Oxidative stress regulates peroxisome dynamics in Arabidopsis plants

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Peroxisomes are organelles with an essentially oxidative metabolism which are involved in different metabolic pathways such as fatty acid β-oxidation, photorespiration, and metabolism of reactive oxygen species (ROS) and reactive nitrogen species (RNS). These organelles are highly dynamic but there is little information about the regulation, and the effect of environment on peroxisome movement. In this work, the movement of peroxisomes under two oxidative stress-inducing conditions, cadmium and herbicide 2,4-D, was studied by confocal laser microscopy in stable Arabidopsis mutants expressing the peroxisome targeted fusion protein GFP-SKL in peroxisomes. The relationship with mitochondria was also studied by using mutants expressing YFP in mitochondria. Treatment of plants with CdCl₂ (100 μM) produced a significant increase in speed which was dependent on peroxisomal endogenous ROS production and Ca²⁺, but was not related to actin cytoskeleton modifications. On the contrary, the treatment with the herbicide 2,4-D slowed down the peroxisomal movement and also considerably reduced the distances covered by the peroxisomes. This effect was mainly due to disturbances in the cytoskeleton induced by the herbicide, as a result of post-transcriptional modifications of the actin filaments. The role of ROS in the regulation of peroxisome dynamics in plants under abiotic stress conditions is discussed.

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