Title Ethylene biosynthesis and signaling in rice

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Abstract

Ethylene accumulates to higher levels upon submergence of rice plants where it plays a central role in hypoxia adaptation. In deepwater rice positive feedback regulation of ethylene on the biosynthetic genes 1-aminocyclopropane-1-carboxylic acid synthase (*OsACS5*), ACC oxidase (*OsACO1* and *OsACO3*) and the Yang cycle *OsARD1* gene likely contributes to maintain elevated rates of ethylene synthesis over prolonged periods of time. Ethylene modulates gibberellin and abscisic acid homeostasis thereby promoting internodal growth which keeps part of the foliage above flood waters. Ethylene further induces growth of adventitious roots and programmed cell death to form aerenchyma and to facilitate adventitious root emergence at stem nodes. The ethylene signaling components identified so far in rice include receptors, an EIN2 and an EIN3 ortholog, and CTR1, RTE1, EBF1/2 and EIN5 homologs that are conserved between the dicot Arabidopsis and the monocot rice. Based on the observation that *ein2* and *eil1* mutants of rice do not display a strong phenotype we conclude that ethylene signaling in rice may be more intricate than in Arabidopsis. In addition, ethylene may have specific signaling outputs in semiaquatic plants such as rice as was shown for Yang cycle regulation. Functional analysis of signaling pathways including the large ethylene response factor (ERF) family may help understand how ethylene co-ordinates adaptive responses to flooding stress in rice.