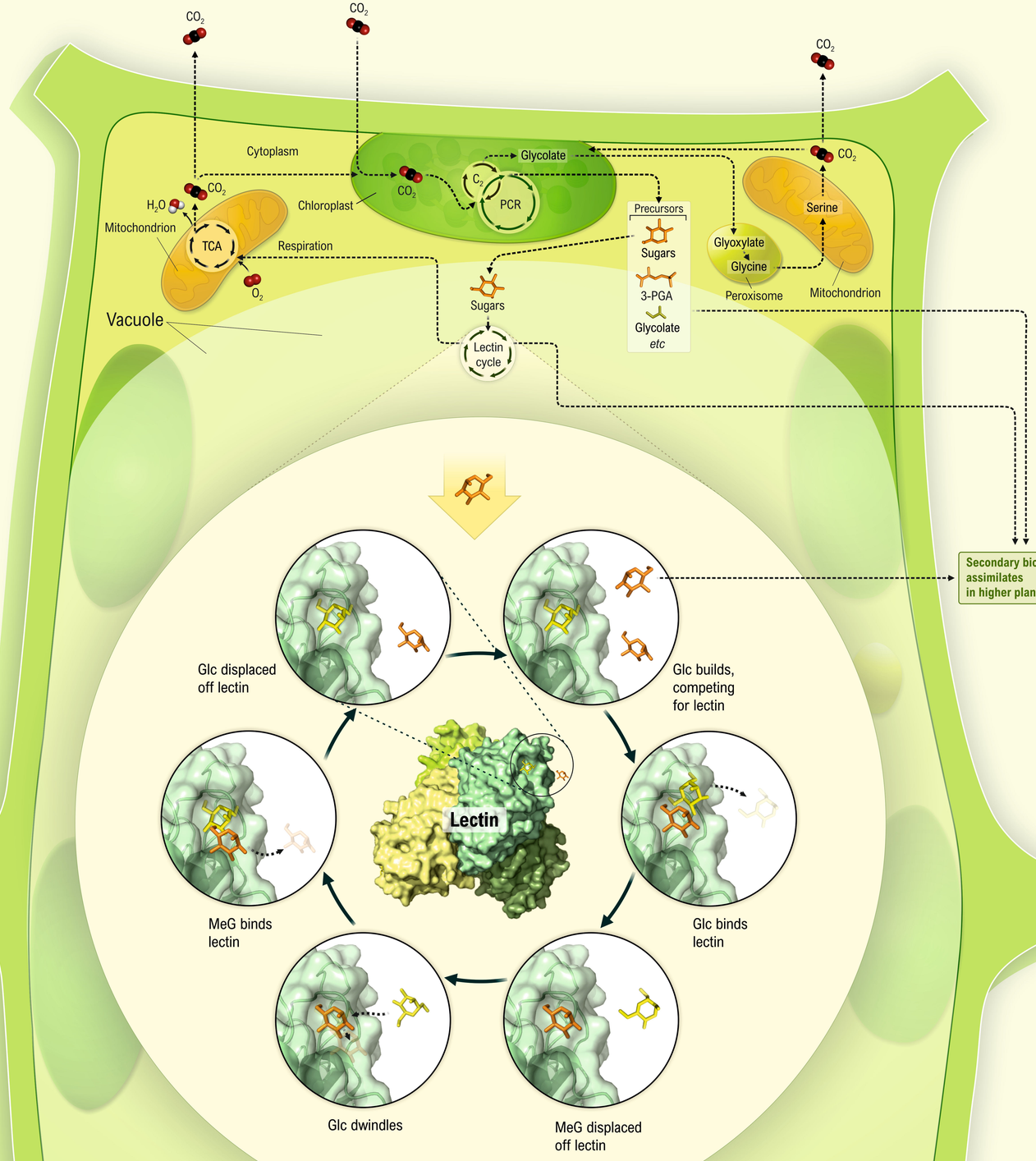
The Carbon Reactions of Photosynthesis
Govindjee's Educational Poster Series

Plant Lectin Cycle



A diagram for glycoconjugation* in the lectin cycle of plants

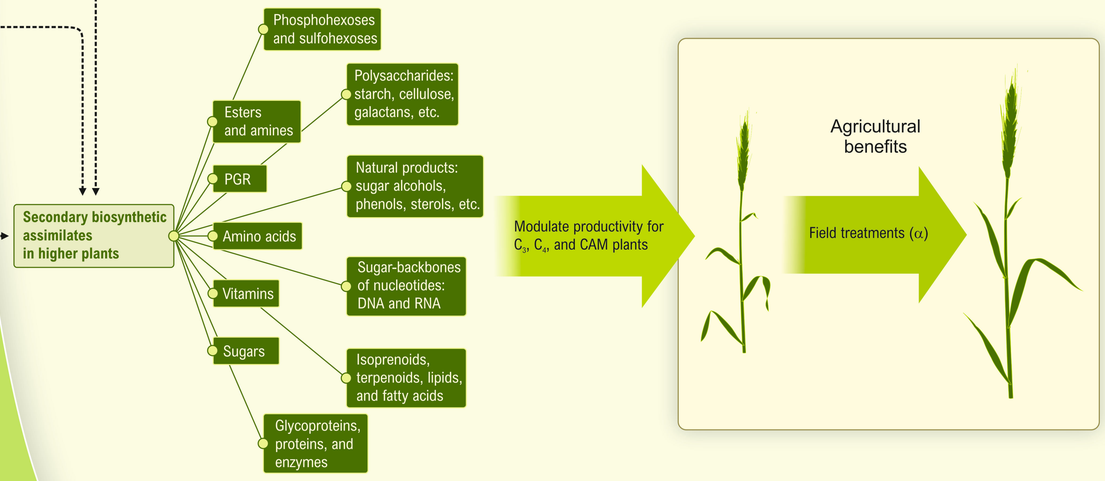
Lectins are ubiquitous protein complexes that reversibly bind photosynthates. Lectin has the same root meaning as *select* and *elect*, that is lectins choose to which structures they would bind. Although they are abundant in all plants, mainly in the vacuoles of plant cells, their function had been unknown. The vacuole is crucial in maintaining plant life functions including turgor, exchange and storage of metabolites and ions, detoxification, and homeostasis. When this natural metabolic pathway was recognized (see [1]), it also indicated the involvement of lectin's "catch and release" function in the carbon reactions of photosynthesis. Mechanisms for glycoregulation had been sought in the chloroplast for over 60 years; and only now, we are able to show how the lectin cycle modulates the flow of carbohydrates in the *vacuole* of plant cells. This is important for the physical and metabolic function of the associated organelles, as well as for the entire plant. We note that an enhanced flow of photosynthates may increase turgor that would press the vacuoles against the cell walls; and these stiffened plant cells may contribute to the recovery of the plant from midday wilt.

External (atmospheric) CO_2 gas, as well as, CO_2 from other plant tissues and already present in the vicinity, enter cells to reach the C_3 Photosynthetic Carbon Reduction cycle (PCR). For further details, see additional posters in this educational poster series.

In vacuoles of plant cells, lectins bind cabohydrates that had been transported from chloroplasts, after being formed there by the PCR. During periods of depletion of glucose (Glc), such as, by respiration, endogenous methyl-β-D-glucopyranoside (MeG) binds lectin while displacing Glc. When Glc concentration increases in the vacuole with fresh supplies from the chloroplast, it may outcompete MeG for lectin binding sites.

Vacuolar lectin binding compounds may include macromolecules with specific saccharide-terminal ligands, as well as plant growth regulators. In agriculture, modulation of glycoregulation has been achieved outdoors with exogenous high potency glycoconjugates in the field (α), such as provided by foliar application of α-mannosides [1]. Soon after the treatment, released photosynthates may be directed to increase productivity.

Glycoconjugation is the covalent linking of carbohydrates with proteins, peptides, lipids, and/or saccharides.



For an historical perspective of the PCR, see [2]; for a review of plant lectins, see [3]; for teaching the carbon reactions of photosynthesis, including the plant lectin cycle, see [1]; and for further information on this part and all other aspects of photosynthesis, see chapters in [4] and [5]. **For convenience of presentation, the plant cell and its organelles are not drawn to scale.**
Send questions and comments to Arthur Nonomura (Art.N@BRANDTiHammer.co).

Abbreviations
C_v, C_c oxidative carbon cycle; MeG, methyl-β-D-glucopyranoside; Glc, glucose; PCR, C_3 Photosynthetic Carbon Reduction cycle; 3-PGA, 3-phosphoglycerate; PGR, Plant Growth Regulator; TCA, Tricarboxylic Acid cycle; α, exogenous treatment of crops for glycoregulation.

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