Effects of ozone stress on physiology and plastidial galactolipids of two tropical cowpea cultivars

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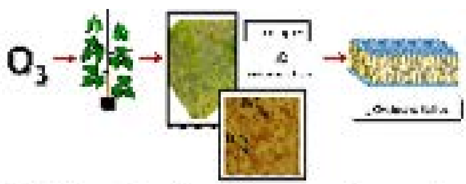
Statement of the Problem: Tropospheric ozone is considered the most detrimental air pollutant to plants. At the cellular level, ozone is itself a strong oxidant and its decomposition in the apoplast generates a range of reactive oxygen species (ROS). Cell membranes are primary targets of damage induced by ROS and the preservation of cell integrity through stable membrane lipid composition is essential to plant survival. The purpose of this study is to investigate the effects of ozone on physiology, on plastidial galactolipid content, as well as on the expression of genes related to membrane lipid metabolism in two cowpea cultivars: EPACE-1 and IT83-D.

Methodology & Theoretical Orientation: Ozone stress (120 ppb) was applied on three-week-old seedlings under controlled conditions during two weeks. After 7 and 14 days of treatment, stomatal conductance and phytotoxic ozone dose were measured. Leaf lipids were extracted in chloroform: methanol:water separated by thin layer chromatography and analyzed using a gas chromatograph/mass spectrometer. Leaf total RNA was extracted; cDNAs were used for the detection of transcript accumulation by real-time PCR.

Findings: Significant effects of ozone were observed at the cellular level. First, ozone exposure provoked symptoms of leaf injury and H_2O_2 accumulation. Second, the ozone treatment induced decreases in the plastidial galactolipids monogalactosyldiacylglycerol (MGDG) and digalactosyl-diacylglycerol (DGDG) in both cultivars. These effects were stronger in the IT83-D cultivar, which also showed specific ozone responses such as a higher DGDG: MGDG ratio and the coordinated up-regulation of DGDG synthase (*VuDGD2*) and ω-3 fatty acid desaturase 8 (*VuFAD8*) genes, suggesting that membrane remodeling occurred under ozone stress in the sensitive cultivar.

Conclusion & Significance: Taken together, these results suggest that the ozone treatment had a limited impact at whole-plant level but provoked leaf injury and altered membrane lipids. These effects were more pronounced in IT83-D, revealing intervarietal differences in ozone tolerance.



Recent Publications:

1. Ainsworth E A, Yendrek C R, Sitch S, Collins W J and Emberson L D (2012) The effects of tropospheric ozone on net primary productivity and implications for climate change. Annu. Rev. Plant Biol. 63:637-661.

2. Baier M, Kandlbinder A, Golldack D and Dietz K J (2005) Oxidative stress and ozone: Perception, signalling and response. Plant Cell Environ. 28(8):1012-1020.

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4. Upchurch R G (2008) Fatty acid unsaturation, mobilization, and regulation in the response of plants to stress. Biotechnol. Lett. 30(6):967-977

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Biography

Deborah Moura Rebouças has her expertise in environmental stresses in plants. Her study aims to characterize the lipids and their changes upon stress and the genes underlying the changes. By establishing a profile of these key factors, agriculture would gain a direction for selective breeding of plants that are more resilient to environmental stresses.