A Plant Specific AtSar1D-AtRabD2a Nexus Modulates Autophagy Biogenesis in Abiotic Stress

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Secretory proteins traffic from endoplasmic reticulum (ER) to Golgi via coat protein complex II (COPII) vesicles in eukaryotes. Intriguingly, during nutrient starvation, COPII machinery constructively act as a membrane source for autophagosome, a double membrane-bound organelle that maintains cellular homeostasis by recycling intermediate metabolites. In higher plants, essential roles of autophagy have been implicated in plant development and stress responses. Nonetheless, the membrane sources of autophagosomes, especially the dedication of COPII machinery to autophagic pathway and autophagosome biogenesis remains elusive in plants. Moreover, how the differential regulation of COPII machinery fulfills distinct cellular roles (conventional secretion or autophagy) in response to environmental cues during plant development remains under-investigated, albeit the novel regulation of specific COPII isoforms in response to environmental stress has been elucidated recently. Here, we uncover the mechanistic connections between ATG (Autophagy-related gene) machinery and specific COPII components using proteomic analysis. Notably, a specific Sar1 homologue AtSar1d exhibits distinct effects on Atg8 lipidation and YFP-Atg8 vacuolar degradation upon autophagic induction through a previously unrevealed mechanism. Consistently, AtSar1d mutants exhibit starvation related phenotypes. Using the *Arabidopsis* protoplast transient expression system as screening platform, we further identify that a plant unique Rab1/Ypt1 homologue AtRabD2a coordinates with AtSar1d to function as the molecular switch in mediating the COPII functions in autophagy pathway. Indeed, AtRabD2a is essential for bridging the COPII machinery with autophagy initiation complex and contribute to autophagosome formation in plants. Our study thus identified a plant specific axis regulating autophagosome biogenesis and provide evidences on the evolutionary importance of gene duplication in higher plants.