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Application of the Li-6800 portable photosynthesis system to study physiological traits of trees

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Introduction

The LI-6800 is a portable photosynthesis system that uses Infrared Gas Analyzers to detect concentrations of CO_2 and H_2O and Multiphase Flash™ Fluorometer to measure chlorophyll fluorescence. The LI-6800 controls environmental conditions in the leaf chamber during measurements, including temperature, humidity, light intensity and wavelength, and CO_2 concentration, as well as airflow and fan speed. The photosynthesis system measures gas exchange parameters, including CO_2 assimilation rate, transpiration, and stomatal conductance. The LI-6800 determines dark adopted and light adopted chlorophyll fluorescence parameters. It also makes it possible to plot and analyse OJIP chlorophyll fluorescence kinetics. Chlorophyll fluorescence and gas exchange analysis can be a very powerful, precise and noninvasive tool to determine the abnormalities in the functioning of the photosynthetic apparatus especially in plants subjected to abiotic stress factors such as salinity and elemental deficiency.

Fig. 1. Portable photosynthesis system LI-6800 during measurements in Suków Nursery Farm

Our work aimed to compare the gas exchange of assimilatory organs in seedlings of three tree species: beech, oak and pine, which differ in their ecological requirements. Gas exchange parameters affecting the intensity of the CO_2 assimilation process were determined.

Materials and methods

One-year-old beech, oak and pine seedlings were obtained from the Suków Nursery Farm, Daleszyce Forest District. The dependence curves of intercellular CO_2 concentration (Ci) and light intensity (PPFD) on assimilation rate were determined at the end of July. The CO_2 compensation point and carboxylation efficiency were determined from the A - Ci curve, while the light compensation point, light saturation point and quantum efficiency were determined from the A - PPFD curve.

Results

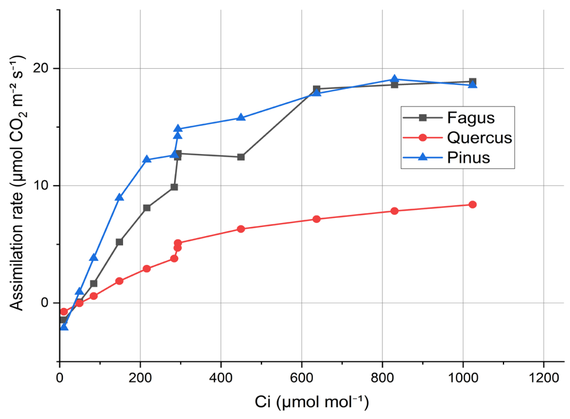

Fig. 2. Dependence of assimilation rate from intercellular CO_2 concentration for beech, oak and pine seedlings

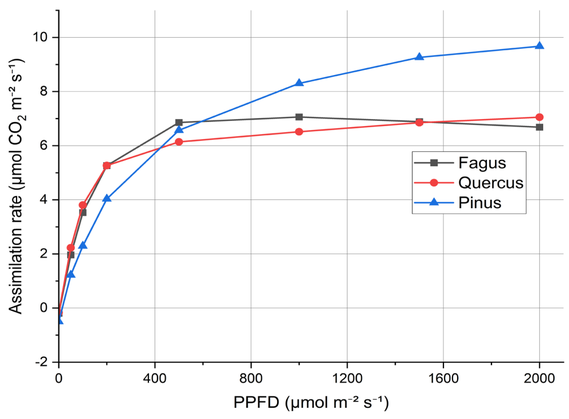

Fig. 3. Dependence of assimilation rate from photosynthetic photon flux density (PPFD) for beech, oak and pine seedlings

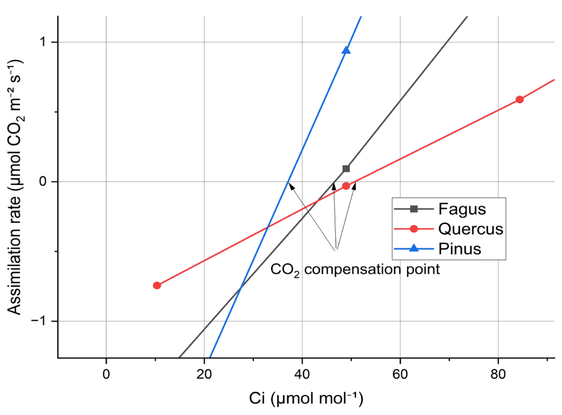

Fig. 4. CO_2 compensation points values for beech, oak and pine seedlings

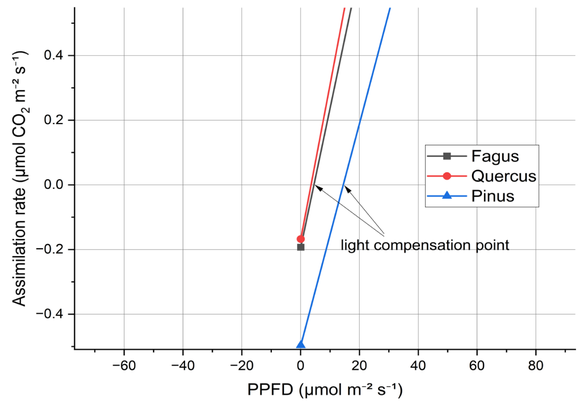

Fig. 5. light compensation point values for beech, oak and pine seedlings

Table 1. Gas exchange parameters affecting the assimilation rate in beech, oak and pine seedlings

Tree species	CO_2 CP µmol mol^{-1}	CE	LCP µmol m^{-2} s^{-1}	LS µmol m^{-2} s^{-1}	QE µmol m^{-2} s^{-1}
Fagus sylvatica	48	0,043	4,5	900	0,00013
Quercus robur	52	0,015	3,5	1500	0,00061
Pinus sylvestris	37	0,004	14,5	1500	0,0021

CO_2 CP – CO_2 compensation point, CE – carboxylation efficiency, LCP – light compensation point, LS – light saturation point, QE – quantum efficiency

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