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PRELIMINARY RESULTS ON THE EFFICACY OF SOME ORGANIC INSECTICIDES AGAINST APHIDS TO EUROPEAN PLUM

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Abstract

The use of ecological treatments in the prevention and control of diseases and pests for fruit trees is increasing. Thus, more and more orchards are established on an ecological system in order to obtain crops with no pesticide residues after harvesting. There are few organic insecticides on the market and their effectiveness is not fully known. This situation creates difficulties for those who choose such crops, assuming practically the risk of potential inefficient control of the main diseases and pests. In this experiment, the effectiveness of several organic insecticides was studied against one of the main plum pests, the aphids respectively. The tests were performed both in the field and under laboratory conditions, on shoots heavily populated by aphids. The treatments were applied by spraying the whole surface of the shoots. The preliminary results obtained after 48 hours highlited two organic insecticides, Ovipron Top and Prev-Am, that had an efficiency of over 90%, and 70%, respectively at the concentrations recommended by the manufacturer.

Key words: *organic insecticides, aphids, prevention and control, plum*.

INTRODUCTION

The necessity to use eco-treatments instead of those of chemical synthesis is due to an ever-increasing demand of developing farmers, which want to return to eco fruit products with no pesticide residues and chemical fertilizers (Maxim, 2008; Neelesh and Attika, 2015). This change is felt globally from the traditionally developed countries in agriculture to the developing states that are trying to align with the current market demands, the consumer being the main segment in this change (Theodosiou et al., 2014; Manoj, 2017; Lacey et al., 2015).

The organic insecticides against diseases and pests, which are currently on the market, are limited in number and their effectiveness is not yet fully known. This could generate some concerns for those who want to practice organic crops, assuming the potential risks for an inefficient control of main diseases and pests to plum.

In Romania, the expansion of new organic orchards took place after the implementation of measure 4.1a "Investments in fruits trees orchards" within the National Programme of the Rural Development, 2014-2020. Establishment of ecological orchards with non-refundable funds from the European Union by the mentioned programme received higher score, and therefore become very attractive to farmers. The problem that arises is, however, the chance of success of these orchards, or rather, how much of the forecasted output will be able to be realized so that the consumer will benefit from organic fruits from the allocated funds.

The plum is still the dominant fruit species in Romania (FAOSTAT, 2018), and part of the production would be desirable to be obtained organically.

In this context, controlling the main diseases and pests in the orchards remainned problematic, since limited information about the effectiveness of organic insecticides are available. This thing leads to the need to test organic insecticides in order to establish their effectiveness against the main diseases and pests.

It is known that the aphids are one of the main factors that affect the development and production of plum trees (Rakauskas, 2015; Țucă, 2013; Lenteren et al., 2006). Treatments against aphids are applied for a dual purpose: first, they are designed to reduce aphid populations to decrease the direct damage due to their feeding on young shoots and leaves; secondly, treatments with insecticides are applied to reduce the potential spread of the most detrimental viral pathogen - *Plum pox virus* (PPV), by decreasing aphid vector populations (Zagrai et al., 2020).

In this study, we assessed the potential use of some organic insecticides against aphids, in order to provide information for practical application.

MATERIALS AND METHODS

The experiment was organised in micro variants in two distinct tests, on plum: one carried out under laboratory conditions, and the other in the orchard. A comparison of organic insecticides in relation to those of chemical synthesis used as controls against aphids was made. The organic insecticides tested in the experience were: Konflic, Laser 240 SC, Prev-Am, Canelys, Oleorgan, Algasil, Ovipron Top, Deffort and BactoSpeine DF. All products used are approved for organic farming.

Konflic (0.3%) it's a contact insecticide based on 50% Potassium Salt from vegetable oil extract and 50% bitter Quassia extract. It is a natural product used to control and reduce the population of pests (*Trialeurodes vaporariorum*, *Thripida* sp., *Aphidoidea* sp.) from horticultural crops.

Laser 240 SC (Spinosad 240 g/l) (0.06%) new family of biological insecticides, naturally includes insecticides derived from metabolites of living organisms. It do not act systemically (it is not translated by xylem or phloem), but they penetrate the leaf blade and are in translation. It is recommended against the orders: Lepidoptera, Diptera, Hymenoptera, Coleoptera, Thysanoptera, Isoptera.

Prev-Am (Orange oil 60 g/l) (0.8%) is a contact product with a physical mode of action, with insecticidal and fungicidal effect. The product is in the category of essential oils, natural and volatile. It acts on the layers of insect protection and the external mycelium to the mushroom.

Canelys (Cinnamon extract 700 g/l) (0.3%) is a contact insecticide based on cinnamon tree extract (*Cinnamomum zaylanicum*). It has a proven effect on stimulating the self-defence reactions of plants in flour and other fungi but also in control of *Acari* spp. found in vegetable crops, flowers, fruit trees and vines.

Oleorgan (0.3%) (Neem extract 400 g/l) is an insecticide based on vegetable oils that can be used to control pests in vegetable crops, flowers, fruit trees and vines. The insecticide also has a repellent effect against pests. It's recommended for effective fighting of: *Trialeurodes vaporariorum*, *Thripida* spp., *Aphidoidea* spp. etc.

Algasil (Algae extract plus K_2O 90 g/l and SiO_2 200 g/1) (0.5%) is a multi-activity self-defence stimulator and inducer (fungicide, insecticide, acaricide). It contains algae extract (*Ascophyllum nodosum*) plus silicon and potassium, which exerts a stimulating effect on crops. It amplifies the natural resistance mechanisms of the plants in the presence of pests such as *Acari* spp. or other insects with soft body.

Ovipron (Top Paraffinic oil 96.5 g/kg) (2.5%) is a highly refined, paraffinic mineral oil with insecticidal action, being also an excellent adjuvant for other contact plant protection products. Insecticidal action is mainly manifested by asphyxiation, covering the body of the insects with a fine film, which penetrates through the trachea channels, blocking the breathing, thus causing death.

Deffort (Fabaceae family extract 8 g/l) (0.3%), an organic insecticides with insecticidal effect, increases the self-defence capacity of the plant. It has a repellent effect that ensures that the plant tissues are not attractive to pests. Even egg laying is avoided. The product has in its composition plant extract from the Fabaceae family and microelements as physiological activators. Contains alkaloids that cause insecticidal activity.

BactoSpeine DF (0.1%) insecticide, the latest generation that acts on the target larvae of pests as soon as they are consumed from the treated plants. The product is a combination of toxic protein crystals and a spore. It contains: 54% *Bacillus thuringiensis*, *Kurstaki* subsp. ABTS

351. It acts on pests by degrading the intestinal walls, the larvae can no longer feed and die within 24 to 72 hours.

The chemical synthesis products used in relation to the ecological ones were: Calypso (Thiacloprid 480 g/l) (0.02%), Mospilan (Acetamiprid 200 g/kg) (0.02%), Actara (Thiamethoxam 250 g/kg) (0.01%), Movento (Spirotetramat 100 g/l) (0.19%), Zeon Karate (Lambda-cyhalothrin 50 g/l) (0.015%).

During the first test carried out under laboratory conditions, 42 plum shoots from a "Stanley" plum tree fully populated by aphids (*Hyalopterus pruni*) were collected. In choosing the shoots, it was taken into account that they have approximately the same size and a similar number of aphids. The shoots were then suddenly distributed in 14 glass containers (three shoots each), in water (Figure 1).

Figure 1. The type of variants distribution (original)

Nine of those were used for testing organic insecticides, while five for chemical synthesis products, used as controls. Each variant was labelled and then the shoots were sprayed with the mentioned products. The concentrations used were those recommended by the manufacturer.

The observations were made at two days, considering the fact that most of the organic insecticides have a contact action and their effect is visible according to the manufacture after 24-48 hours.

The second test was performed in the orchard, where two trees of Stanley variety, strongly populated by aphids, were selected for spraying. These trees were not treated before from the beginning of the vegetation period until the moment of spraying. Organic insecticides were tested on one of the trees, and the products of chemical synthesis, used as controls, were tested on the other tree. Thus, nine variants were prepared on the tree on which the organic insecticides were applied, corresponding to the nine organic insecticides. For each variant, six shoots with a similar size, placed on the same branch from different parts of the crown, were labelled. After the clear delimitation for each variant, shoots were treated by spraying with organic insecticides, depending on the variant previously established. To reduce the risk of accidentally spraying another variant, a cardboard panel was used for protection. In a similar way, five variants were prepared on the control tree, where the chemical insecticides were applied.

The observations were made at two days, taking into account the fact that most of the organic insecticides have a contact effect and the results should be visible after 24-48 hours from application. Thus, the rate of mortality was determined after 24, and 48 hours respectively from the spraying time by counting the aphids on infested leaves.

RESULTS AND DISCUSSIONS

In the first experiment, performed under laboratory conditions, the results revealed that after 24 hours from the treatments, the highest rate of mortality after spraying with organic insecticides, was recorded at Ovipron Top, with a rate of mortality of 70%. Spraying with Prev-Am produced a rate of mortality that was reach to 40%, while the treatments with the rest of the organic insecticides determined a rate of mortality between 3-10% (Figure 2).

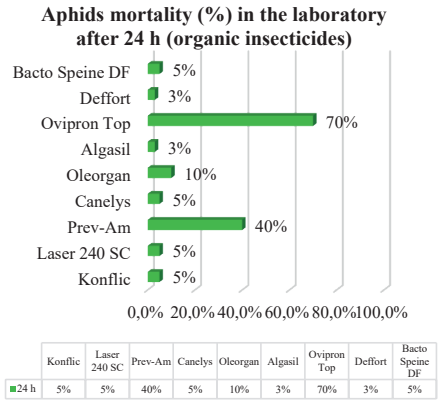
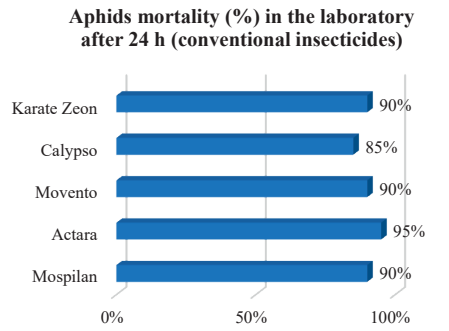


Figure 2. Rate of aphids mortality on variants with organic insecticides (after 24 hours) under laboratory conditions

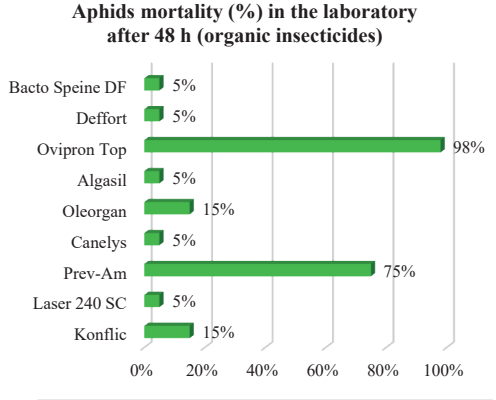
In the same experiment, application of chemical insecticides produced a mortality of over 80% in the first 24 hours (Figure 3).



	Mospilan	Actara	Movento	Calypso	Karate Zeon
24 h	90%	95%	90%	85%	90%

Figure 3. Rate of aphids mortality on variants with chemical products (after 24 hours) under laboratory conditions

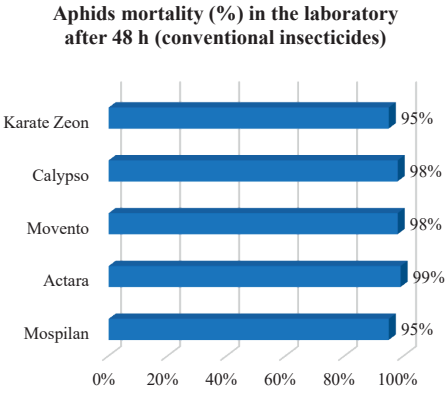
The results obtained after 48 hours for the organic insecticides generally showed a slightly increasing rate of mortality in comparison with those recorded after 24 hours. However, treatments with Ovipron Top led to a high rate of mortality (98%), comparable with that recorded on chemical variants. Also, treatments with Prev-Am reach to 60%. Treatments with the other organic insecticides determined a rate of mortality between 3-15%, being thus unsatisfactory (Figure 4).



	Konflic	Laser 240 SC	Prev-Am	Canelys	Oleorgan	Algasil	Ovipron Top	Deffort	Bacto Speine DF
48 h	15%	5%	75%	5%	15%	5%	98%	5%	5%

Figure 4. Rate of aphids mortality on variants with organic insecticides (after 48 hours) in laboratory conditions

In the case of chemical synthesis products, their effectiveness reaches at almost 100% mortality after 48 hours from spraying (Figure 5).

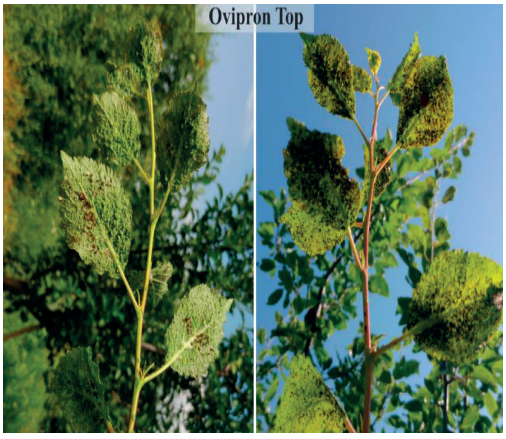


	Mospilan	Actara	Movento	Calypso	Karate Zeon
48 h	95%	99%	98%	98%	95%

Figure 5. Rate of aphids mortality on variants with chemical products (after 48 hours) in the laboratory conditions

For the second experiment undertaken in the orchard, the results are largely preserved similar to the data from the first test, under laboratory conditions.

Thus, the highest rate of mortality was determined by spraying with Ovipron Top, with 95% mortality after 24 hours, and 98% mortality after 48 hours (Figure 6).

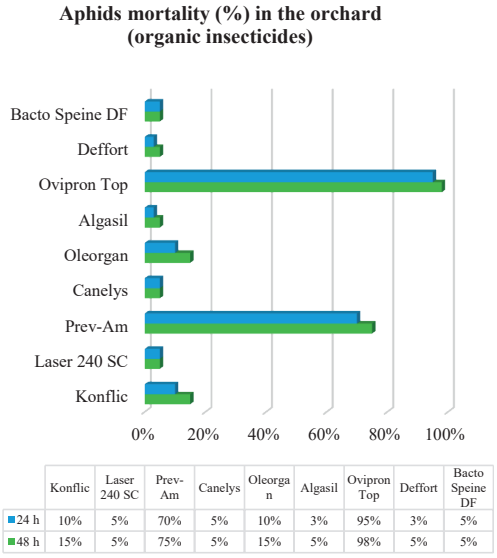


a b

Figure 6. Phytosanitary status before (a) and after (b) application the treatment with Ovipron Top

Spraying with Prev-Am also produced a good rate of mortality that reach to 70% after 24

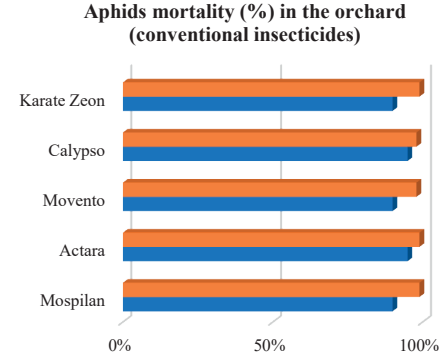
hours from application, and 75% after 48 hours (Figure 7).



	Konflic	Laser 240 SC	Prev-Am	Canelys	Oleorgan	Algasil	Ovipron Top	Deffort	Bacto Speine DF
24 h	10%	5%	70%	5%	10%	3%	95%	3%	5%
48 h	15%	5%	75%	5%	15%	5%	98%	5%	5%

Figure 7. Rate of aphids mortality on variants with organic insecticides (after 24 hours and 48 hours respectively) in the orchard

Treatments with the five chemical insecticides produced a similar rate of mortality after 24 and 48 hours, respectively, reaching to almost 100% mortality after two days (Figure 8).



	Mospilan	Actara	Movento	Calypso	Karate Zeon
48 h	99%	99%	98%	98%	99%
24 h	90%	95%	90%	95%	90%

Figure 8. Rate of aphids mortality on variants with chemical products (after 24 hours and 48 hours respectively) in the orchard

This experiment will be extended along few consecutive years and will take into account a larger period after spraying to determine the pest mortality since some products gave unexpectedly results. For example Laser SC 240 gave favorable results in other experiments, such as against whitefly (*Trialeurodes vaporariorum*) in tomato (Prijović et al., 2012) and for *large pine weevil* (*Hylobius abieti)* control in spruce seedling (Brudea and Ciucla, 2007). Important to mentioned that these results were obtained at 14 days and 21 days (treatments against *Hylobius abieti),* and 23 days (treatments against *Hylobius abieti)* after spaying.

CONCLUSIONS

Preliminary results from the two experiments undertaken both, under laboratory conditions and in the orchard, revealed that Ovipron Top is an effective organic insecticide that could be used against aphids in plum crops. However, the treatments applied along vegetative period in a few consecutive years could provide further and more well documented results. Prev-Am is also a potentially valuable promising organic insecticide that required attention in the future. Treatments with the other seven organic insecticides were unsatisfactory under the study conditions since the rate of mortality was between 5-15% after 48 hours from spraying.

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REFERENCES

Brudea, V. & Ciucla, C. (2007). Cercetari privind eficacitatea bio-pesticidului SPINOSAD în combaterea trombarului puieților de molid *Hylobius abietis* L. (O. Coleopera - F. Curculionidae). *Analele Universitatii Stefan cel Mare Suceava* - Secțiunea Silvicultură, 9:12-18.

Lacey. L. A., Grzywacz D., Shapiro-Ilan, D. I., Frutos, R., Brownbridge M., Goettel M. S. (2015). Insect pathogens as biological control agents: Back to the future, *Journal Of Invertebrate Pathology,* 132: 1-41.

Lenteren, J.C. Van, Bale, J., Bigler, F, Hokkanen, H.M.T., Loomans, A.J.M. (2006), Assessing risks of releasing exotic biological control agents of arthropod pests, *Annual Review of Entomology*, 51: 609-634.

Manoj K. (2017). Future Approach to Organic Agriculture, *Brajesh Kumar Tiwari Media Centre,* Bihar.

Maxim A. (2008). *Ecologie Generală și Aplicată*, Ed. Risoprint, Cluj-Napoca.

Neelesh N., Attika G. (2015). Organic farming: a new revolution in agriculture, *Journal of Agroecology and Natural Resource Management*, 2: 2394-0794.

Prijović M., Drobnjaković T., Marčić D., Perić P. and Petronijević S. (2012). Efficacy of insecticides of natural origin in whitefly (*Trialeurodes vaporariorum*) control in tomato. *Acta Horticulturae*, 960, 359-364.

Rakauskas R. (2015). Orchard aphids (Hemiptera: Sternorrhyncha, Aphdoidea) of Lithuania: A century of research, *Polish Journal of Entomology*, 84, 311–323.

Theodosiou L., Hiltunen T., Becks, L. (2019) The Role of Stressors in Altering Eco-evolutionary Dynamics. *Functional Ecology*, 33, 73–83.

Țucă O. A., (2013). *Grapholita funebrana* Tr. *și Hyalopterus pruni* Geoffr*, specii periculoase din plantațiile de pruni*, Editura Universitaria, Craiova.

Zagrai, I., Zagrai, L.A., Ravelonandro, M., Scorza, R., Jakab, Z. and Guzu, G. (2020). Assessment on the potential decrease of insecticide treatments against aphids in 'HoneySweet' plum (*Prunus domestica* L.) plantings. *Acta Hortic.,* 1269, 185-190. DOI:10.17660/ActaHortic.2020.1269.25.

FAOSTAT, 2018. http://www.fao.org/faostat/en/#data /QC