論文の内容の要旨

論文題目　Studies of membrane trafficking system of the basal land plant, *Marchantia polymorpha*
（基部陸上植物ゼニゴケにおける膜交通機構の研究）

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Function and dynamics of organelles are flexibly modified responding various cell events, environmental changes and external stimuli. These modifications are accompanied by organelle interactions, and single membrane-bound organelles are interconnected by the membrane trafficking system. Membrane trafficking system requires pathway-specific key regulators, which include a coat complex, RAB GTPase and SNARE. Compartmentalization and expansion of gene families encoding such key regulators led to establishment of diversification of the endomembrane system in extant taxa from prokaryote. Some membrane traffic pathway should be common among eukaryotes, while some should be specific in particular lineages with lineage-specific key regulators. And the lineage-specific pathway should have a functional role in life strategy of the particular lineages.

Plants have a plant-specific RAB GTPase, ARA6, belonging to RAB5 subfamily and whose homologs are highly conserved especially among land plants. In *Arabidopsis*

thaliana, ARA6 regulates transport from endosomes to the plasma membrane while other RAB5 members act in the traffic to vacuoles from endosomes, and this ARA6 pathway is involved in the salinity stress response. Then, the question is whether this function is conserved among land plants. There are various morphology and lifestyles, and ARA6 might have changed its function in *A. thaliana*. To answer this question, *Marchantia polymorpha* was chose as the experimental material.

M. polymorpha is a key model plant because of its important location in evolutionary studies; the liverwort is one of most basal groups of land plants. With establishment of technology of agrobacterium-mediated transformation and proceeding genome project, the research field using *M. polymorpha* is now rapidly expanding, which includes taxonomy, evolution, morphology, photoresponse, genetics, and secondary metabolism. To develop the infrastructure of cell biology of *M. polymorpha*, I have visualized organelles and actin microfilaments of *M. polymorpha* with mainly using live imaging technology. Fluorescent protein-fused SNAREs and Rabs were used as organelle markers and Liveact-Venus as an AF marker. There are some unique features in their structures and moving. For example, actin microfilaments show myosin-dependent sliding movement, which was affected by microtubule stability.

ARA6 homolog in *M. polymorpha* (MpARA6) labeled a group of multivesicular endosomes like *Arabidopsis* ARA6. GTP-fixed MpARA6, however, accumulated on the plastid outer envelope, suggesting its role in the trafficking pathway to plastids unlike *Arabidopsis* ARA6. The mpara6 knock-out mutants exhibited abnormal phenotypes under some stress conditions, indicating that while functions of ARA6 homologs in

membrane traffic are diverged among land plant lineages, they conserve common physiological functions in stress responses.

The trafficking pathway from endosomes to plastids regulated by MpARA6 is obviously a specific transport pathway to plants. This study is the first report of RAB GTPase which is responsible for transport to the double membrane bounded organelle, and recommends to use some model materials for understanding of plant evolution and environmental adaptation.