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# P-38. ASCORBATE REDOX CONTROL OF PLANT GROWTH, CARBON METABOLISM AND SOURCE-SINK REGULATION IN TOMATO

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The regulation of carbon allocation between photosynthetic source leaves and sink tissues in response to stress is an important factor controlling plant yield. The activities of two enzymes involved in the maintenance of the ascorbate redox state in different cellular compartments have been shown to affect both carbon metabolism and yield in tomato in response to the environment.

Ascorbate oxidase is an apoplastic enzyme which controls the redox state of the apoplastic ascorbate pool. RNA interference was used to decrease ascorbate oxidase activity in tomato and the magnitude of changes seen in the leaf apoplastic ascorbate redox state was under environmental control. Furthermore the apoplastic hexose-sucrose ratio was positively correlated with the apoplastic ascorbate redox state and favours transport of assimilate to fruits in the ascorbate oxidase lines. Fruit yield is indeed increased in these lines under conditions where assimilate becomes limiting for wild type plants: when fruit trusses are left unpruned or when water supply is limited or leaves removed. Ascorbate oxidase plants also showed increases in stomatal conductance and leaf and fruit sugar content. Modifications in gene expression, enzyme activity and the fruit metabolome were coherent with the notion of the ascorbate oxidase RNAi lines showing altered sink strength.

In contrast, monodehydroascorbate reductase activity has the opposite effect on yield to ascorbate oxidase in tomato. RNAi MDHAR lines have decreased fruit size depending on fruit load and environmental conditions and accumulate less sugar in their leaves over the day. The transgenic plants also show higher ascorbic acid, glutathione and hydrogen peroxide levels. Carbohydrate metabolism is modified in the transgenic lines and analysis reveals an increase in glucose-6-phosphate dehydrogenase activity, an enzyme that directs glucose into the pentose phosphate pathway, the pathway used by cells to regenerate NADPH. NADPH is the final electron provider in the ascorbate-glutathione cycle, and an increase in the level of this molecule allows regeneration of the antioxidants glutathione and ascorbate and thus higher protection against hydrogen peroxide. Other changes in carbon metabolism in these lines reinforce the hypothesis that the plant orientates its reserves away from sucrose synthesis, and development of sink organs, and towards oxidative stress protection.

Enzymes controlling the ascorbate redox state in tomato therefore provide a link between the ascorbate-glutathione cycle, stress tolerance and carbon allocation in response to the environment.