Studies Regarding the Combat of the Braches Burns Produced by the \textit{Phomopsis Vaccinii} at Blueberry Bushes Cultivated in Maramures County

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Abstract
This study has examined the response of two species of the blueberry bushes: Elliot and Bluecrop cultivated in the climate conditions of the years 2014 and 2015 to the attack of the \textit{Phomopsis vaccinii}; we have also tested and determined the biological efficiency of three fungicide products in order to recommend the best of them to be used in the bushes treatment. The attack was calculated by determining the disease frequency (F\%) and its intensity (I\%). We also calculated the biological efficiency for the three selected products, considered as being the best ones. We utilized the interrupted-linear setting method which consists of 5 plants/three repetitions / product and we monitored 3 plants from each repetition; 2 marginal plants were for untreated control. Our analysis of the two species pointed that the Bluecrop species has a much higher sensitivity against the pathogen than the one discovered in the Elliot species. The calculation of the biological efficiency proved that the best product Funguran OH 50 PW (90,5\%) was followed by Alcupral 50 PU (88,8\%) and the Copac (86,2\%) for the Elliot variety, occupied the last place; the same hierarchy with smaller values was found for the Bluecrop variety.

Keywords: attack, whitefly, fungicides, testing

INTRODUCTION
The Romanian territory is situated in the continental zone, with a temperate climate that favors the development of a rich assortment of fruit shrubs (Ghena \textit{et al}., 1977). The blueberry bush has a particular importance and that is why it is cultivated all over the country (Mladin and Ancu, 2005) the blueberry fruit are rich in sugars, vitamins, mineral salts, tanning substances (Parvu, 2002). Their leaves have a series of medical utilizations such as: the treatment of some stomach, intestine and urinary affections, diabetes, the visual accuracy amelioration (Chira, 2000). As the spontaneous plants are more rustic and better adapted, they constitute an important biologic background for making new species (Hoza, 2005).

As certain cultures may be affected by damaging factors, the necessity of their identification and of their combat is compulsory (Oroian \textit{et al}., 2006). The study of any disease must take into account the interdependence of the phyto-pathogenic factors in their occurrence and in their evolution (Comes \textit{et al}., 1977).

Important problems in the blueberry bushes plantations have been created by the burns of their branches (\textit{Phomopsis vaccinii}); this infection spread rapidly and affected the sprouts and the whole plant, the leaves withered, the plants resistance to frost diminished (Weingartner and Klos,1975). All the blueberry bush species in the present assortment were found to be affected by the \textit{Phomopsis vaccinii} (Milholland and Daykin, 1983). The infections caused by these one
fungi decreases the yield and quality of crops and are responsible for significant losses in the fruits (Stromeng and Stensvand, 2001; Szmagara and Machowicz-Stefaniak, 2005; Szmagara, 2008; Szmągara, 2009). The variety resistance and their sensitivity degrees are important for the application of the various treatments in order to reduce their number and to get the best efficiency (Sin, 2005). The chemical products prove their efficiency only if they are utilized rationally and their usage without discerning leads to diminished and depreciated crops (Oltean and Oltean, 2003).

The purpose of this study is to monitor the response of two variety of the blueberry bushes: Elliot and Bluecrop; what is their reaction to the attack of the branches burns caused by the fungi Phomopsis vaccinii; we have also tested and determined the biological efficiency of three fungicide products in order to recommend the best of them to be used in the bushes treatment.

**MATERIALS AND METHODS**

The experimental researches were performed during the period between 2014-2015, on a young blueberry bush plantation, located in the village Finteusu Mare, Maramures County. This farm has an area of 4 hectares, and the cultivated species are Bluecrop and Elliot. The agrotechnics is applied on a black soil field, on rows and with grass between them, equipped with an irrigation system. Our experiment selected the lots where the fungi attack degree ranged from the moderate to high frequencies (50-70%) in order to monitor the biological efficiency of the tested fungicides.

In 2014, we tested 5 fungicides used to combat branches burns that occurred in the two studied species of blueberry bushes; thus we calculated the frequency and the intensity of the Phomopsis vaccinii attacks.

The testing continued during the year 2015 in order to acknowledge that the efficient products range remained the same with that of the previous year. We also calculated the biological efficiency for the three selected products, considered as being the best ones. In our experiments, we used 5 plants/variant set in three repetitions for each product. We monitored 3 plants; the margin 2 other plants were for untreated control. We determined the frequency (F%) and the intensity (I%) in order to calculate the fungi attack. We registered the agro-meteorological data using the system Agro Expert. The efficiency assessment was performed by respecting the technique against the control sample.

**RESULTS AND DISCUSSION**

The five tested fungicides were (Alcupral 50PU, Copac, Funguran OH 50 WP, Score 250 EC and Captan 80 WDG). In the figure 1, we can see that the determinations of the branches attack display that in 2014, in the variety Elliot case, treated with Funguran OH 50 WP, the attack frequency is only of 0,1 % the other two products Score 250 EC and Captan 80 WDG had a very low efficiency, as the attack frequency was of 1,5 %.

The attack frequency, when we used the product Alcupral 50PU was of 0,3 % and 0,5 % for the product Copac thus their efficiency was...
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The results obtained for the second studied variety the Bluecrop, are presented in Fig. 2. In the case of Bluecrop variety, the Funguran OH 50 WP had the highest efficiency too, as the offspring attack frequency represented only 0.3%, while the Alcupral 50 PU is of 1.0% and Copac is of 1.5%. In the Bluecrop case, we may observe that the products hierarchy remained the same with that found for the first studied variety. The only differences concern the higher values of the attack frequencies because the Bluecrop variety proved a higher sensitivity.

The climate conditions of the year 2014 characterized by higher temperatures and a higher atmospheric humidity of more than 70%, created specific conditions for this fungi development and increase its power attack, and thus the both species were affected.

The results obtained in the testing of the 5 fungicides for the Elliot variety during 2015 are displayed in Fig. 3. The best results were found for the following products: Copac, Funguran OH 50 WP, Alcupral 50 PU with a shoot attack frequency ranging from 0.1% to 0.3% for Elliot variety. The figure 4 displays the shoot attack frequency when the following products were Copac, Funguran OH 50 WP and Alcupral 50 PU, ranging from 0.9 to 1.1 % for the Bluecrop variety.

The research continued with the biological efficiency calculation for the above three products the results of the two experimental years proved their good efficiency. Figure 5 shows that for the Elliot variety, the shoot attack intensity has values...
ranging from 7.2 % to 10.4%. The untreated check plant had 75.6 % intensity, while the variant V1 treated with the product Funguran OH 50 WP, the intensity was of 7.2%. In conclusion, the product Funguran OH 50 WP had a biological efficiency of 90.5 %.

In the variant V2 case, the biological efficiency of the product was of 88.8% and in V3 case it was of 86.2 %. The analysis of these data proved that the best efficiency was obtained in the V1 case, where the product Funguran OH 50 WP was utilized there followed V2 Alcupral 50 PU and the last one was the product V3 Copac. In all three variants, where the copper products were utilized, the treatments were executed during the autumn season, when the leaves started to fall and during spring, since the buds swelling up to the leaves appearance thus the utilized concentrations were the winter ones.

The results obtained through the biological efficiency calculation for the tested products in Bluecrop variety, under the year 2015 conditions, may be observed in the graphic representation of Fig. 6.

The biological efficiency of the tested products had lower values for the Bluecrop variety in comparison with the Elliot variety values, thus the former species had a higher sensitivity to the pathogenic attack. The biological efficiency of the product Funguran OH 50 WP proved to be the highest one, being namely of 87.5%, while the Copac had only a 85.1% efficiency.

The results obtained by Baker and Hancock, 1995 indicate that that Elliott and Bluetta may be at least moderately resistant to Phomopsis vaccinii, a higher proportion of these plants survived inoculation, and those that were infected died at a slower rate than did plants of the other cultivars. Percent survival of blueberry cultivars after
inoculation with *Phomopsis vaccinii* was Elliot 40%, Bluetta 27%, Bluecrop 12% and Bluejay 5%. In our research we have tested the biological effectiveness of some fungicides, where the Elliot variety proved to be much better than the variety Bluecrop.

Similar studies by Longstroth, Schilder, 2017 looks like that Elliot variety has a good resistance to *Phomopsis*. With respect to Phomopsis, some variety are resistant to the disease, (e.g., Elliott, Draper, Liberty and Legacy, and won’t need as much protection as susceptible varieties (e.g., Bluecrop, Bluetta, Blueray, Jersey). Thus, the results obtained are consistent with the obtained in our research.

**CONCLUSIONS**

During the two experimental years, when we monitored the combat of the branches burns, we found that the climate conditions influenced differently the fungi attack degree. During 2014, the fungi attack against both studied species was higher, because of the hot temperatures occurring on an atmospheric humidity background; the 2014 circumstances favored the fungi development, while the 2015 conditions were less favorable for them.

The results obtained through the determination of the attack frequency (F%) for both species, illustrate the fact that it ranged from 0.1% to 3.0%.

The analysis of both species brought the conclusion that the Bluecrop variety has a much higher sensitivity to the pathogenic attack than the sensitivity of Elliot variety.

The best results were obtained by the following products: Funguran OH 50 WP, Alcupral 50 PU and Copac. The biological efficiency calculation showed that in the Elliot variety, the highest one was of 90.5%, for the Funguran OH 50 WP product, followed by Alcupral 50 PU, with 88.8% and the the Copac product with 86.2%. The same classification was found for the Bluecrop variety, but in this case, the values were lower because of the species sensitivity.

The results obtained through this survey may be very useful for the owners of blueberry plantations. The resulting recommendations concerning the variety with the highest resistance or the information about the products with the best efficiency in the combat of the shoots burns may be very useful for the farmers involved in this activity.

**REFERENCES**