Towards Resilient Forests: The Interplay of Priming, Epigenetics, and Adaptive Responses to Abiotic and Biotic Stresses

Hans Hoenicka*[1], Marta Starczak[2], Susanne Bein[1], and Daniel Gackowski[2]

[1]Thünen Institute – Germany
[2]Nicolaus Copernicus University – Poland

Abstract

Background
Forest trees play a crucial role in maintaining biodiversity and providing essential ecosystem services. However, they are increasingly facing environmental challenges such as drought, heat, and diseases, which threaten their survival and resilience. The induction of epigenetic modifications represents a promising, yet complex and still developing approach to potentially enhance the stress tolerance of forest trees over time.

Investigating Epigenetic Modulation for Improved Forest Resilience

This study explored the effects of 2-aminobutyric acid (BABA) on the growth, physiology, and epigenetic parameters of field elms (*Ulmus minor*) under normal and drought stress conditions. Furthermore, the potential of BABA for reduction of ash dieback disease was studied in European ash (*Fraxinus excelsior*). Epigenetic modifications were assessed in both DNA and RNA using UPLC-MS. The results demonstrated that BABA treatment significantly improved stress tolerance in both tree species. Moreover, BABA induced extensive epigenetic alterations in both DNA and RNA. The findings highlight the potential of BABA and other epigenetic modifiers to enhance the resilience of forest ecosystems to environmental stressors. Additionally, the research institute is conducting long-term field trials to evaluate the persistence of epigenetic modifications induced by BABA. Epigenetic changes provide a unique advantage over genetic methods for adaptation to rapidly changing environmental conditions. Unlike genetic changes, which under natural conditions require multiple generations, epigenetic changes can be induced relatively rapidly and can be reversed or modified in response to changing environmental cues.

Conclusion
This study highlights the potential of BABA and other priming strategies in enhancing disease tolerance in forest tree species. Short-term improved stress tolerance and epigenetic changes were confirmed. Yet, the exact priming conditions for inducing long-term effects in plants, including long-living forest trees, remain unknown, posing a challenge for applying priming strategies to manage stress tolerance and protect endangered forest tree species.

Keywords: Priming, Stress tolerance, Epigenetics, Forest trees

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