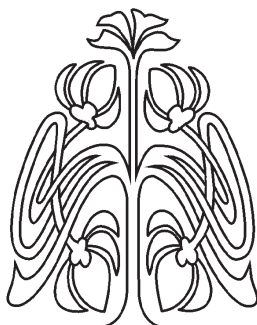
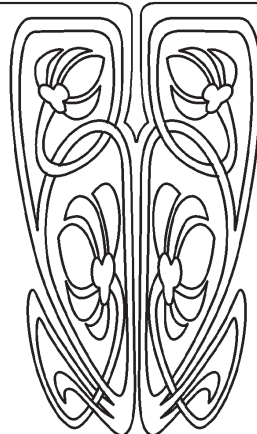




ЭКОЛОГИЯ



НАУЧНЫЙ
ОТДЕЛ



Известия Саратовского университета. Новая серия. Серия: Химия. Биология. Экология. 2024. Т. 24, вып. 2. С. 208–213

Izvestiya of Saratov University. Chemistry. Biology. Ecology, 2024, vol. 24, iss. 2, pp. 208–213

<https://ichbe.sgu.ru>

<https://doi.org/10.18500/1816-9775-2024-24-2-208-213>

EDN: WERUOG

Article

A new host plant for *Cameraria ohridella* Deschka & Dimić, 1986 (Lepidoptera: Gracillariidae) in Volga region

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Abstract. Six years have passed since, in 2018, an invasive species from Europe – the Ohrid miner *Cameraria ohridella* (Lepidoptera: Gracillariidae) penetrated into the Lower and Middle Volga region and began to actively populate urban landscapes planted with horse chestnut. Using the example of the regional center of Saratov, the temporary aspects of settlement and damage to horse chestnut trees over the specified period are considered. As a result of the settlement of the species and the annual increase in its population density, the degree of damage to the leaves of horse chestnut in parks and alleys of the regional center – showed a massive drying and leaf fall in *Aesculus hippocastanum* in early August 2023. The total output of the imago of the 3rd generation of the occupier completed the process of withering and shrinking of the trees by switching to another type of urban tree – walnut. This is the first case of such a choice of a new host object for this type of invader in the Volga region.

Keywords: chestnut moth, distribution, *Aesculus hippocastanum*, *Juglans regia*, Saratov city, Russia

For citation: Anikin V. V. A new host plant for *Cameraria ohridella* Deschka & Dimić, 1986 (Lepidoptera: Gracillariidae) in Volga region. *Izvestiya of Saratov University. Chemistry. Biology. Ecology*, 2024, vol. 24, iss. 2, pp. 208–213 (in Russian). <https://doi.org/10.18500/1816-9775-2024-24-2-208-213>, EDN: WERUOG

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Научная статья

УДК 595.782

Новое кормовое растение для *Cameraria ohridella* Deschka & Dimić, 1986 (Lepidoptera: Gracillariidae) в Поволжском регионе

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Аннотация. С 2018 г. прошло 6 лет как инвазивный вид из Европы – охридский минер *Cameraria ohridella* (Lepidoptera: Gracillariidae) проник в Нижнее и Среднее Поволжье и начал активно заселять городские ландшафты с посадками конского каштана. На примере областного центра Саратова рассмотрены временные аспекты заселения и повреждения деревьев конского каштана за указанный период. Как итог расселения вида и ежегодного



увеличения его плотности заселения и степени повреждения листьев конского каштана в парках и аллеях областного центра – массовое усыхание и опадание листьев у *Aesculus hippocastanum* в начале августа 2023 г. Тотальный выход имаго 3-го поколения каштановой моли завершил процесс увядания и усыхания деревьев переходом на другой вид городских древесных интродуцентов – грецкий орех. Это первый случай такого выбора нового кормового объекта у данного вида инвайдера в Поволжье.

Ключевые слова: каштановая моль, распространение, *Aesculus hippocastanum*, *Juglans regia*, город Саратов, Россия

Для цитирования: Anikin V. V. A new host plant for *Cameraria ohridella* Deschka & Dimić, 1986 (Lepidoptera: Gracillariidae) in Volga region [Аникин В. В. Новое кормовое растение для *Cameraria ohridella* Deschka & Dimić, 1986 (Lepidoptera: Gracillariidae) в Поволжском регионе] // Известия Саратовского университета. Новая серия. Серия: Химия. Биология. Экология. 2024. Т. 24, вып. 2. С. 208–213. <https://doi.org/10.18500/1816-9775-2024-24-2-208-213>, EDN: WERUOG

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Introduction

Studies of herbarium collections of horse chestnut from the Balkan Peninsula, collected since 1737, have shown that the chestnut moth has been “living” in Europe since at least 1879 [1]. After the description of the species, the moth was discovered in 1989 in Austria [2] and Croatia [3]. Then the species began to actively settle and form a secondary habitat in other European countries [4]. The successful invasion of the horse chestnut leaf miner was the successful introduction of *Aesculus hippocastanum* into the urban and park landscapes of European countries in the XVI–XIX centuries [5–8].

On the territory of the Lower and Middle Volga region, this species was not observed until 2018, when it was first discovered in the cities of Saratov and Samara [9]. Already in 2019, the leaf miner was noted in other cities of Volga region – Volgograd, Ulyanovsk, Penza. Observations of the spread of the Ohrid miner showed its rapid invasion in 2019–2021 of all major cities of the Saratov region – Balakovo, Volsk, Engels, Krasnoarmeysk [10–12, etc.]. A similar situation developed in other regions – Dimitrovgrad, Karsun, Inza [13] were settled in the Ulyanovsk region, from 2021 the miner was noted in Tatarstan [14], in the parks of Nizhny Novgorod [15], completely occupied Samara in 2022 [16] and Chuvashia [17].

A study of the chestnut miner haplotypes of the European part of the Russian Federation and the Volga region [18] showed their low diversity in the secondary species distribution compared to the natural species distribution in Western Europe. It was found that only two of the 44 known *C. ohridella* haplotypes (8% of all known haplotypes) have an “invasive” trait, i.e. they can spread quickly and effectively consolidate in new regions, which happened in the Lower and Middle Volga over the past 5–6 years. This fits into the framework of the “bottleneck” hypothesis, which assumes that during the invasion process only a few hap-

lotypes can have a stimulus to spread, while most other haplotypes that do not have such properties remain “locked” in their primary distribution.

In addition to the rapid spread in Saratov, the species also has a fast rate of reproduction, the species gives in the region 3 generations per season, and in some seasons the 4th [19], while each female can lay from 20 to 90 eggs. Such features of the biology of the species make it possible to quickly increase the population density of the forage plant (horse chestnut) in the “captured” territories.

Horse chestnut is the main food plant for *C. ohridella* caterpillars [20]. However, in the conditions of the secondary range, miner caterpillars were recorded on other species of the chestnut genus [21, 22], as well as on other plants of other families: *Acer pseudoplatanus* L., *A. campestre* L., *A. platanoides* L., *Fraxinus excelsior* L., *Prunus avium* L., *Ligustrum vulgare* L., *Euonymus europaeus* L., *Carpinus betulus* L., *Fagus sylvatica* L., *Cornus sanguinea* L., *Tilia platyphyllos* Scop., *Lonicera xylosteum* L., *Corylus avellana* L. [23]. In Belarus, since 2021, the species has been observed on silver maple *Acer saccharinum* [24]. In the southern region of Russia, a miner species was recorded on *Acer pseudoplatanus* L. [18], other plants were not noted as host for miner larvae before the author’s research.

The transition of the chestnut moth to other plants is a forced course of events, because with the full settlement of the main forage plant and its “consumption” there is only one way out – to look for other food sources suitable for assimilation by the caterpillar.

Material and methods

Our study is based on collected material of mines with larvae and adults (emerged ex larvae after overwintering) of *C. ohridella* from the territory of Saratov city until 2018 up to 2023. All material deposited in the collections of the Zoological



Museum Saratov State University, Saratov, Russia. Photos of trees with mines on leaves, larvae were taken with an Olympus Tough TG-5.

Results and discussion

From the 2020 the number of inhabited chestnuts in Saratov increased by 6 times compared to the year of invasion, then by the end of August 2021, as the monitoring of green urban plantings showed, the Ohrid miner completely “mastered” all the trees of the horse chestnut of Saratov. It was from 2021 that the entire area of the regional center could be marked with solid hatching, showing the complete settlement of all growing chestnuts on its territory.

During the 4-year period of the spread of the miner in the city, there was a gradual settlement of all trees (of all ages), the fodder plant of caterpillars – horse chestnut. If in the first “foci” of the spread in 2018, the mines were located on the lower branches of trees, less often on the middle tier of a tree, mines on a leaf were single and only 3–8 affected leaves per tree [9], then by the end of the 2020 season there was a tendency for the trees to be completely populated by the miner, starting from the bottom tiers and ending with the top. The number of mines on the leaves increased

to 6–11 per individual leaf, and the total design coverage of damaged leaves began to range from 50 to 70% [19].

In the spring of 2022, the first dead trees in the city began to appear. In addition, severely damaged trees became targets for the development of fungal infections and bacterial necrosis, which accelerated the death of especially young trees (up to 3 m tall). Microbiological studies of colleagues in 2020 showed the presence of bacteria and fungi that “accompany” the Ohrid miner in Saratov [25– 29].

After 2 years in 2023, the picture of the occupation of urban landscapes with horse chestnut turned into a catastrophic phenomenon. The peculiarities of early spring and rapid warming of the soil cover with good moisture led to the appearance of the first generation of the Ohrid miner already in mid-May. The shift of the usual release dates of butterflies in Saratov after wintering for 1 month ahead (!) was reflected in the end of the development of the 3rd generation in early August, i.e. a very early end of the entire species cycle before the horse chestnut proceeds to the autumn-winter period. Unlike the 2021 season, when the damage caused by the caterpillars led to premature drying and twisting of leaves in 90–99% of damaged horse chestnut trees in the city (Fig. 1).

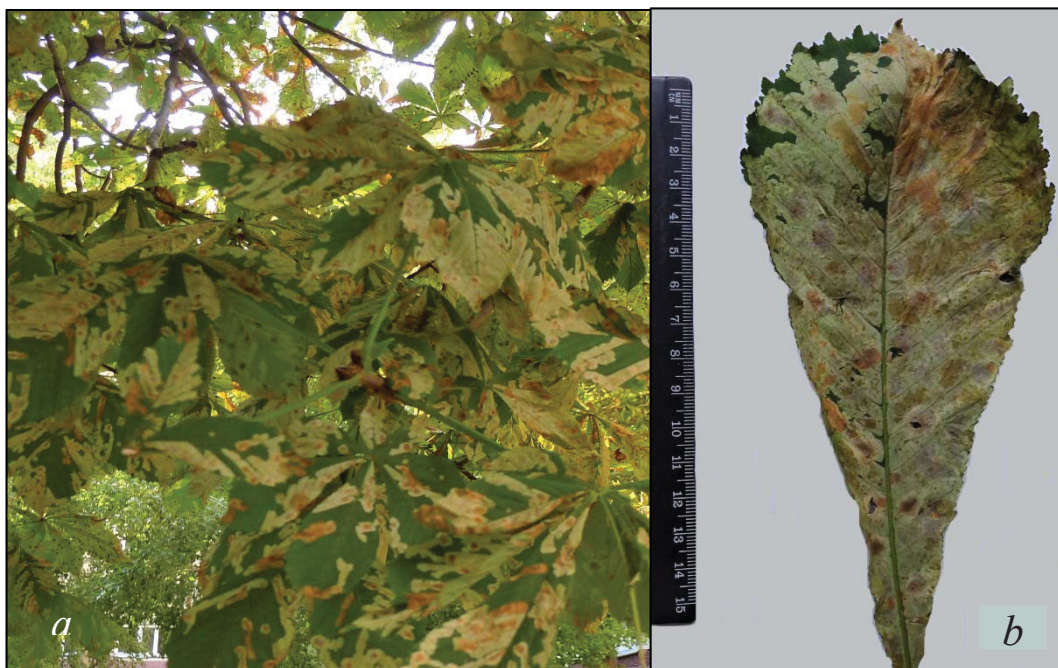


Fig. 1. Damaged leaves of horse chestnut: *a* – 2nd miner generation, 40–65% of the leaf surface was damaged (06.08.2021, chestnut alley of the Technical University); *b* – 3rd miner generation, 90–99% of the leaf surface was damaged (21.09.2021, there)



In 2023, the population of the regional center was perplexed by the yellowing and falling of the leaves of chestnuts in parks and on the Volga embankment already in early August, and by the early “ripening” of fruits at the end of August, swinging alone at chestnuts on branches without leaves.

The total output of the imago of the 3rd generation of the “occupier” in August 2023 completed the process of withering and shrinking of trees by switching to another type of urban tree introducers – walnut (*Juglans regia* L.). This is the first case of such a choice of a new feeding object for this type of invader in the Volga region (Fig. 2).

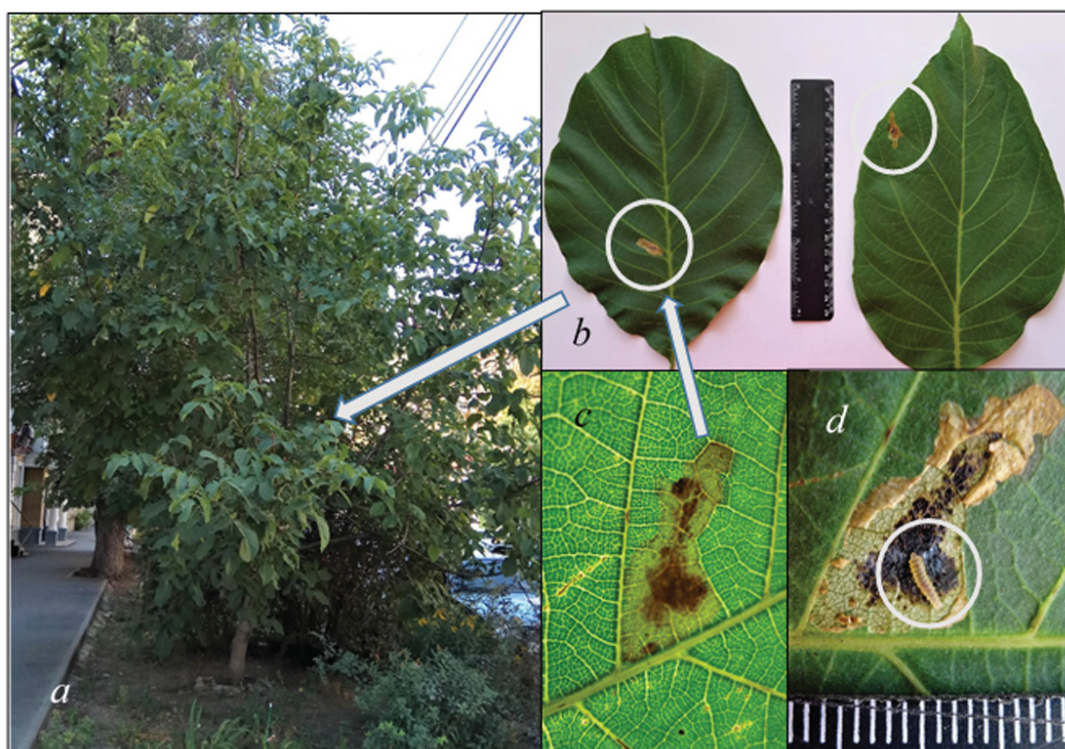


Fig. 2. Walnut leaves with mines of the Ohrid miner: *a* – the lower tier of a tree with damaged leaves (Saratov, intersection of Zheleznodorozhnaya and Bolshaya Kazachya streets, lawn with a tree); *b* – single mines on walnut leaves; *c* – mine with traces of the caterpillar’s vital activity; *d* – a caterpillar of a chestnut moth from an open mine

It can be assumed that such a transition is due to the lack of feed resources for the caterpillars of the new generation. Almost 100% death of horse chestnut leaves on the territory of Saratov left no chance for the formation and normal development of the next generation of the invader, even while maintaining normal summer-autumn conditions in urban biotopes for the Ohrid miner himself. There remains the search for a new source of food for the occupier – these are trees located in relative proximity, on the leaves of which a butterfly can lay eggs. Despite the large range of urban tree species (elm, linden, birch, oak, maple, ash, etc.), walnut leaves were selected by butterflies, whose leaves have a large area, which cannot be the main factor for choosing a site for settlement and nutrition.

Most likely, the higher content of “toxic” tannins in walnut leaves attract the invader, they are the basis of the substance content in horse chestnut leaves.

The result of the 2023 season for the chestnuts of the city of Saratov turned out to be terrible. The trees were left without a crown at the beginning of August, weakened, and will not be able to properly prepare for the winter period. Unlike the previous year 2022, when the leaves were also heavily populated with chestnut moth, but their death from the caterpillars of the 3rd generation occurred then in the autumn period (September-October) and the effect of rapid yellowing, drying and falling was smoothed by the departure of trees for winter rest.

It can be stated that what the author was discussing at the beginning of 2021, did happen [19].



This small butterfly 5–7 mm in wingspan caused such massive damage to chestnuts not only in Europe, but also in Russia on the banks of the river Volga. This is an early fall of foliage, the tree loses its decorative effect, turns yellow and dries up by the end of July – early August. And now the city authorities will have to deal with the sawing and complete replacement of horse chestnuts in the urban cultures of the regional center next season in 2024. There was no need to wait until the chestnuts of Saratov died, they had to be saved or to start replacing this culture in the urban landscapes of the regional center 3 years ago.

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Поступила в редакцию: 28.11.2023; одобрена после рецензирования 29.11.2023; принята к публикации 01.12.2023
The article was submitted 28.11.2023; approved after reviewing 29.11.2023; accepted for publication 01.12.2023