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Dark chilling imposes metabolic restrictions on photosynthesis in soybean

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ABSTRACT

Dark chilling inhibited photosynthesis in two soybean [*Glycine max* (L.) Merr.] cultivars (Fiskeby V and Maple Arrow). The inhibition of CO_2 assimilation was characterized by a simultaneous decrease in stomatal conductance (G_s) and intercellular CO_2 concentration (C_i) in Maple Arrow, whereas a similar decrease in G_s in Fiskeby V occurred without any change in C_i. Dark chilling had little effect on total ribulose-1, 5-bisphosphate carboxylase/oxygenase (Rubisco) activity, Rubisco protein content or Rubisco activation state in the subsequent light period. Chilling reduced the abundance of the nocturnal Rubisco inhibitor, 2-carboxyarabinitol 1-phosphate, only in Fiskeby V. The abundance of Rubisco small subunit transcripts was enhanced in both cultivars as a result of dark chilling. Dark chilling decreased the maximal extractable activities and activation states of stromal fructose-1,6-bisphosphatase (FBPase) and NADP-malate dehydrogenase but had no effect on sucrose phosphate synthase or leaf sucrose and starch contents. It is concluded that dark chilling-induced limitations on CO_2 assimilation are predominantly due to metabolic restrictions rather than to direct effects on electron transport reactions and that stromal FBPase is particularly susceptible to dark chilling.

Key-words: *Glycine max*; 2-carboxyarabinitol-1-phosphate (CA1P); fructose-1, 6-bisphosphatase; night temperatures; Rubisco; sucrose-phosphate synthase.

Abbreviations: A, CO_2 assimilation rate; A_{max}, CO_2 saturated rate of CO_2 assimilation; C_a, atmospheric CO_2 concentration; C_c, chloroplastic CO_2 concentration; C_i, intercellular CO_2 concentration; CABP, 2-carboxyarabinitol-1,5-bisphosphate; CA1P, 2-carboxyarabinitol-1-phosphate; FBPase, fructose-1,6-bisphosphatase; G_s, stomatal conductance; NADP-MDH, NADP-malate dehydrogenase; Rubisco, ribulose-1,5-bisphosphate carboxylase/oxygenase; RuBP, ribulose-1,5-bisphosphate; SPS, sucrose-phosphate synthase; $\delta A/\delta C_i$, carboxylation efficiency; Ψ_w, leaf water potential.

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