of the water yellow traps do not truly reflect the populations of aphids in flight, but they provide important data regarding the activity of aphids inside the fields. The monitoring and identification of aphid vectors has as its ultimate goal the establish viral infections risk for seed potato crops, the forecasting and warning of phytosanitary treatments necessary for quality management of crops by farmers producing potato seeds.

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