**(Z)-3-hexenol integrates drought and cold stress signaling by activating abscisic acid glucosylation in tea plants**

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**Abstract**

Cold and drought stresses severely limit crop production and can occur simultaneously. Although some transcription factors and hormones have been characterized in plants subjected each stress, the role of metabolites, especially volatiles, in response to cold and drought stress exposure is rarely studied due to lack of suitable models. Here, we established a model for studying the role of volatiles in tea(*Camellia sinensis*) plants experiencing cold and drought stresses simultaneously. Using this model, we showed that volatiles induced by cold stress promote drought tolerance in tea plants by mediating reactive oxygen species and stomatal conductance. Needle trap micro-extraction combined with GC-MS identified the volatiles involved in the crosstalk and showed that cold-induced (Z)-3-hexenol improved the drought tolerance of tea plants. In addition, silencing *CsADH2* (*Camellia sinensis alcohol dehydrogenase 2)* led to reduced (Z)-3-hexenol production and significantly reduced drought tolerance in response to simultaneous cold and drought stress. Transcriptome and metabolite analyses, together with plant hormones comparison and abscisic acid (ABA) biosynthesis pathway inhibition experiments, further confirmed the roles of ABA in (Z)-3-hexenol-induced drought tolerance of tea plants. (Z)-3-hexenol application and gene silencing results supported the hypothesis that (Z)-3-hexenol plays a role in the integration of cold and drought tolerance by stimulating the dual function glucosyltransferase UGT85A53, thereby altering ABA homeostasis in tea plants. Overall, we present a model for studying the roles of metabolites in plants under multiple stresses and reveal the roles of volatiles in integrating cold and drought stresses in plants.

**Keywords**

Volatile cues, (Z)-3-hexenol, abscisic acid (ABA), glucosylation, cold stress, drought stress, tea plants, inter-plant interaction