Orchestration of carbohydrate processing for crassulacean acid metabolism

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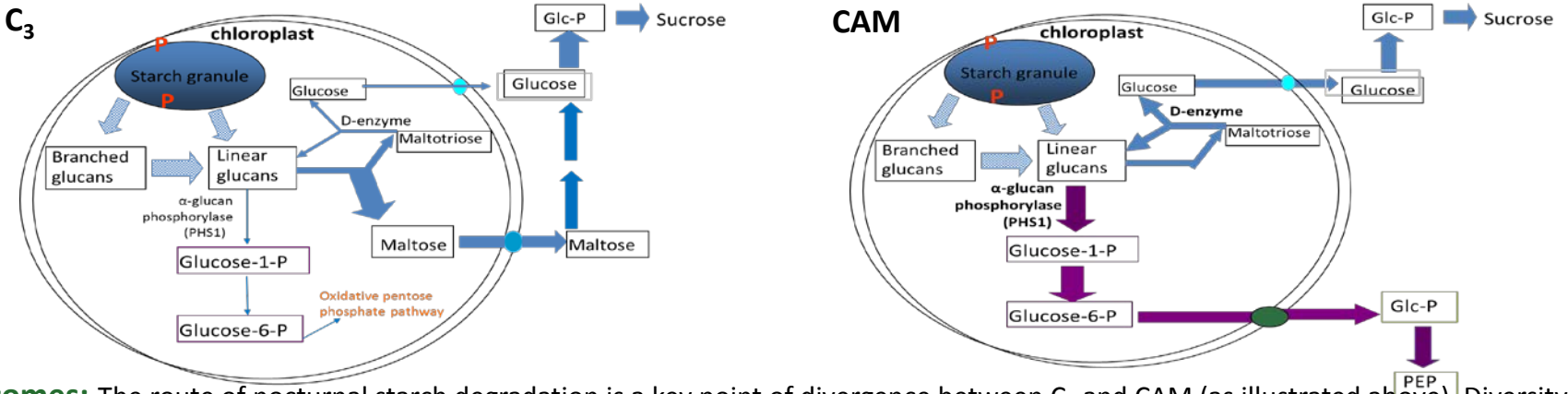
Background: Crassulacean acid metabolism (CAM) is a water conserving mode of photosynthesis and a strategic target for synthetic biology to engineer improved water use efficiency into non-CAM crops to sustain productivity in a warmer, drier world. Carbohydrate availability limits the nocturnal uptake of CO_2 which defines CAM. This paper reviews pathways and mechanisms purported to underpin the day/night processing of carbohydrates for nocturnal carboxylation and growth in CAM plants.

Approach: Chloroplastic and vacuolar transporters are discussed as strategic checkpoints for regulating provisioning of carbohydrate for nocturnal carboxylation and growth in CAM plants. We also consider how elements supporting the diel regulation of carbohydrate partitioning in CAM might have been derived from C_3 plants.



Outcomes: The route of nocturnal starch degradation is a key point of divergence between C_3 and CAM (as illustrated above). Diversity in chloroplast metabolite transporters accommodates a division of labour for directing C-skeletons towards providing PEP for nocturnal carboxylation or sucrose for growth. Orthologues of vacuolar sugar transporters with putative roles in orchestrating carbohydrate processing for CAM are identified from the pineapple genome.

Significance: Elucidating mechanisms which orchestrate day/night carbohydrate processing in CAM plants is central for ensuring that bioengineering of CAM to improve plant water use efficiency does not compromise plant growth and productivity.

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