Accumulation and localization of phenolic compounds under future environmental conditions: the joint effects of CO_2 concentration and light intensity

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November 16, 2020

Abstract

Barley (Hordeum vulgare) accumulates phenolic compounds (PhCs), which play a key role in tolerance to environmental stress. The influence of irradiance and atmospheric CO_2 concentration ($[CO_2]$) on the accumulation and localization of PhCs in barley leaves was examined for two varieties with different tolerances to oxidative stress. PhC localization was visualized using Naturstoff reagent A and fluorescence microscopy. Close relationships were found between fluorescence-determined localization of PhCs in barley leaves and PhC content estimated using liquid chromatography coupled with mass spectroscopy detection. High intensity light had the strongest effect on the accumulation of PhCs, but total PhC content converged at elevated $[CO_2]$, minimizing the differences between high and low irradiance. PhCs localized preferentially near the surfaces of leaves, but under low light, increasing allocation of PhCs deeper mesophyll layers was observed. The PhC profile was very different between barley varieties. Our research presents novel evidence that $[CO_2]$ modulates the accumulation of PhCs accumulation in barley leaves. Mesophyll cells, rather than epidermal cells, were most responsive to environmental stimuli in terms of PhC accumulation. The relatively tolerant variety accumulated significantly more hydroxycinnamic acids, indicating these PhCs may play a more prominent role in oxidative stress prevention.

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