Identification and Functional Characterization of Two Geranylgeranyl Diphosphate Synthases in Maize: Implications for Growth and Pathogen Resistance.

Geranylgeranyl diphosphate (GGPP) plays a crucial role in plant development and stress resistance as a common substrate in the biosynthesis of diterpenoid hormones and phytoalexins. However, no GGPP synthases (GGPPS) have been identified in maize. Through a comprehensive analysis integrating whole-genome identification, transcriptional co-regulation patterns, enzyme function characterization, and pathogen-induced expression, we identified two functional GGPPS enzymes in the maize genome, both located in plastids. ZmGGPPS1 is expressed in the meristem and contains growth-related elements in its promoter, indicating its involvement in plant growth and development. In contrast, ZmGGPPS2 is induced by pathogen inoculation and shows a high correlation with phytoalexin biosynthesis, suggesting its potential role in pathogen resistance. These findings suggest that ZmGGPPS1 contributes to plant growth by providing substrates for hormones, while ZmGGPPS2 is likely to be involved in defense mechanisms against pathogens.