GROWTH RATE AND SAP FLOW OF *PICEA ABIES* (L.) KARST. SEEDLINGS UNDER ELEVATED CO_2 CONCENTRATION

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Keywords

Norway spruce, "Baby" sensors, transpiration, oven-dry wood density

ABSTRACT

The global atmospheric CO_2 (carbon dioxide) level is likely to increase to 550 – 1000 ppm (parts per million) by the end of the century. Therefore, it is an urgent task to perform more studies examining the adaptive capacity of European tree species in the face of climate changes, because the forests regenerated today will have to adapt and cope with the climate conditions that will be present during the life of the trees in the stand. It is believed that the properties and productivity of the trees will be strongly affected by the increasing CO_2 concentration in the atmosphere and global mean temperature, and also by alteration in the water and nutrient cycle**.** We examined the performance of the sap flow measuring system based on the TBH (trunk heat balance) method. Sap flow measurements in trees are today the most common method to determine the transpiration of the forest canopy (Ec).

AIMS OF THE RESEARCH

The objective of the present study was to investigate the effects of elevated CO_2 on oven-dry wood density, aboveground biomass, and sap flow of Norway spruce seedlings planted in the spheres at Bílý Kříž in the Beskydy Mountains, Czech Republic. In this research, we grew 84 per sphere of Norway spruce seedlings and we hypothesized that the strength of the CO_2 "fertilization" will contribute to higher biomass, and wood density, and according to that the higher transpiration of the seedlings in an enriched CO_2 atmosphere.

MATERIALS AND METHODS

The experiment was carried out at the Bílý Kříž experimental ecological research study site situated in the Moravian-Silesian Beskydy Mountains, Czech Republic (49°30' N, 18°32' E). The altitude of the climatological station is 894 m a.s.l. In this research we used the two lamellar glass–domes, one with ambient 400±20 ppm CO_2 and one with elevated 700 ±20 ppm CO_2 concertation, to elucidate their effect on seedling's ecophysiological response. There are no statistically significant differences between spheres in atmospheric conditions. We observed biometrical parameters (tree height, diameter), aboveground biomass (leaves, branches, stems), wood density, as well as the daily pattern of sap flow using the THB method. The method does not need any empirical, tree- or species-specific parameters. It is almost independent of the radial conductivity profile and directly outputs volumetric water flow values.

RESULTS

Based on this preliminary result, we can conclude that elevated CO_2 concentration will improve aboveground biomass (statistically not significant) and wood density (statistically significant). Morphological parameters such as (tree height, and diameter) of the seedlings for both spheres are in the same range (statistically not significant). From sap flow measurements, we observed a few "normal" days in comparison with a few "dry" days. We defined "Normal" as those days with satisfactory atmospheric conditions such as VPD (vapor pressure deficit), calculated from the temperature and humidity of the air. So "normal" days are with high RH (relative humidity), low VPD, and SWC (soil water content) > 25 %, on the other hand, the "dry" days are those days with SWC <25 %, low RH and high VPD.

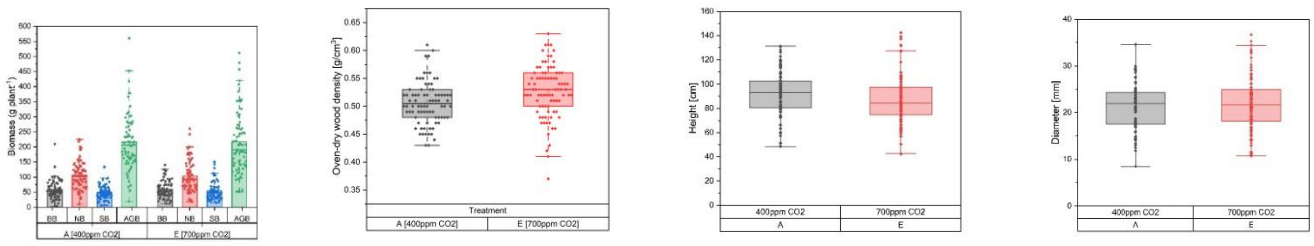

Figure 1: Changes in aboveground biomass (a) and over – dry wood density (b) (g/cm^3), tree height (c) and diameter (d) of (*Picea abies* L.) seedlings treated under ambient (400 ppm CO_2) and elevated (700 ppm CO_2)

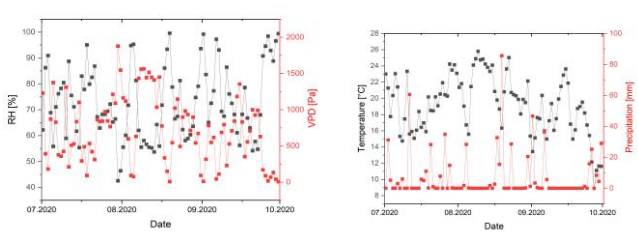

Figure 2: Atmospheric condition RH [%], VPD [Pa], air temperature [°C] and precipitation [mm] for certain period of 2020 year

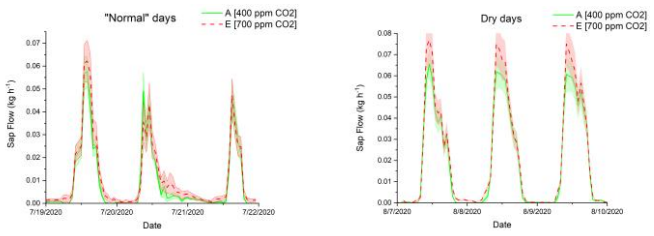

Figure 3: Daily values of sap flow (THB) method on "normal" and "dry" days of (*Picea abies* L.) seedlings treated under ambient (400 ppm CO_2) and elevated (700 ppm CO_2)

CONCLUSIONS

In accordance with the hypothesis tested, our preliminary results confirmed the effects of CO_2 concentration on aboveground biomass and particularly on wood density. The elevated CO_2 concentration will improve the sap flow, one of the main reasons for that can be that the soil of the experimental site is quite rich in nutrients and water is not a limiting factor at this specific site. Most likely we can find an answer in the higher lumen of cells and if in accordance with that also higher conductivity, nevertheless, the seedlings invest a more significant portion in belowground biomass (coarse and fine roots). Some changes in wood properties would affect the CO_2 sinks ability of tree species, but this is an experiment with juvenile trees so, we cannot conclude what will happen with a mature tree. Still, this research is a starting point for some new experiments in the future.

ACKNOWLEDGEMENT: The work was supported by the Internal Grant Agency of Mendel University in Brno with grant no. IGA-LDF-22-IP-024.