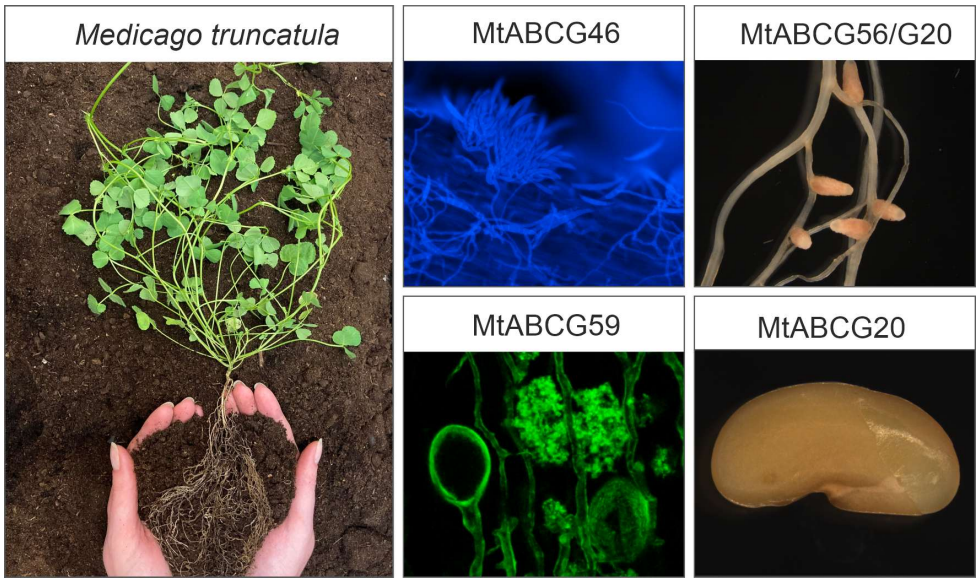
Expansion and specialization of ABCG transporters in legumes

ATP-binding cassette (ABC) transporters are an ancient and widespread family of membrane proteins that utilize ATP to translocate various substrates across biological membranes. In plants, ABC transporters are notably abundant and diverse compared to other organisms. Importantly, the duplication of genes encoding ABC transporters, particularly those in the G subfamily, preceded the origin of land plants, suggesting a crucial role for these proteins in plant adaptation to environmental changes. This raises the question of whether ABCG transporters could contribute to the evolution of distinct plant lineages within flowering plants, e.g., the agriculturally and economically important legumes. Phylogenetic analyses and functional studies of ABCG transporters in the model legume *Medicago truncatula* reveal their expansion and specialization for functions relevant to legume biology. These include the role of MtABCG46 in the biosynthesis of legume-specific 5-deoxyisoflavonoids and their derivatives, contributing to plant defense. Additionally, the early stages of legume-rhizobium symbiosis (LRS) are coordinated by the translocation of cytokinin from the epidermis to the cortex mediated by MtABCG56. Another transporter, MtABCG20, has been shown to translocate abscisic acid (ABA) and negatively influence the nodulation process under osmotic stress. MtABCG20 also helps to remove ABA from a specific growth zone of the embryonic root, limiting ABA's inhibitory effects and promoting germination. Furthermore, the secretion of strigolactones by MtABCG59 during the pre-symbiotic stage of arbuscular mycorrhiza (AM) is associated with specific root anatomical features found in legumes, such as the absence of exodermis, an apoplastic barrier. Overall, these findings suggest that the expansion and functional diversification of ABCG transporters in legumes have been driven by adaptation to specialized metabolism and the acquisition of new functions, including establishing specific symbiotic interactions.



Graphical abstract