PHOTOSYNTHETIC RESPONSE AND CARBON ISOTOPE DISCRIMINATION OF COTTON (*GOSSYPIUM HIRSUTUM* L.) IN RESPONSE TO POTASSIUM DEFICIENCY

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Abstract

Leaf photosynthesis and carbon isotope composition in response to K deficiency was determined with Cotton (*Gossypium hirsutum* L.) grown in sand filled 8-L pots under two potassium (K) treatments in a growth chamber at the Altheimer Laboratory in Fayetteville, Arkansas. Plants were watered every second day with deionized water and with nutrient solution on alternate days. At 14 days after planting (the fourth true leaf stage) the treatments were established consisting of (1) continued complete nutrient solution, and (2) nutrient solution containing no K. Leaf photosynthesis and related gas exchange measurements were taken 13, 19, and 26 days after treatment establishment (DATE). Leaf samples from each analysis date were then dried and reserved for nutrient and carbon isotope analysis. Photosynthesis declined as the K deficiency developed in the no-K treatment. Decreased carboxylation efficiency and an increased CO_2 compensation point also resulted from declined leaf K concentration, which is attributed to changes in photosynthesis and respiration in the light. Potassium deficiency also resulted in increased stomatal and non-stomatal limitations to photosynthesis. Gas exchange studies showed stomatal resistances were most limiting to photosynthesis at 13 DATE whereas instantaneous measurements at 19 and 26 DATE indicated non-stomatal resistances were most limiting. However, carbon isotope analyses, which integrated stomatal and non-stomatal resistances over the entire analysis period, indicated that the most limiting resistance to photosynthesis was stomatal. Decreased carbon isotope discrimination in the no-K treatment is also in agreement with increased stomatal limitations. We conclude from these studies that, during a mild K deficiency, increased stomatal resistance is first to result in a decrease in photosynthesis and, as the deficiency becomes more acute, biochemical factors also contribute.

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