EARLY PLANT CELLULAR RESPONSES TO CARBON DIOXIDE (CO_2) AND MECHANICAL WOUNDING: REDOX AND TRANSCRIPTOMICS

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Abstract

Atmospheric carbon dioxide (CO_2) concentrations have been rapidly rising since the industrial revolution. Available data shows that hormonal changes are involved in the modified patterns of C_3 plants defense observed under elevated CO_2 (eCO_2) in response to insect herbivory and mechanical wounding where the phytohormone jasmonic acid (JA) plays a central role. Changes in pyridine nucleotides, redox metabolites, and phytohormone profiles were monitored in control and mechanically wounded *A. thaliana* plants fertilized with nitrate or ammonium and grown at ambient or elevated CO_2. Decreased levels of JA were observed at 24h after wounding, indicating a possible attenuating effect on the JA pathway in plants grown at eCO_2. Nitrate fertilization promoted an increased oxidative state that was possibly translated to a robust JA burst. Nevertheless, this effect was reduced in plants grown at eCO_2. Our results indicate that in wounded plants grown at eCO_2 the oxidative state and jasmonate burst are attenuated and induced changes in ascorbate (Asc) and SA may contribute to the observed JA levels. RNA-Seq analyses allowed the identification of differentially expressed genes (DEGs) involved in the activation of brassinosteroid and ethylene signaling, growth, and xyloglucan metabolic processes in plants grown at eCO_2. In wounded plants, the transcriptional upregulation of genes involved in JA biosynthesis and signaling supports the induction of JA that we observed after wounding independent of CO_2 level. Wounded plants receiving ammonium showed the downregulation of genes related to general stress response in comparison to nitrate-fertilized plants. Overall, this research presents insights into the defense-related phytohormone, early transcriptomic, and redox status changes triggered in response to mechanical wounding in plants under eCO_2 and generates evidence of the critical role of nitrogen fertilization in plant responses modulation, establishing essential implications for fertilization strategies under future predicted climatic conditions.

About the Candidate Julian holds an M.Sc. in Microbiology from the National University of Colombia and a B.Sc. in Biology. Prior to attending McGill University, he worked at the Colombian Agricultural Institute (ICA) conducting research on molecular epidemiology of plant virus and insects. He joined Dr. Jacqueline Bede's laboratory to research the effects of elevated CO_2 on redox, phytohormonal, and transcriptomic plant responses to mechanical wounding.