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Development, characterization, and application of needle-type microsensors for in situ monitoring of ions in citrus plants

For over a decade, the incidence of Huanglongbing (HLB) has grown at an alarming rate, affecting citrus crops worldwide. Current methods of nutrient therapy have little to no effect in alleviating symptoms of HLB, and scarce research has been put forth towards non-destructive tools for monitoring zinc transport in citrus plants. The present study investigated in situ monitoring of Zn^{2+} ion transport in citrus plants. We have developed a solid contact micro-ion-selective electrode (SC-µ-ISE) for the determination of zinc transport in sour orange seedlings using a non-invasive microelectrode ion flux estimation (MIFE) technique. Foe better penetrating ability, a metallic bismuth microelectrode was developed for the in situ monitoring of Zn^{2+} in the vascular bundle of citrus leaves using a novel two-step square wave anodic stripping voltammetry (SWASV) analysis. The SC-µ-ISE displayed a 26.05±0.13 mV decade-1 Nernstian response and a limit of detection (LOD) of 0.026 ppm. The bismuth microelectrode presented a 0.172 µA/ppm Zn^{2+} response and a LOD of 0.92 ppm Zn^{2+}. Application of these sensors showed a significant Zn^{2+} uptake in the leaves and roots of sour orange seedlings when bulk concentrations were higher than 5.99 mM. Above this concentration, a linear relationship between flux and bulk Zn^{2+} concentration was observed which relationship suggests passive diffusion may be a key mechanism for Zn transport into plants. Overall, the developed microsensors, capable of tracking its systemic Zn^{2+} activity directly in plants will lead to better understanding of its potential fate in plants for effective HLB management.

Biography

Woo Hyoung Lee is an Assistant Professor in the Department of Civil, Environmental, and Construction Engineering (CECE) at the University of Central Florida (UCF). He received his PhD from the University of Cincinnati, OH in 2009. Before joining UCF, he was a Post-doctoral researcher at U.S. Environmental Protection Agency (EPA), National Risk Management Research laboratory, Cincinnati, OH. He has published more than 32 papers in reputed journals and has been serving as an Associate editor of Water Environment Research (WER).

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