EFFECT OF NITROGEN DEFICIENCY ON PHYSIOLOGICAL PROCESSES IN COTTON

Ved Parkash
John Snider
Amrit Pokhrel
Gurpreet Virk
Henry Sintim
Lavesta Campbell Hand
Cristiane Pilon
University of Georgia
Tifton, GA

Nitrogen is an integral constituent of the photosynthetic apparatus. Nitrogen deficiency can affect the activity of one or more than one key component of the photosynthesis process such as light capture, photochemistry, and carbon fixation. Determining the response of individual photosynthetic components to nitrogen deficiency will improve our understanding of the most susceptible processes to N deficit. The objective of our study was to determine the underlying mechanisms driving limitations to carbon assimilation in different canopy layers of cotton under nitrogen deficient conditions. It was hypothesized that nitrogen deficiency will reduce photosynthetic rate of cotton by affecting underlying photosynthetic components to different degrees at different vertical leaf positions in canopy. Treatments included 0 and 179 kg nitrogen ha^{-1}. Single leaf measurements were taken from main stem leaves present at the 4^{th}, 7^{th}, and 10^{th} node below the terminal. Specific leaf nitrogen content (SLN), net photosynthesis rate (A_N), dark respiration (R_d), electron transport rate (ETR), maximum rate of carboxylation ($V_{c,\ max}$), maximum rate of RuBP regeneration (J_{max}), stomatal conductance (g_s), and mesophyll conductance (g_m) were negatively impacted by nitrogen deficiency and these negative impacts were more pronounced at lower leaf positions. However, CO_2 concentrations in intercellular spaces and at the chloroplast were not impacted by nitrogen deficiency at each leaf position, suggesting that stomatal limitations were not the primary limitation to net photosynthesis under nitrogen deficient conditions. Declines in R_d, ETR, $V_{c,\ max}$, and J_{max} suggested that metabolic impairments were limiting photosynthetic rate under nitrogen deficiency. Moreover, light-dependent electron transport rate (ETR) was strongly correlated with N-induced variations in net photosynthesis. Therefore, future research should evaluate the use of ETR measurements along with SLN from different leaf positions to scale from leaf to canopy level photosynthetic performance in cotton.