Title Effect of postharvest water deficit stress on gene expression in heads of broccoli (*Brassica oleracea* var. *italica*)

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Abstract

Harvested plant organs such as heads of broccoli (*Brassica oleracea* L. var. *italica*) experience a range of stresses that can lead to premature reduction in quality and eventual senescence. Understanding plant responses to stress may open up novel opportunities to extend postharvest life. One of the first stresses experienced by harvested organs is likely to be water deficit stress since severance of the vascular system halts the normal flux of water into the tissue. For broccoli branchlets with their cut ends held in water, transcriptome analysis based on hybridization of broccoli floret mRNA to a heterologous *Arabidopsis* microarray revealed that the transcript abundance of 431 genes reliably changed within 48 h of harvest. Of these, transcripts of 146 genes increased and 34 genes decreased in abundance by 3-fold or more. When broccoli branchlets were held with their cut ends in PEG solution they showed a five-fold reduction in branchlet fresh weight at 48 h compared with controls. Holding branchlets in humid air resulted in an intermediate loss in fresh weight. This PEG-induced high water deficit stress further enhanced the mRNA accumulation of only a small percentage (14%) of the harvest-induced genes. However, for the group of 110 genes that responded to the PEG treatment, the transcript abundance of 90 correlated with the extent of water deficit. Another group (18% of harvest-induced genes) was repressed under more severe water stress, indicating that harvest and water-deficit stress have opposite effects on the transcript abundance of some genes. Gene cluster analysis showed that these genes included a cluster associated with sugar metabolism that may be responding to reduced sugar content. Genes required for photosynthesis and protein translation were also down-regulated by severe water stress, but were unaffected in the water control 48 h after harvest. We conclude that water deficit stress is not the primary driver of harvest-related transcriptome changes in the florets of a detached broccoli head. The findings suggest that the molecular responses to sugar depletion and water deficit stress are not simply additive and appear to be interactive in the harvested tissue.