The Effects of Carbon Dioxide and Environmental Factors on Stomatal Density, Size, and Potential Conductance Index

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Stomata account for 95% of the terrestrial movement of water vapor and CO2 and are, therefore, essential aspects to the survival of plants and all organisms that depend on them. The climate change crisis is challenging plants with several environmental alterations including combinations of increased CO2, drought, soil salinity, soil acidity and temperature. Markedly less research on how stomata respond to elevated CO2 combined with other environmental factors warrants us to determine the effect of these factors on stomatal density, size, and conductance in radish, barley, tomato, and buckwheat plants. For each plant, six groups were created: a control with standard conditions, a control with increased CO2 conditions, and four groups with increased CO2 combined with one of the following factors: increased temperature, soil salinity, soil acidification, or drought. Stomatal density and stomatal size were measured 3 times throughout the experiment and potential stomatal conductance index was calculated from stomatal density and guard cell length. Results show that the variation of data among the plants indicate that large generalizations about CO2 impact and other environmental factors are risky to make. Also, barley stomatal area data supports findings that for some plants, elevated CO2 induces stomatal closure and lowers area, which is validated because the PCI (dependent on area and density) of barley in elevated CO2 also decreased. Finally, the stomatal area of barley in drought and elevated CO2 conditions is higher than that of stomata in elevated CO2 conditions, which not only goes against our hypothesis and previous studies, but warrants further research testing varying degrees of drought to see its impact on agricultural adaptation and water management strategies.

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