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DISTRIBUTION OF INVASIVE SPECIES *METCALFA PRUINOSA* IN GREEN FOREST OF WESTERN ROMANIA

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Abstract

The Green Forest around Timişoara is home to numerous species of harmful insects. We would like to focus our attention on the species Metcalfa pruinosa known as Citrus Flatid Planthopper through this work. Uncontrolled, it is clear that the species can become dangerous for both woody plants in forests and those that constitute ground vegetation. Our study included observations of the size of nymph groups through the specific wax secretion left on the leaves of deciduous trees, 60-80 years old, but also older. The analysis was carried out in 7 sectors of the forest and had macroscopic techniques on site, by marking the target trees. All 8 plant species analyzed were affected in percentages ranging from 4.5% to 38%. The results showed that in sectors with predominant plants of Ulmus sp. and Acer sp. there were the most foliage with secretions, nymphs and adults. Also, the inner part of marginal trees and those near wide, airy paths were more affected by Metcalfa colonies. Regular monitoring could lead to reduction of damage.

Key words*: Metcalfa pruinosa, pest, Green Forest, trees, monitoring.*

INTRODUCTION

Metcalfa pruinosa, commonly known as the citrus flatid planthopper (CFP), is considered an invasive species in Europe (IUCN, 2000; Strauss, 2010; Forest Pests Europe website, 2024). Its origin is unclear, but it is known for sure that the first reports were made a long time ago, in North and Central America (Ontorio, Florida, Mexico and Cuba) (Metcalf and Bruner, 1948).
It entered Europe much later, in 1979, northern Italy (Zangheri & Donadini, 1980) and then gradually spread in entire continent (Pantaleoni, 1989) so that it was observed also in Romania for the first time in 2009 (Preda and Skolka, 2009). It was also reported in Asia, first in Korea (Kim et al., 2014).
Interestingly, it has established itself in various habitats in Europe, including forests. It is very polyphagous, feeding on a wide range of plants (330 species of woody and herbaceous plants) (Wilson & Lucchi, 2000), from various categories such as ornamental plants in parks, fruit trees, vines, vegetables, forest trees (Pons et al., 2002; Moosbeckhofer et al., 2012; Gogan and Grozea, 2013; Pencheva & Yovkova, 2016; Tancik & Seljak, 2017; Dobrin et al., 2020; Muntean & Grozea, 2021).
Its feeding habits can affect the general health of plants. Thus, through direct damage (feeding by extracting cell sap), photosynthesis is affected and implicitly growth and development (Vlad & Grozea, 2016).
Through indirect damage, i.e. by vax white secretion and "honeydew" by nymphs, the last sticks to leaves, fruits or other vegetative organs and can cause inhibition of essential processes (respiration and photosynthesis of leaves). In addition, a qualitative depreciation of the leaves is also created (Chireceanu & Gutue, 2011).
Most of the time, the basic symptoms are confused with secondary symptoms, so the presence of waxy filaments on the plant organs, or honeydew are considered the main symptoms in recognizing the species through the attack (Gogan & Grozea, 2013; Świerczewski et al., 2022).
It is assumed that honeydew would be eliminated depending on the body size, especially L4, L5 and adults eliminate appreciable quantities, especially in late summer (Kahrer et al., 2009).
Its adaptability allows it to thrive in diverse environments, from grassy areas, shrubs to mixed deciduous forests. The association of the CFP pest with forest habitats is often highlighted at a significant level. Studies have shown that

the cicada is frequently found in forested areas. A weighting of the host plant categories was found as, for example, in South Korea approximately 33.8% of *Metcalfa pruinosa* populations were recorded in forests (Lee et al., 2019).
The occurrence and dispersal of CFP are closely linked to a number of factors such as meteorological conditions, geographical conditions, biological factors, human activities and the availability of host plants (Pantaleoni, 1989, 1989; Kill et al., 2011).
The impact that this flatid species has on host plants can be viewed depending on the type of habitat (agro-horti-ecosystem or natural ecosystem), in many cases being underestimated (Derim, 2018).
The multiple factors contributing to the spread and presence of the CFP pest in forests are of concern with impacts on biodiversity (Byeon et al., 2017).
Given its ability to spread widely and adapt to new host plants, continuous monitoring of susceptible areas is essential for managing the impact of PCF in forested areas. Therefore, through this work we would like to bring to attention the current distribution of the foliar pest in a mixed deciduous forest through the symptomatology and characteristics but also the presence of active stages.

MATERIALS AND METHODS

Characterization of the study site

The on-site observations were made in a natural recreational forest type area, called "Padurea Verde" (Engl. "Green Forest"), which is located in the western part of Romania and belongs to the municipality of Timisoara (Figure 1). It covers an area of 560.48 ha and is composed of both deciduous and coniferous trees. Deciduous trees are predominant (560.03 ha) while conifers have a low share (0.45 ha). This forest is inhabited by the Behela River, which supplies water to the plants. Oak is the predominant species among deciduous trees, but other species such as ash, acacia, field sycamore, elm and walnut are also present (Achim & Buzatu, 2018).

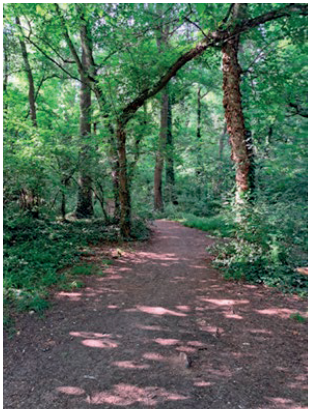

Figure 1. Place of study, the deciduous forest in Western Romania known as "Padurea Verde" (landscape image - indoor alley)

Observation points

Our attention was directed to the marginal sectors in the southern part of the forest that are located next to public roads and constructions. Thus, 7 sectors (according to the division made by the Timisoara Forest District in 2018) of this section were subjected to light visual observations, directly on site 2 times a month (July-September), during 2024. With the help of GPS, the observation points were marked (2.85 points/sector), a total of 20 points subjected to observations (Figure 2) (Table 1).

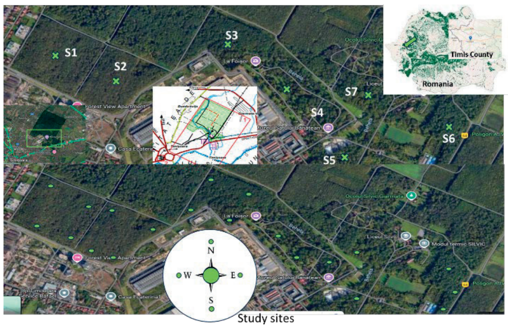

Figure 2. Marking study sites within the marginal sectors of the southern part of the forest

In some sectors we marked 4 points, in others 3 and in others 2 depending on the surface and shape. Around the observation point, approximately 2 m was measured radially (as appropriate) in the direction of the cardinal points (N, S, E and W) and to include 4 trees each (Figure 2).

Table 1. Technical characteristics of the sectors under study

Sections	Observation points	Identification date
Section 1	P1	45.783122, 21.247595
	P2	45.783067, 21.247571
	P3	45.781965, 21.250220
	P4	45.780230, 21.248703
Section 2	P5	45.779468, 21.250372
	P6	45.781584, 21.251737
	P7	45.780568, 21.253831
	P8	45.779150, 21.251646
Section 3	P9	45.781754, 21.257048
	P10	45.783572, 21.258683
	P11	45.782682, 21.260775
	P12	45.781213, 21.259337
Section 4	P13	45.780028, 21.262335
	P14	45.778917, 21.264083
	P15	45.778378, 21.266115
Section 5	P16	45.775585, 21.266365
Section 6	P17	45.775794, 21.273754
	P18	45.776674, 21.274223
	P19	45.778235, 21.273754
Section 7	P20	45.779519, 21.268485

The leaves on the lower level of the tree crown were observed (sometimes using a mobile foldable ladder) and were directly analysed. The leaves with white secretions on the underside (specifically for *Metcalfa* nymphs) were counted, as well as the nymphs inside the secretions and the adults (known to be good jumpers) where they were observed. Images were taken by video and photos then quantified on electronic material enlarged on the computer. This method was adapted for this type of ecosystem (natural) so that the leaves with pests and damage present would continue to remain on the tree.

Indirect symptomatology (white secretion) produced by the nymphs of *Metcalfa pruinosa* can be easily confused with that of the woolly aphid (*Eriosoma lanigerum*), but the distinction between the two can be made on the spot. That is; to identify the woolly aphid, high density of secretion and it's much more robust consistency are considered (Palagesiu et al., 2000).

Grassy vegetation on the ground or on the tree trunk was also observed. Additionally, the levels of secretions on them and the presence of nymphs and adults were taken into account. The reason was based on the potential migration onto the leaves of the tree under analysis.

No leaf was detached from the tree regardless of the degree of attack.

Where applicable, raw data were statistically interpreted (Anova test, descriptive statistics).

This type of study is one of observation and warning about the future danger of population growth and direct and indirect damage.

RESULTS AND DISCUSSIONS

Our observations showed that on the 8 species of plants marked (ash, acacia, elderberry, elm, hornbeam, maple, oak, walnut) the CFP species as a phytophagous pest was present in various percentages on leaves and shoots. Among these tree species, the elder is considered a small tree or shrub (like elderberry). Most are tall trees but even so the pest presence was reported in active forms (nymphs and adults). Although oak is the predominant species in the Green Forest, the phytophagous pest (*Metcalfa*) was present in a diversified manner on the monitored trees.

From what was observed on the active stages, nymphs and adults were present on all tree species, more precisely the leaves and shoots of the trees in various sizes. The highest numbers of nymphs in all sectors and observation points (P) taken as a whole were quantified on field sycamore (with an average of 6.8/leaf), elm (4.5 nimph/leaf), oak (average of 4.0) and ash (average of 3.0). Considered to be of small size were the average levels seen on elder and hornbeam (2.6 nymphs/leaf), acacia (average of 1.0) and walnut (0.5) (Figure 3).

Adults were also present on all 8 tree species, smaller than nymphs and observed only on shoots. There were differences in values between them, so the most were observed on elm (with an average of 2.8 ind./shoot) and sycamore (2.0 ind./shoot) and on oak (1.9 ind./shoot). Fewer were observed on ash and hornbeam (with an average of 1.5 ad./shoot), acacia and elder (0.5 ind./shoot) and walnut (0.2 ad./shoot) (Figure 3).

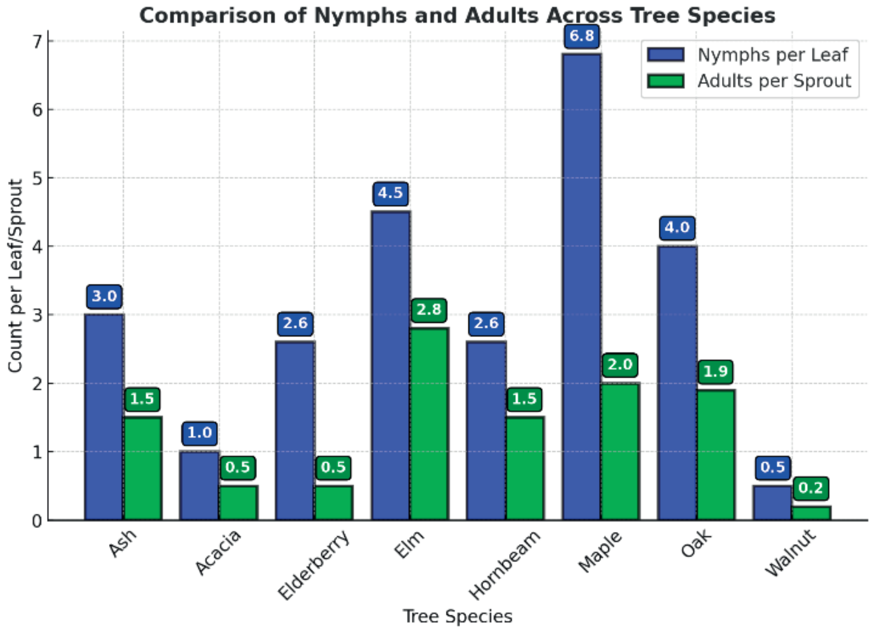

Figure 3. Chart comparing the average number of nymphs per leaf and adults per shoot from different tree species

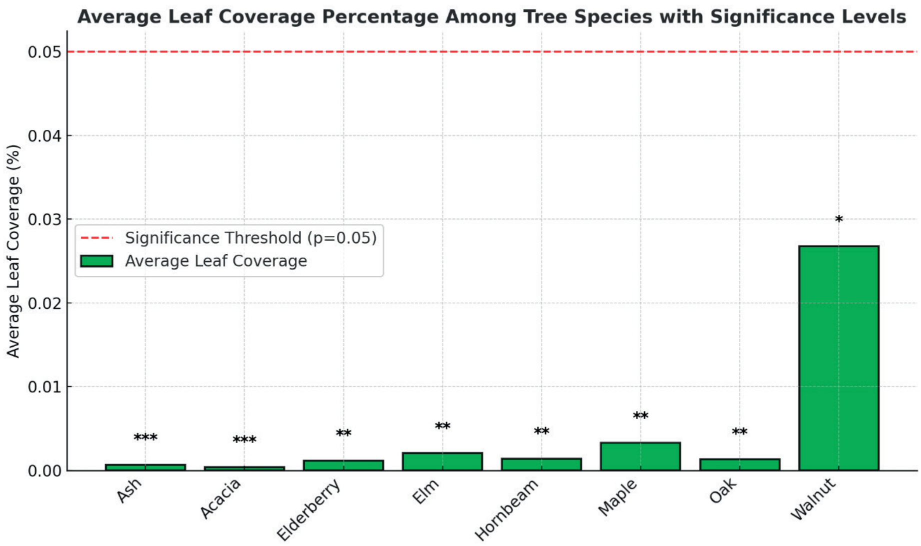

Figure 4. Diagram comparing the percentage of leaves covered with secretions produced by *Metcalfa pruinosa* nymphs (out of a total of 50 leaves analyzed/each tree)

A descriptive analysis of these without taking into account the observation points and months shows average values of nymphs per leaf of 3.13 and standard deviation (StD) of 2.0 and of adults per sprout 1.36 with Std of 0.9 and range (R) of 0.5 - 6.8 and of adults per sprout 1.36 with Std of 0.90 with R of 0.2 - 2.8.

All species have statistically significant differences from the mean, namely walnut is statistically significant (*) ($p<0.05$), oak, elderberry, elm, hornbeam and maple very statistically significant (**) ($p < 0.01$) and ash and acacia extremely statistically significant (***) ($p < 0.001$) (Figure 4).

Considering the percentage of leaves covered with nymphal secretions from 50 leaves (Figures 4, 5) analyzed over 3 months (July, August, September) we found that all trees had positive mean values of nymphal secretions on leaves, in percentages varying from 2% to 38%, with maple and elm predominating with 20 and 33% respectively, but also hornbeam, oak and elderberry with 14, 13 and 12%. Ash, acacia and walnut had mean values lower than 8% (7, 4 and 2%).

Figure 5. a) Nymphal colonies and fine white filamentous secretions on the underside of leaves (woody vegetation); b) details of the damage and nymphs present on the leaf petioles and leaves; c) d) adults on shoot

Monthly percentage of damage without considering observation points and tree species revealed an increasing trend in values, with an average of 8.9% in July, 11.9% in August and 13.0% in September (Figure 6).

Standard deviation shows an increase in the variation of damages from one month to another (July: 5.46%, August: 7.29%, September: 8.01%), suggesting that the differences between the observation points increased during the three months analyzed. Minimum value of damages is very small (0.1%-0.5%), indicating the presence of observation points with minimal or almost non-existent damages.

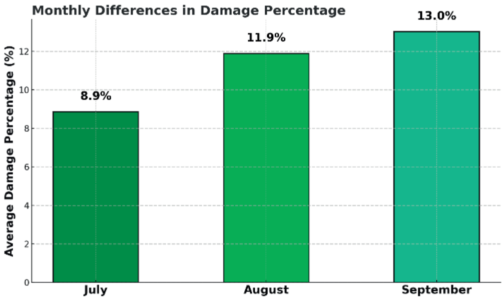

Figure 6. Graph showing the monthly percentage of damages without taking into account the observation points

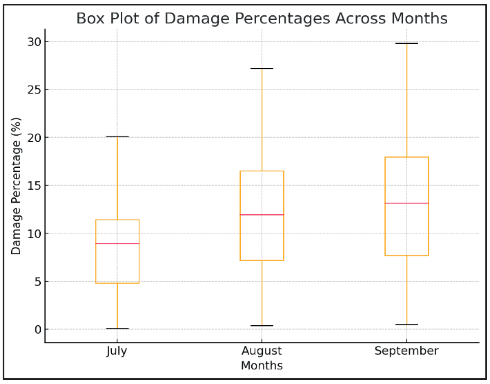

Figure 7. Boxplot diagram of damage percentage for the period June-October

Maximum value of damages is significantly higher in September (29.8%) compared to July (20.1%) and August (27.2%), signalling that over time certain points suffered a considerable increase in damages. Quartiles confirm the increasing trend, showing that most points suffered increasing damages, especially those in the upper part of the distribution (75%) (Figure 7).

Observation points vary significantly in terms of the average damage recorded, with both areas with minimal damage and areas that were severely affected (Figures 8, 9).

Overall average damage is approximately 11.26%, which shows that, in general, the points recorded a moderate level of damage (Figure 8).

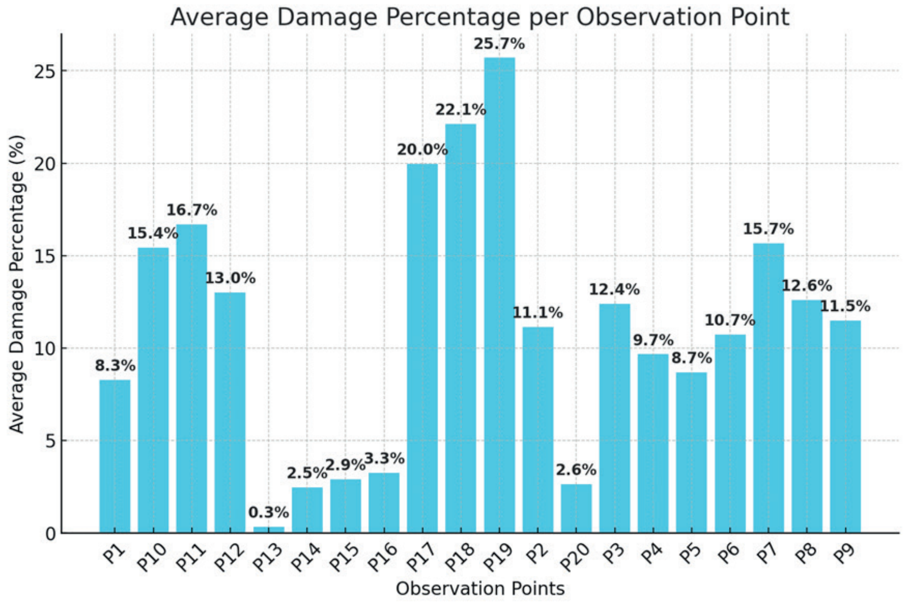

Figure 8. Chart comparing the average percentage of damage for each observation point (P) without considering months

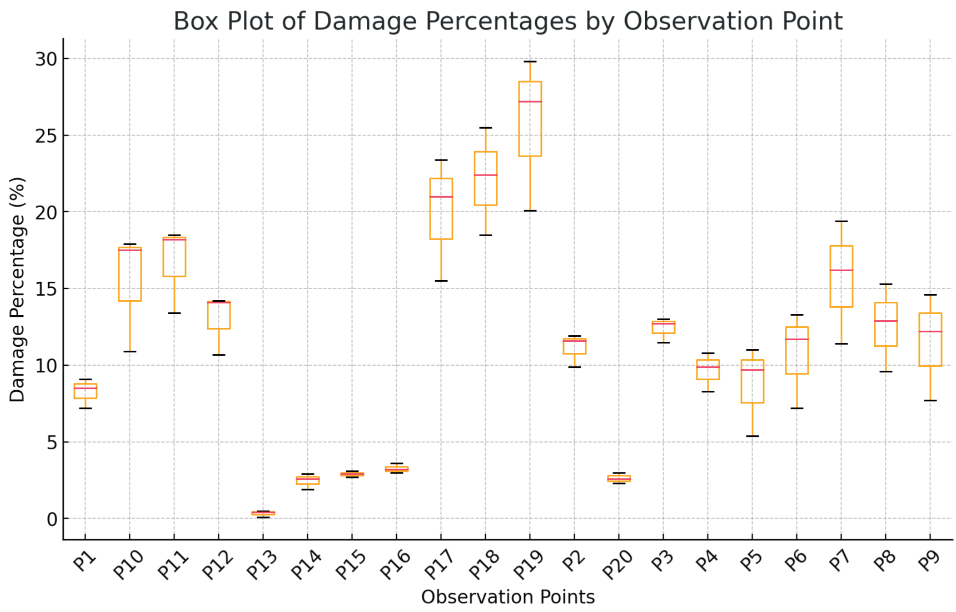

Figure 9. Box plot comparing damage percentages across observation points; viewing medians and potential outliers for each point

The standard deviation of 6.88% indicates a significant variation between the observed points, which suggests the existence of different conditions that influence the damage. Minimum value of the average damage per observation point is very low (approximately 0.33%), highlighting the existence of points with minimal or insignificant levels of damage. The maximum value of the average damage (25.7%) shows that there are observation points with high damage, well above the overall average. The quartiles suggest that half of the observed points have average damage below 11.32%, while a quarter of the points recorded damage above approximately 15.49%.

CONCLUSIONS

As a result, in the marginal sectors of the southern part of the Green Forest in Timisoara, both nymphs and adults of *Metcalfa pruinosa* were evident on the leaves and/or shoots, on the one hand, but also white secretions on the leaves. All monitored tree species had leaves with direct and indirect attack that disrupted the proper functioning of deciduous trees. The evolution of the damage in 2024 was progressive and is expected to increase in the following years in the absence of a strategy to keep it under control. We suggest the use of traps in future monitoring activities to assess the evolution of the damage.

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