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Short Communication

Preliminary assessment of selected sweet cherry hybrids regarding their resistance to black cherry aphid (*Myzus cerasi* Fabr.) in Bulgaria

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Abstract. *One of the main insect pests of the cherry trees in Bulgaria is Myzus cerasi (Homoptera, Aphididae). The black cherry aphids occur annually in orchards and cause yield loss or degraded quality. In 2018 and 2019, resistance to Myzus cerasi was assessed on 11 selected sweet cherry genotypes in a breeding orchard at the Fruit Growing Institute - Plovdiv. Susceptibility to aphid infestation was assessed through inspection of 100 leaf rosettes from individual tree hybrids. Some of the studied genotypes 6-132, 6-132 (1), 6-131, and 6-131 (1) were not infested by black cherry aphids in the two years of this research. Aphid colonies were observed on all other studied trees from the selected hybrids. The study is still ongoing.*

Keywords: aphid infestation, genotypes, *Prunus avium*, susceptibility

Introduction

Sweet cherry *Prunus avium* (family Rosaceae, genus *Prunus*) is a major fruit crop in countries with temperate climate. In recent years, this fruit crop has had a major share in Bulgaria in terms of harvested areas (a total of 25%) according to the Ministry of Agriculture, Food and Forestry, agrostatistics department (fruit production in Bulgaria – 2019). Fruits of the sweet cherry are highly valued because they are among the first ones to appear on the market after the cold months (Zhivondov and Manolova, 2001).

Increased interest in the planting of new cherry orchards necessitates the provision of new market-oriented varieties with a better sensory profile of the fruit, resistant to biotic and abiotic stressors - plants that are better than the parent forms and often more resistant to diseases or pests, with better local adaptation and fruitiness suitable for creating modern intensive cherry plantations (Zhivondov and Manolova, 2001; Malchev and Zhivondov, 2016).

One of the main insect pests of the cherry trees is the black cherry aphid (*Myzus cerasi* Fabr.). *Myzus cerasi* occurs annually in orchards and attacks mainly sweet cherries, sour cherries, and wild cherries. Damage is caused by adults as well as by nymphs which, in the course of their feeding, cause strong deformation and wrinkling of the young leaves. They lose their turgor which leads to decrease in the photosynthetic efficiency. In sour cherries, the deformation is usually slight or unnoticeable (Grigorov, 1980). The upper shoots look like "packages" and subsequently turn brown and dry out. Usually, aphid colonies are very large and produce a huge amount of honeydew which covers the leaves and encourages the growth of sooty mold. Honeydew contaminates the fruit, thus making it unfit and of poor quality for the market. The black cherry aphids are especially dangerous for young orchards where trees are shaping and in a nursery where fruit seedlings are produced (Lecheva et al., 2003; Andreev, 2020). Warm and early spring, hot summer together with long and warm autumn cause higher pest abundance of *Myzus cerasi* on sweet cherries and correspondingly higher levels of infestation (Cichocka, 2007).

As the season progresses, *Myzus cerasi* leaves the primary hosts and migrates to the secondary hosts where it feeds until autumn. Many weed plant species have been identified as secondary hosts which are usually abundant in the agrocenosis. Various annual wild weeds can play this role, e.g. sticky weed (*Galium aparine*), speedwell (*Veronica officinalis*), mugwort (*Artemisia sp.*), woodruff (*Asperula sp.*), shepherd's purse (*Capsella bursa-pastoris*) and other plants of the *Rubiaceae*, *Scrophulariaceae*, and *Brassicaceae* families (Lecheva et al., 2003; Cichocka, 2007; Andreev, 2020).

Control of the black cherry aphids may be difficult. The number of colonies can explode sharply and the deformed leaves and the abundant amount of honeydew can suspend the insecticides from reaching them directly. Difficulty in pest management with aphids also stems from their high reproductive capacity, which also contributes to the acquisition of resistance to the most common insecticides used (Hohn et

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al., 1995; Bourgouin et al., 2000; Bylemans, 2000; Bass et al., 2014).

A possible solution for black cherry aphid control is the selection of resistant hybrids and cultivars (Granger, 2005; Arnaudov and Kolev, 2007). In one study, Arnaudov and Kolev (2007) reported that none of the studied varieties showed complete resistance to *M. cerasi*. The cultivar "Bigarreau Burlat" on *Prunus mahaleb* was highly susceptible to *M. cerasi* infestation. In another study, Arnaudov (2006) established that the cultivars "Stella" and "Rivan" are slightly susceptible to *M. cerasi* infestation.

In several countries there are efforts towards identifying and selecting hybrids, resistant to the black cherry aphid. In Germany, Gruppe (1991) reported that some of the observed hybrids showed low levels of infestation or none at all. Granger (2005) in South Australia observed variation in the natural infestation and selected seedlings, resistant to the black cherry aphid. Bargioni (1996) reported that some of the plants showed tolerance, but not complete resistance to *M.cerasi*.

Studies were carried out worldwide on resistant hybrids and varieties to other aphids such as *Myzus persicae* (Sulzer) on the peach (Monet et al., 1998; Sauge et al., 2002; Staudt et al., 2010), rosy apple aphid *Dysaphis plantaginea* Pass. and green apple aphid *Aphis pomi* (Habekuss et al., 1999; Dapena and Miñarro, 2001; Fischer and Fischer, 2004; Kutinkova and Dzhuvinov, 2006, 2014) .

The aim of the present study was to identify the level of susceptibility to black cherry aphid *Myzus cerasi* Fab. (Homoptera, Aphididae) and the degree of infestation of some selected cherry hybrids under field conditions.

Material and methods

A study was conducted in 2018 and 2019 in a breeding orchard at the Fruit Growing Institute - Plovdiv. From a hybrid population of 351 cherry genotypes, after secondary screening, 11 genotypes were selected, propagated, and planted (6-94, 6-97, 6-113, 6-196, 6-130, 6-160, 6-200, 6-197, 6-132, 6-131, 6-199) in the spring of 2011. Selected hybrids showed medium, low or no infestation. The rootstock of the trees is "Mahaleb" (*Prunus mahaleb*) from seeds and the hybrids are obtained by open pollination of the variety "Sweet September". The planting scheme is 6 x 4 m, the orientation of the rows is north-south.

At least three trees of each genotype were monitored in the orchard. The infestation rate was recorded every year at the beginning of May, before the aphids leave the primary host. Susceptibility to aphid infestation was assessed through inspection of 100 leaf rosettes from each individual tree, examined onsite (in the field). All individuals of *M.cerasi* were counted and reported as a total number of aphids (adults, nymphs and winged adults). When it was necessary, the samples were inspected under a stereomicroscope in a laboratory.

The infestation on rosettes was rated according to the following seven-point scale:

0: no aphids;
1: 1 to 5 aphids per rosette;
2: 5 to 20 aphids per rosette;
3: 20 to 50 aphids per rosette;
4: 50 to 100 aphids per rosette;
5: 100 to 200 aphids per rosette;
6: more than 200 aphids per rosette.

The degree of susceptibility is based on the percentage of infested leaf rosettes and hybrids are categorized according to the following four-point scale:

0: not infested;
1: slightly susceptible: up to 5% of infested rosettes;
2: moderately susceptible: 6 to 15% of infested rosettes and
3: highly susceptible: more than 15% of infested rosettes.

Statistical analyses were carried out by the sign test, like the Wilcoxon signed-ranks test, which is a non-parametric alternative to the repeated-measures t-test. Excel was also used for additional statistical processing.

Results and discussion

In both years of observation, aphids showed up around mid-April but the highest abundance was reported in the last 10 days of May. Field observations have shown that there are differences in the degree of infestation as well as in the number of aphids in the colonies.

In general, most of the hybrids studied showed different susceptibility levels to aphids in the sweet cherry orchard in both years. The most strongly infested hybrids in 2018 were 6-94, 6-114 (1), 6-200 (1) and 6-160. With some of these hybrids, there were almost no intact shoots left. The degree of aphid infestation on the leaf rosettes of sweet cherry trees can be seen in Figure 1.

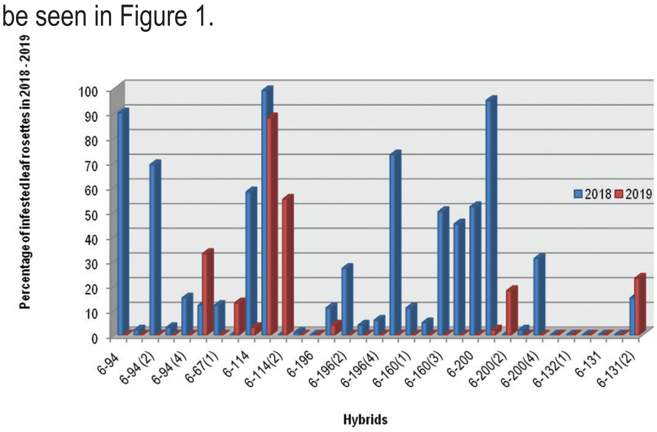

Figure 1. Percentage of colonized leaf rosettes of *Myzus cerasi* on selected sweet cherry hybrids in 2018 and 2019

Hybrid 6-114(1) was heavily infested (Table 1). Other hybrids like 6-67 and 6-131(2) showed moderate to high level of susceptibility in both years. In 2018, the degree of infestation was relatively low on the plants of hybrids 6-94 (1), 6-94 (3), 6-114 (3), 6-196 (3), 6-160 (2), 6-200 (2).

Table 1. Degree of susceptibility categorized according to the four-point scale

Number of hybrids	2018	2019	Number of hybrids	2018	2019
6-94	***	0	6-160	***	0
6-94(1)	*	0	6-160(1)	**	0
6-94(2)	***	0	6-160(2)	*	0
6-94(3)	*	0	6-160(3)	***	0
6-67	**	***	6-200	***	0
6-67(1)	**	0	6-200(1)	***	0
6-67(2)	0	**	6-200(2)	*	0
6-114	***	*	6-200(3)	***	0
6-114(1)	***	***	6-132	0	0
6-114(3)	*	***	6-132(1)	0	0
6-196	**	0	6-132(2)	**	0
6-196(1)	**	*	6-131	0	0
6-196(2)	***	0	6-131(1)	0	0
6-196(3)	*	0	6-131(2)	**	***

No infestation: 0, Slight: *, Moderate to high: **, Heavy: ***

A large part of the surveyed hybrids showed wide variance in the infestation degrees for 2018 and 2019. This is most likely due to the features of the microclimate and the trophic conditions, as reported by Arnaudov (2007). In 2019, aphids decreased in abundance on most of the hybrids which can be attributed to the climatic conditions in the orchard. The temperatures as well as the amount of precipitation were relatively lower, unlike 2018, which undoubtedly had an impact on the development of aphids (Figure 2). Climate data were taken from the weather station Meteobot® App.

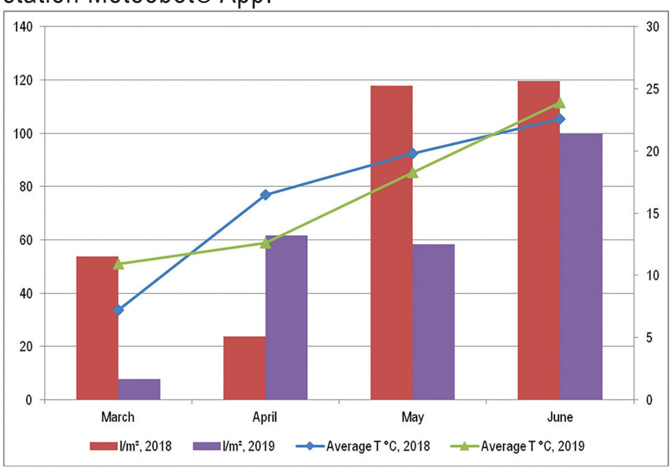

Figure 2. Average temperature (T, °C) and rainfall (l/m²) in 2018 and 2019

The highest average number of aphids (Figure 3) in the colony was reported in 2018 for hybrids 6-94, 6-114(1), 6-94(2) and 6-114, while in 2019 these were 6-114(1), 6-67 and 6-114(2).

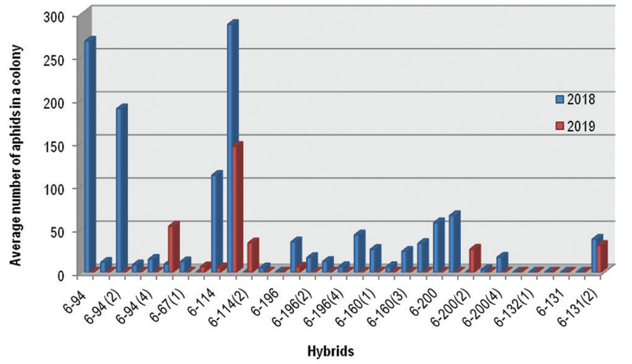

Figure 3. Number of aphids (*Myzus cerasi)* per colony on average on sweet cherry hybrids in 2018 and 2019

The p-value is .00042. The result is significant at $p<0.05$ (Figure 4).

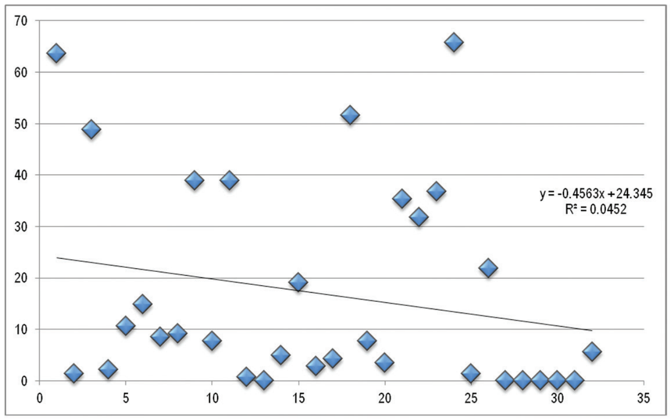

Figure 4. Standard deviation (±SD) for sweet cherry hybrids

Four genotypes stand out in the chart (Table 1) as showing no infestation at all in the two consecutive years - 6-132, 6-132 (1), 6-131, and 6-131 (1).

Conclusion

The data from these studies have shown that different varieties of cherry hybrids are not equally susceptible to infestations of the black cherry aphid, *Myzus cerasi* Fab. Genotypes 6-132, 6-132 (1), 6-131, and 6-131 (1) were not infested with black cherry aphids in the two consecutive years of the study. Therefore, they can serve as good donors of plant material for the selection and breeding of cherries. Aphid colonies were observed on all other trees from the selected hybrids (6-94, 6-97, 6-113, 6-196, 6-130, 6-160, 6-200, 6-197, and 6-199). The reasons for the described resistance of individual hybrids to *Myzus cerasi* cannot be determined unambiguously. The study is promising and ongoing.

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