ABSTRACT

THE ROLE OF JAZ PROTEINS IN THE REGULATION OF PLANT GROWTH AND DEFENSE

By

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When challenged with environmental stress, plants devote a significant proportion of their biosynthetic capacity to the production of secondary metabolites and other defense-related strategies. Increased production of defensive compounds is associated with diversion of resources (e.g., carbon) from primary growth, thereby limiting plant biomass accretion. This growth-defense antagonism has a profound impact on plant biology and ecological relationships. However, the molecular mechanisms controlling tradeoffs between growth and defense are still poorly understood. The plant signaling molecule jasmonate (JA) is a key regulator of resource allocation as it reprograms transcriptional networks that appear to redirect resources from primary metabolism and growth to secondary metabolism and defense. This molecular "switch" is mediated in part by JAZ repressor proteins that, in the absence of JA, bind to and inhibit the action of JA-related transcription factors (TFs). Stress-induced production of JA promotes the formation of COI1-JAZ co-receptor complexes that targets JAZ proteins for rapid destruction by the E3 ubiquitin ligase SCFCOI1, thereby releasing TFs from inhibition. Here, I use two approaches to show that JAZ proteins have a major role in balancing resource allocation between growth and defense in the model plant Arabidopsis thaliana. First, I demonstrate that alternative splice variants of JAZ10 that are stable in the presence of high levels of JA function to attenuate JA responses, thereby prioritizing growth over defense. Second, I developed a jaz quintuple mutant (jazQ) that lacks five of the 13 JAZ genes and show that this mutant constitutively produces defense compounds but grows slowly. The jazQ mutant was then employed as the parental line in a genetic suppressor screen aimed at uncoupling the growth-defense antagonism. Characterization of one suppressor mutant showed that loss of function of the red light receptor phytochrome B (phyB) rescues the slow growth of jazQ without significantly affecting defense traits. These findings suggest that growth-defense antagonism may not be dictated by limited

metabolic resources but rather by hard-wired transcriptional programs that exert control over resource partitioning in dynamic environments. In the long term, the findings described in this dissertation may inform efforts to increase food production and security while reducing the use of pesticides that are detrimental to the environment and human health