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# MOTIVATION FOR HORSE CHESTNUT REPLACEMENT BY TURKISH HAZEL

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**Summary.** The article discusses the consequences of damage to the horse chestnut (*Aesculus hippocastanum* L.) by the horse chestnut leaf miners (*Cameraria ohridella* Deschka & Dimic) in an urbanized environment. It is proposed to use Turkish hazel (*Corylus colurna* L.) to replace horse chestnut in single and group plantings, as well as for landscaping roads and streets and creating park alleys.

**Keywords**: *Aesculus hippocastanum* L., *Corylus colurna* L., horse chestnut leaf-mining, invasive pest, leaf miners-resistant genotypes, phytophagous insect.

## Introduction

Until recently, horse chestnut (*Aesculus hippocastanum* L. *Sapindaceae* Juss. family) was considered one of the best ornamental species in Ukraine, used in solitary and group plantings, as well as for planting roads and streets and creating park alleys. Highly decorative and beautifully flowering trees of the horse chestnut have become a symbol of Kyiv. However, in the late 20th/early 21st centuries its trees began to be damaged by horse chestnut leaf miners (*Cameraria ohridella* Deschka & Dimic). Since chemical treatment is prohibited in settlements, the disfigure of horse chestnut leaves by this pest during June–August distorts these beautiful trees (Peterken, 2023; Shavanova et al., 2012).

Horse chestnut leaf-mining insects intensively damage the leaves, which lead to a decrease in the photosynthetic surface, discoloration of the leaves, and they're drying out. The expansion of this pest throughout Ukraine is facilitated by favorable reproduction conditions, the availability of sufficient food, and the absence of natural enemies (Holoborodko et al., 2022; Lisovyy et al., 2019).

The within a species itself search for sources of resistance against this dangerous invasive pest has not yet yielded unambiguous results, although there are some reports of relatively resistant *Ae. hippocastanum* plants. Understanding the molecular nature of *Ae. hippocastanum* adaptation to this phytophage may contribute to the development of horse chestnut leaf miners-resistant genotypes (Seliutina et al., 2020)

*C. ohridella* caterpillars feed mainly on the leaves of *Ae. hippocastanum* (Walczak et al. 2017). There are also reports that the horse chestnut leaf-mining caterpillars damage the leaves of other plant species (Freise et al. 2004, Heitland et al. 2005). Thus, for instance, the degree of damage to leaf blades of the sycamore maple (*Acer pseudoplatanus* L., *Sapindaceae* Juss. family) by *C. ohridella* caterpillars can be quite significant but there is little evidence of a major risk (Péré et al., 2010).

Some probabilities of protecting horse chestnut from damage by horse chestnut leaf miners are associated with the search for parasitoids which may have a useful role in controlling *C. ohridella*. However, the studied parasitoid complexes are currently inadequate to restrain *C. ohridella* populations effectively (Ferracini & Alma, 2007).

There are also reports of immunization and stimulation of horse chestnut trees by injecting the composite preparation Imunocomplexon-CH into their trunks (Lesovoy et al., 2020).

It's worth noting that according to German authors (Friese et al. 2004), all leaf miner larvae discovered on *Corylus avellana* L. plants that grew very nearly to horse chestnuts infested by the *C. ohridella* caterpillars had died. This suggests that *C. avellana* plants are tolerant to the horse chestnut leaf miners (Straw & Tilbury, 2006).

Because of the massive damage to the leaves caused by horse chestnut leaf miners and thus the loss of decorative value of this species plants, Ukrainian enterprises of green building and greenery exploitation search woody plant species for a replacement for the horse chestnut, which has determined the direction of our research.

## Materials and methods

Different-aged horse chestnut (*Ae. hippocastanum*) trees from the National dendrological park "Sofiyivka" of the National Academy of Sciences of Ukraine (NDP "Sofiyivka") plant collection and from the Uman-city various streets and park plantings were studied in the period from 2007 to 2024. The degree of damage to plants by *C. ohridella* was estimated by commonly used methods. The species selection for the horse chestnut replacement in the greenery was executed in our woody plant collections based on the general appearance of the tree and their adaptability to unfavorable conditions of the urbanized environment.

## Results and discussions

From 2007 to 2015 we studied the efficacy of the Confidor injections (active ingredient imidacloprid) into the trunks to protect more than 60-year-old horse chestnut trees at NDP "Sofiyivka". The drug was relatively effective for one to two years after the injection (80–90% effectiveness rate). However, the horse chestnut's trunks are injured during the injections, which can damage the trees after several treatment cycles.

At the first stage of selection, several maples (*Acer* L., *Sapindaceae* Juss. family), plane trees (*Platanus* L., *Platanaceae* T.Lestib. family), linden/basswood trees (*Tilia* L., *Malvaceae* Juss. family) species, and also Turkish hazel (*Corylus colurna* L., *Betulaceae* Gray family) were selected based on the general appearance of the trees, growth rates, and adaptability to urban environments. But the danger of damage to maples by *C. ohridella* caterpillars (Freise et al. 2004, Heitland et al. 2005), and the massive damage to linden trees in Uman-city by spider mites (*Tetranychidae* Donnadieu family) we found, prompted us to refrain from spreading these both plants.

More prospects were attached to the plane trees (*Platanus* spp.), which were well studied in NDP "Sofiyivka" (Hrabovyi, 2007), however, the plants of this genus have also proven to be potentiality susceptible to the invasive leaf miner *Phyllonorycter platani* (Lepidoptera: Gracillariidae).

However, Turkish hazel (*C. colurna*) trees appear to be quite tolerant to common in the urbanized environment of the Right-Bank Forest-Steppe of Ukraine pests and plant pathogens, including the viral causative agents of diseases (Tarasenko et al. 2016).

The *Corylus* L. genus includes 16 accepted species. This genus is plants of large shrubs (most species) and deciduous trees (some species). In addition to *C. colurna*, the *Corylus* L. genus includes the following woody species: *C. fargesii* (Franch.) C.K.Schneid., *C. jacquemontii* Decne., and also Transcaucasian hybrid *C.* ×*colurnoides* C.K.Schneid. The plants of this hybrid species grow as a shrub or tree.

The plants of *Corylus* spp. are very valuable nut crops, the production of which is mainly aimed at supplying the needs of the confectionery industry (Dobhal et al., 2018). In addition to the main importance of hazelnut growing for providing raw materials for the confectionery industry, hazelnuts are becoming more important in the production of hazelnut oil and for pharmacy. The very promising areas of decorative and phytoreclamation use of *Corylus* spp. in landscaping and for optimization of agroecosystems and forest restoration are also developing (Granata et al., 2020).

Cultivated *Corylus* spp., while retaining the status of multipurpose plants, are still grown mainly for the production of nuts and their products. Herewith, unlike most fruit and berry plants with juicy fruits and inedible seeds, the nuts of *C. avellana*, as well as some other species of wild hazel, are still collected in various regions of the world in natural forests, and the collected nuts are used on a par with the nuts of cultivated hazelnut cultivars. It may be said that since ancient times, *Corylus* spp. have not undergone the process of absolute domestication, so hazel thickets still occur in the wild not only in their native state but also in the form of groves that sometimes form on the site of running wild hazelnut orchards (Allegrini et al., 2022).

The plants of various *Corylus* spp. were planted as part of many park compositions, both during the foundation of the NDP "Sofiyivka" and in the following years. The experience gained in cultivating many forms of North American and East Asian species valuable for their decorative qualities shows great prospects for the introduction of *Corylus* spp. into ornamental gardening. It turned out that many species, as well as some varieties and forms of *Corylus* spp. also may be used to protect slopes and in various protective plantations due to their resistance to unfavorable environmental influences.

Understanding plant breeding as the most effective means of improving the genotypes of cultivated plants through their ability to sustainably meet human needs through the creation of new improved cultivars and hybrids with increased anthropo-adaptability (Opalko & Opalko, 2015), it is worth recognizing that human needs are far from being limited to water, food, and other purely biological components inherent in all living organisms. Unlike animals and other living organisms, humans have always tried and are still constantly striving to achieve a spiritual ideal, to experience aesthetic pleasure from the habitat, of which green plants have been and still are a significant component. Therefore, the cultivation of ornamental plants has a long history, comparable to the history of domestication of other food plants, but the forerunners of ornamental gardening are difficult to reliably separate from ancient fruit growing, forestry, or vegetable growing (Ingels, 2010).

Because since ancient times, people have been growing garden plants in their yards, including representatives of *Corylus* spp. that, like some other plants, do not belong to the components of the well-known triad of "bread, salt, and water" that protect people from starvation. Therefore, it can be supposed that aesthetic appeal was not the last motive for planting many plants (Janick, 2014; Read & Bavougian, 2014; Van Tuyl et al., 2014), including hazel, in multifunctional gardens.

The evidence of Gerd Krüssmann and colleagues (Krüssmann et al., 1986), who quoted the ancient Roman poet Horace (Quintus Horatius Flaccus), reported that to meet the needs of the Romans for roses, the increase in the area for their cultivation even led to a decrease in the area under cereals, confirms the great importance attached to ornamental plants in ancient times. Analyzing the gardens of the ancient world from the perspective of modernity, it is worth reading the monograph by Linda Farrar (Farrar, 2016), which describes in detail the Egyptian gardens, gardens of ancient Mesopotamia and the Middle East; gardens of the Greek Bronze Age, in particular the Minoan and Mycenaean cultures, Greek gardens and groves of the Archaic, Classical and Hellenistic periods; Etruscan gardens; Roman and Byzantine gardens; Islamic and Persian gardens, as well as medieval gardens of Europe. The traditions of oriental gardening, as well as those of pre-Columbian America, are characterized by their specificity, which is analyzed in the relevant sources (Farahani et al., 2016; Kosenko et al., 2020; Kosenko, 2021; Zhu et al., 2022).

*Corylus* spp. plants demonstrate considerable decorative value both in summer and winter (during the flowering period), which encourages their planting in public and private gardens and parks, as well as in the entrance areas of offices and individual houses and along streets (Allegrini et al., 2022). In particular, *C. colurna* plants at the entrance to NDP "Sofiyivka" from Kyivska Street look great during the winter-spring flowering of the earrings (Fig. 1a), when most deciduous trees

are not yet developing, and in late autumn (Fig. 1b), and *C. colurna* trees planted along transport routes form a continuous noise, gas, and dust shield for pedestrians (Fig. 1c).

Furthermore, *C. colurna* trees are characterized by high resistance to the bitter chestnut moth (Fig. 2) and other pathogens common in Ukraine, not inferior to *Ae. hippocastanum* in terms of overall decorative value (see Fig. 1). Researchers at NDP "Sofiyivka" have selected some *C. colurna* forms valuable for horticulture, among which the most decorative are 'Nadiia', which stands out for its bark structure and color, 'Poltavska', which attracts with its large beautiful leaves, as well as forms with a pyramidal and spherical crown, which can withstand both prolonged summer and autumn drought and forty-degree frosts.

a  b  c 

**Figure 1. *Corylus colurna* trees: *a* — during March flowering; *b* — in October 2023; *c* — along Kyivs'ka Street (Uman city)**



**Figure 2. Damaged by *Cameraria ohridella* *Ae. hippocastanum* tree in mid-summer 2023 (foreground) against a green-leaved *Corylus colurna* tree (Uman-city, Maksym Zaliznyak Side Street)**

## Conclusions

Attempts to develop agronomic measures (chemical treatment and search for parasitoids/entomophagous) to protect horse chestnut (*Aesculus hippocastanum* L.) from damage by horse chestnut leaf miners (*Cameraria ohridella* Deschka & Dimic) to unfavorable conditions of the urbanized environment did not provide convincing stable results.

More successful was the search for woody plant species for a horse chestnut replacement in the settlements' greenery. The Turkish hazel (*Corylus colurna* L.) can be successfully used for horse chestnut replacement in solitary and group plantings, as well as for planting roads and streets and creating park alleys.

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