Previously unknown SCEP3 protein found essential for plant chromosome mixing in meiosis

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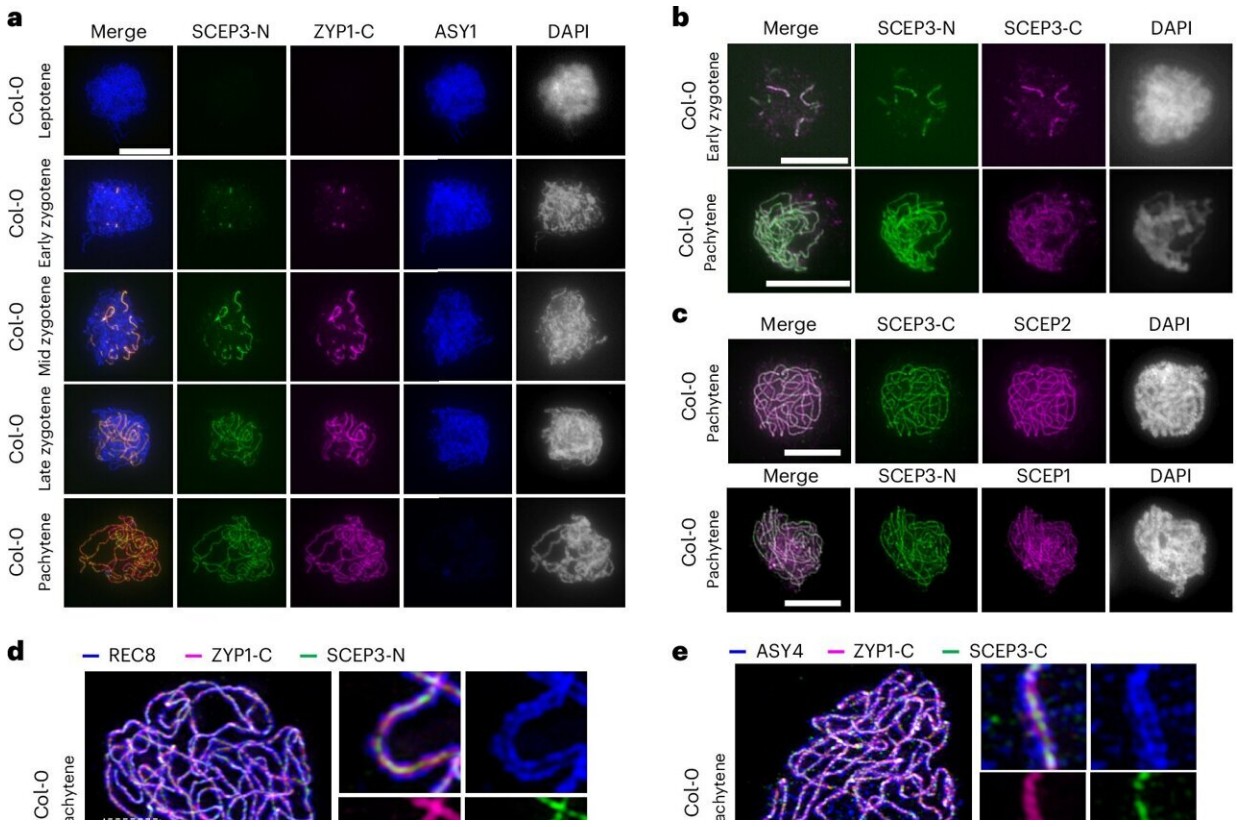


Localization of SCEP3 at the CR of the SC. Credit: *Nature Plants* (2025). DOI: 10.1038/s41477-025-02030-9

Researchers at the IPK Leibniz Institute have discovered a previously

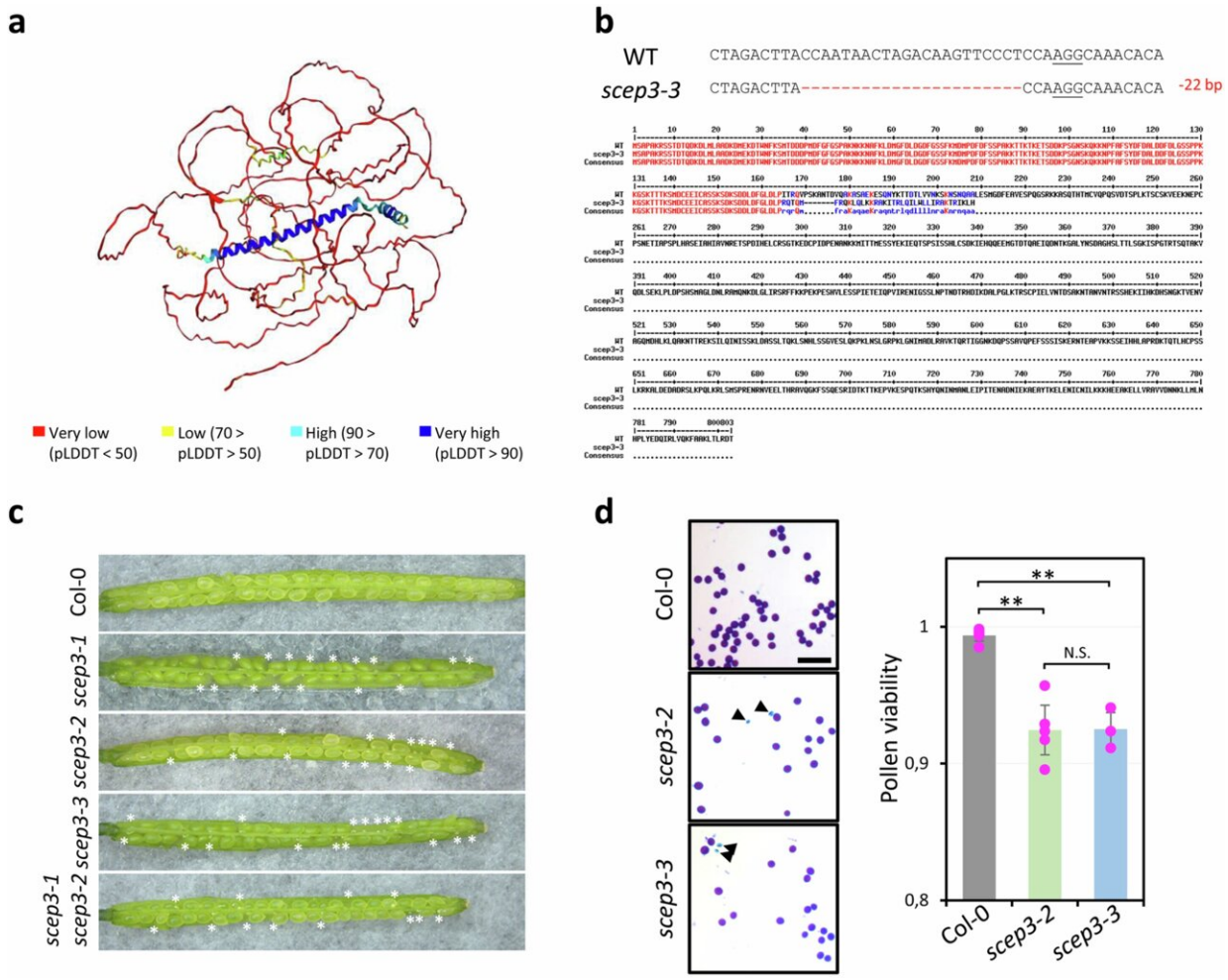
unknown protein that is central to plant reproduction. The protein SCEP3 enables plants to mix and precisely distribute their chromosomes—carriers of genetic information—during meiosis. This process is crucial for maintaining genetic diversity. The results of the study were published in the journal *Nature Plants*.

Meiosis is a crucial process for sexual reproduction. It produces germ cells with a reduced set of chromosomes (pollen and egg cells in plants), which then fuse during fertilization to form offspring with the original number of chromosomes. At the onset of meiosis, recombination (the reciprocal exchange between parental homologous chromosomes) also occurs, which is critical for genetic diversity.

A central structure during meiosis is the so-called synaptonemal complex. This is a kind of zipper made of proteins that holds homologous chromosomes together and enables the exchange of genetic material. These exchanges (crossovers) are important because they reshuffle genes and thus ensure the genetic diversity of the offspring. However, their number and distribution along the chromosomes are limited, which restricts the possible genetic variation in breeding.

Previously, only the three proteins ZYP1, SCEP1 and SCEP2, were identified as essential components of this complex in the model plant Arabidopsis thaliana. Nothing was known about additional proteins or their roles and functions. The newly discovered protein SCEP3 also belongs to this complex—and is located right at its center.

To investigate the function of SCEP3, the researchers generated specific Arabidopsis mutant plants using the precise genome editing technology CRISPR/Cas9. Using high-resolution microscopy, they were able to visualize the exact position of SCEP3 within the synaptonemal complex and track its interaction with other proteins.



Isolation of scep3-3 and phenotypic analysis of scep3 alleles. Credit: *Nature Plants* (2025). DOI: 10.1038/s41477-025-02030-9

Furthermore, the offspring of these mutants showed an increased number and random distribution of recombination events. Additionally, there were no longer any differences in crossover numbers between male and female germ cells—normally, the number of crossovers in female Arabidopsis thaliana is lower than in males.

"We found that SCEP3 is a crucial component of the synaptonemal complex. It is evolutionarily conserved in plants, and without SCEP3, the complex cannot form," explains Dr. Chao Feng, first author of the study. However, the newly discovered protein not only plays a decisive role in its formation. "Our results show that SCEP3 also significantly influences both the distribution and number of crossovers."

"The study expands our knowledge of the complex mechanisms of meiosis and genetic recombination, which are crucial for the evolution and diversity of life. Since SCEP3 is evolutionarily conserved, this points to similar functions in other plant species and even other organisms," explains Dr. Stefan Heckmann, head of the independent "Meiosis" working group at the IPK.

"A better understanding of how crossover formation is controlled will enable breeders to develop new varieties with favorable traits in a more targeted way. This could ultimately help to adapt crops to climate change, improve resistance to diseases and pests and also increase yields."

More information: Chao Feng et al, The synaptonemal complex central element SCEP3 interlinks synapsis initiation and crossover formation in Arabidopsis thaliana, *Nature Plants* (2025). DOI: 10.1038/s41477-025-02030-9

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