Role of ethylene and the APETALA 2/ethylene response factor superfamily in rice under various abiotic and biotic stress conditions

ABSTRACT

Ethylene, the simplest gaseous plant growth regulator (PGR), controls diverse physiological pathways in plants. Under various stress conditions and during different developmental stages, such as root elongation, leaf and flower senescence, seed germination, tissue differentiation and organ abscission, ethylene biosynthesis is significantly increased. In rice, the internal ethylene concentration is rapidly regulated to a genetically, physiologically and morphologically relevant level under various stresses. Regulation of the ethylene signalling pathway under adverse conditions results in up- and/or down-regulation of the expression of stress-related genes in different families. Transcription factors are proteins that influence and control a number of biological processes under both normal and stress conditions. APETALA 2/ethylene response factor (AP2/ERF) is a transcription factor that is considered to function in stress response pathways in rice. To date, many AP2/ERF genes have been functionally characterised in rice. An understanding of the interactions between the AP2/ERF genes and ethylene-dependent mechanisms may provide new insights to facilitate the enhanced adaptation of rice to stress. In the current review, the structure and function of ethylene in rice under normal and stress conditions are described, and then the general functions of the plant AP2/ERF transcription factors are discussed. In addition, the interactions between the AP2/ERF genes and ethylene pathways under abiotic stresses, including submergence, cold, salinity, drought and heavy metal stresses, as well as those under biotic stresses, are summarised. Although the AP2/ERF genes have been identified, information on the physiological mechanisms of this gene family under stress conditions in rice remains limited. Therefore, further physiological studies must be performed in the future to identify additional features of this crucial gene family.

Keyword: AP2/ERF; Ethylene; Rice; Stress; Transcription factor