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EFFECTS OF LOW DOSES X-RAY ON BEECH SEED GERMINATION DURING COLD STRATIFICATION

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European beech (*Fagus sylvatica* L.) is an ecologically and economically important forest tree species, and the search for environmentally safe methods to improve seed germination is of considerable practical interest. The aim of our study was to evaluate the effects of low-dose X-ray irradiation (1, 2, 3, 4 and 5 Gy) on the germination performance and radicle development of *F. sylvatica* seeds during cold stratification. The experiments were carried out in the laboratory Natural Bioregulators of the Institute of Genetics, Physiology and Plant Protection, Moldova State University (IGPPP, MSU) during 2025-2026. The seeds of *F. sylvatica* collected in autumn 2023 from the "Plaiul Fagului" Nature Reserve, Republic of Moldova with viability – 68.0% were used in the study. The results were analyzed using Statgraphics Plus 5.0 software. Statistical analysis included one-way analysis of variance (ANOVA), Tukey's HSD post hoc test for multiple comparisons, and box-and-whisker plot analysis. Statistical significance was accepted at a significance level of $p \leq 0.05$.

The results showed that low doses of X-rays exerted a non-uniform effect on germination parameters during 120 days of cold stratification. The most pronounced stimulatory effect was observed at 1 Gy, which increased seed germination from 46% in the control to 59%, accompanied by higher germination rate index (GRI) and radicle vigor index values, together with a shorter mean germination time (MGT), indicating accelerated germination processes. Increasing the dose to 2–4 Gy did not produce a further enhancement of the stimulatory effect, as most germination parameters remained comparable with or only slightly exceeded the control values but were lower than those obtained at 1 Gy. The least favorable effect was recorded at 5 Gy, where germination, GRI and radicle vigor decreased below the control, indicating a transition from a stimulatory to an inhibitory effect of irradiation. Analysis

of radicle length using Tukey's multiple range test (LSD, 95%) revealed no statistically significant differences between the control and most irradiation treatments, although the 1 Gy treatment showed the highest mean value and was statistically separated from the 5 Gy treatment, which had the shortest radicles. The treatments at 2–4 Gy showed substantial statistical overlap with both the control and each other, preventing their separation into distinct homogeneous groups. Box-and-whisker plot analysis confirmed a weak but dose-dependent effect of irradiation on radicle morphometry. Overall, the results indicate that irradiation at 1 Gy stimulates germination processes in *F. sylvatica*, whereas further increases in dose progressively reduce the positive effect and lead to the appearance of inhibitory effects.

The results indicate that low-dose X-ray irradiation exerts a dose-dependent hormetic effect on the germination of *F. sylvatica* seeds during cold stratification, with 1 Gy representing the optimal stimulatory dose.

Keywords: *Fagus sylvatica*, seed, X-ray irradiation, cold stratification, germination

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