proceedings

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Abstract

Elemental Composition and Isotope Ratio in Pine Needles: The Impact of Arginine Phosphate-Containing Fertilizer Application in Pine-Planting Sites †

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† Presented at the International Conference EcoBalt 2023 "Chemicals & Environment", Tallinn, Estonia, 9–11 October 2023.

Keywords: pine needles; arginine phosphate; isotope ratio; chemometric analysis

Forests in Latvia are crucial, covering over half of the country's territory and expanding continuously through afforestation and natural growth. However, like forests globally, they face challenges requiring attention. Climate and biodiversity changes call for sustainable forest management practices different from those in the past to ensure the long-term health, resilience, and ecological value of Latvia's forests. This study investigates the impact of an arginine phosphate-containing fertilizer on nitrogen uptake, carbon content, and elemental concentrations in pine needles across different forest types in Latvia. By examining the effects of this fertilizer in the context of Latvia's specific forest-related issues, the research aims to contribute valuable insights into nutrient dynamics and concurrence in the first years after planting. The study encompasses three distinct forest types: Vacciniosa, Aegopodiosa, and Myrtillosa. Soil treatment was implemented during the planting of the seedlings, followed by the analysis of pine needle samples. Isotope ratio mass spectrometry and inductively coupled plasma mass spectrometry were employed to determine the nitrogen and carbon mass fraction, the nitrogen isotope ratio, and elemental concentrations. Chemometric analysis facilitated data evaluation. The findings reveal diverse patterns in nitrogen uptake and isotope ratio changes among the forest types. Aegopodiosa and Myrtillosa forests exhibited increased nitrogen mass fraction and decreased $\delta^{15}N$ values in pine needles, indicating arginine phosphate as the primary nitrogen source. Conversely, Vacciniosa forests displayed elevated $\delta^{15}N$ values in control samples, suggesting alternative nitrogen uptake due to low soil nitrogen content. All samples exhibited a significant increase in carbon content and a decrease in $\delta^{13}C$ values associated with transplantation and environmental shifts. Aegopodiosa forests demonstrated the least variation in $\delta^{13}C$ values, indicating a more consistent response during transplantation. Chemometric analysis highlighted correlations between elemental concentrations, seedling age, and forest types [1]. This study highlights the importance of considering forest type and environmental conditions when assessing fertilizer efficacy. It provides insights into the varying effects on nitrogen uptake and carbon content in pine needles across different forest types in Latvia, contributing to our understanding of nutrient dynamics in forest ecosystems and guiding sustainable forest management practices.

Author Contributions: Conceptualization, M.B. and D.L.; methodology, A.V., D.L. and M.K.; software, M.B. and L.A.-B.; validation, D.L., M.K. and A.V.; formal analysis, M.B., J.S., L.B., K.D., A.Z,

Citation: Bertins, M.; Svinska, J.; Zigure, S.; Busa, L.; Zusevica, A.; Dumins, K.; Vendina, V.; Stals, T.A.; Ansone-Bertina, L.; Lazdina, D.; et al. Elemental Composition and Isotope Ratio in Pine Needles: The Impact of Arginine Phosphate-Containing Fertilizer Application in Pine-Planting Sites. *Proceedings* **2023**, *92*, 50. https://doi.org/10.3390/proceedings2023092050

Published: 24 November 2023

V.V., T.A.S. and S.Z.; data curation M.B., J.S., L.B., K.D., A.Z., V.V., T.A.S. and S.Z.; resources, A.V., D.L. and M.K.; writing—original draft preparation, M.B., J.S. and L.A.-B.; writing—review and editing, M.B., L.A.-B., D.L., M.K. and A.V.; visualization, M.B., J.S. and L.A.-B.; supervision, D.L., M.K. and A.V. All authors have read and agreed to the published version of the manuscript.

Funding: Research was funded by the Project "Strengthening the Doctoral Capacity of the University of Latvia within the framework of the new doctoral model" with project identification No.8.2.2.0/20/I/006, LU registration No. ESS2021/434, co-financed by the European Social Fund. Trees were measured to determine the growth rate and potential of accumulation of elements in cooperation with the Latvian State Forest initiated research "Working methods and technologies for restoration, planting, care and protection of forest stands" No. 5-5.9.1_007O_101_21_77).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

Acknowledgments: The authors would like to express their gratitude to all individuals who provided assistance and support throughout this research project. Their contributions and collaboration were invaluable in the successful completion of this study.

Conflicts of Interest: The authors declare no conflict of interest.

Reference

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