

***DISTRIBUTION FEATURES OF LEAFMINER MOTH ON BOLLE'S POPLAR
POPULUS PYRAMIDALIS BORKH IN KIEV CITY***

A.V. DRAZHNIKOVA, E.M. POPOVA

National Aviation University, Kyiv

*The paper shows the results of monitoring studies of leafminer moth distribution on poplar trees in Kiev in 2012-2013. Trophic preferences of leafminer moth are determined depending on the damage degree of poplar leaves. Trophic polyphenism of leafminer moths is experimentally confirmed. It was grounded the possible explaining the emergence of leafminer moth on poplar trees as transition of widely distributed in Kiev horse-chestnut leafminer moth *Cameraria ohridella* on a new host-plant – poplar tree as a result of invasive parasitic mycobiota distribution on the leaves of horse-chestnut trees, such as powdery mildew *Erysiphe flexuosa*.*

Key words: *mycobiota, leafminer moth, Cameraria, phytopathogenic fungi, horse chestnut, Aesculus, poplar tree, Populus, powdery mildew, Erysiphe.*

Introduction. Modern environmental conditions are characterized by an intensification of the distribution of invasive species on a global scale. The appearance of atypical for urboecosystems species can have unpredictable consequences, and the interaction of invasive species in the new environment complicates understanding of their distribution and development of integrated methods of their control.

In September 2012, in the Solomyanskyi district of Kyiv we for the first time discovered a massive lesion of leaves of pyramidal poplar trees *Populus pyramidalis* Borkh. (hereinafter referred to as – poplar) by leafminer moth (Fig. 1), which was

morphologically similar to horse-chestnut leafminer moth *Cameraria ohridella* Deschka & Dimic, 1086 (Fig. 2).



Fig. 1. Poplar leaves damaged by leafminer moth (September 2012)



Fig. 2. The appearance of adult stage leafminer moth (x25)

Caterpillars of leafminer moth feed on the sap of plant epidermal cells first, and then – leaf parenchyma, forming in them typical by form and color mines – a hollows

filled with their excrement. In the mid or late summer leaves with lack of chlorophyll dry up and then fall [1].

We found last year's fallen leaves of poplar with signs of a lesion by leafminer moth on the ground under the trees in lesion focus. So 2011 can be considered the year of lesion beginning of poplar trees by leafminer moth in Kiev.

It should be mentioned that the center of distribution of moth in the alley of poplar trees located near the horse chestnut *Aesculus hippocastanum* L. (hereinafter referred to as – horse chestnut) plantations with high level of total leaf surface lesion by horse chestnut leafminer moth *C. ohridella* and pathogenic mycobiota, in particular powdery mildew *Erysiphe flexuosa* (Peck) U. Braun & S. Takam., 2000. There was 80-100 % of the leaf surface lesion by biotic factors and some chestnut trees were already dead.

Our following research was focused on the confirmation of the hypothesis of a transition of horse chestnut trees leafminer moth *C. ohridella* on the new host-plant – poplar tree as a result of competition for space for the existence with pathogenic mycobiota of horse chestnut trees. For this it was necessary to confirm that the horse chestnut and poplar leafminer moth is one species. For confirmation of the herbivore of poplar trees species we provided the comparative morphobiological and ecological characteristics of founded leafminer moth.

Materials and methods of research. The research of phytosanitary condition of trees was carried out in Solomyansky district of Kyiv from May to October 2012 and 2013. During the observations we examined leaves of poplar and chestnut trees, identifying the signs of leaf lesion by pathogenic fungi and leafminer moth with determining their character and dynamics.

Photos in nature were made by A.V. Drazhnikova. The photomicrography were made on a light microscope “Микмед-1” and defectoscope МПБ-3 by V.G. Lazariev and A.V. Drazhnikova in the laboratory of the Biotechnology Department of National Aviation University.

Genitalia preparations of leafminer moth imagoes were made by the method [2] from freshly killed insects without pretreatment.

Results and discussion. The degree of poplar leaves lesion by leafminer moth reached 90-100 % in early June (Fig. 3), it is possible to argue about an abnormal outbreak of poplar pest insect number.



Fig. 3. Outbreak of leafminer moth on the poplar leaves (June 2013)

Damaged leaves of poplar quickly dried out and began to fall off the end of June. The end of August there was a complete defoliation of poplar trees along Vidradnyi avenue (Fig. 4), while unaffected by moth poplar trees in Kiev were foliated until November.

At the end of the vegetation season 2013 leafminer moth distributed to all poplar tree in diameter of 2 km from the lesion focus in Solomyansky district of Kyiv.

Some features of trophic preferences of leafminer moth were identified. The first generation of moth in May and June damaged leaves only of poplar trees. The second generation in June and July, in the absence of sufficient space to lay their eggs on the leaves of poplar trees, began settling chestnut leaves that grew near.



Fig. 4. Defoliation of poplar trees along Vidradnyi avenue of Kyiv city in August 2013

Moth imagoes with lighter color of wings accumulated on chestnut bole and leaves (Fig. 5). Also it is noticed attention the fact that the lesion degree of chestnut tree leaves, that were near the poplar trees, by horse chestnut leafminer moth *C. ohridella* at that time was minimal and was determined to 5-10 % of the leaf surface, that is also evident from Fig. 5.

Third and fourth generations of moth in the lesion focus began settling on leaves of single in this green area balsam poplar *Populus balsamifera* (Fig. 6). The main feature of the balsam poplar leaves lesion was that the mines were only on the lower leaf surface, whereas lesions of pyramidal poplar leaves were characterized by the presence of mines as the lower and the upper surfaces of the leaves, while primary lesions were focused at the lower plate leaves.



Fig. 5. Imagos on bole and leaves of horse-chestnut tree

Trophic features of leafminer moth during the outbreak observed in Kiev in 2013 are summarized in the table 1.

Table 1

Trophic features of leafminer moth during the outbreak observed in Kiev in 2013

Moth generation	Period of year	Trophic base
I	May-June	<i>P. pyramidalis</i>
II	June-July	<i>P. pyramidalis</i> , <i>A. hippocastanum</i>
III	July-August	<i>P. pyramidalis</i> , <i>A. hippocastanum</i> , <i>P. balsamifera</i>
IV	August-September	<i>P. pyramidalis</i> , <i>A. hippocastanum</i> , <i>P. balsamifera</i>



Fig. 6. Lesion of balsam poplar leaves by leafminer moth

The localizations of moth imagoes on bole of lime trees that grew nearby were identified, but signs of lime leaves lesion were not identified in the future.

To confirm the trophic relations between leafminer moth, that damages the leaves of poplar trees in Kyiv, with horse chestnuts we conducted an experiment. We artificially infected leaves of horse chestnut trees with moth collected from the affected poplar trees. For this one-two-year old horse chestnut plants were transplanted into pots and placed in a glass aquarium with wrapped top by cheesecloth and plastic film to create an isolated conditions. Watering of horse chestnut plants conducted through pipettes and tubes that did not disturb the isolation (Fig. 7).



Fig. 7. One-year old horse-chestnut trees were placed in a glass aquarium for creation of isolated conditions with possibility of watering through tubes

Inside the aquarium with pots we released imagoes of leafminer moth with a distinctive bright color of the wings collected from damaged poplar trees. After three days the formation of mines on the upper surface of horse chestnut leaves have been seen (Fig. 8).

Further our observations were focused only on horse chestnuts with developed mines (Fig. 9-11).



Fig. 8. Formation of mines on the leaves of chestnut in 3-rd day after insects introduction



Fig. 9. Formation of mines on the leaves of chestnut: 9-th day



Fig. 10. Formation of mines on the leaves of chestnut: 13-th day



Fig. 11. Leafminer moth pupa cases on the leaves of chestnut (20-th day)



Fig. 12. Change of imago wings color

When observing the leafminer moth imagoes, which began to emerge from mines in 20th day after the beginning of the mines formation, immediately our attention was attracted to change of wings color of daughter imagoes (Fig. 12) compared with the wings color of the parent individuals (Fig. 2), which were released in the aquarium for the infection of horse chestnut plants. All eight emerged imagoes were with the same wings color, which was identical to the typical wings color of horse chestnut leafminer moth *C. ohridella*.

Thus, the question is put about the nature of the phenomenon of changes the wings color of the moth. We are inclined to think about the possibility of explaining this phenomenon as adaptive resource or trophic polyphenism of leafminer moth. Possibly the moth, that damages the horse chestnut and poplar trees in Kiev, is the same species, but with a different imago wings color according to trophic preferences. Also, the imagoes wings color matches the color of poplar or horse chestnut trees bark correspondingly.

To confirm the belonging of leafminer moth that damages the horse chestnut and poplar trees in Kyiv to the same species, we have prepared genitalia preparations of imagoes. Comparing Fig. 13 and Fig. 14, it can be argued the genitalia morphological similarities of horse chestnut leafminer moth *C. ohridella* and leafminer moth that damages the leaves of poplar trees in Kiev.

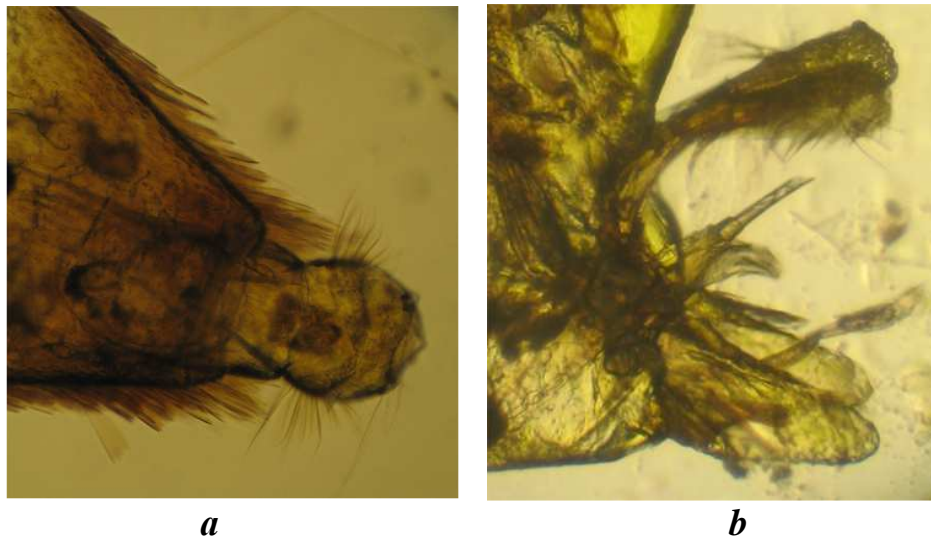


Fig. 13. The structure of the female (a) and male (b) genitalia of leafminer moth that damages the poplar tree in Kiev (×400)

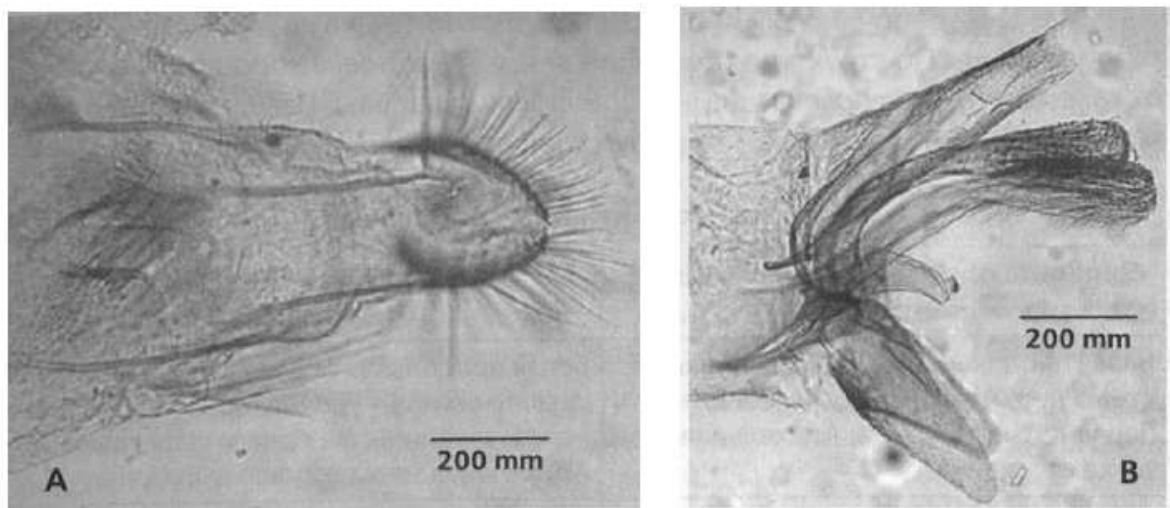


Fig. 14. The structure of the female (A) and male (B) genitalia of *C. ohridella* [3]

Mechanical damage of poplar leaves, as a result of leafminer moth outbreak, creates additional conditions for the spreading of the pathogen mycobiota on poplar trees. Therefore, in the coming years in Kiev, we can predict progressive lesion of poplar trees leaves by powdery mildew, as it happens now with horse chestnut trees.

By this time the origin of leafminer moth that damages the leaves of poplar trees in Kiev remains unknown. One theory is the introduction of its egg by birds. However, obtained data point to its trophic relations with horse chestnuts and possible relation with horse chestnut leafminer moth *C. ohridella* prevailing in Kiev during the last 10 years.

Our previous study [4, 5] devoted to characteristics of the mycobiota of urban horse chestnut plantations indicates the antagonistic character of the relationship “leafminer moth – pathogenic mycobiota”. Therefore, we can suppose that the outbreak of leafminer moth on poplar trees in Kiev is the result of competitive exclusion of horse chestnut leafminer moth *C. ohridella* from ecological niche of horse chestnut tree by pathogenic mycobiota, particularly by powdery mildew *E. flexuosa*. This hypothesis is confirmed by research of scientists from Finland [6], who observed the interaction of invasive powdery mildew *Erysiphe alphitoides* and insects community on oak *Quercus robur*. It was found that powdery mildew of oak influences the insect choice of food base, thus changing the distribution of specialized pests at two spatial scales (on tree and between trees). The presence of an invasive mildew on host trees decreases both herbivore number and herbivore species number on host plants.

In this case, there may be unobserved direct effects between the mildew and insects, or the mildew may be able to manipulate host defenses to its advantage. As a result, there are still several potential unexplored mechanisms describing the interactions between invasive microbes, insects and plants [7].

CONCLUSIONS

Conducted researches suggest that the beginning of the leafminer moth distribution on poplar trees in Kiev is 2011, and the outbreak occurred in 2013.

Some trophic preferences of leafminer moth were discovered: primary settlement of pyramidal poplar trees leaves, and in the absence of sufficient space to laying eggs on the leaves of pyramidal poplar, the next moth generation began settling horse chestnut and balsam poplar trees leaves.

It is assumed that the leafminer moth outbreak on poplar trees in Kiev is the result of competitive exclusion of horse chestnut leafminer moth *C. ohridella* from ecological niche of horse chestnut tree by pathogenic mycobiota, particularly by powdery mildew *E. flexuosa*.

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ОСОБЛИВОСТІ ПОШИРЕННЯ МІНУЮЧОЇ МОЛІ НА ДЕРЕВАХ ТОПОЛІ ПІРАМІДАЛЬНОЇ *POPULUS PYRAMIDALIS* BORKH. В МІСТІ КИЄВІ

А.В. ДРАЖНИКОВА, Е.М. ПОПОВА

Національний авіаційний університет, м. Київ

*У статті наведено результати моніторингових досліджень поширення мінуючої молі на деревах тополі в м. Києві у 2012-2013 роках. Встановлено трофічні уподобання мінуючої молі в залежності від ступеня ушкодженості нею листя дерев тополі. Експериментально підтверджено трофічний поліфенізм мінуючої молі. Обґрунтовується можливість пояснення появи мінуючої молі на деревах тополі як перехід загальнопоширеної у м. Києві каштанової мінуючої молі *Cameraria ohridella* на нового господаря – дерево тополі внаслідок поширення на листі дерев каштана паразитарної мікобіоти, зокрема збудника борошнистої роси *Erysiphe flexuosa*.*

Ключові слова: *мікобіота, мінуюча міль, Cameraria, фітопатогенні гриби, каштан, Aesculus, тополя, Populus, борошниста роса, Erysiphe.*

ОСОБЕННОСТИ РАСПРОСТРАНЕНИЯ МИНИРУЮЩЕЙ МОЛИ НА ДЕРЕВЬЯХ ТОПОЛЯ ПИРАМИДАЛЬНОГО *POPULUS PYRAMIDALIS* BORKH. В ГОРОДЕ КИЕВЕ

А.В. Дразникова, Э.М. Попова

Национальный авиационный университет, г. Киев

В статье приведены результаты мониторинговых исследований распространения минирующей моли на деревьях тополя в г. Киеве в 2012-2013 годах. Установлены трофические предпочтения минирующей моли в зависимости от степени повреждению нее листьев деревьев тополя.

Экспериментально подтвержден трофический полифенизм минирующей моли. Обосновывается возможность объяснения появления минирующей моли на деревьях тополя как переход общераспространенной в г. Киеве каштановой минирующей моли *Cameraria ohridella* на нового хозяина – дерево тополя вследствие распространения на листьях деревьев каштана паразитарной микобиоты, в частности возбудителя мучнистой росы *Erysiphe flexuosa*.

Ключевые слова: микобиота, минирующая моль, *Cameraria*, фитопатогенные грибы, каштан, *Aesculus*, тополь, *Populus*, мучнистая роса, *Erysiphe*.