RESEARCH ON THE EVOLUTION OF THE MAJOR PEST OF SYCAMORE TREE (*Platanus* spp.) IN THE BOLINTIN DEAL NURSERY

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Abstract: In 2014-2018, a study was conducted to observe the evolution of the lace bug *Corythucha ciliata* (Say) and the mining moth *Phyllonorycter platani* (Staudinger) on the sycamore tree leaves, and the soil pests as well. *C. ciliata*, which causes the yellowing of sycamore tree leaves, was observed in the Bolintin Deal nursery in August 2014, whose attack on the leaves was between 1.31-6.31% during August-October, with a maximum number of 45 adults and nymphs / colonized leaf. During the years 2015-2018, between April and October, the percentage of trees attacked was between a minimum of 1.58% in 2016 and a maximum of 29.17% in 2015. *P. platani* on the sycamore tree were also reported in 2014. There were observed leaves with characteristic symptoms (more or less oval, subeliptical forms mines) and leaves with obvious discoloured areas (with the upper edges arched and the lower and crested lower cuticle). The sycamore mine moth is part of the group of invasive species of Lepidoptera Gracilariidae which have an obvious economic and/or ecological effect and have expanded in Europe over the last 20 years. The mining moth was present from April to October. The mines formed in October and November are larger and evident on the leaves, often several mines on the same leaf. In 2014, during the August-October period, out of the total of the leaves attacked, 41.38% presented only one mine/leaf, 6.9% two mines/leaf, 17.24% three mines/leaf and 34.48% five mines/leaf. In the following years the percentage of mines per leaf was between 14.1% for 5 mines/leaf and 46.1% for 1 mine/leaf. As regards the soil fauna, the main groups of soil pests (wire worms, white worms and grey worms) were evaluated. The numerical density of larvae was somewhat uniform, and the populations of wire worms are predominant.

Keywords: *lace bug, mining moth, soil pests, sycamore tree*

INTRODUCTION

In the area of Bucharest, during 2014, there was an extension of two dangerous pests of the sycamore tree, the tiger of the sycamore tree (*Corythucha ciliata* Say 1832, Hemiptera: Tingidae) and the mining moth of the sycamore tree (*Phyllonorycter platani* Staudinger 1870, Lepidoptera: Gracilariidae) (Neacşu & Roşca, 2015), an aspect that will surely determine in the coming years the need to take measures to control them, probably by chemical treatments difficult to apply due to the height of the trees and often the presence of the sycamore tree in urban agglomerations.

In our observations in 2014-2018, there was recorded the evolution of main pests from sycamore tree nursery like laced pest of the sycamore tree, the mining moth of the sycamore leaves and the soil pests from Bolintin Deal nursery.

MATERIALS AND METHODS

The two species of harmful insects, *C. ciliata* and *P. platani* have been noted according to the usual methods. As we observed in the nursery, the number of leaves of *Platanus* trees was considered on average 45. Four lots of *Platanus* trees (761 trees) were considered. The samples were collected in the field and the more detailed processing was carried out under laboratory conditions. Species of insects have been determined in the laboratory. The frequency of the two harmful insect species has been noted according to common methods. The collection of soil fauna was done by different methods, both of the larvae and of the adult insects, serves to establish the exact species of the harmful species, to establish their numerical density, to make the forecast and the attack period of the larvae.

In the Bolintin Deal nursery, during the research of soil pests for the period 2015-2018, for the collection of larvae of elaterids (wire worms), melolonthidae (white worms) and noctuid (gray worms) we used the soil survey method, the biological material collections have performed throughout the active period of the year, especially in spring and autumn (March-April, September-October), in order to be able to highlight the changes in the structure of soil pests under the influence of the climatic and soil conditions of the area. The number of surveys in each plot studied was 3.12 per season, respectively 24/year, 96 during the four years of research, there were a total of 384 surveys. From each survey during the extraction of trees to be delivered (Figure 1) we collected the entire fauna from which we extracted larvae of elaterids, white and gray ash worms, which we identified.

Figure 1. Removing the trees grown in the nursery to be delivered to the buyers

In the nursery from Bolintin Deal, the following treatment scheme was applied in the period 2015-2016: the usual treatments in the nursery (pesticides in 10 liters of water) in 2015 were done on: May 6 with Confidor Energy 200 SL + Dursban 50W (5 ml + 10 ml); May 25 with Mimic 240 LV-0.4 l/ha (5 ml), Atonik biostimulator (10 ml), Lannate 20SL (20 ml), Nissorun acaricide 10WP (5 g); on June 20 with Confidor Energy 200 SL (5 ml + 10 ml); Atonic (10 ml), Lannate 20SL (20 ml), Nissorun acaricide 10WP (5 g); on July 29 with Confidor 200 SL (10 ml); on October 29 with Confidor Energy 200 SL (5 ml); Decis Mega EW50 (10 ml), Novadim Progress (20 ml) and in 2016 on May 15 with Decis Mega EW (10 ml), Confidor Energy 200 SL (5 ml), Novadim Progress (20 ml), Atonik (10 ml) , in 2017 on June 20 and August 20 with Decis Mega EW (10 ml), in 2018 on July 28 with Decis Mega EW (10 ml).

RESULTS AND DISCUSSIONS

Corythucha ciliata, the tiger of the sycamore tree belongs to the Tingidae family, Hemiptera order is presented in the Figure 2. This was recorded for the first time in Bucharest by Kis in 1990 (Kis, 1990).

Figure 2 Adult of *Corythucha ciliata*

Observations in 2014, regarding the presence of the pest *C. ciliata* in the nursery from Bolintin Deal, showed that out of 761 trees (found in the first year in the process of growing in the nursery), analyzed on August 18, only 5 (1.31 %) were attacked with 6 leaves with pests, on August 29, 9 (1.18%) with 19 leaves with harmful colonies, on September 18, 48 (6.31%) with 122 leaves with pests, and in October 16, 47 (6.18%) with 144 leaves with pest colonies (Table 1). The maximum number of adults and nymphs/colonized leaf was 45.

Table 1. The attack of *Corythucha ciliata* in 2014

Date of observation	Number of attacked trees	% attacked trees	Leaves with colonies of pests
18.VIII.2014	5	1.31	6
26.VIII.2014	9	1.18	19
18.IX.2014	48	6.31	122
16.X.2014	47	6.18	144

The observations continued during the years 2015-2018, the months of April-October. Five trees were analyzed on a monthly basis, from each lot, in 4 repetitions, taking into account the presence of the pest on 20 leaves arranged randomly in the crown of the plant. The number of adults and/or nymphs/leaf was recorded. It was considered that the observations should be made at least 7 days before the application of the phytosanitary treatments provided in the technology.

From the data summarized in table 2, it can be observed that the percentage of sycamore tree leaves on which the pest *C. ciliata* is present is variable depending on the year. From the data presented in table 2, it was observed that during the year, there was an obvious tendency for the population of the *C. ciliata* pest to increase, from 0.44% leaves attacked in April (taking into account the average over the 4 years studied) at 48.38% in October.

Table 2. Percentage of sycamore tree leaves with *Corythucha ciliata* and time of treatment (highlight)

Month	2015	2016	2017	2018	Average
April	0.25	1.5	0	0	0.44
May	11.25	3.75	3.25	0	4.56
June	0.50	8.25	15.75	5.75	7.56
July	3.00	35.75	8.25	15.25	15.56
August	25.50	5.75	35.75	3.75	17.69
September	5.75	25.25	17.25	8.75	14.25
Octobre	28.50	50.50	48.25	66.25	48.38
Average/year	10.68	18.68	18.36	14.25	15.49

As can be easily observed from the data presented in figure 3 it is obvious that any application of a control treatment applied in the sycamore tree plantation influences the percentage of sycamore tree leaves on which the pest *C. ciliata* is present.

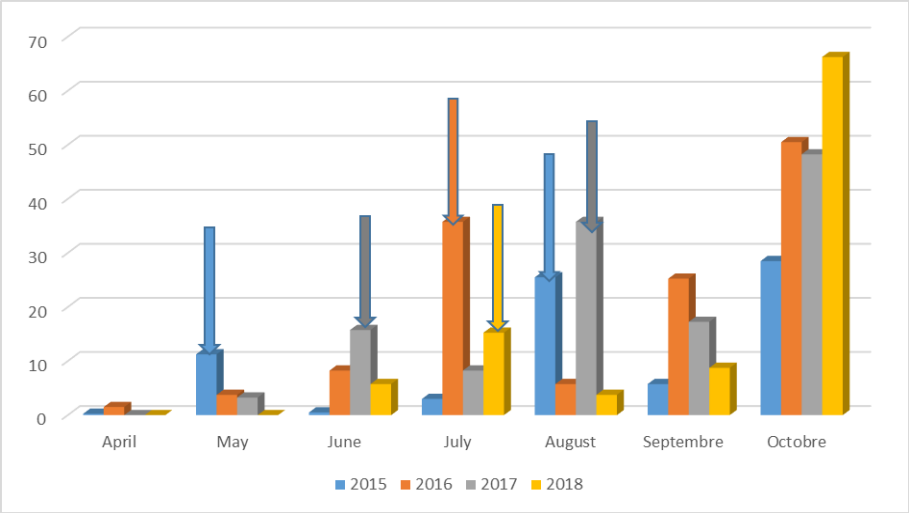


Figure 3. Percentage of sycamore tree leaves with *Corythucha ciliata* and the time of treatments

Thus, in 2015, 5 treatments were applied, throughout the entire vegetation period of the trees and thus the percentage of the leaves on which the presence of the pest was detected was the lowest (10.68%, with a maximum of 28.5 in October), in at the same time the application of only 2 control treatments during 2016 and 2017 led to an increase of the pest population to (18.68% in 2016 with a maximum of 50.5% in October and 18.36% in 2017 with a maximum of 48.25 % in October.

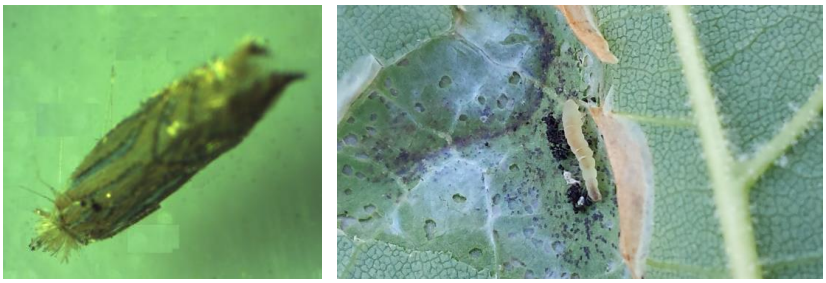
In 2018, the percentage of leaves detected with the pest was 14.25% with the maximum of 66.25% in October. The presence of the pest reaching the maximum in October (2015-2018) and especially the fact that after applying the control treatments (regardless of the type of treatment) the population of the pest is reduced.

There may be a more particular phenomenon, namely the decrease in the number of specimens/leaf of attacked sycamore tree, in September (2.44 number of specimens/leaf of attacked sycamore tree (2015-2018), this phenomenon being related to the fact that in the middle of September second-generation adults appear that begin to winter around the end of October, the month when the pest population reaches maximum development.

Phyllonorycter platani (Gracillariidae), the sycamore tree leaf mining moth has also been the subject of our research.

In the last century, in Europe, the first outbreak of the attack of *P. platani* on the sycamore tree leaf was observed, but the massive expansion of the species and its route began around the middle of the century (Šefrová, 2001).

In Romania, *P.platani* (Figure 4 A) was first reported in Bucharest in 1970 (Drăghia, 1970; Rákosy et al., 2003), and then in Lovrin in 1996 by Sandru (Ureche, 2006). Larvae of pests (Figure 4 B) develop large and very distinct mines, the attack often manifests itself by the presence of several mines, frequently, several on a leaf.



A **B**

Figure 4. *Phyllonorycter platani*: (A) adult, (B) larvae

The *P. platani* mining moth was observed in the nursery at Bolintin Deal in 2014, on August 30, in the form of an incipient attack with small larvae in the mines in the leaves, which become large and very obvious later in October, often some mines appear on the leaf (Table 3). At the end of August, from 761 sycamore tree the attack was reported on 1.71% (13 sycamore tree where the pest is present). The attack increased towards the end of the vegetation period when it can reach 3.81% (29 trees where the pest is present), on average, if we take into account all 4 batches, the percentage of infested sycamore tree increased from 2.94% at the end of August, to 6.49% in mid-October.

Table 3. *Phyllonorycter platani* mining attack in the Bolintin Deal nursery in 2014

BATCH	No. of sycamore tree	Infested sycamore trees			% of infested sycamore trees	
		30.08.2014	18.09.2014	16.10.2014	30.08.2014	16.10.2014
BATCH1	101	9	19	19	8.91	18.81
BATCH2	466	0	0	0	0.00	0.00
BATCH3	140	4	10	10	2.86	7.14
BATCH4	54	0	0	0	0.00	0.00
TOTAL	**761**	**13**	**29**	**29**	**2.94**	**6.49**

During the period 2015-2018, the attack of the *P. platani* pest, increased to 222 infested sycamore trees out of the total of 761 existing in the plantation in 2015. However, the pest attack was not significant, the observations made on August 18 and October 16 highlighted the fact that out of 761 existing sycamore trees in 2015, 222 (29.17%) were attacked by the pest, then, probably due to the control treatments applied, the attack of the pest decreased until 2018, (12 attacked trees or 1.58%, in 2016; subsequently it increased slightly, 48 trees attacked or 6.31%, in 2017; 92 trees attacked or 12.38%, in 2018) (Figure 5).

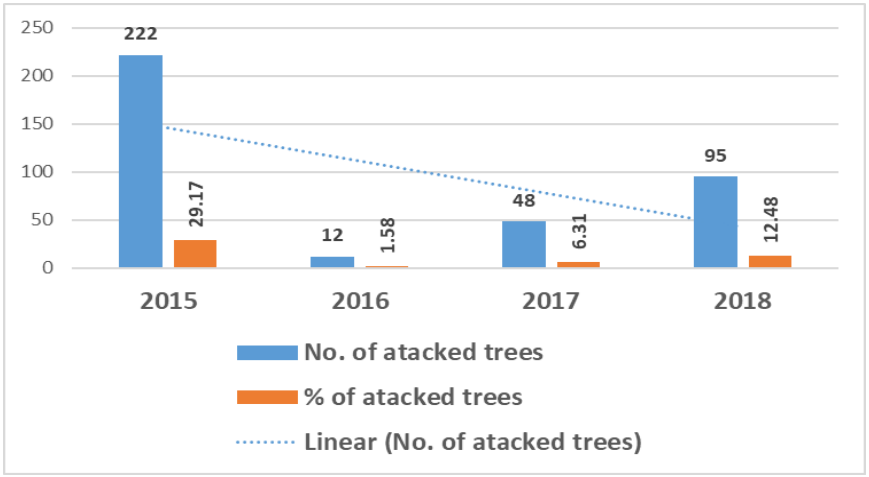


Figure 5. Attack of *Phyllonorycter platani* on the sycamore tree (2015-2018)

The pest attack mode was different during the years 2015-2018 (Figure 6). In 2015, were attacked by pests, 41.38% of the leaves attacked from the attacked sycamore trees, existing in the plantation had only one attack on a leaf that presented a mine, 6.9% of the leaves attacked from the attacked sycamore tree, existing in the plantation they had only an attack on a leaf that presented two mines, and the attack was manifested in them only on a leaf with a mine, 17.24% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented three mines and 34.48% of the leaves attacked from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented five mines.

In 2016, were attacked by pests, 58.33% of the attacked leaves from the attacked sycamore trees, existing in the plantation had only one attack on a leaf that presented a mine, 25.0% of the attacked leaves from the attacked sycamore tree, existing in the plantation they had only one attack on a leaf that presented two mines, and the attack was manifested in them only on a leaf with a mine, 8.33% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented three mines and 8.33% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented five mines.

In 2017, were attacked by pests, 52.08% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented a mine, 35.42% of the attacked leaves from the attacked sycamore tree, existing in the plantation they had only one attack on a leaf that presented two mines, and the attack was manifested in them only on a leaf with a mine, 8.33% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented three mines and 4.17% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented five mines.

In 2018, were attacked by pests, 32.63% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented a mine, 29.47% of the attacked leaves from the attacked sycamore tree, existing in the plantation they had only one attack on a leaf that presented two mines, and the attack was manifested in them only on a leaf with a mine, 28.42% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented three mines and 9.47% of the attacked leaves from the attacked sycamore tree, existing in the plantation had only one attack on a leaf that presented five mines.

From the data presented in figure 6 it is noted that in 2015, according to the number of mines, it is found that the attack on most leaves was with one mine (41.38%), then with 5 mines (34.48%) and the number of leaves attacked with 2 mines (6.9%) or 3 mines (17.24%) is located between these two values, during 2016 it is noticed that the number of the attacked leaves gradually decreases from 58.33% of the attacked leaves that have a single mine until 8.33% in the case of the leaves attacked with 5 mines, the same phenomenon happens in 2017 when the number of the attacked leaves gradually decreases from 52.08% attacked leaves that have a single mine to 4.17% in the case of the attacked leaves with 5 mines, but in 2018 when the number of the attacked leaves decreases slightly easier from 32.63% attacked leaves that have a single mine to 9.47% in the case of attacked leaves with 5 mines.

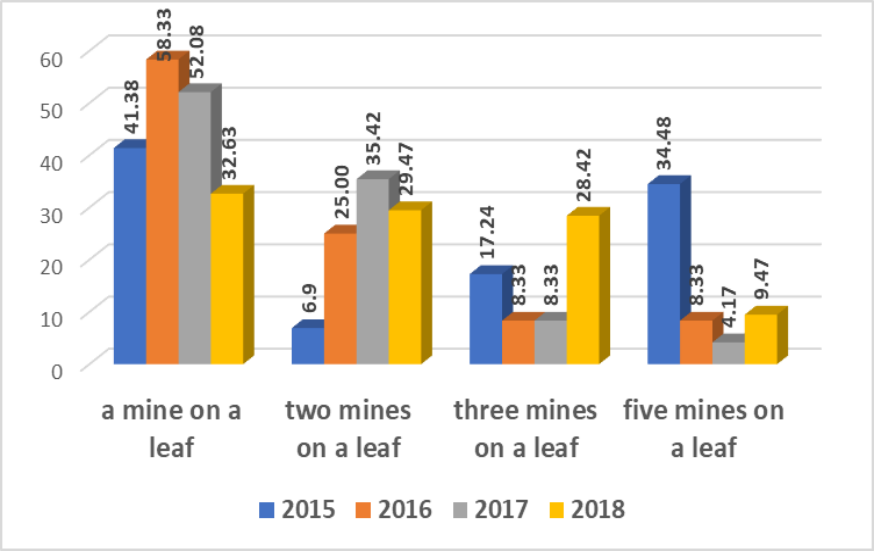


Figure 6. Attack of *Phyllonorycter platani* (2015-2018), according to the number of mines existing on the attacked leaves from the attacked trees

Our research aimed at establishing the composition and structure of the larvae of the main groups of pests in the soil (wire worms, white worms and gray worms), establishing the dynamics of the evolution of these pests, considering that the numerical density of the larvae is somewhat uniform, predominance of wire worms being evident. The surveys carried out and their processing revealed that 320 larvae were collected during the period followed, of which 254 (80%) are wire worms, 49 (15%) white worms and 17 (5%) gray worms.

The biological material collected through soil surveys during the four years of research (table 4) included 254 worm larvae, belonging to 6 subfamilies and 7 genera were identified after Perju & Mare (1984) as follows: *Elater* Linnaeus, *Agriotes* Eschscholtz, *Melanotus* Eschscholtz, *Selatosomus* Stephens, *Athous* Eschscholtz, *Limonius* Eschscholtz, *Drasterius* Eschscholtz, with a total of 17 strictosensum species and a variety.

Considering the extension of the sycamore in the urban agglomerations and even their possible use for the creation of protective curtains for roads, knowing the problems that may arise due to the harmful agents, including the possible modification of the microclimate or / and the structure of the weeds, as shown by Gradillă et al. (2018), it is necessary to know the possible problems that may arise due to the extension of this species.

It is also known that a number of sycamore pests can cause human discomfort and this aspect should be clarified in the future by quantifying these inconveniences and finding the means to prevent them.

Table 4. Structure of family Elateridae from the sycamore tree plantation (2015-2018) after the larval stage

Subfamily	Genus	Species
Elaterinae Leach	*Elater* Linnaeus	*Elater pomorum* Herbst
Agriotinae Champion	*Agriotes* Eschscholtz	*A. gurgistanus* Faldermann
		A. lineatus Linnaeus
		A. obscurus Linnaeus
		A. sputator Linnaeus
		A. ustulatus Schällér
		A. ustulatus var. flavicornis Panzer
Melanotinae Candèze	*Melanotus* Eschscholtz.	*Melanotus rufipes* Herbst
		M. brunnipes Germar
Ctenicerinae Fleutiaux	*Selatosomus* Stephens	*Selatosomus aeneus* Linnaeus
		S. latus Fabricius
Athoinae Candèze	*Athous* Eschscholtz	*Athous haemorrhoidalis* Fabricius
		A. niger Linnaeus
		A. hirtus Herbst
	Limonius Eschscholtz	*Limonius pilosus* Leske
		L. parvulus Panzer
Pyrophorinae Candèze	*Drasterius* Eschscholtz	*Drasterius bimaculatus* Rossi
6	7	17

CONCLUSIONS

During the years 2014-2018, the sycamore tree nursery (Bolintin Deal) was affected especially by two leaves pests, the tiger of the sycamore tree (*Corythucha ciliata*) and the mining moth of the sycamore tree (*Phyllonorycter platani*) and a series of soil pests.

C. ciliata, which causes the yellowing of sycamore tree leaves, was observed in the Bolintin Deal nursery in August 2014, but the attack was not significant, during the years 2015-2018, between April and October, the percentage of trees attacked was between a minimum of 1.58% in 2016 and a maximum of 29.17% in 2015.

P. platani was evident from April to October at the beginning of the observations, in 2014, in the August-October period, out of the total of the leaves attacked, in 41.38% the attack of the pest made only one mine/leaf, in 6.9% two mines/leaf, in 17.24% three mines/leaf and in 34.48% five mines/leaf, and in the following years the percentage of mines per leaf was between 14.1% for 5 mines/leaf and 46.1% for 1 mine/leaf.

The composition and structure of the larvae of the main groups of pests in the soil revealed that 320 larvae were collected during the period followed, of which 254 (80%) are wire worms (the main pests in the soil that affect nursery from Bolintin Deal), 49 (15%) white worms and 17 (5%) gray worms.

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