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THE INFLUENCE OF DEFOLIATION CAUSED BY THE *STEREONYCHUS FRAXINI* L. BEETLES ON THE RADIAL GROWTHS IN THE SIRET BASIN STANDS

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Abstract
The appearance of mass multiplication of a primary defoliator - Stereonychus fraxini L.- in the past years, which caused injuries of economic importance, imposed measures of knowledge of pest biology in order to supervise and even combat it (Simionescu et al., 2012).
The research aimed at understanding the influence of defoliation caused by the Stereonychus fraxini L. beetles on the growth and vitality of forest stands with ash trees in their composition or ash forest stands.
The network with permanent control surfaces was materialized in the field, there where observations and measurements were taken and biological material for laboratory analyses was periodically harvested throughout the entire vegetation season, at different stages of insect development.
Defoliation causes a sensible reduction in growth of trees in forest stands. Complete, unrepeatable defoliation has important consequences on tree vitality, especially in the case of early defoliation, causing a 50-70% reduction in the vegetative mass compared to the witness trees unaffected by defoliation; the effect of defoliation manifests differently, depending on the age of the stands, being more pronounced in young stands than in older ones; repeated defoliation within the same year causes partial or total drying of the trees towards the end of the vegetation season (Blaga, 2010).
The defoliation caused by Stereonychus fraxini L. in ash stands or broad-leaved stands with ash trees in their composition generates the reduction in growth of wood mass (when the defoliation exceeds 25% of the foliage surface); the age of the stands influences the reduction in growth due to defoliation, in the sense that young stands are more sensitive than old (mature) stands; in severely and very severely defoliated stands, a small percentage of dry trees is observed. Drying occurs especially among the trees belonging to the last classes in Kraft's classification and in the case of young stands not subjected to specialized treatments/care; it would be equivalent to an accentuation of the self-elimination phenomenon (Blaga, 2010).
Prevention of defoliation is possible through pest control methods. Pest control treatments manage to prevent defoliation and to put an end to mass multiplication of insects.

Keywords: ash plantations, defoliation insects, radial growth.

1. INTRODUCTION

A widespread species in Southern and Central Europe, North Africa and Asia Minor (Lohse and Tischler, 1983), where it lives on species of the Oleaceae family, such as *Olea* sp., *Fraxinus excelsior*, *Phillyrea latifolia*, *Syringa vulgaris* (Drekić et al., 2014; Galović et al., 2019).

Stereonychus fraxini – has first exhibited a gradation in the years 1958 – 1959 in UP I Padurea Verde – Timisoara Forest District (Teicu, 1959). A second gradation occurred in the years 1965 –

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1966 in the same UP and extended to UP II Poiana Florilor – Aleşd Forest District. Since 1985, several outbreaks have been recorded, followed by emerging strong mass multiplications in several counties with ash tree populations, especially in the southern counties of the country. Ash forests in the Siret River Basin have been affected since 1999 by several biotic and abiotic stressors. Natural and anthropic factors weakened ash stands, leading to the appearance of some gradations of defoliators. This complex set of factors contributed to the occurance of drying phenomenon and its exacerbation over time. These circumstances concurred to the appearance of *Stereonychus fraxini* and its gradation.

The effects of defoliation caused by phytophagous insects concern tree physiology and include debilitations, decrease in biomass accumulations, increased sensitivity to secondary pests, diseases, and even tree death.

At the beginning of this century, climate changes appeared, the climate became warmer and drier, which favoured pest multiplication, especially that of defoliating insects and phytopathogenic agents.

2. MATERIALS AND METHODS

Species determination within *Stereonychus fraxini* genus was made in adult stage using determinants (Panin, 1951; Rogojanu and Perju, 1979).

In the beginning, the network with permanent control surfaces was selected and materialized in the field, there where observations and measurements were taken and biological material for laboratory analyses was periodically harvested throughout the entire vegetation season, at different stages of insect development. The biological material was harvested at significant times (at different developmental stages) from these permanent surfaces as well as from the itinerary.

For the egg stage, branch samples were collected from the control trees and analysed.

For the larval stage, branch samples were collected in order to determine the morphological elements of the larvae (cephalic capsule width) and growth under laboratory conditions was carried out in order to determine the food consumption, the total duration of development and the duration on individual stages.

For the pupal stage, soil surveys were used.

In order to establish the flight dynamics of *S. fraxini* beetles in adult stage, five batteries (control points) of three glue panels each were placed on trees in Vaslui Forest District (UP I Crasna, 40 E, 40 D and 38) and Brodoc Forest District (UP IV Zăpodeni, 50 B and 51 A) in two ways: at 1.30 m height (in 2007 and 2008) and at different heights (0.50 m, 1.50 m and 2.00 m) (in 2009). For all four stages of development, elements of detection were determined (Bliss, 1935).

In order to assess injuries and to determine the frequency and intensity of attacks, biometric measurements, counts, weights, etc. were performed. The identification and determination of pest insects have been carried out at various developmental stages.

Different procedures were used in the field surveys, based on the aspects of interest. Thus, to acquire knowledge about the biology of pests, phenological observations were made on the experimental surfaces, the time of occurrence of pests and of their attacks being established.

3. RESULTS AND DISCUSSIONS

The atack starts in early spring with the adults atacking and perforating the buds, which determines the diminishing in growth of the leaves and even their drying. Later, after the leaves are formed, the adults make perforations grouped in folioles, which turn into holes (they cross both epidermis layers). This injury is more reduced than the one caused by larvae.

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The larvae injure the lower part of the leaf and the mesophyll, leaving the upper epidermis initially untouched. It is not until the final ages that the upper epidermis is damaged, resulting in holes in the leaves. The holes produced by larvae are larger than those produced by adults and have brownish edges.
There's a significantly higher intensity of the attack in spring, caused by the second generation adults, as well as by the first generation larvae and adults (figure 1 a,b). The intensity of damage varies depending on the age of the trees. The attack is much more intense in young stands and tree nurseries, and it is evenly spread in the crown of adult trees (Abgrall and Soutrenon, 1991).
Young beetles carry out a maturation attack by perforating into the stems (figure 1c).

Figure 1. The damage characteristics produced by the Stereonychus fraxini:
a) attack produced by larvae on leaves; b) attack produced by larvae on flower buds; c) maturation attack of adults from the I^{st} generation

Defoliations caused by S*tereonychus fraxini* pest in young ash stands and ash plantations in forest disctricts of Moldova, 2006 and 2010

Defoliation percentage of folioles of ash tree leaves, caused by *Stereonychus fraxini* larvae, varies between 0 and 70% for the analysed trees. The most severe defoliations were located especially on the leaves harvested from the top of the trees. However, severe defoliations were also identified on the leaves harvested from the middle or the base of tree crowns.
If we analyse the degree of defoliation temporarily, it is observed that the trees with the highest percentage of leaves affected by defoliation are those analysed towards the end of the period when the study was conducted (trees from forest districts of Vaslui Forest Department, leaves analysed on May 11,2010), whereas the analysed trees within Iasi Forest Department (analysed on May 4 and 5,

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2010), still have a fairly high percentage of untouched leaves, the attacked ones being defoliated on average by 5-10 % (figure 2).

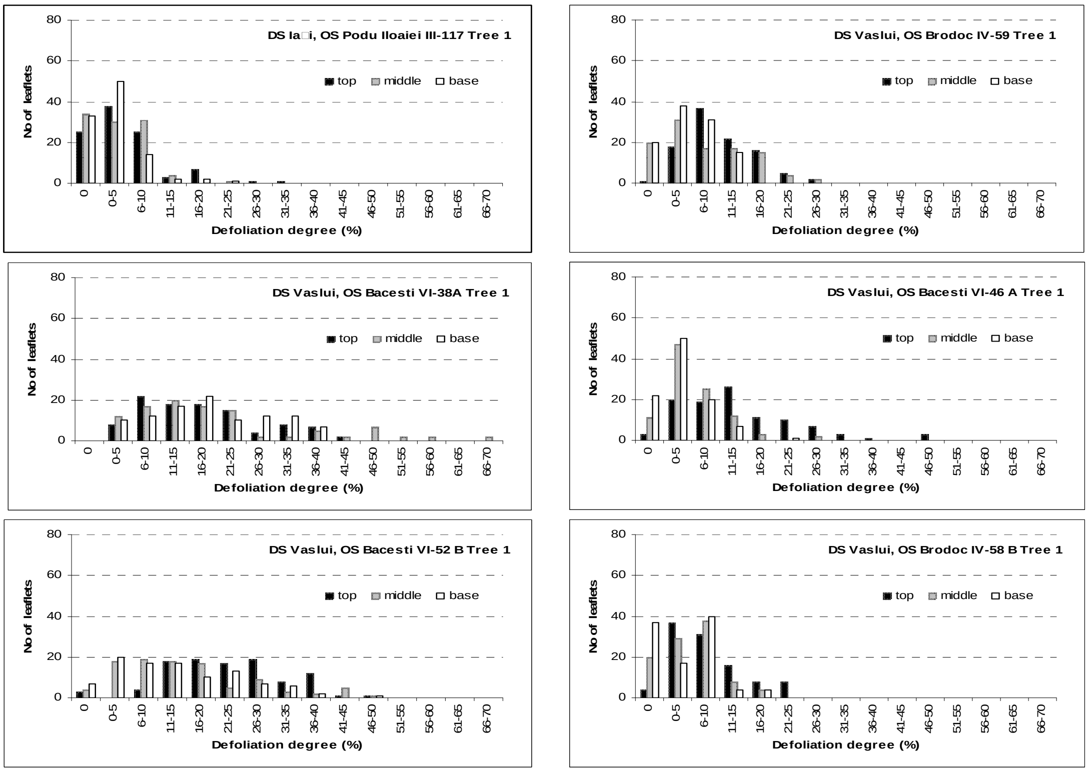

Figure 2. The defoliation produced by Stereonychus fraxini at different levels in the ash trees crown

With regard to larvae density of *Stereonychus fraxini* on ash trees leaves (figure 3), we notice that the largest populations of larvae are to be found on the analysed trees in Husi Forest District (Vaslui Forest Department), where the highest concentration of larvae is on the leaves in the middle and at the base of the crown , with almost 2 larvae/leaf. For the rest of the analysed trees, larvae density is below 1.2 larvae/leaf.

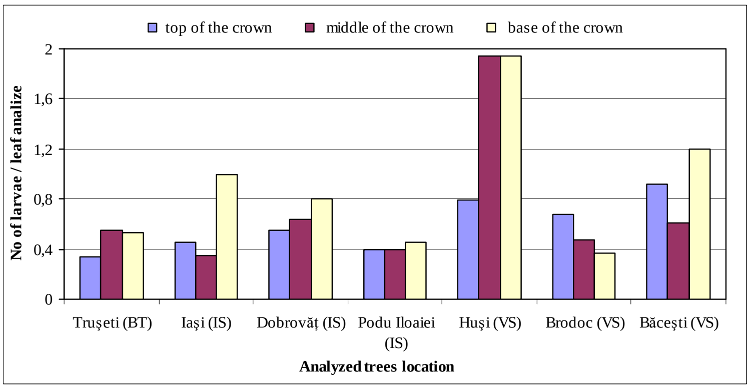

Figure 3. The Stereonychus fraxini larvae density on the ash trees leaves harvested from different levels in tree crowns in several forests districts from Moldova

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For most trees, it was noticed that most larvae are to be found at the bottom of the crown, except for the analysed trees in Brodoc Forest District (Vaslui Forest Department), where the highest concentration of larvae is on the top branches.

Effects of defoliation caused by *Stereonychus fraxini* De Geer

The impact of defoliation on radial growth in analysed ash trees is shown in figure 4. By applying the statistical calculation, an indirect correlation is observed between defoliation degree and reduction in radial growth.

In Brodoc Forest District r = - 0.6250, and in Vaslui Forest District, ua 30 A, r = - 0.6271 and on the whole UP r = -0.32.

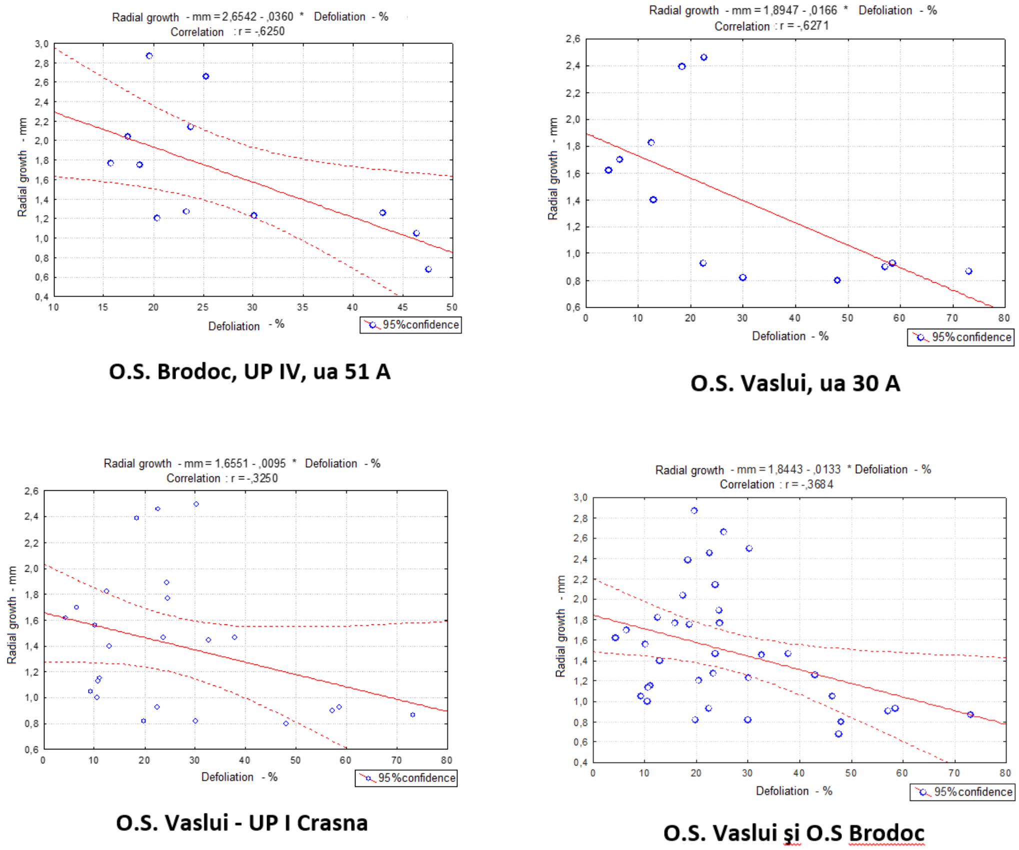

Figure 4. Corelations between the defoliation degree and the radial average growth on experimental areas, in Vaslui Forest District and Brodoc Forest District

We should mention that both experimental surfaces (Brodoc Forest District and Vaslui Forest District) are situated in areas with temperate continental climate, with extreme temperatures both in winter and summer and low precipitation. Average annual temperature in Vaslui is 10^0 C, and average annual precipitation is 525 mm.

Figure 4 shows the influence of temperatures on increases and a negative correlation between radial growths and average annual temperatures, thus: in Brodoc Forest District, correlation coefficient "r" is -0.8716 for ash tree, -0.1112 for pedunculate oak, -0.4585 for elm and -0.7405 for field maple. In Vaslui Forest District, correlations register negative values of -0.8110 for ash tree and -0.8896 for field maple.As for the correlation between precipitation and radial growth (figure 4), (except for the

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field maples ua 51 – Brodoc Forest District), the values are positive, with correlation coefficients r = 0.02026 for ash tree, 0.30754 for pedunculate oak, 0.35220 for field maple, in Brodoc Forest District, and r = 0.31207 for ash tree and r= 0.17542 for field maple, in Vaslui Forest District.

4. CONCLUSIONS

High-intensity defoliation (leaf area decreased by more than 90%), preceded or followed by weak or even imperceptible defoliations, influences the growth of stands in the year of defoliation, as well as in the following 2 years. The largest losses are recorded in the year of defoliation and in the following year (35-50% of the growth, for each year). In the second year after defoliation, growth is generally much less affected. By adding up the growth losses over the three years, it results that they are equivalent and in some cases exceed the growth of stands in one year.

Growth losses due to defoliation are not commensurate with the intensity of the attack. Calculating the value of the ratio between the sum of the percentages of growth reduction and the sum of the percentages of defoliation, it results that the highest values of this ratio are recorded in the case of a single strong defoliation, followed by strong defoliation and repeated very strong defoliation, then by medium defoliation, ending up with weak defoliation.

The decline in the production of ash stands following defoliation varies widely and depends on the frequency of insect gradations and the amount of average growth loss during a process of mass multiplication.

The age of the stands influences the reduction in growth due to defoliation, in the sense that young stands are more sensitive than old stands. However, the more pronounced effect of defoliation on the growth of young stands is partially offset by the fact that old stands suffer more intense defoliation.

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