DOI: https://doi.org/10.53040/cga12.31 UDC: 633.872.3:631.53

ADAPTATION OF BEECH PLANTS FROM DIFFERENT PROVENANCES TO NATURAL GROWTH CONDITIONS

Dina ELISOVETCAIA[1], ORCID: 0000-0003-0521-6428
dina.elisovetcaia@sti.usm.md
Raisa IVANOVA[1], ORCID: 0000-0002-2554-2039
Ecaterina POPOVSCHI[1], ORCID: 0000-0002-6620-4597
Elena FEDORENCO[2]
Jan BRINDZA[3], ORCID: 0000-0001-8388-8233

[1]Institute of Genetics, Physiology and Plant Protection, Moldova State University, Chisinau, Republic of Moldova
[2]"Plaiul Fagului" Nature Reserve, Republic of Moldova
[3]Slovak University of Agriculture in Nitra

Abstract. *This study assessed the adaptive potential of Fagus sylvatica L. seedlings from various provenances under natural growth conditions in the Republic of Moldova. Between 2022 and 2024, seedlings of different ages and origins (Slovakia, Romania, Moldova, and Ukraine) were transplanted and monitored. Key indicators included adaptation rate, survival rate and annual growth. Seedlings from Slovak provenances (Nitra-19 and Rožňava-22) showed the highest initial transplant resistance, with survival rates of 96.15% and 97.00%, respectively. Plants from Cioreşti-21 (Republic of Moldova) followed closely, demonstrating the highest survival rate (87.00%) one year after transplantation. Growth assessments showed that although Romanian seedlings (Humosu-20) were initially taller, those from Slovakia and Republic of Moldova surpassed them in growth after one year. Adaptation was influenced by genetic and epigenetic factors, seedling morphology, precipitation levels, and climatic similarity between the origin site and the planting location. These results highlight the importance of selecting suitable provenances sites for beech seed collection and conditions for successful conservation and restoration of beech forests.*

Keywords: Fagus sylvatica, beech seedlings, adaptation, survival.

INTRODUCTION

Fagus sylvatica L., commonly known as European beech, is the most important native forest tree species in Central Europe, with a lifespan of up to 300 years and late reproductive maturity [1]. In Republic of Moldova, beech forests cover about 400 hectares, representing the easternmost range of the species in Europe. These forests play a vital ecological role, supporting biodiversity, soil and water protection, and climate regulation [2, 3]. Due to illegal logging, land use changes, and climate extremes, beech forests in Republic of Moldova have been significantly reduced [4]. Restoration is essential for preserving rare species,

enhancing ecological resilience, and ensuring long-term sustainability [5, 6]. Successful regeneration depends on local adaptation, especially under increasing heat and drought stress [3, 6]. High genetic heterogeneity in seedlings is crucial for future resilience. Therefore, the aim of this study was to assess the adaptive potential of European beech (*Fagus sylvatica* L.) plants from different provenances to natural growth conditions in the Republic of Moldova

MATERIALS AND METODS

Study objects: beech plants obtained under greenhouse conditions from seeds of different provenances and collected in different years, namely: Nitra-19 and Rožňava-22 (Slovakia); Humosu-20 (Romania); Plaiul Fagului-20, Codrii-20, Hîrjauca-20, Hîrjauca-21, Cioreşti-21 and Plaiul Fagului-23 (Republic of Moldova); Chernivtsi-20 and Ivano-Frankivsk-20 (Ukraine). Beech seedlings from various provenances and ages were planted under natural growth conditions over three consecutive years. On March 24, 2022, 135 three-year-old seedlings from Slovakia (Nitra-19) and 115 two-year-old seedlings from Romania (Humosu-20) were planted. In 2023 and 2024, additional seedlings from Republic of Moldova, Ukraine, Romania, Slovakia, and Austria were introduced to enrich the genetic diversity of the collection.

The monitoring of the adaptive capacities of beech plants was carried out 2–3 times per year. The following indicators were studied: the adaptation rate of the plants, the survival rate over one growing season, and the annual growth of the transplanted beech plants.

RESULTS ANS DISCUSSIONS

The monitoring revealed that beech plants obtained from seeds of both Slovak populations – Nitra-19 and Roznava-22 demonstrated the highest initial resistance to transplantation, with survival rates of 96.15% and 97.00%, respectively, three months after being transferred (Fig. 1). The second-highest three-month survival rate was recorded for plants from Cioreşti-21, Republic of Moldova, at 90.00%. The lowest survival rate was observed in plants of Romanian provenance, Humosu-20 (Fig. 1). One year after transplantation, plants from Cioreşti-21 (Republic of Moldova) became the leaders in survival, with a survival rate of 87.0%. Plants from Nitra-19 (Slovakia) had a survival rate of 68.79%, while those from Humosu-20 (Romania) had only 43.01%. After two years of observation, the Slovak population Nitra-19 led in terms of surviving plants, while the remaining populations continue to be monitored (Fig. 1). The overall condition of all plants in 2024 is more than satisfactory, due to a high level of precipitation during spring and the first two decades of June 2024.

The height of seedlings at the time of transplantation varied significantly,

ranging on average from 17.41 cm to 26.40 cm across populations (Fig. 2). The Nitra-19 seedlings from Slovakia were the shortest (19.73 cm), although they were in their third year of growth when transplanted, compared to seedlings from other provenances, which were in their second year. Humosu-20 plants from Romania were the tallest at the time of transplantation, measuring an average of 26.4 cm. Three months after transplantation, the growth of seedlings from Cioresti-21 (Republic of Moldova) and Roznava-22 (Slovakia) was nearly equal to that of Nitra-19 (Slovakia). Humosu-20 seedlings remained 4.9–7.4 cm taller than other populations on average.

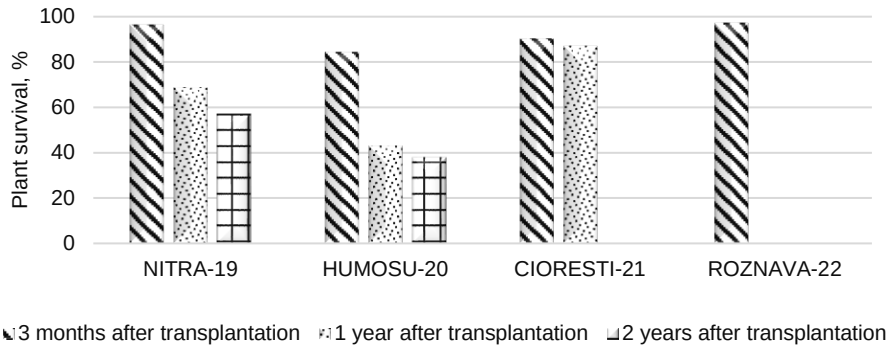


Figure 1. Survival dynamics of *F. sylvatica* seedlings from different provenances (Republic of Moldova, Romania and Slovakia) under natural growth conditions for the period 2022-2024, "Plaiul Fagului" Nature Reserve.

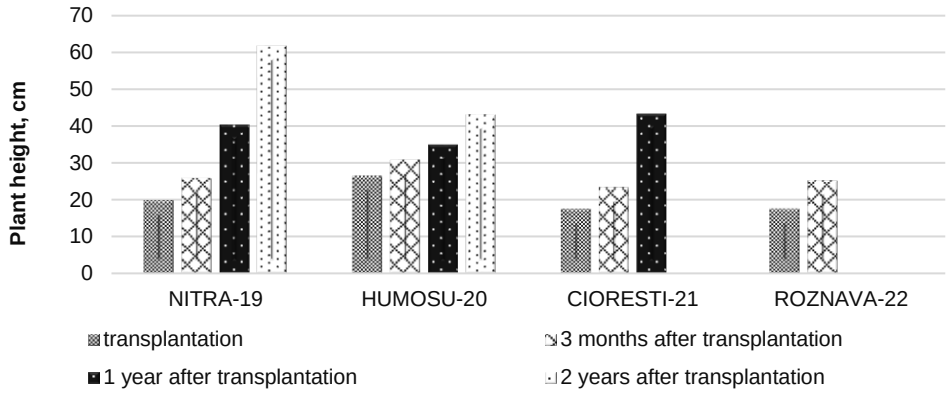


Figure 2. Height of *Fagus sylvatica* beech plants from different provenances (Republic of Moldova, Romania, and Slovakia) under natural growth conditions during the period 2022–2024, "Plaiul Fagului" Nature Reserve.

However, one year after transplantation, seedlings from Slovakia (Nitra-19 and Roznava-22) and Moldova (Cioresti-21) outpaced the growth rate of Romanian seedlings (Humosu-20) by an average of 5.4–8.3 cm.

CONCLUSIONS

The monitoring revealed that the Slovak population Nitra-19, transplanted in its third year of growth, demonstrated a higher adaptation rate compared to the Romanian population Humosu-20, while the Cioreşti-21 (Moldova) and Roznava-22 (Slovakia) populations, transplanted in their second year, showed similarly high survival rates, confirming that adaptation in natural conditions depends on a complex interplay of genetic, epigenetic, morphological, climatic, and topographic factors.

Acknowledgments: This study was supported by the Ministry of Education and Research of the Republic of Moldova within the Subprogram 011101 "Genetic and biotechnological approaches to agroecosystem management under climate change conditions" for 2024-2027; scholarship programs ID #52310291, supported by the International Visegrad Fund of the Slovak Republic for 2022–2023; and in the project in flame of bilateral cooperation between the Republic of Moldova and the Slovak Republic for academic year 2023-2024, supported by the Ministry of Education, Science, Research and Sports of the Slovak Republic.

REFERENCES

1. FORMATO, M., PICCOLELLA, S., ZIDORN, C., PACIFICO, S. 2021. UHPLC-HRMS analysis of *Fagus sylvatica* (Fagaceae) leaves: a renewable source of antioxidant polyphenols. Antioxidants, vol. 10, 1140. 10.3390/antiox10071140.
2. ALBERTO F.J., AITKEN S.N., ALÍA R., et al. 2013. Potential for evolutionary responses to climate change – evidence from tree populations. *Global Change Biol*, 19, Pp. 1645-1661. https://doi.org/10.1111/gcb.12181
3. ROIBU C.C., PALAGHIANU C., NAGAVCIUC V., IONITA M., SFECLA V., MURSA A., CRIVELLARO A., STIRBU M.-I., COTOS M.-G., POPA A., SFECLA IRINA, POPA I. 2022. The response of beech (*Fagus sylvatica* L.) populations to climate in the easternmost sites of its European distribution. *Journal Plants*. Vol. 11, Pp. 3310. https://doi.org/10.3390/plants11233310 [accessed: March 18, 2024].
4. NEDEALCOV, M., APOSTOL, L., DONICA, A., GRIGORAŞ, N. 2020. Climatic and ecological constraints in the distribution of European beech (*Fagus sylvatica*) at the eastern limit (Scientific Reserve "Plaiul Fagului"). In: *Present Environment and Sustainable Development*, Vol. 14(1), Pp. 255-263. https://doi.org/10.15551/pesd2020141020
5. CUZA P., POSTOLACHE Gh., GOCIU D., CUROŞ B. 2006. "Plaiul Fagului" Scientific Reserve – Representative area of Codrii Moldovai. *Mediul Ambiant*, Vol. 2(26), Pp. 32-35. Available on https://ibn.idsi.md/sites/default/files/j_nr_file/mediul%20ambiant%202_2006_1.pdf.
6. MUFFLER L., SCHMEDDES J., WEIGEL R., BARBETA A. et al. 2021. High plasticity in germination and establishment success in the dominant forest tree *Fagus sylvatica* across Europe. *Global Ecology and Biogeography*, Vol. 30(8), Pp. 1583-1596. https://doi.org/10.1111/geb.13320