Can native parasitoids control the invasive lime leaf-miner *Phyllonorycter issikii* (Lepidoptera: Gracillariidae) in Western Siberia?

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The lime leafminer *Phyllonorycter issikii* (Kumata) (Lepidoptera: Gracillariidae) is an invasive moth from East Asia that nowadays is found in many regions across the Palearctic [1,2]. It is a pest of limes (*Tilia* spp., Malvaceae) in both native and urban plantings. For the first time, the species was recorded in Russia in Moscow in 1985 [3]. In Western Siberia it was documented in 2006 [4]. It noticeably damaged the native small-leaved lime (*Tilia cordata*) In Novosibirsk in 2020 (Figure 1).

Figure 1. The lime leaf miner (**a**), significantly damaged leaves of *Tilia cordata* (**b**), the lime grove (**c**). Central Siberian botanical garden SB RAS, Novosibirsk, 2020.

Aim

In this study we aimed

(1) to estimate relative number of mines per leaf (Figure 2);

(2) to assess the survival of *Ph. issikii* on *T. cordata*, a plant with which the pest established a novel trophic association during its invasion westward;

(3) to define the infestation rate of the late instar larvae and pupae of *Ph. issikii* by the native parasitoid wasps (Hymenoptera).

Figure 2. The leaf of *T. cordata* with *Ph. issikii* mines.

Study region

Figure 3. Sampling locality in Novosibirsk Oblast (black dot). The distance between Moscow and Novosibirsk is 2813 km (in a straight line).

- Novosibirsk, the Central Siberian botanical garden, Siberian Branch of the Russian Academy of Sciences (CSBG SB RAS) (Figure 3).

The moth was recorded in Novosibirsk in 2008. Since then, the pest progressively increased its population density reaching the outbreaking level.

Sampling

We sampled by 300 leaves in the lower part of the crown from three *T. cordata* trees in the arboretum of CSBG SB RAS on 25th of June 2020.

We placed by five leaves with the mines per Petri dish (90 mm in diameter) in 15 replications (i.e. 15 dishes) (Figure 4). The remaining leaves were used for mass rearing (to get more parasitoids for identification).

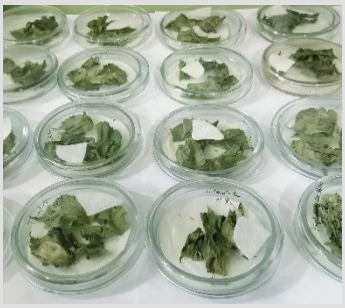

Figure 4. Rearing arranging in the laboratory conditions.

The dishes were kept in stable laboratory conditions (+24° C, 65% of humidity; 17/7 h light/dark) and checked regularly to count the number of hatched moths and parasitoid adults.

The number of mines was counted per a leaf; the number of emerged adult moths and emerged parasitoids were recalculated per a number of mines on the leaves. The parasitoids were collected in the microtubes with 95% alcohol solution for further study.

Preliminary results

On average, 7,1±0,5 mature mines per leaf was documented on *T. cordata* in the arboretum in the end of June 2020. In one case, we counted 29 mines on a leaf (the mines were present on both sides of the leaf lamina), that was the maximum absolute number of mines on an average-size leaf.

In the laboratory rearing, up to 70% of *Ph. issikii* pupae successfully developed to adults. The remaining late instar larvae and pupae (i.e. 30%) died, among which only 7.4% of the moth's individuals were parasitized. Across 15 dishes, in which the leaves with *Ph. issikii* mines were kept, we obtained 38 parasitoid adults (mainly Eulophidae) (Figure 5).

Figure 5. Some parasitoids reared from *Ph. issikii* larvae and pupae that were collected in the Central Siberian botanical garden SB RAS (Novosibirsk) in 2020. The parasitoids are currently being under identification (based both on morphology and DNA barcoding).

The obtained results suggest that the invader seems to benefit from establishing the new trophic association with the native lime (bearing in mind the current outbreaking density and a high survival rate of the pest) and releasing from its domestic enemies.

The low mortality due to parasitoids that are native to Siberia indicates that, at present, the local complex of parasitoid wasps is not effective to control the population on the alien moth in the invaded region in Western Siberia.

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Acknowledgments

We thank Dr. Maria Tomoshevich (CSBG SB RAS, Novosibirsk) for her help and hospitality during our stay in Novosibirsk. In the study, the materials of the bioresource scientific collection of the CSBG SB RAS "Collections of living plants indoors and outdoors" USU_440534 (Novosibirsk, Russia) were used.

Funding

This research was funded by the Russian Foundation for Basic Research (grant no. 19-04-01029 A).