SHORT-TERM NITRATE UPTAKE AND ITS IMPACT ON THE BIOELECTRICAL IMPEDANCE SPECTRUM OF LETTUCE LEAVES

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Monitoring plant nutrient uptake dynamics is essential for optimizing cultivation practices. In this study, we investigated the short-term uptake of nitrate (NO_3^-) by lettuce leaves and the associated changes in their bioelectrical impedance spectrum (BIS). Plants were grown in a nutrient solution based on Hoagland's protocol and, after 14 days, were transferred to an N-free medium for five days to suppress root nitrate uptake mechanisms. Subsequently, the leaves were exposed to 5 mM KNO_3 for 5 and 6 hours, during which BIS measurements were performed in the 1 Hz–100 kHz frequency range. Our findings indicate that the N-free treatment led to a significant increase in leaf impedance, particularly at lower frequencies (1–10 Hz). Upon reintroduction of NO_3^-, a significant decrease in impedance was detected within one hour, with this decrease becoming more pronounced over time, especially at low frequencies. Examination of correlation coefficients revealed a significant drop at higher frequencies (~10^4 Hz), while values at lower frequencies (around 1 Hz) remained close to 1, suggesting that BIS is highly sensitive to the alterations in tissue fluid environment. Overall, these results demonstrate the potential of BIS as a rapid and non-destructive method for assessing early NO_3^- uptake responses in lettuce leaves. Frequency-dependent changes in impedance may serve as a valuable indicator of plant nutritional status and metabolic activity.