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Host Preference of *Myzus cerasi* (Fabricius, 1775) to Half-sib Lines of *Prunus avium* L. from Six Populations Assessed in the Nursery Trial

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Abstract: *Myzus cerasi* Fabr. is a cosmopolitan species colonizing plants from families *Cruciferae*, *Plantaginaceae*, *Rosaceae*, *Rubiaceae* and *Scrophulariaceae*, as hosts. *Myzus cerasi* causes curling and distortion of the leaves by establishing large leaf nests colonies on top of shoots. It is very dangerous in nurseries and young plantations. We investigated host preference of *Myzus cerasi* to 49 half-sib lines of *Prunus avium* L. from six different populations based on the intensity of leaf damage. Populations of *Prunus avium* are Kalinovik, Višegrad, Milići, Ribnik, Prnjavor and Vlasenica, all from Bosnia and Herzegovina. According to the results of hierarchical analysis of variance, the effect of differences between examined wild cherry populations were not significant, while the main contribution to the total expected variance was found for half-sib lines within populations (45.6%) and for plants within lines (52.5%). Out of 49 examined half-sib lines there were eleven lines that had less than 20% of damaged leaves, while there were no lines that had no damage. However, out of 432 examined plants, 49 of them had no damage from examined pest (11.3%), while 149 of examined plants (34.5%) had less than 20% of damaged leaves. Only populations Kalinovik and Ribnik had no lines with less than 20% of damaged leaves, while in every population there were found plants that were not damaged by pest. Gained data suggest that every examined population could be an object of selection for the tolerance on the attack of *Myzus cerasi*. Also, genotypes with no or tolerable damage might be vegetatively propagated and used in breeding programs.

Keywords: *Prunus avium* L., *Myzus cerasi* Fabr., pest tolerance, populations.

1. Introduction

Based on regular monitoring of the occurrence and significance of harmful insects that occur spontaneously on different species of trees that are widely used in practice, many researchers have notified and investigated the trait of insects to differentiate or colonize different genotypes of the same species (Augustin at al. 1993; Augustin at al. 1993a; Drekić at al. 2009;

Drekić at al. 2009a; Poljakovic-Pajnik at al. 1999; Poljakovic-Pajnik at al. 2005; Poljakovic-Pajnik at al. 2011). The study of the preference of insects according to certain genotypes can enable us more successful selection of the most favorable genotypes of the investigated species for afforestation or for some other purpose. In our case, populations of wild cherries to that *Myzus cerasi* shows the lowest degree of preference would be favorable.

Myzus cerasi is a small to medium-sized aphid. Adults are shiny, very dark brown to black, with a sclerotized dorsum. Siphunculi and cauda are entirely black. The legs and antennae are yellow and black. Apterous summer virginoparae have a shiny black body, siphunculi and antennae. Cauda dusky to black, and tibiae yellow except tips (Blackman and Eastop, 1994).

Myzus cerasi lives in dense, ant-attended colonies at shoot tips of *Prunus* spp., especially *Prunus cerasus* and *Prunus avium*. *Myzus cerasi* causes curling and distortion of the leaves by establishing large leaf nests colonies on top of shoots. It is very dangerous in nurseries and young plantations in Serbia. During our research, we have recorded that the most numerous colonies of this species can count up to 500 individuals per leaf of *Prunus avium* (data not shown). We assume that those deformations are directly led to decreased physiological activity of leaves as it was found by Poljaković-Pajnik (2005) and Poljaković-Pajnik (2014) for aphid colonized leaves of numerous tree and shrub species.

Myzus cerasi is a cosmopolitan species colonizing plants from families *Cruciferae*, *Plantaginaceae*, *Rosaceae*, *Rubiaceae* and *Scrophulariaceae*, as hosts (Blackman and Eastop, 1984). *Myzus cerasi* occurs throughout Europe, the Middle East, and across Asia, from India and Pakistan to Siberia and the far eastern part of the Palearctic. It has been introduced more recently into Australia, New Zealand and North America (Blackman and Eastop, 1994). In Serbia it was found for the first time in 1980 (Simova-Tosic and Vuković, 1980).

This species is a pest in the fruit growing where it causes great damage to the cherries (McLaren et al. 2002). It is pest in forest nursery production and in young plantations of *Prunus avium* causing damages to young seedlings and trees causing curling and distortion of the leaves by establishing large leaf nests colonies on top of shoots. In urban areas, this is a common pest on the species *Prunus* sp. and their cultivars. It causes heavy curling of the leaves. In urban areas this aphid mostly affects the aesthetic appearance of the plants.

Wild cherry (*Prunus avium* L.) is a perennial woody angiosperm from the family *Rosaceae* (Russell, 2003). It has generally scattered distribution, although occasionally forms mixed stands with other broadleaved tree species (Santi et al. 1998). Wild cherry has a widespread distribution spanning from the Scandinavia to northern Africa, and western Eurasia to Ireland and Spain (De Rogatis et al. 2013). The species forms large continuum in the central and western Europe, whereas at southeastern limits (i.e. in Greece), *P. avium* appears in small isolated populations (Ganopoulos et al. 2011). In Bosnia and Herzegovina, wild cherry occurs mostly in the mesophilic forests of sessile oak and hornbeam, as well as forests of European beech, sycamore, common ash, etc. (Šilić, 2005).

Due to valuable timber, wild cheery has a great economic importance across Europe. Therefore, several countries developed intensive breeding programmes aimed to quality wood production, as well as conservation of species forest genetic resources (Jarni et al. 2012; Ducci et al. 2013). Studies conducted in the region, so far, were mainly focused on the variability of certain leaf functional traits in natural populations (e.g. Ballian et al. 2000; Ballian et al. 2012; Mratinić et al. 2012; Rakonjac et al. 2014; Popović and Kerkez, 2016), whereas researches conducted in progeny trials have been less represented (e.g. Orlović et al. 2014; Stanković Neđić et al. 2018).

Selection for pests and diseases resistance in forest tree species should represent the integral part of any breeding programme initial phase in order to prevent loses during later phases of wood production. Indeed, discussing the main selection criteria in wild cherry breeding programmes, Ducci et al. (2013) listed numerous pest and diseases, among which significant place took *Myzus cerasi*, which might hardly damage apical sector of the young branches.

2. Material and Methods

We investigated host preference of *Myzus cerasi* (Fabricius, 1775) to 49 half-sib lines of *Prunus avium* L., from six different populations from Bosnia and Herzegovina: Kalinovik, Višegrad, Milići, Ribnik, Prnjavor and Vlasenica (Table 1, Figure 1). The trial was established in the spring of 2016 (Figure 2), and the assessment of the damage from *Myzus cerasi* was performed on 21st May 2018. At the shoot of every plant total number of leaves and number of damaged leaves were counted and then the damaged leaves with pseudogals/total number of leaves ratio was calculated. This ratio at the level of plants within lines was transformed by arcsin transformation in order to meet normal distribution of frequencies, needed for further parametric statistics. Data at the level of plants within families was used for further analysis. Hierarchical analysis of variance was performed with populations as main effect, then lines within populations and residual effect. The significance of differences between population was tested by Tukeys' HSD Test. Also, the expected variances of examined sources of variation and their contribution to the total expected variation was calculated, based on results of hierarchical analysis of variance. All statistical procedures were performed by STATISTICA for Windows version 13 (TIBCO Software Inc. 2017).

Figure 1. Leaf nest on *Prunus avium* caused by *Myzus cerasi* Fabr.

Table 1. Location and climate data for examined *Prunus avium* populations.

Population	Longitude	Latitude	Altitude (m. a.s.l.)	Average annual air temperature (°C)	Average growth season air temperature (°C)	Sum of annual precipitation (mm)	Sum of growth season precipitation (mm)
Kalinovik	18°29'	43°31'	1100	7.8	13.4	1193	498
Višegrad	19°18'	43°48'	460	9.8	11.2	902	509
Milići	19°07'	44°10'	690	11.2	13.7	1048	599
Ribnik	16°51'	44°28'	480	11.3	17.9	1239	646
Prnjavor	17°39'	44°54'	230	10.1	16.6	1004	555
Vlasenica	18°54'	44°11'	634	9.4	13.6	1111	607

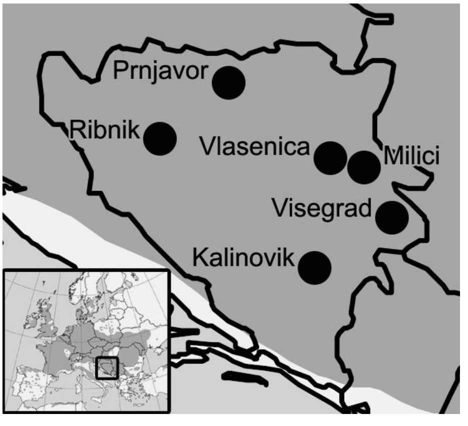

Figure 2. Location of examined populations of *Prunus avium*.

Figure 3. Established nursery trial with examined *Prunus avium* half-sib lines.

3. Results and Discussion

According to the presented results of hierarchical analysis of variance for percentage of damaged leaves, there were no significant effect of differences between populations, but there was very significant effect on lines within populations on variation of percentage of damaged leaves (Table 2). While contribution of populations was just 1.5%, the contribution of lines within populations was 45.6% (Figure 4), suggesting considerable variability within population and that genetic basis for tolerance on *Myzus cerasi* should be searched among lines within populations, rather than between populations themselves.

Although the effect of populations on variation of percentage of leaves damaged by *Myzus cerasi* was not significant, the results of Tukeys' HSD test suggest significant differences between populations and the fact that considerable variation within populations significantly disturb more precise assessment of differences between populations (Figure 5). The most severe damage suffered lines were those from populations Kalinovik and Ribnik (33.9% and 28.0% of damaged leaves, respectively), while the most tolerant were lines from the population Višegrad (13.55%) (Table 3). Only populations Kalinovik and Ribnik had no lines with less than 20% of damaged leaves (data not shown). So, although the results of analysis of variance suggest low effect of populations, the differences between populations are considerable and deserve further attention.

Table 2. Results of hierarchical analysis of variance of percentage of damaged leaves for examined populations of *Prunus avium*.

Source of variation	Degree of freedom	Sum of squares	Mean square	F-test
Populations	5	5503.78	1100.76	1.294
Lines within populations	43	36590.90	850.95	8.348**
Residual	383	39043.22	101.94	
Total	431	81137.89		

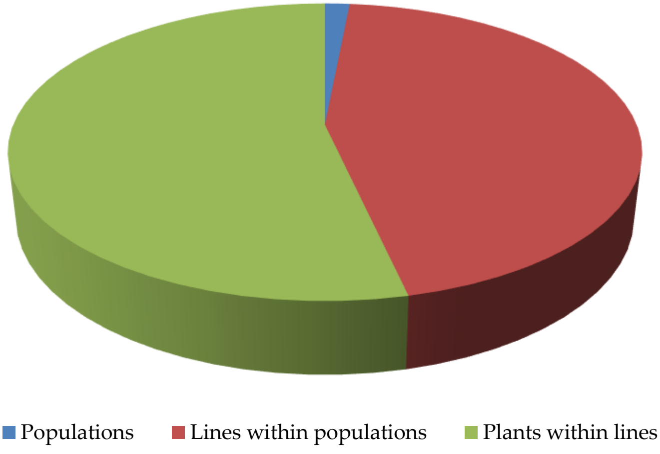

Figure 4. Contribution of examined sources of variation to the total expected variance of percentage of leaves damaged by *Myzus cerasi* for examined *Prunus avium* populations.

In accordance to these results are also data about percentage of plants with no damaged leaves and with less than 20% of damaged leaves. While population Kalinovik achieved less than 20% of plants per line with less than 20% of damaged leaves, population Višegrad had 69.2% of such plants per line, and 14.5% of plants with no damage per line. Almost 24.7% of plants with no damaged leaves per line were found in population Prnjavor (Table 3).

There were no lines without any damaged leave, but in population Višegrad all lines had at least one plant that had no damaged leaves. Also, there were eleven lines in total in which all plants had less than 20% of damaged leaves. In all examined populations there were found some plants that had no damages caused by *Myzus cerasi*. Out of 432 examined plants in total, there were 49 plants (11.3%) with no leaves damaged by *Myzus cerasi*, and 149 plants (34.5%) with less than 20% of damaged leaves (data not shown).

Although Ducci et al. (2013) describe examples of monoclonal wild cherry stands, study of Poljakovic at al. (1999) on poplar clones strongly suggest importance of multiclonal plantations for preservation of tolerance to and avoidance of the threat of insects and diseases. Considerable influence of lines within operations factor in our study support selection of trees that gave offspring less attractive for colonization of *Myzus cerasi* for further afforestation. On the other hand, the lines according to which the *Myzus cerasi* shows a higher degree of predilection can be used as a bait plants for more efficient pest control in nurseries and plantations. This is in line with the basic principles of integral forest protection and biodiversity preservation.

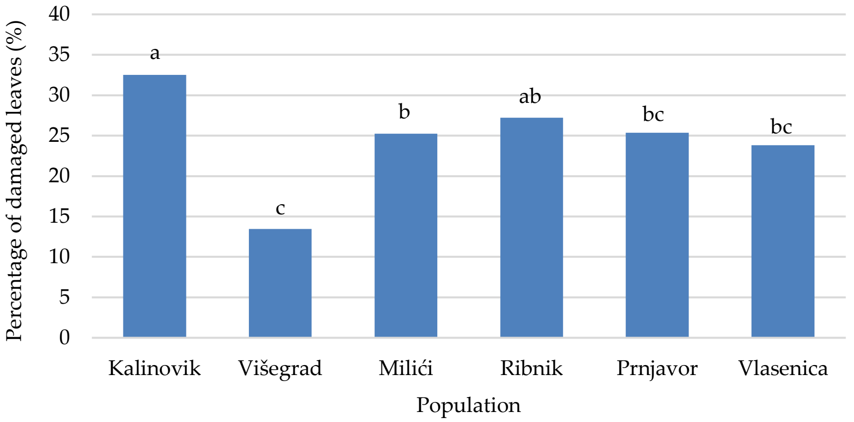

Figure 5. Tukeys' HSD test for percentage of damaged leaves for examined populations of *Prunus avium*.

Table 3. Data for examined populations of *Prunus avium* according to presence of plants with no damage or with less than 20% of damaged leaves.

Population	Percentage of plants with no damaged leaves	Percentage of plants with less than 20% of damaged leaves	Number of lines with no plants with no damaged leaves	Number of lines with no plants with less than 20% of damaged leaves
Kalinovik	4.69	16.66	6 of 10	3 of 10
Višegrad	14.54	69.72	0 of 3	0 of 3
Milići	9.44	32.04	6 of 9	3 of 9
Ribnik	4.20	24.59	6 of 9	3 of 9
Prnjavor	24.69	41.25	4 of 8	2 of 8
Vlasenica	11.17	39.70	7 of 10	2 of 10
Total	11.45	37.33	29 of 49	13 of 49

4. Conclusion

According to the presented data it could be concluded that every examined population could be an object of selection for the tolerance to the attack of *Myzus cerasi*. However, although the significant variability was found between lines within populations and plants within lines, there are considerable differences between examined populations in their tolerance to *Myzus cerasi*. Therefore, some populations could be utilized as the basis for the genetic improvement to the tolerance to *Myzus cerasi*. In that sense, populations and trees within them could be considered as a source for generative production of planting material, while selected genotypes with no or tolerable damage might be vegetatively propagated and used in further breeding initiatives.

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