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## The Genetics and Dendrochronology of the Larches at Järvelja Centre

Pâques, L.E., Läänelaid, A., Sander, H.

The article deals with the genetics and dating of the larches growing at the Järvelja Centre for Learning and Experimental Forestry (N: 58° 16'; E: 27° 19') established by the University of Tartu in 1921 for student practical training needs. Prior to that, the site was owned by Kastre Manor, which founded a manorial forest management district there. The first forester of the manor (1883–1897) was Martin Maurach, who initiated the planting of the first larches there. Two Dunkeld specimens (*Larix × marschlinsii*) have been morphologically identified among the larches at the Centre. According to dendrologist Aleksei Paivel, the first reports of the approximately 40-year trees date from 1957–1960 [7] or the early 1960s. Their dimensions were as follows: 1) H (height) = 17.5 m, PBH (girth at breast height 1.3 m) = 154 cm; 2) H = 17 m, PBH = 138 cm [7]. The objective of the article, in addition to the morphological approach, was to genetically verify the species of the local larches and to dendrochronologically determine their ages. Altogether, eight larches were examined at Järvelja on 15-16 August 2022 (Figure 1): 1) H = 23.5 m, PBH = 285 cm; 2) H = 27.9 m, PBH = 258 cm; 3) H = 39.4 m, PBH = 275 cm; 4) H = 37.1 m, PBH = 258 cm; 5) H = 40.6 m, PBH = 276 cm; 6) H = 23.4 m, PBH = 225 cm; 7) H = 21.2 m, PBH = 141 cm; 8) H = 22.4 m, PBH = 230 cm (below 1.3 m because of a branch). They were measured and photographed by the head of the foundation, Chief Forester Tanel Piir. According to dendrologist Heino Kasesalu, who lives at Järvelja, the morphology pointed to two Euro-Japanese larches (Nos. 1 and 2) as well as an old *L. kaempferi* tree (No. 3 – one of Estonia's highest and thickest trees), two *L. decidua*'s (Nos. 4 and 5) and three specimens of *L. kaempferi* (Nos. 6, 7 and 8). Concerning Nos. 1 and 2, dendrologist professor Endel Laas (1915–2009) wrote in 1967: “Both trees, aged approximately 40 years, are rather similar in appearance, although there are differences in cone shapes as well as other morphological features. A comparison of [.....] the morphological features of individual specimens to those described by Beissner-Fitschen [...] in [...] would result in the recognition of a very great similarity.” [2, 5: 154].

The genetical analysis of the larches was performed on the initiative of L. E. Pâques at the laboratory of Integrated Biology for valorisation of genetic diversity of trees and forests of INRAE (Institut National de Recherche pour l'agriculture, l'alimentation et l'environnement). The methodology was based on the study [1: Acheré, V., et al., 2004], which is also outlined. In 2017, four larches out of the eight at Järvelja were morphologically and genetically identified as Japanese larches (No. 3 – photo missing; Nos. 6, 7, 8 – Photo 4). Their maternal and paternal species was Japanese larch. The remaining four specimens proved problematic due to the absence of a clear pattern for the chloroplastic marker. The larches with Euro-Japanese morphology (Nos. 1 and 2 – the trees in Photo 1 with young cones and in Photo 2 with old cones) were not typical Dunkeld larches. Similarly, the morphology of the European larches (No. 4 – photo missing, and No. 5 – Photo 3, the highest larch) was not typical. Based on genetical analysis, their maternal species was Japanese larch while the second species was unidentifiable with the markers used. Indeed for the chloroplastic DNA (of male origin) marker, EL is normally distinguished from JL by the presence of a single band at 481 bp while JL has a band at 601 bp (Acheré et al. 2004). For trees 1 and 2, we found not just one band as expected but two, a case we cannot interpret at this stage (revealing an extra species. However, it is in no case a hybrid between EL & JL or in this case between JL & EL. The best scenario would have been first to get and test new samples from these trees just in case to confirm this result, but most probably this would not change the matter. Other trees, such as Nos. 4 and 5, show a similar situation. According to the dendrochronological analysis of 2008 (at the height of 1.3 m), the age of two Euro-Japanese larches (Nos. 1 and 2) could not be correctly determined as the stems were decayed on the inside. Samples could only be obtained from the years 1945–2008 and 1955–2008 (Figures 2 and 3); the trees had probably been planted in the 1920s. A morphological dating of three larches (in the figure, *L. kaempferi* – No. 6 = No. 1 in the figure and No. 3 = No. 2 and *L. decidua* – No. 4 = No. 3) (Figure 4) revealed that the younger Japanese larch (No. 6) had probably been planted in 1935 as a 1.3 m-high sapling, the older Japanese larch (No. 3)

in 1907 and the older European larch (No. 4) in 1895. The last mentioned year reportedly saw the start of larch planting at Järvelja Centre. The most problematic is the larch planted as a 1.3-m sapling (No. 4), whose maternal species is Japanese larch and paternal species is unknown. Currently, we see no way how this could have happened? As far as is known, Japanese larch was introduced to England in 1861 and to St. Petersburg in 1863. From the latter, larches might have been introduced to Järvelja, but there are no reports to that effect. The opinion of the Russian researcher Jevgeni G. Bobrov [8, 9] published in his paper of 1972 is refuted [8]. According to Bobrov, the peculiar larches spreading in the European part of Russia had attracted dendrologists' interest for a whole century and a half. They were often described using binary epithets and were titled as a hybrid *L. leptolepis* × *L. decidua*. However, Bobrov is wrong at this point, as such a hybrid could not have emerged in Europe so early.

**A comment:** According to archival data, 20 pounds of European larch seeds were imported to Kastre - Peravald (Järvelja) from H. Keller's seed store in Darmstadt in 1887. In the same year, the first forest culture was established in Kastre – Peravald. It was sown as patchwork in Square 224. The patches were sown with a seed mix composed of Norway spruce, Scots pine, European larch and Austrian pine. Today, the site accommodates a mixed stand, which includes an occasional Scots pine or larch. The Austrian pine is entirely extinct. The largest larch is 41 metres high and has a breast height diameter of 92 cm. It is the highest larch at Järvelja and its morphological features resemble those of the specimens growing by the Centre. There are grounds to believe that the latter originate from the aforesaid seed batch (Kasesalu, 2022). Kasesalu, Heino. 2022. E-mail to Heldur Sander on 9. September.