Leibniz Institute of Plant Genetics and Crop Plant Research (IPK)
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The epigenetic state of the chromosome remains stable after inversion by CRISPR/Cas

Press Release

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Gatersleben, 29.01.2025 **The epigenetic state of chromatin, gene activity, and chromosomal positions are interrelated. A research team from the IPK Leibniz Institute (IPK) and the Karlsruhe Institute of Technology (KIT) investigated how the chromosomal location affects epigenetic stability and gene expression by chromosome engineering. Today, the results were published in the journal "New Phytologist".**

Chromosomal rearrangements, such as chromosome segment inversions, may affect the epigenetic landscape as well as gene expression. Indeed, different kinds of chromosome segment inversions have been found in many prominent crops like rice, maize, and barley. Until now, it has only been possible to study historical chromosome rearrangements that have occurred naturally. With the recent establishment of the CRISPR/Cas-based chromosome engineering technique, pre-defined chromosome rearrangements can now be induced, and their genetic and epigenetic consequences can be analysed immediately after they occurre.

To elucidate the effect of chromosomal inversions on the epigenetic state of chromatin and the activity of genes, the research team used CRISPR/Cas-based chromosome engineering to generate chromosomal inversions of different sizes in the model plant *Arabidopsis thaliana*. The epigenetic state of these lines was compared to wild-type plants. Finally, the effect of the chromosomal rearrangements on the activity of genes was analysed.

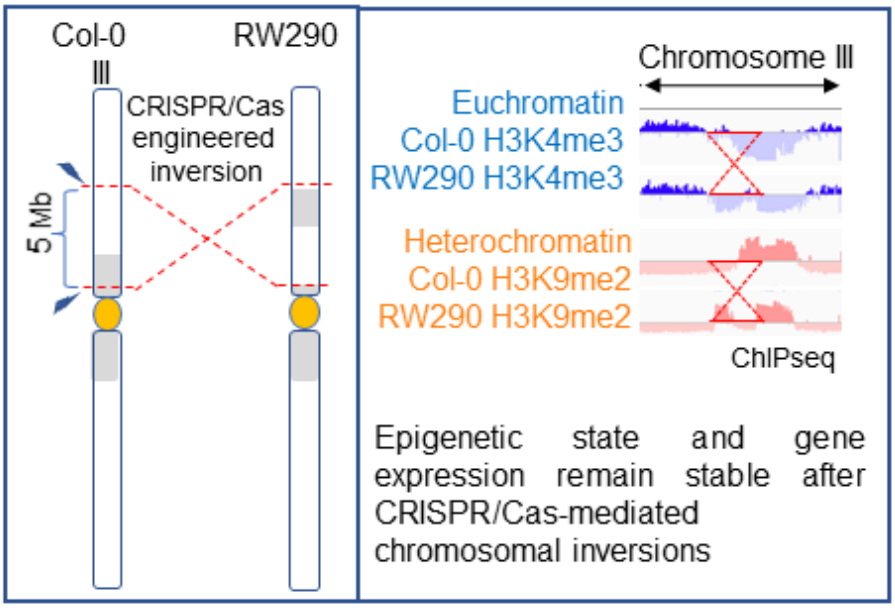
"Our results indicated that none of the studied inverted chromosome segments and their neighbouring regions changed in epigenetic marks and gene expression besides minor genome-wide effects", explains Dr. Solmaz Khosravi, first author of the study. Gene expression analysis showed that genome-wide, only 0.5 - 1% of genes were differentially expressed following the induction of the inversions. "The findings demonstrate the robustness of the epigenome and the transcriptome following CRISPR/Cas-induced chromosomal restructuring, at least in the following generations", says Prof. Dr. Andreas Houben, head of IPK's research group "Chromosome Structure and Function". "And our study is the first study in the plant scientific community which shows the effect of structural variations on the epigenetic state of chromatin in the following generations after the occurrence of an inversion."

"Our results prove that inversions can be specifically generated in plants without causing further unwanted changes in the expression of genetic information", says KIT researcher Prof. Dr. Holger Puchta. "This is of great importance for future applications of chromosome engineering in the breeding of crops."

Original publication:

Khosravi *et al.* (2024): Epigenetic state and gene expression remain stable after CRISPR/Cas-mediated chromosomal inversions. New Phytologist. DOI: 10.1111/nph.20403

Graphic (for free use):



CRISPR-Cas9-induced *A. thaliana* inversion line with a 5 Mb-large inversion.
Distribution of histone marks specific to eu- and heterochromatin.
Red lines show the location of inversion.