

IN BRIEF

The Nuclear Pore Complex in *Arabidopsis*

Getting molecules in and out of the nucleus is a critical function of eukaryotic cells. The task is performed by the nuclear pore complex (NPC), a massive protein complex (estimated at 125 MD in vertebrates) that spans the nuclear envelope and allows diffusion of small molecules but tightly controls transport of larger molecules, such as proteins, RNA, and ribosomal subunits. The NPC comprises at least 30 different proteins, called nucleoporins. Knowledge of the functions of individual components and the overall structure in plants lags behind that of vertebrates and yeast, for which the NPC is well characterized (recently reviewed in Wälde and Kehlenbach, 2010). **Tamura et al. (pages ■■■)** present a detailed investigation of components of the NPC in *Arabidopsis* based on an interactive proteomic ap-

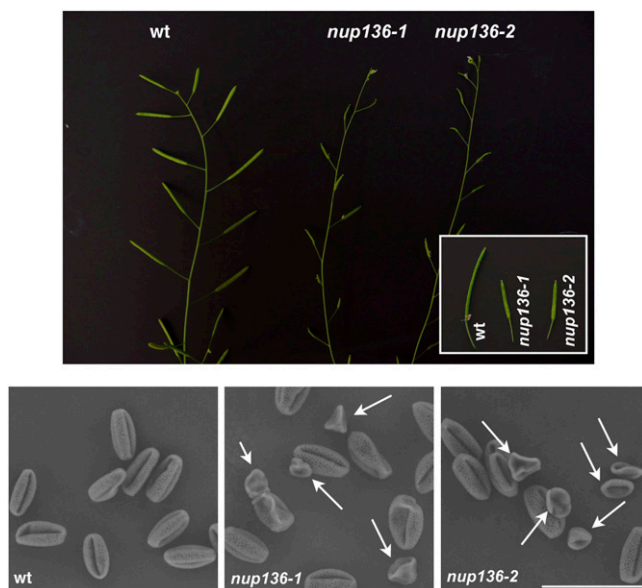
proach using green fluorescent protein (GFP)-tagged nucleoporins.

The authors started with a known plant nucleoporin, RNA export factor 1 (RAE1), which is encoded by numerous plant genomes. Transgenic *Arabidopsis* plants expressing GFP-tagged At-RAE1 were generated and used to analyze the NPC in living cells and to identify other nucleoporins that make up the NPC in *Arabidopsis*. Nucleoporins were identified by immunoprecipitation from transgenic *Arabidopsis* tissue using anti-GFP antibody followed by mass spectrometry identification of proteins present in the immunoprecipitate. Using this approach, eight known plant nucleoporins and 22 novel nucleoporins were isolated and further characterized by cloning and localization of GFP-nucleoporin fusion proteins.

Most of the *Arabidopsis* nucleoporins show homology to human nucleoporins, except for one protein, called Nup136/Nup1, which was found to be plant specific. Database searches revealed Nup136/Nup1 homologs in a number of plant species but not in yeast or vertebrates. T-DNA insertional mutants of *nup136/nup1* showed defects in flowering time and pollen development (see figure), suggesting that Nup136 plays a role in aspects of flowering and reproductive development in plants. Structural features of Nup136/Nup1 indicate that the protein might be involved in regulating active transport through the NPC.

Overall, the *Arabidopsis* nucleoporins identified shared higher homology with vertebrate than with yeast nucleoporins, suggesting that the plant NPC structure is more similar to that of vertebrates than yeast. This work shows that the basic NPC structure is conserved in plants, yeast, and vertebrates, although each organism uses specialized nucleoporins with functions specific to their own NPCs. The identification of 22 novel plant nucleoporins will facilitate further studies into their interactions, regulatory roles, and biological functions within the NPC.

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Mutants of *nup136* exhibit defects in plant development. Top panel: *nup136* knockout mutants showed a defect in fruit maturation. Inset shows a magnified view of representative siliques. Bottom panel: Scanning electron micrographs of pollen grains of wild-type (wt) and *nup136* mutant plants. Arrows indicate the shrunken pollen grains of the mutants. Bar = 50 μ m. (Figure reproduced from Tamura et al. [2010].)

REFERENCES

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Plant Cell; originally published online December 23, 2010;
DOI 10.1105/tpc.110.221211

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