Previously unknown protein turns plants into dwarfs

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Plants with experimentally knocked down DWEORG1 (left) showed reduced translation efficiency as well as growth retardation and overall smaller size. Credit: Kiel University

Arabidopsis thaliana belongs to the crucifer family and serves researchers around the world as a common model organism that allows comparatively simple analyses of genetic information and the functions associated with it. The Arabidopsis genome was fully sequenced about 20 years ago. Although the plants are among the most intensively studied organisms, they continue to reveal previously unknown components of plant regulation. At Kiel University, researchers from the Department of Botanical Genetics and Molecular Biology, led by Professor Frank Kempken, are working on deciphering these processes.

In a new study, scientists from the Botanical Institute have now characterized a novel component of this regulation: The large family of plant PPR proteins was previously thought to be primarily involved in RNA maturation in mitochondria. Now the Kiel research team has been able to identify a new protein. This particular protein is part of the mitochondrial ribosomes and is involved in protein biosynthesis. Although the exact mechanism is still unknown, the authors were able to show that the protein probably interferes with growth regulation. If it is artificially switched off, Arabidopsis exhibits delayed and dwarfed growth, although the full functionality of the plant is maintained. The scientists, who are also active in the Kiel Plant Center (KPC), recently published their results in the journal *Scientific Reports*.

PPR proteins active in mitochondria

Genetic information is not only found in the cell nucleus, but also in cell organelles such as mitochondria. PPR proteins are encoded by genes in the cell nucleus and transferred to the ribosomes as so-called messenger RNA. There they are finally translated into proteins in the course of translation. The synthesized PPR proteins are then transported to the mitochondria, where they are involved in controlling a variety of life processes.

Recently, researchers have discovered that the subgroup of rPPR proteins occurs in mitochondrial ribosomes. Because mitochondria were originally self-sufficient single-celled organisms early in the evolution of life, they have an independent gene expression capacity. In order to better understand the regulation of genetic information in today's plants, the Kiel University researchers have analyzed a specific common mitochondrial rPPR protein, which is encoded by the so-called DWEORG1 gene.

"We found evidence suggesting a direct role for DWEORG1 in mitochondrial translation," said Dr. Stefanie Grüttner, a research associate in Kempken's group. "Plants with experimentally knocked down DWEORG1 showed reduced translation efficiency, which was also evident from the significantly reduced appearance of a number of proteins."

However, DWEORG1 does not seem to play a fundamental role in the functioning of the organism as a whole, because the manipulated plants showed only growth retardation and overall smaller size. Their overall shape and life processes, on the other hand, were not affected. "We assume that DWEORG1 is responsible for a previously unknown rPPR protein that is involved in the synthesis of a number of plant proteins and thus plays an important stabilizing function for gene expression in mitochondria," Grüttner says.

Possible approaches for plant breeding

A better understanding of the genetic basis of plant regulation is of fundamental importance, for example, to assess the susceptibility or resistance of different plants to climate change and their responses to the associated changes in agricultural growth conditions. Plant researchers around the world are therefore studying the genetic regulation of plant growth and life processes in depth.

"Research into the role of rPPR proteins in mitochondria is just beginning. Our new work on mitochondrial gene regulation in Arabidopsis thaliana contributes an important building block to the development of this knowledge, which could also be applied in plant breeding in the future," says Kempken, KPC member and head of the Department of Botanical Genetics and Molecular Biology at Kiel University.

More information: Stefanie Grüttner et al, The P-type pentatricopeptide repeat protein DWEORG1 is a non-previously reported rPPR protein of Arabidopsis mitochondria, *Scientific Reports* (2022). DOI: 10.1038/s41598-022-16812-0

Provided by Kiel University

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