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ON THE DISCOVERY OF THE MULTIBRACTEATE SILVER-LEAVED LINDEN (*Tilia tomentosa* Moench.) IN MOSTAR, BOSNIA AND HERZEGOVINA

O PRONALASKU MULTIBRAKTEALNE SREBRNE LIPE (*Tilia tomentosa* Moench.) IZ MOSTARA, BOSNA I HERCEGOVINA

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Abstract

In the scope of the genetic, morphological and phenological research of the genus *Tilia* in Bosnia and Herzegovina, with control populations in Germany, multibracteate silver-leaved linden (*T. tomentosa* Moench.) was discovered in Mostar. In addition to the usual primary bract, there are also bracts of the second and the third order, which as phenomenon is, to our knowledge, new for the science. Since the bracts vary in size, as well as in shape, and additional bracts do not appear on all the sampled trees, the task in the future is to further investigate this phenomenon.

Key words: bract, fruit, Mostar, population, *Tilia tomentosa*

1. UVOD / INTRODUCTION

Silver-leaved linden (lat. *Tilia tomentosa* Moench.) is a native species of the genus *Tilia* in Europe (Eaton et al., 2016; Figure 1). It occurs in a wider area of almost all countries of the Balkan Peninsula (Caudullo et al., 2017), except for Slovenia, where it grows only in the border area with the Republic of Croatia (locality *Gorski Kotar*). In North Macedonia, silver-leaved linden trees are found in very inaccessible areas, such as canyons (Jane Acevski, personal communication, 2020). The optimal altitude for the growth and development of silver-leaved linden, for example in Romania, is 150–450 m (Radoglou et al., 2008), but it can generally thrive at much higher altitudes. It thrives best in xerothermic communities of forest trees, such as pubescent oak (Vejzagić et al., 2021), where it integrates and can easily hybridize with small-leaved (*Tilia cordata* Mill.) and large-leaved linden (*Tilia platyphyllos* Scop.). The silver-leaved lime blossoms relatively late, in July, when bees are very active and in search of fragrant nectar (Binder, 2016). Due to the flowering time, which can coincide with the flowering of the small-leaved linden, hybridization of the two species often occurs, resulting in fertile hybrids (Binder, 2016). The morphological characteristics of T. tomentosa in the countries of the former Socialist Federal Republic of Yugoslavia were described in detail by Herman (1971), and as an excellent connoisseur of flora and fauna, he described small-leaved, large-leaved and silver-leaved linden, as well as hybrids and cultivars. According to this author, all three basic species of linden that occur naturally in the Balkan Peninsula have a single-shelled fruit, which facilitates dispersion by wind. The author cites the Czech researcher Svoboda,

who states that the identification of species within the genus *Tilia* is extremely difficult, due to the high degree of morphological variability and frequent hybridization in natural forests. By reviewing the existing literature on species within the genus *Tilia*, no information was collected on the finding of linden fruit with more than one bract. Linden trees are insufficiently researched, and due to the intensification of climate change in Europe, they will be important for forestry in the future (Stobbe & Gumnior, 2021; Heinrichs et al., 2021). Since linden seeds with one bract can be dispersed ca. 300 m (Danusevičius et al., 2021) from the parent tree, - to maintain the quality of the seed during further wind dispersion, which is important for germination - it would be interesting to investigate any appearance of a fruit with a greater number of bracts.

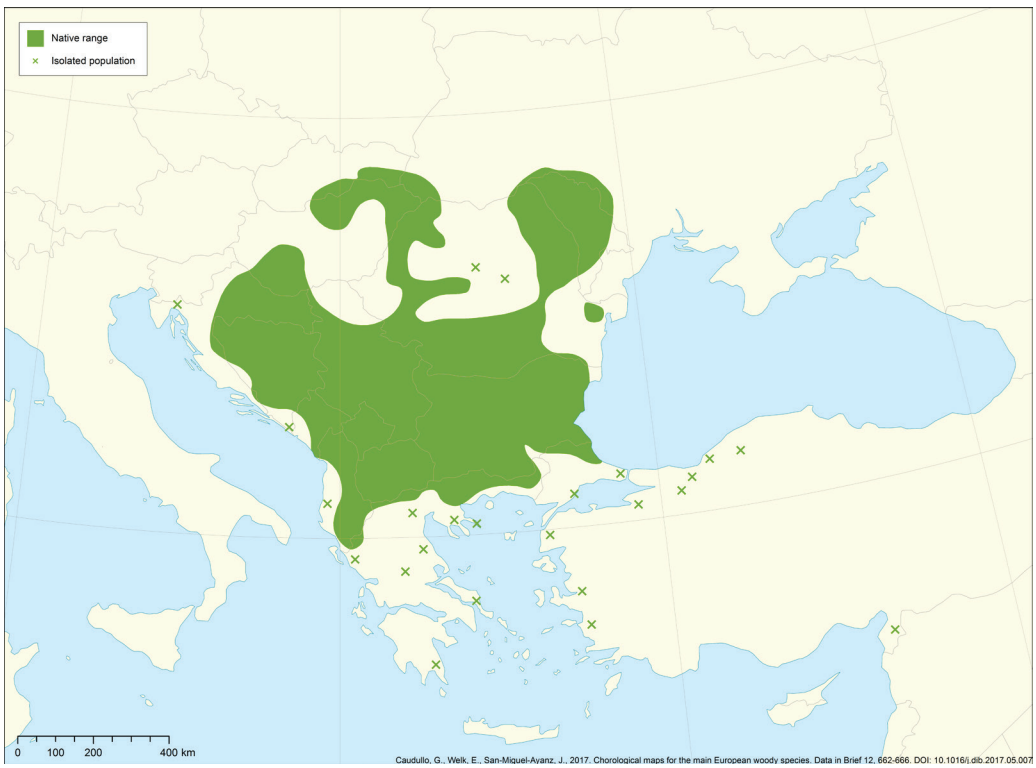

Figure 1. Distribution map of *T. tomentosa* species in Europe (Caudullo et al., 2017) /
Slika 1. Karta areala vrste *T. tomentosa* u Evropi (Caudullo et al., 2017)

2. MATERIAL AND METHODS / MATERIJAL I METOD RADA

The fruits were collected in the population "Mostar", locality "Potoci", in the sub-Mediterranean part of Bosnia and Herzegovina, where the influence of the sub-Mediterranean climate - colliding with the continental one, begins. The locality "Potoci" is known for the natural forest of silver-leaved linden, which grows on sandstone and limestone rocks (going towards the Neretva River Canyon) as well as on Calcomelanosol in the nearby hills. Thirty fruits were collected from 30 trees each, which are at least 50–70 meters apart. Most of the trees are medium-aged and located on the banks of the Neretva River. The fruits were collected from the side of the crown that is the best lit, and care was taken to collect fruits that correspond to the average dimensions of the fruits of the tree, as well as fruits that are as similar as possible to each other.

3. RESULTS AND DISCUSSION / REZULTATI I DISKUSIJA

Although most of the fruits on silver-leaved linden trees had one bract, in some trees fruits with bracts of second and third order were observed and sampled for further analysis. Considering whether they are bracts of the first, second or third order, the following names are given to the bracts: **1) primary bract**; **2) secondary bract** and **3) tertiary bract** (Figure 2). The fruits were discovered in the summer of 2019 when they were analyzed and described, and carefully stored. In the continuation of the field research, a similar phenomenon within silver-leaved linden populations was observed in the Cazinska Krajina area. Since the discovery of this phenomenon is interesting for the wider research project of the *Tilia* complex in Bosnia and Herzegovina, the publication of findings of similar fruits from other populations in Bosnia and Herzegovina is planned for next year.

It should be stressed that the recorded fruits appear only on individual trees, i.e. those that abundantly fructified after the previous droughts in 2017 and 2018. Theoretically, if the fruit had a larger number of bracts, it is assumed that wind transport could be faster over somewhat longer distances than usual. In the last few thousand years, plants have shown exceptional abilities to adapt to climate changes, and the adaptation of *T. tomentosa* trees to dry years could potentially be observed through the morphology of the fruits. In addition to the appearance of unusual appendages in the fruits of silver-leaved linden, it is necessary to investigate the dispersion of seeds through birds, rodents and insects. For example, rodents in some forest ecosystems do not participate much in the dispersal of beech (*Fagus sylvatica*) seeds (Nilsson, 1985), which can be related to the specifics of the rodent's diet. The dispersion of linden seeds could potentially be observed through the behavior of mice and squirrel populations in a given locality and through monitoring the abundance of these species of wild animals. In addition to mice and squirrels, chipmunks and songbirds are important for the dispersion of American linden (*Tilia americana*) seeds (SVBPA.org, n.d.) on the North American continent. Research of the morphology of these specific fruits in silver-leaved linden forests in Bosnia and Herzegovina continues in the following vegetation season and several locations. It is considered necessary to include the analysis of weather conditions, the occurrence of droughts, the monitoring of fructification and the monitoring of wild animal populations in the analysis of this phenomenon.

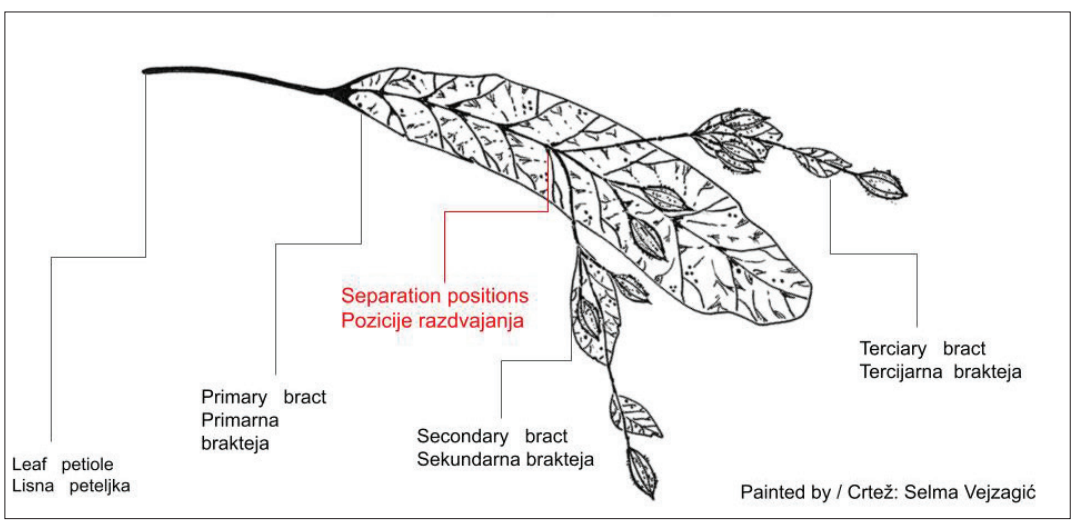

Figure 2. Silver-leaved linden fruit in the population "Mostar" in Bosnia and Herzegovina found in 2019. Original drawing / **Slika 2**. Plod srebrnolisne lipe (*Tilia tomentosa* Moench.) u Mostaru, pronađen 2019. godine. Originalan crtež (Selma Vejzagić)

Acknowledgements / Zahvale

The results of the morphological analysis of the fruits of *T. tomentosa* will be an integral part of the monograph - doctoral dissertation within the project "Morphological and genetic characterization of the *Tilia* complex in Bosnia and Herzegovina in the context of climate change".

References / Literatura

SBVPA.org. (n.d.). *American basswood*. City of South Bend, Venues Parks & Arts. Retrieved December 7, 2022, from https://sbvpa.org/treetrail/american-basswood/

Binder, F. (2016, July 5). *Kurzportrait Silberlinde (Tilia tomentosa)*. Landesbetrieb Wald und Holz NRW. https://www.waldwissen.net/de/waldwirtschaft/waldbau/kurzportrait-silberlinde#c81919

Caudullo, G., Welk, E., & San-Miguel-Ayanz, J. (2017). Chorological maps for the main European woody species. *Data in Brief, 12*, 662–666. https://doi.org/10.1016/j.dib.2017.05.007

Danusevičius, D., Kembrytė, R., Buchovska, J., Baliuckas, V., & Kavaliauskas, D. (2021). Genetic signature of the natural gene pool of *Tilia cordata* Mill. in Lithuania: Compound evolutionary and anthropogenic effects. *Ecology and Evolution, 11*(11), 6260-6275. https://doi.org/10.1002/ece3.7473

Eaton, E., Caudullo, G., & de Rigo, D. (2016). *Tilia cordata*, *Tilia platyphyllos* and other limes in Europe: distribution, habitat, usage and threats. In J. San-Miguel-Ayanz, D. de Rigo, G. Caudullo, T. Houston Durrant, & A. Mauri (Eds.), *European Atlas of Forest Tree Species*. Publications Office of the European Union, Luxemburg.

Heinrichs, S., Öder, V., Indreica, A., Bergmeier, E., Leuschner, C., & Walentowski, H. (2021). The influence of *Tilia tomentosa* Moench on plant species diversity and composition in mesophilic forests of western Romania–A potential tree species for warming forests in central Europe? *Sustainability*, *13*(14), 6260–6275. https://doi.org/10.3390/su13147996

Herman, J. (1971). *Šumarska dendrologija*. Stanbiro, Zagreb.

Nilsson, S.G. (1985). Ecological and evolutionary interactions between reproduction of beech *Fagus silvatica* and seed eating animals. *OIKOS, 44*(1), 157–164.

Radoglou, K., Dobrowolska, D., Spyroglou, G., & Nicolescu, V.N. (2008). A *review on the ecology and silviculture of limes (Tilia cordata Mill., Tilia platyphyllos Scop. and Tilia tomentosa Moench.) in Europe*. ValBro, COST Office.

Stobbe, A., & Gumnior, M. (2021). Palaeoecology as a tool for the future management of forest ecosystems in Hesse (Central Germany): Beech (*Fagus sylvatica* L.) versus Lime (*Tilia cordata* Mill.). *Forests, 12*(7), 924. https://doi.org/10.3390/f12070924

Vejzagić, S., Ballian, D., & Memišević-Hodžić, M. (2021). Preliminary research of morphological traits of Silver linden (*Tilia tomentosa* Moench) leaves in Bosnia and Herzegovina and Serbia). *Glasnik Šumarskog fakulteta Univerziteta u Banjoj Luci, 31*, 65–77. https://doi.org/10.7251/GSF2131065V

Sažetak

U sklopu genetičkih, morfoloških i fenoloških istraživanja roda *Tilia* u Bosni i Hercegovina, sa kontrolnim populacijama u Njemačkoj, u Mostaru je otkrivena multibraktealna srebrnolisna lipa (*T. tomentosa* Moench.). Osim uobičajene primarne brakteje, prisutne su i brakteje drugog i trećeg reda, što je kao pojava, prema našim saznanjima, novo za nauku. Budući da se brakteje razlikuju po veličini, ali i obliku, te se dodatne brakteje ne pojavljuju na svim uzorkovanim stablima, zadatak je da se u budućnosti ovaj fenomen dodatno istraži.

Ključne riječi: brakteja, Mostar, plod, populacija, *Tilia tomentosa*