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Drought Alters the Expression of a Candidate Zea Mays P-Coumarate 3-Hydroxylase Gene and Caffeic Acid Biosynthesis

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Abstract : The enzymatic activity of p-coumarate 3-hydroxylase (C3H) synthesize caffeic acid from p-coumaric acid. We recently showed that exogenously applied caffeic acid confers salinity tolerance in soybean (Glycine max) by inducing antioxidant enzymatic activity to promote enhanced scavenging or reactive oxygen species, thus limiting salinity-induced oxidative stress. Recent evidence also establishes that pre-treatment of plants with exogenously supplied caffeic acid improves plant tolerance to osmotic stress by improving plant antioxidant capacity and enhancing biosynthesis of compatible solutes. We aimed to identify a C3H in maize (Zea mays) and evaluate the effect of drought on the spatial and temporal expression of the gene encoding the candidate maize C3H (ZmC3H). Primary sequence analysis shows that ZmC3H shares 71% identity with an Arabidopsis thaliana C3H that is implicated in the control of Arabidopsis cell expansion, growth, and responses to stress. In silico ZmC3H promoter analysis reveals the presence of cis-acting elements that interact with transcription factors implicated in plant responses to drought. Spatial expression analysis by semi-quantitative RT-PCR shows that ZmC3H is expressed in both leaves and roots under normal conditions. However, drought represses the expression of ZmC3H in leaves whereas it up-regulates its expression in roots. These changes in ZmC3H expression correlate with the changes in the content of caffeic acid in maize in response to drought. We illustrate the implications of these changes in the expression of the gene in relation to maize responses to drought and discuss the potential of regulating caffeic acid biosynthesis towards genetic improvement of maize tolerance to drought stress. These findings have implications for food security because of the potential of the implications of the study for drought tolerance in maize.

Keywords : caffeic acid, drought-responsive expression, maize drought tolerance, p-coumarate 3-hydroxylase
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