YOUNG SPRUCE ROOT BIOMASS ALLOCATION IN CONTROLLED CONDITIONS

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INTRODUCTION

Intensive human technological and industrial development caused continuous change in the CO_2 concentration in the atmosphere (IPCC, 2013). Currently, the concentration has exceeded 413 ppm (Global monitoring Laboratory, 2021). Increasing CO_2 concentrations in the atmosphere are contribute to climate change at the global and regional levels (Klein et al., 2016; Nilsen and Strand, 2013). The importance of the whole issue is confirmed by the fact that the extreme climatic conditions we have encountered in recent years were previously predicted for the period around 2050 (Hanewinkel et al., 2012). Elevated CO_2 level can potentially support growth of all tree organs (DeLucia et al. 1999), however this effect can be supressed by low availability of nutrients (Oren et al. 2001). This study in concerned about **root biomass**. **Roots are the crucial part of not only forest ecosystem- they are responsible for water and nutrients uptake and tree stability.**

The main goal of the study was to evaluate the structure of Norway spruce (*Picea abies* (L.) H.Karst) belowground biomass in controlled abiotic conditions.

MATERIALS AND METHODS

Study was carried out at the Bílý Kříž Ecosystem Station (ES) in Beskydy Mountains. ES is equipped with two lamellar spheres where controlled conditions were monitored. The **sphere A** represents ambient atmospheric CO_2 concentration. **Sphere E** represents elevated CO_2 concentration of 700 ppm. The working field in each of the spheres was divided into 12 parts The effect of fertilization was studied on 6 partial areas in both spheres, that were fertilized with nitrogen lime once a year, at a dose of 50 kg. ha^{-1} in April.

Young spruces were picked up manually, divided to upper and belowground part. Root system was carefully washed, labelled and transported to laboratory. The root system was divided into fractions- coarse roots (**<2 mm**) and fine roots (**>2 mm**) and further analysed statistically. Measured values were divided into **3 groups** according to root collar diameter (1/3 and 2/3 quantiles).

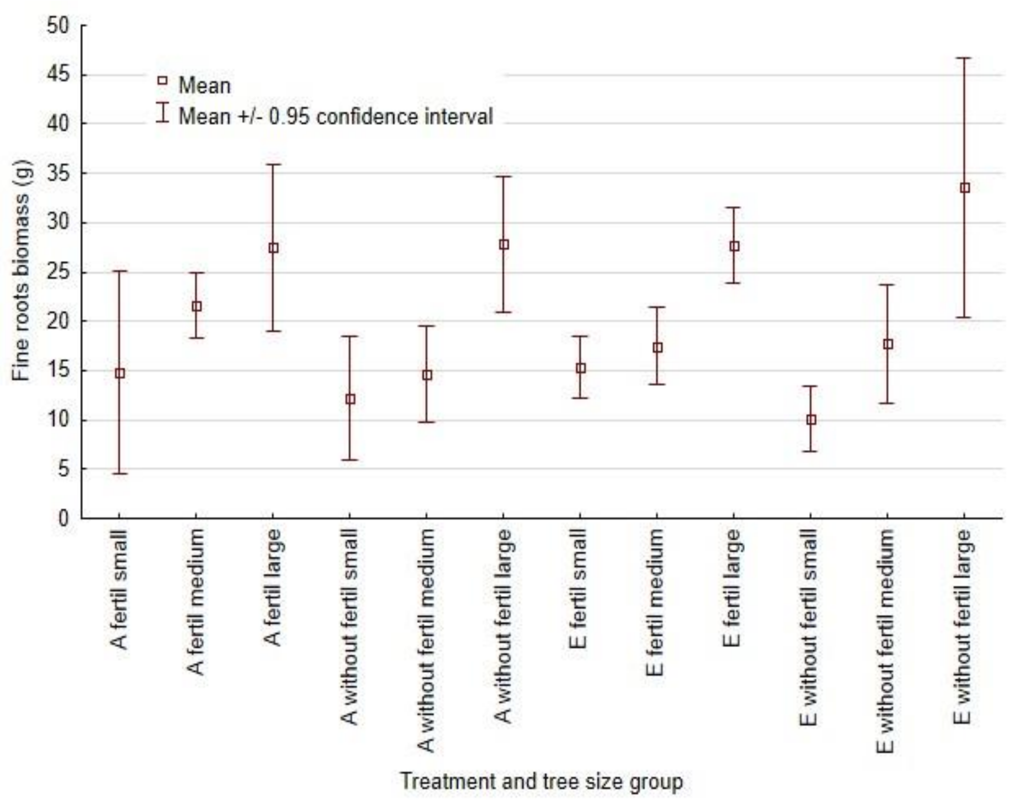

Fig. 1 Fine root biomass of Norway spruce young trees on ES Bílý Kříž.

RESULTS

Average amount of root biomass for sphere A was 83 g per tree of which is 24 % fine roots and 76 % coarse roots. In E sphere, average belowground biomass was 74 g, made of 27 % fine roots and 73 % coarse roots. **Root collar size had a significant effect** on overall root biomass. With increasing root collar diameter, the amount of root biomass was higher as well. However **supportive effect of fertilizer** was visible in both spheres. This trend was observed mainly for small and medium trees. Analogically, small trees fine roots reaction to fertilizer was **positive** in sphere E, **none** in medium sized young trees and **negative** in large trees. Almost similarly, fertilizer in A sphere had significantly positive effect on fine roots in medium sized spruces and none in large trees (Fig. 1). In E sphere, coarse root biomass tended to be higher when fertilised for all root collar diameter groups. In A sphere this tendency was not confirmed.

Ratio of fine/total root biomass was 25 % for A sphere and 27 % for E sphere (Fig. 2). In A sphere, **diminution trend of ratio fine/total root biomass** with increasing tree size is visible. On contrary, this trend was not present in E sphere. However, effect of fertilization in E sphere was apparent in fine/total root biomass ratio, for fertilized it was 25 %, for not fertilized 29 %. In A sphere, no such effect on this ratio was observed. Coarse/total root biomass ratio was 70-75 % for both spheres. Ratio of fine/coarse roots ranged from 34 to 42 %. For A sphere, the mean ratio was 34 % (not fertilized) and 35 % (fertilized), while in E sphere, these ratios were 42 % and 34 % respectively.

CONCLUSION

Positive effect of elevated CO_2 in atmosphere on root biomass amount **was not proved**. **Fertilization had positive effect** especially on small and medium- sized trees. The highest portion of fine roots in total belowground biomass was observed in elevated CO_2 level without fertilization.

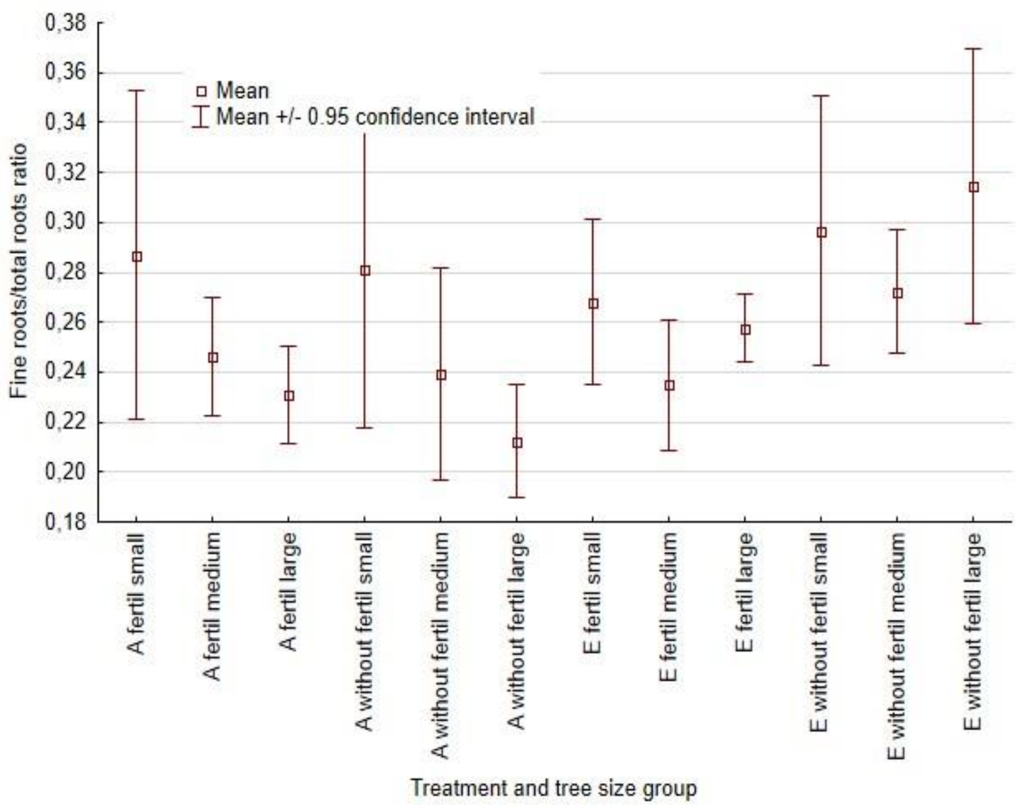

Fig. 2 Fine root/total root biomass ratio of Norway spruce young trees on ES Bílý Kříž.

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