Regulation of the black cherry aphid (*Myzus cerasi*) in organic table cherry production

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Abstract

*The black cherry aphid (*Myzus cerasi*) is the main pest in modern organic table cherry production. Especially in orchards with installed rain protection and insect nets, strong aphid populations can build up what can lead to large yield losses and tree damages. At FiBL for many years different products and strategies to regulate M. cerasi were tested. In different trials paraffin oil applications at the beginning of bud swelling showed to be effective to kill fundatrices in the eggs or shortly after hatching.*

Keywords: organic cherry production, black cherry aphid, *Myzus cerasi,* plant protection, paraffin oil

Introduction

The black cherry aphid (*Myzus cerasi*) is the main pest in modern organic table cherry production. Especially in orchards with installed rain protection and insect nets, strong aphid populations can build up, as such closed orchards have a microclimate favourable for aphid development and also impede the flight and settlement of specific aphid antagonists such as hover flies, lacewings or ladybirds (Häseli, 2017). In orchards with rain protection and insect nets the reproduction rate of *M. cerasi* can be very high. This can lead to large yield losses due to fruit contamination and especially for young trees strong deformation of shoots can be problematic. Looking at the biology of *M. cerasi*, there are different stages, where a regulation can be successful. A treatment with oil products before the hatching of the fundatrices in spring time is the first option. A successful regulation of the fundatrices is essential since each fundatrice and its following generation can produce up to about 200 nymphs (Karczewska, 1970). A second point in time for a regulation is a treatment with contact insecticides after the hatching but before curling of the leaves caused by the sucking activity of the aphids. The third opportunity for a regulation is during the return flight of the winged aphids from secondary hosts to the cherry trees but before laying of eggs in autumn (McLaren & Fraser, 2002). At FiBL for many years different products and strategies were tested to regulate *M. cerasi* in an organically managed cherry orchard with a rain protection and insect nets.

Material and Methods

2017 a trial was conducted in an organically managed cherry orchard at FiBL in Frick (Switzerland). The trial included three repetitions per treatment with 2 to 3 trees per repetition and was conducted on the varieties Kordia (planted 2013) and Merchant (planted 2008). Three treatments were tested. In the “early” (shortly before hatching) and “early + late (shortly after hatching)” treatments the paraffin oil (WEISSOEL Omya) was sprayed divided in two passes on the 15.03.2017 with a concentration of each 1.75%. 1.75% corresponds to half of the recommended concentration. The application was performed during dry and warm (12 to 18 °C) weather conditions with a backpack sprayer with a high volume of water until complete wetting (almost dripping) of the trees. On the 27.03.2017 a divided application in two passes with each 1% paraffin oil for the “early + late” and “late”

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treatments with the same amount of water as for the previous treatment was performed. The number of aphid colonies per tree was assessed on the 27.04.2017.

2018 a trial was conducted in an organically managed cherry orchard at FiBL in Frick (Switzerland). The trial was conducted on 4 repetitions for the variety Kordia (planted 2017), 2 repetitions for the variety Christiana (planted 2017) and 3 repetitions for the variety Kordia (planted 2013) and included 2 to 4 trees per repetition. Three treatments were tested. In the “early” and “early + late” treatments paraffin oil (WEISSOEL Omya) was sprayed divided in two passes on the 02.04.2018 with a concentration of each 1.75%. On the 06.04.2018 a divided application with two passes with each 1.75% paraffin oil for the “late” and “early + late” treatments was performed. The number of aphid colonies per tree was assessed on the 13.04.2018.

2018 a second trial in the same organically managed cherry orchard at FiBL in Frick was conducted. The trial was conducted on 4 repetitions for the variety Kordia (planted 2017), 2 repetitions for the variety Christiana (planted 2017) and 3 repetitions for the variety Kordia (planted 2013) and included 1 to 2 trees per repetition. One treatment was tested. On the 13.04.2018 pyrethrum (Pyrethrum FS, Andermatt Biocontrol AG, Switzerland) + soap (Natural, Andermatt Biocontrol AG, Switzerland) was sprayed divided in two passes with each 0.025% pyrethrum + 0.63% soap just before the curling of the leaves caused by the sucking activity of the aphids. The number of aphid colonies per tree was assessed on the 24.04.2018.
Statistical analysis was performed using the computing software R (version 3.6.1).

Results

In the trial in 2017, the aphid population was very high in the untreated young trees of the variety Kordia (7.5 colonies/tree) and in the untreated old trees of the variety Merchant (21.5 colonies/tree) at the assessment on the 27.04.2017 (Figure. 1). The number of aphid colonies was reduced significantly in all the treatments compared to the untreated control. In the young trees the infestation could be reduced by 96% and 98% respectively with one treatment in two passes both in the "early" treatment (before hatching) and in the "late" treatment. A complete reduction of aphids was achieved in the treatment “early +late”. In the case of the large-volume trees of the variety Merchant, the early treatment and repeated treatment also reduced the infestation by 99% and 97% respectively. The "late" treatment showed a weaker effect with 80% reduction of infestation. The reduction was highest in the “early” treatment followed by the “early + late” treatment and was lowest in the “late” treatment compared to the control.

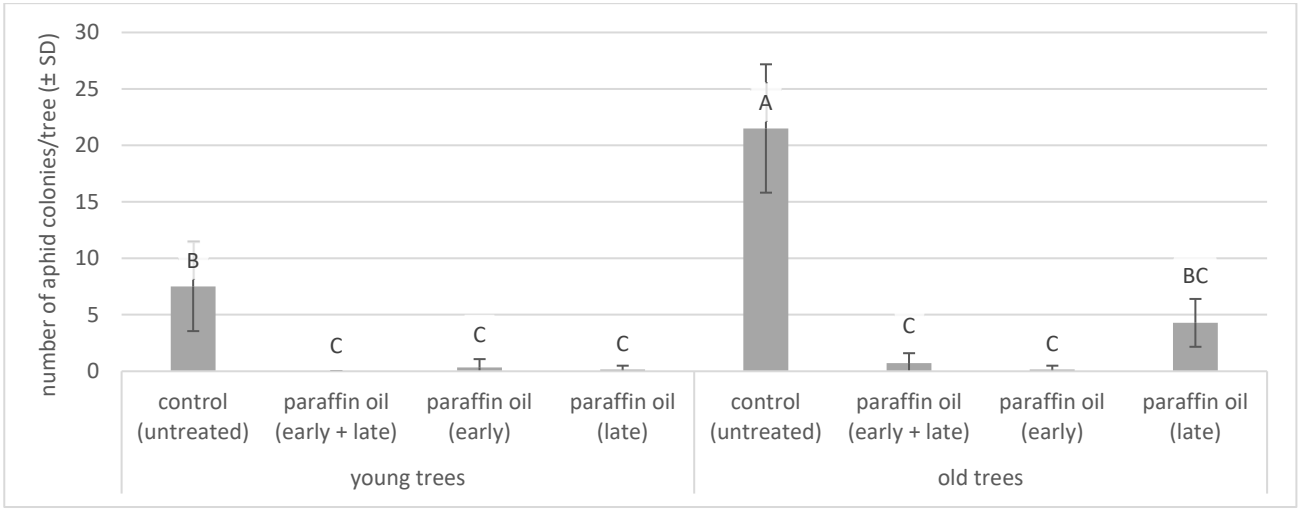

Figure 1: Number of aphid colonies per tree (+/- standard deviation (SD)) on the 27.04.2017 for the different treatments and young trees (variety Kordia) and old trees (variety Merchant). Different letters indicate a significant differences ($p<0.05$) between treatments by Tukey's HSD test.

In the trial in 2018, a complete infestation reduction was achieved in the young trees of the varieties Christiana and Kordia with the two treatments "early" and "early + late" (Figure 2). For the older, voluminous trees, the strong aphid pressure could only be completely reduced by the treatment with two applications. The treatments with one application achieved only a partial reduction of 62% (early) respectively 77% (late).

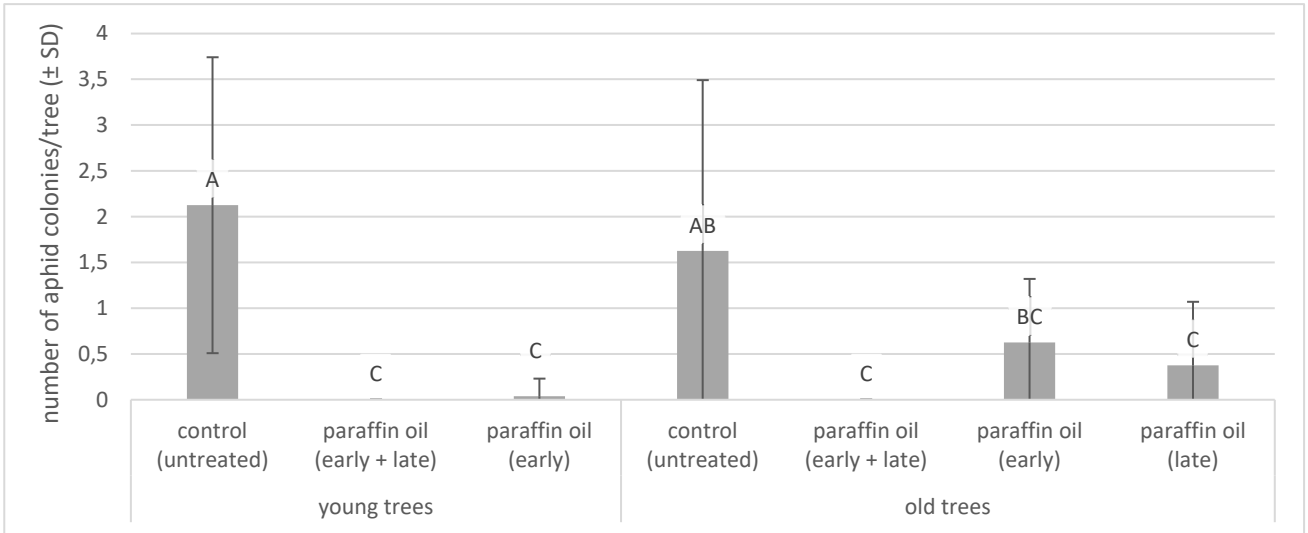

Figure 2: Number of aphid colonies per tree (+/- standard deviation (SD)) on the 13.04.2018 for the different treatments and young trees (mean of varieties Kordia and Christiana) and old trees (variety Kordia). Different letters indicate a significant differences ($p<0.05$) between treatments by Tukey's HSD test.

In the second trial in the year 2018, the contact effect of the treatment pyrethrum + soap was tested on the already reproducing aphids. The treatment shortly before the leaves were curled up only showed a non-significant partial reduction of 82 % on the young trees 11 days after the application (Figure 3). In the voluminous older trees the infestation could not be reduced by the application of pyrethrum + soap.

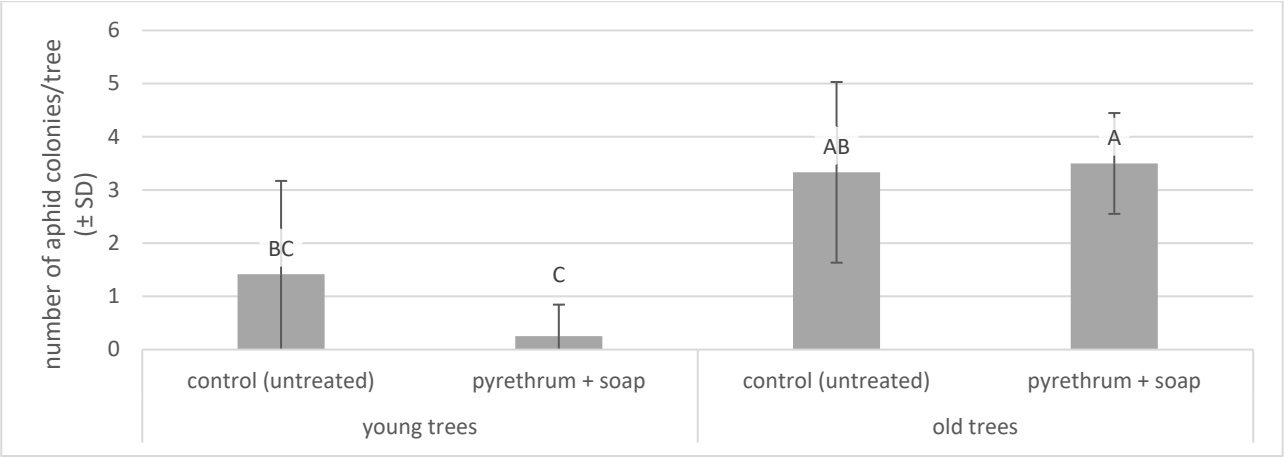

Figure 3: Number of aphid colonies per tree (+/- standard deviation (SD)) on the 24.04.2018 for the different treatments and young trees (mean of varieties Kordia and Christiana) and old trees (variety Kordia). Different letters indicate a significant differences ($p<0.05$) between treatments by Tukey's HSD test.

Discussion

The trials of 2017 and 2018 on the regulation of *M. cerasi* have shown that treatments at sprouting with paraffin oil can reduce the overwintering stem mothers by up to 100% (Figures 1 & 2). The treatments shortly before and shortly after aphid hatching did not differ in their effect. This is due to the fact that paraffin oil not only has an ovicidal effect but also a good contact effect against freshly hatched aphids. The importance of a good application technique with a good wetting of the whole tree was shown by the differences in effect in the trial 2018 between the young trees and the old trees, where the large tree volume makes it much more difficult to apply the spray film evenly than with young trees. While a nearly 100% effect could be achieved on the young trees with just one treatment, this was only possible with two treatments on the old trees. For optimum agent covering it is also recommended, as applied in the trials, that the paraffin oil is applied in two passes within a few hours after drying and with driving in the opposite directions.

An early and strong reduction of the overwintering stem mothers is crucial to delay the development of the aphid population. This can greatly reduce the risk of aphid calamities and thus fruit contamination and tree damage caused by shoot deformations. Nevertheless, under the favourable microclimatic conditions and reduced access of beneficial insects in closed systems with weather protection, large aphid colonies can develop from just a few surviving stem mothers. Effective treatments are therefore needed. One possibility is the use of contact agents in the period after hatching until before the leaves curl up. After that, the aphids in the curled leaves are protected and can no longer be reached by pure contact agents. In the experiment in 2018, the effect of pyrethrum + soap was tested during this period (Figure 3). Despite very careful treatment in two passes, each with 50% of the recommended application rate, only on the young trees a clear but insufficient partial effect of 82% reduction of infestation 11 days after treatment was achieved, whereas on the voluminous old trees the aphid infestation was not reduced. These results confirm the experience from previous trials (Cahenzli & Daniel, 2018; Häseli *et al.*, 2012-2019) as well as from practical farms.

Thus, for the direct control of *M. cerasi* in practice, only neem preparation can be used besides the paraffin oil treatments during sprouting. In the trials of the last few years and in practice, the following findings for an optimised effect were obtained with the *NeemAzal-T/S* neem preparation:

- Due to the lack of initial toxicity and the slow development of the effect by inhibiting the reproductive capacity, the effect is not sufficient in the case of rapid population development of aphids, particularly in fast-growing young trees. Therefore, a strong reduction of the initial population by the use of paraffin oil is crucial.
- The duration of effect is limited. If the effect of the treatment is not sufficient to eliminate all aphids, the remaining colonies can recover from the temporary reproductive inhibition and build up huge colonies again until harvest or, in the case of fast-growing trees, beyond that, and cause damage to the fruit and shoots. Therefore, 2 to 3 treatments are necessary in case of a strong aphid pressure. Thanks to its translaminar mode of action, *NeemAzal-T/S* can still be used after the leaves have been rolled up.
- For *NeemAzal-T/S* to be absorbed and develop its full effect, it is essential that sufficient leaf mass is existing during a treatment. This is usually the case shortly after flowering. At this stage, the first treatment should be carried out. Despite the translaminar effect, a good wetting of the entire tree is a prerequisite for a sufficient effect.

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