

Proceedings

The Impact of Long-Term Fertilisation of Potato Starch Wastewater on the Growth of Scots Pines: A Retrospective Analysis [†]

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Abstract: The article discusses the impact of the application of potato starch wastewater as a fertiliser on the radial growth of Scots pines. The research was carried out in a forest area in northern Poland, where organic wastewater from the Potato Industry Plant in Iława (Poland) and lake waters were sprinkled for almost 28-long. More specifically, our study sought to determine the direction, extent, and duration of changes in the trees' growth responses caused by the application of fertiliser and the influence of climatic conditions on secondary growth in the trees to which the fertiliser had been applied. As part of the study, the extent of and changes in the growth responses were determined with reference to annual ring widths and earlywood and latewood widths using dendrochronological methods. The research was carried out in four pine stands: two stands of different ages (80 and 110 years) located within the FWTP site and two control stands of corresponding ages located outside that area. Core samples were collected from 12 trees in each stand. We were carried out tree-ring analyses using standard dendrochronological techniques. The measurements of the annual tree-ring widths and earlywood and latewood widths were made with the CooRecorder software, visual and statistical cross-dating TRW, and quality checking with CDendro and COFECHA software, and chronologies construction and basic statistics using the ARSTAN program. A non-parametric test, Kruskal–Wallis, was used to determine the significance of differences between the pine growth on respective research and control plots. We found a two-way impact of potato starch wastewater on radial growth in the trees under study, with a stimulatory effect (27%–30%) in the first decade of fertiliser application followed in the subsequent years by a strong reduction in growth (30%–45%, depending on the age of the trees). The trends of these changes could be seen in both the overall annual ring widths and the widths of earlywood and latewood. The direction of the changes was the same for trees of different ages, although age was found to have affected the extent and duration of the stimulatory or inhibitory effect. Over the entire period during which the fertiliser was applied, changes occurred in the structure of the wood as manifested in the increased share of earlywood. The sprinkler application of potato starch wastewater and the accompanying irrigation caused a shift in dendroclimatic relationships in comparison to the control plots. Surface irrigation and the resulting changes in water balance reduced the drought susceptibility of the pines under study. At the same time, however, trees weakened by the excessive concentration of toxic nitrates became more sensitive to temperature conditions in winter. The results confirm that the implementation of substances containing significant amounts of organic nitrogen and potassium into forest ecosystems may impair the vigour of trees, reduce stand productivity, cause an imbalance in the ecosystem and may consequently lead to forest degradation.

Keywords: tree ring widths; organic sewage; forest experiment, *Pinus sylvestris*