## LABORATORY OF BIOLOGICAL DIVERSITY

### MANO Group


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Plant cells can induce, degenerate and differentiate their organelles to adapt to environmental changes. This flexibility of plant organelles is the basis of the strategy for environmental adaptation in plants.

The aims of our research group are to clarify the molecular mechanisms underlying the induction, differentiation, and interaction of organelles, and to understand the integrated functions of individual plants through organelle dynamics.

## I. Molecular mechanisms of peroxisome dynamics and functions in plant cells

Peroxisomes are single-membrane bounded organelles, which are ubiquitously present in eukaryotic cells, and they are involved in various biological processes such as lipid metabolism and photorespiration. To understand peroxisome dynamics and functions, we have been analyzing a number of Arabidopsis mutants having aberrant peroxisome morphology (*apem* mutants) and peroxisome unusual poisoning (*peup* mutants). Based on the analyses using these mutants a part of the mechanism of division, protein transport, degradation of peroxisomes, and the interactions of peroxisomes with other organelles were revealed (Figure 1). In addition, we found that peroxisomes are involved in the reproductive process. Therefore, peroxisome dynamics in gametes and gametophytes are currently under investigation.

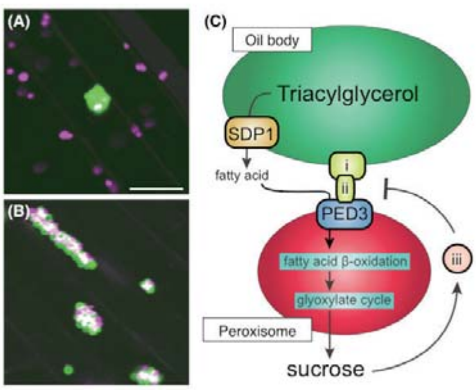


Figure 1. Physical interaction of peroxisomes and oil bodies. (A, B) Fluorescence observation of 3-day-old cotyledons of Arabidopsis wild-type (A) and *sdp1 (sucrose dependent 1)* plants (B). Magenta and green signals represent peroxisomes and oil bodies, respectively. Bar: 20 μm. (C) Model of the interaction of peroxisomes and oil bodies. PED3 (Peroxisome Defective 3) is the potential anchor protein on peroxisomal membranes. Sucrose acts as a negative signal for the interaction between both organelles.

## II. Accumulation mechanism of seed storage oils and proteins

Plant seeds accumulate huge amounts of storage reserves such as oils, carbohydrates and proteins. Humans use these storage reserves as foods and industrial materials. Storage reserves are different among different plant seeds. Wheat, maize and rice seeds mainly accumulate starch, whereas rapeseed, pumpkin and sesame contain large amounts of oils. Soybean contains proteins as a major reserve. We are analyzing the mechanisms controlling oil and protein contents in seeds, and trying to apply our knowledge and techniques for increasing beneficial storage reserves.

## III. Construction of The Plant Organelles Database 3 (PODB3)

PODB3 was built to promote a comprehensive understanding of organelle dynamics. PODB3 consists of six individual units: the electron micrograph database, the perceptive organelles database, the organelles movie database, the organellome database, the functional analysis database, and external links. Through these databases, users can obtain information on plant organelle responses to environmental stimuli of various tissues of several plant species, at different developmental stages. We expect that PODB3 will enhance the understanding of plant organelles among researchers.

### Publication List:

〔Original papers〕


- Aboulela, M., Tanaka, Y., Nishimura, K., Mano, S., Kimura, T., and Nakagawa, T. (2017). A dual-site gateway cloning system for simultaneous cloning of two genes for plant transformation. Plasmid *92*, 1-11.
- Aboulela, M., Tanaka, Y., Nishimura, K., Mano, S., Nishimura, M., Ishiguro, S., Kimura, T., and Nakagawa, T. (2017). Development of an R4 dual-site (R4DS) gateway cloning system enabling the efficient simultaneous cloning of two desired sets of promoters and open reading frames in a binary vector for plant research. PLoS ONE *12*, e0177889.
- Hayashi, M., Tanaka, M. Yamamoto, S., Nakagawa, T., Kanai, M., Anegawa, A., Ohnishi, M., Mimura, T., and Nishimura, M. (2017). Plastidial folate prevents starch biosynthesis triggered by sugar influx into non-photosynthetic plastids of Arabidopsis. Plant Cell Physiol. *58*, 1328-1338.
- Kanai, M., Mano, S., and Nishimura, M. (2017). An efficient method for the isolation of highly purified RNA from seeds for use in quantitative transcriptome analysis. J. Vis. Exp. *119*, e55008.
- Watanabe, E., Mano, S., Yamada, K., Nishimura, M., Iuchi, S., Kobayashi, M., Uemura, M., and Kawamura, Y. (2017). Physiological analysis of Arabidopsis ecotype to investigate the freezing tolerance after cold acclimation process. Cryobiol. Cryotechnol. 63, 161-164.


〔Review article〕


- Watanabe, E., Mano, S., Hara-Nishimura, I., Nishimura, M., and Yamada, K. (2017). HSP90 stabilizes auxin receptor TIR1 and ensures plasticity of auxin responses. Plant Signal. Behav. *12*, e1311439.


Note: Those members appearing in the above list twice under different titles are members whose title changed during 2017. The former title is indicated by an asterisk (*).