The lipidic phytohormone jasmonyl-isoleucine (JA-Ile) is a key mediator of stress-versus-growth signaling in vascular plants. Upon its accumulation, JA-Ile is detected by the F box receptor protein COI1 (CORONATINE INSENSITIVE1), which in turn leads to the ubiquitination and proteasomal degradation of JAZ (JASMONATE ZIM-DOMAIN) repressor proteins that would otherwise bind to and inhibit MYC-family basic helix-loop-helix (bHLH) transcription factors. This hormone-triggered derepression of the jasmonate (JA) pathway allows for the induction of JA-related gene expression, physiological adjustments, and the accumulation of specialized metabolites like glucosinolates and terpenoids (Wasternack and Hause, 2013).

Studies exploring the evolutionary history and functional significance of JA signaling in early divergent land plants (bryophytes) have recently uncovered a conserved COI1-JAZ module centered on the perception of the modified JA and 12-oxo-phytodienoic acid (OPDA) precursor dinor-OPDA (dn-OPDA) rather than JA-Ile (Monte et al., 2018, 2019). In this issue, Peñuelas et al. (2019) build on this knowledge and determine the degree to which JA/dn-OPDA signaling in bryophytes relies on the conserved action of MYC-family bHLH transcription factors. Phylogenetic analyses identified MYC homologs with appropriate domain architecture in certain charophytic (freshwater) algal lineages and across land plants, indicating that MYC transcription factors predate the colonization of land. In the model liverwort Marchantia polymorpha, two ubiquitously expressed MpMYC homologs were discovered on male (MpMYCY) or female (MpMYCX) sex chromosomes. Both MpMYC homologs interact strongly with the MpJAZ repressor through conserved interaction domains, similar to angiosperm MYC and JAZ homologs. Moreover, M. polymorpha MpMYC homologs interact with Arabidopsis (Arabidopsis thaliana) AtJAZ proteins, suggesting a strong evolutionary pressure to maintain MYC-JAZ interactions throughout the evolution of plants.

Phenotypic analysis of overexpression and knockout lines revealed a functionally conserved role for MpMYC transcription factors in mediating dn-OPDA signaling in liverworts. Unlike wild-type Tak-1 (male) liverworts, Mpmycy (male) and Mpcoi1 (dn-OPDA receptor) mutants are insensitive to the growth-suppressing effects of exogenous OPDA treatment (dn-OPDA precursor). The ectopic overexpression of MpMYCX (female-encoded MYC) in Mpmycy leads to heightened OPDA sensitivity, demonstrating a functionally interchangeable role for MpMYCs in mediating the OPDA response in liverworts. Bar = 1 cm. Adapted from Peñuelas et al. (2019), Figure 5.

Functional Conservation of MYC-regulated dn-OPDA Signaling in Liverworts.
combined work of Peñuelas et al. (2019) now solidifies MYC transcription factors as broadly conserved master regulators of the JA/dn-OPDA pathway in land plants.

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REFERENCES