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Noé Gest[1], Cécile Garchery[1], Mathilde Causse[1], Hélène Gautier[2], Pierre Baldet[3], Rebecca Stevens[1]

[1] INRA, UR1052, Génétique et amélioration des fruits et légumes, Domaine St Maurice BP94, 84143 Montfavet, France
[2] INRA, UR1115, Plantes et systèmes de culture horticoles, Domaine St Paul, Site Agroparc, 84914 Avignon, France
[3] INRA, UMR 619, Biologie du Fruit, BP 81, 33883 Villenave d'Ornon, France

Water supply is the greatest single limitation on crop yields and improving agricultural productivity while reducing water use is of increasing importance for world food production. Maintenance of productivity under unfavourable environmental conditions is a stress tolerance trait. The response to stress involves the plant's antioxidant defences and maintenance of a redox equilibrium. Antioxidants such as ascorbate can therefore protect the plant from different types of stresses, including drought, and enzymes controlling the redox state of the ascorbate pool are likely to be suitable candidates for stress tolerance traits. We will show with our work in tomato that ascorbate oxidase and monodehydroascorbate reductase, two enzymes involved in the maintenance of the ascorbate redox state, affect yield in tomato in response to the environment. Tomato plants expressing an RNAi ascorbate oxidase construct show improved yield under conditions of water deficit, and other conditions where the production of assimilates is limited, whereas plants expressing an RNAi monodehydroascorbate reductase construct have decreased yield and fruit size under normal conditions, the decrease in yield being more severe when plants are grown under water deficit. The effects seen on plant and fruit development in the transgenic plants are due to modifications to carbon metabolism and carbon allocation between source leaves and fruit. The effects seen are specific to each enzyme and under different environmental control. Mechanistic details concerning alterations to carbon metabolism, notably sugar accumulation in both leaves and fruits, will be given to explain how the activity of these two enzymes could be influencing yield.

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