THE EFFECT OF ALTERNATIVE TREATMENT METHODS ON THE POPULATION EVOLUTION OF METCALFA PRUINOSA IN GOOSEBERRY CULTURE

EFECTUL METODELOR ALTERNATIVE DE TRATAMENT ASUPRA EVOLUȚIEI POPULAȚIEI DE *METCALFA PRUINOSA* ÎN CULTURA DE AGRIȘ

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Abstract.
European level research has shown that Metcalfa pruinosa attacks over 300 plant species. The results of this research on the effect of alternative pest control methods in gooseberry cultivation could be applied to other plants of the more than 300 species attacked by Metcalfa pruinosa. The attack capacity of Metcalfa pruinosa is influenced by the following factors: variety tolerance, the phenological stage corresponding to the attack, climatic conditions and the type of treatment applied. The alternative treatment methods investigated in this study involved the application of infusions of: Urtica dioica, Mentha piperita, Thymus serpyllum and Mentha pulegium, plants that have beneficial effects on humans. The applied treatments had different effects, with the most effective being the infusion of Thymus serpyllum across all variants.
Key words: *Mentha* spp., *Metcalfa pruinosa*, *Ribes* spp., *Thymus serpyllum, Urtica dioica*

Rezumat.
În lucrare sunt prezentate efectele metodelor alternative de tratament asupra evolutiei populației de Metcalfa pruinosa, in cazul a trei soiuri de agriș: Invicta, Captivator și Hinnonmaki roșu. Studiile au fost efectuate în perioada 2021-2024. Capacitatea de atac a speciei Metcalfa pruinosa este influențată de: toleranța soiului, fenofaza corespunzătoare atacului, condițiile climatice și tipul de tratament aplicat. Tratamentele efectuate au fost făcute cu infuzii de: Urtica dioica, Mentha piperita, Thymus serpyllum și Mentha pulegium. S-au studiat și s-a comparat efectele tratamentelor asupra Metcalfa pruinosa. Tratamentele aplicate au avut efecte diferite, iar eficacitatea cea mai bună în cazul tuturor variantelor a avut-o infuzia cu Thymus serpyllum.
Cuvinte cheie: *Mentha spp., Metcalfa pruinosa*, *Ribes spp., Thymus serpyllum, Urtica dioica*

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INTRODUCTION

Metcalfa pruinosa is an insect from the order *Homoptera*, family *Flatidae*, a polyphagous species that causes significant economic losses in countries from Europe, Asia, and North America.

Studies conducted in southern Romania concluded that *Metcalfa pruinosa* attacks 204 species from 56 families [Bărbuceanu *et al*., 2015]. European-level research has shown that *Metcalfa pruinosa* attacks over 300 plant species [Vlad, 2016].

The first appearance of *Metcalfa pruinosa* in Italy was reported in 1979. In Romania, it was first reported in 2009 [Chriceanu and Gutue, 2011] at Constanța. In western Romania, *Metcalfa pruinosa* was observed in 2010 [Grozea *et al*., 2015; Vlad, 2016]. Its presence was reported in Bucharest in 2011 and in Slatina in 2014 [Bărbuceanu *et al*., 2015]. In Ukraine, the first appearance was recorded in Kyiv in 2016 [Kushnir and Bondareva, 2022]. Global warming will favor the spread of *Metcalfa pruinosa* in the northern areas of the continents [Byeon *et al*., 2018].

Metcalfa pruinosa moves naturally at a speed of 0.5 km/year but can be spread when infested plants are supplied or traded [Vlad, 2016].

In Europe, there are over 22 parasites and predators, the most important of which is *Neodryinus typhlocybae* [Vlad, 2016]. Korean researchers [Baek *et al*., 2024] mentioned that in their country, there are no natural predators for *Metcalfa pruinosa*, but the species can be parasitized by the wasp *Neodryinus typhlocybae*.

Metcalfa pruinosa is a univoltine species with five larval stages, the last two of which are nymph stages. The species does not exhibit sexual dimorphism. The larval development period, under optimal conditions, lasts 42 days. Nymphs appear in May-July, and adults in August [Vlad, 2016]. Adults lay 90 eggs in August [Vlad, 2016]. It overwinters as eggs in the bark of branches on the trees or shrubs it parasitizes. The biological threshold is 10.1°C [Kim *et al*., 2021].

Insect development is limited by a minimum air temperature of 17-20°C, but it is also influenced by other factors [Kushnir and Bondareva, 2022]. There is no correlation made with relative air humidity.

Climate change leads to alterations in the biology and ecology of insects: physiology, population density, adaptation, distribution, and voltinism [Musoli and Saulich, 2012].

Weather conditions favoring the spread of *Metcalfa pruinosa* include temperature and precipitation [Zhao *et al*., 2024].

The invasion of *Metcalfa pruinosa* is favored by hot and dry summers, and large populations have been observed in shaded habitats [Bărbuceanu *et al*., 2015]. *Metcalfa pruinosa* promotes the dissemination of bacteria *Erwinia amylovora* [Bărbuceanu *et al*., 2015], *Pseudomonas syringae pv. actinidiae* and phytoplasmas [Zhao *et al.*, 2024].

MATERIAL AND METHOD

The research was conducted in the experimental field in Domnești commune, Ilfov County. The coordinates of the location are: latitude 44°24'18.4"N, longitude 25°55'45.5"E. The altitude above sea level is approximately 90 m. The experimental field was established in 2021, in an area where there are no other gooseberry crops.

The planting distances were 1 m within the row and 2 m between rows. The rows were mulched with geotextile fabric, and the space between the rows was mowed.

The experiment was carried out with three gooseberry varieties - Invicta, Captivator, and Hinnonmaki Red, in five variants with three repetitions, each repetition containing three plants.

The treatment variants used were infusion of: *Urtica dioica, Mentha piperita Thymus serpyllum* and *Mentha pulegium.* The treatments were applied monthly during the period from April to July. One row was used as a control.

The treatments were applied monthly during the period from April to July. Meteorological data for Domnești (minimum and maximum temperature, minimum and maximum relative humidity, daylight duration, ultraviolet intensity) were taken daily from the website www.weather.com.

To achieve the proposed goals and objectives, the following general working methods were used: documentary study on the level of knowledge regarding the research topic addressed – both nationally and internationally, analysis and synthesis of data and biological material, observation in the experimental field, identification of pests, preparation of infusions, comparison and experimentation.

RESULTS AND DISCUSSIONS

During the 2021-2022 period, no specimens of *Metcalfa pruinosa* were observed in the experimental field. *Metcalfa pruinosa* appeared in the experimental field in 2023.

The periods during which the first specimens and wax coating of *Metcalfa pruinosa* were observed in 2023 and 2024 were different due to varying weather conditions.

At the end of March 2023 and 2024, there were three consecutive days with temperatures above 10 °C. However, in April 2023, a cooling period followed, with daily average temperatures between 5.5-6.5°C, which delayed the hatching of eggs and favored the diapause of larvae that might have emerged. The first specimen of *Metcalfa pruinosa* was observed on the gooseberry variety Invicta on May 15, 2024, before the treatment was applied. The evolution of temperatures and the biological threshold are show in fig.1.

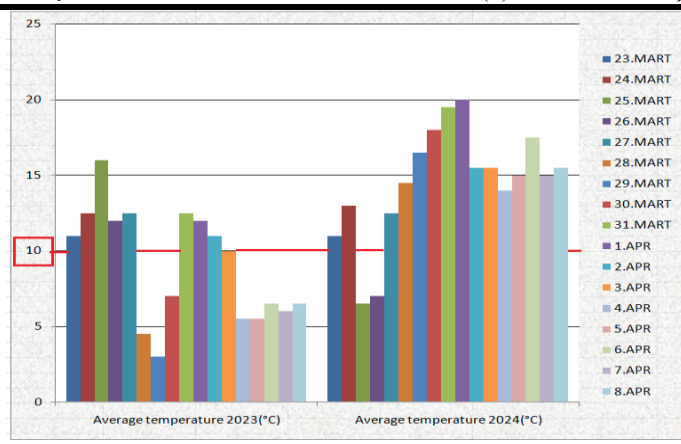

Fig.1. Evolution of temperatures from March 23, 2023, to April 6, 2023, and March 23, 2024, to April 6, 2024

The average daily temperatures were higher in 2024 than in 2023. This influenced both the biology of the gooseberry plants and the *Metcalfa pruinosa* species.

In 2023, the first wax coating/specimens were observed in the first decade of July, while in 2024, they appeared earlier, at the beginning of June.

The air temperature was higher in 2024 compared to 2023, while the air humidity was lower.

The evolution of temperatures is show in fig.2.

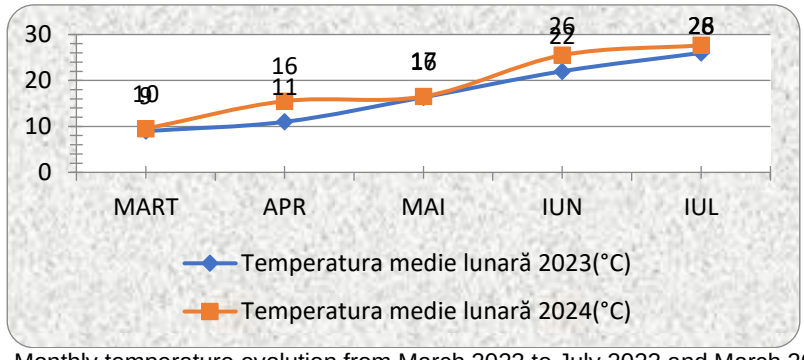

Fig. 2. Monthly temperature evolution from March 2023 to July 2023 and March 2024 to July 2024

From March to July of the years 2023-2024, the relative humidity of the air exhibited the following trend (fig.3):

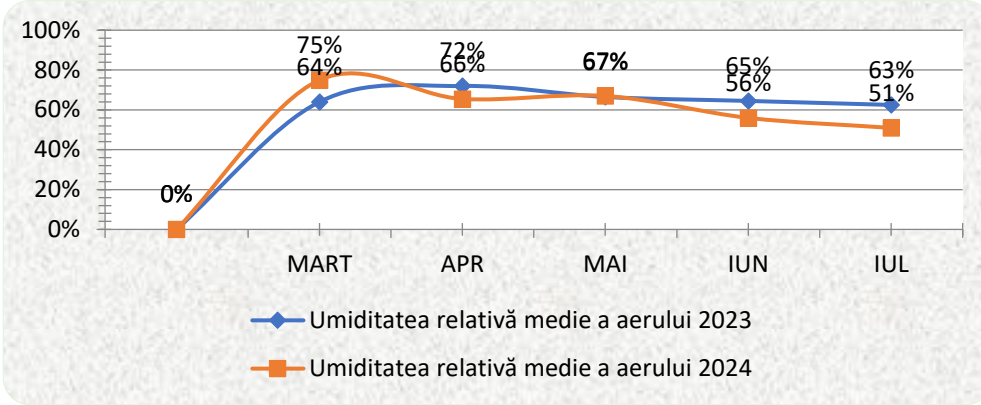

Fig. 3. Average relative humidity of the air from March to July in the years 2023 and 2024

In 2023, in the experimental field, a population of *Metcalfa pruinosa* was observed in July. It attacked the Captivator and Hinnonmaki Red varieties, predominantly on the fruits. The Invicta variety is early, and by the time *Metcalfa pruinosa* was reported, the fruits had already been harvested.

The experiment was carried out with three gooseberry varieties - Invicta, Captivator, and Hinnonmaki Red, in five variants with three repetitions, each repetition containing three plants.

The situation of plants on which specimens of *Metcalfa pruinosa* or wax have been identified is as follows (fig.4):

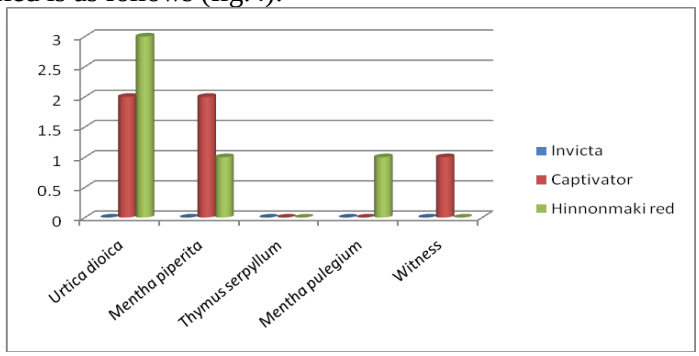

Fig. 4. Evolution of the *Metcalfa pruinosa* population on the gooseberry variety Invicta, Captivator and Hinnonmaki red in July 2023, across treatment variants

In 2024, the *Metcalfa pruinosa* population was reported on the variants treated with *Urtica dioica*, *Mentha piperita* and *Mentha pulegium*. The pest was not observed on the control variant or on the variants treated with *Thymus serpyllum*. The evolution of *Metcalfa pruinosa* population is show in fig.5.

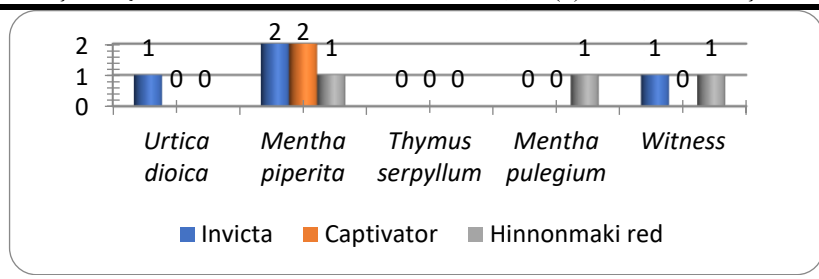

Fig. 5. Evolution of the *Metcalfa pruinosa* population on the gooseberry variety Invicta, Captivator and Hinnonmaki red in June 2024, across treatment variants

Determination of the attack level was performed using the Preda and Solka method, specific to bushes with dense foliage [Vlad, 2016]. This method is based on the severity of the attack and the presence of specific symptoms.Determination of the attack level was performed using the Preda and Solka method, specific to bushes with dense foliage [Vlad, 2016]. This method is based on the severity of the attack and the presence of specific symptoms.

For the gooseberry variety Invicta, the attack levels were as follows:

In 2023: *Metcalfa pruinosa* prefers fruits. The research conducted in 2023 showed that *Metcalfa pruinosa* appeared after the early harvest of the Invicta variety fruits. Consequently, in 2023, the attack level of *Metcalfa pruinosa* on Invicta gooseberries was 0. In 2024: isolated individuals were observed on variants treated with *Urtica dioica* and *Mentha piperita* (attack level 1). Variants treated with *Thymus serpyllum* and *Mentha pulegium* had an attack level of 0.

For the gooseberry variety Captivator, the attack levels were as follows: In 2023: the bushes treated with *Mentha piperita*, *Thymus serpyllum*, and *Mentha pulegium* were not attacked (attack level 0). In the variant treated with *Urtica dioica*, *Metcalfa pruinosa* appeared two weeks after treatment (attack level 1). In the control variant, the attack level was 1 at the beginning of July, and one week later, it increased to 2. In 2024: The bushes treated with *Urtica dioica*, *Thymus serpyllum*, and *Mentha pulegium* were not attacked (attack level 0). Isolated *Metcalfa pruinosa* individuals were observed on the variant treated with *Mentha piperita* four weeks after treatment. The control variant had an attack level of 1 in the first decade of June.

The evolution of attack level is show in fig.6.

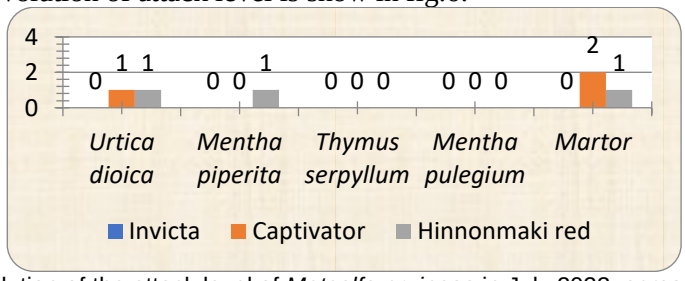

Fig. 6. Evolution of the attack level of *Metcalfa pruinosa* in July 2023, across treatment variants

For the gooseberry variety Hinnonmaki Red, the attack levels were as follows: In 2023: The bushes treated with *Thymus serpyllum* were not attacked (attack level 0). In the variant treated with *Urtica dioica*, *Metcalfa pruinosa* appeared one week after treatment. In the variant treated with *Mentha piperita*, *Metcalfa pruinosa* appeared one week after treatment. The untreated variant had an attack level of 1 (fig.7). In 2024: The bushes treated with *Urtica dioica*, *Mentha piperita*, *Thymus serpyllum*, and *Mentha pulegium* were not attacked (attack level 0). The control variant had an attack level of 1 in the first decade of June.

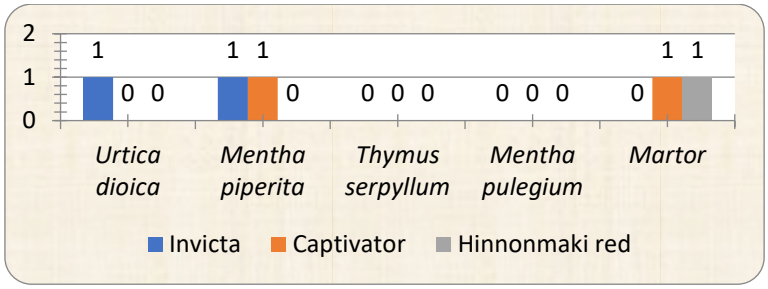

Fig. 7. Evolution of the attack level of *Metcalfa pruinosa* in June 2023, across treatment variants

CONCLUSIONS

The research conducted on gooseberries could also be applied to other plants among the more than 300 species attacked. In the first two years after the establishment of the experimental field, no specimens of *Metcalfa pruinosa* were observed. The appearance of *Metcalfa pruinosa* occurred in the third year after establishment.

Since *Metcalfa pruinosa* overwinters as an egg in the bark, it is important to apply treatments during the dormant period.

The alternative treatment methods investigated in this study involved the application of infusions of *Urtica dioica*, *Mentha piperita*, *Thymus serpyllum*, and *Mentha pulegium*, which have beneficial effects on humans. The treatments were applied monthly.

Metcalfa pruinosa prefers fruits. The research conducted in 2023 showed that *Metcalfa pruinosa* appeared after the early harvest of the Invicta variety fruits. Consequently, in 2023, the attack level of *Metcalfa pruinosa* on Invicta gooseberries was 0. Due to changes in climatic conditions, specifically increased temperatures, in 2024 *Metcalfa pruinosa* appeared earlier than the previous year, and gooseberry fruits ripened earlier. In 2024, the attack level on the Invicta variety was 1 for variants treated with *Urtica dioica* and *Mentha piperita*, and 0 for variants treated with *Thymus serpyllum* and *Mentha pulegium*.

For the Captivator variety, both in 2023 and 2024, no specimens of *Metcalfa pruinosa* and pruine were observed on variants treated with *Thymus serpyllum* and *Mentha pulegium*. For the Hinnonmaki Red variety, both in 2023 and 2024, no

specimens of *Metcalfa pruinosa* and pruine were observed on the variant treated with *Thymus serpyllum*.

The previous research indicates that regardless of the gooseberry variety studied (Invicta, Captivator, Hinnonmaki Red), the treatment with *Thymus serpyllum* had the highest efficiency. However, *Mentha pulegium* has proven to be less effective.

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