Angiosperms study provides insights into genome evolution after whole-genome duplications

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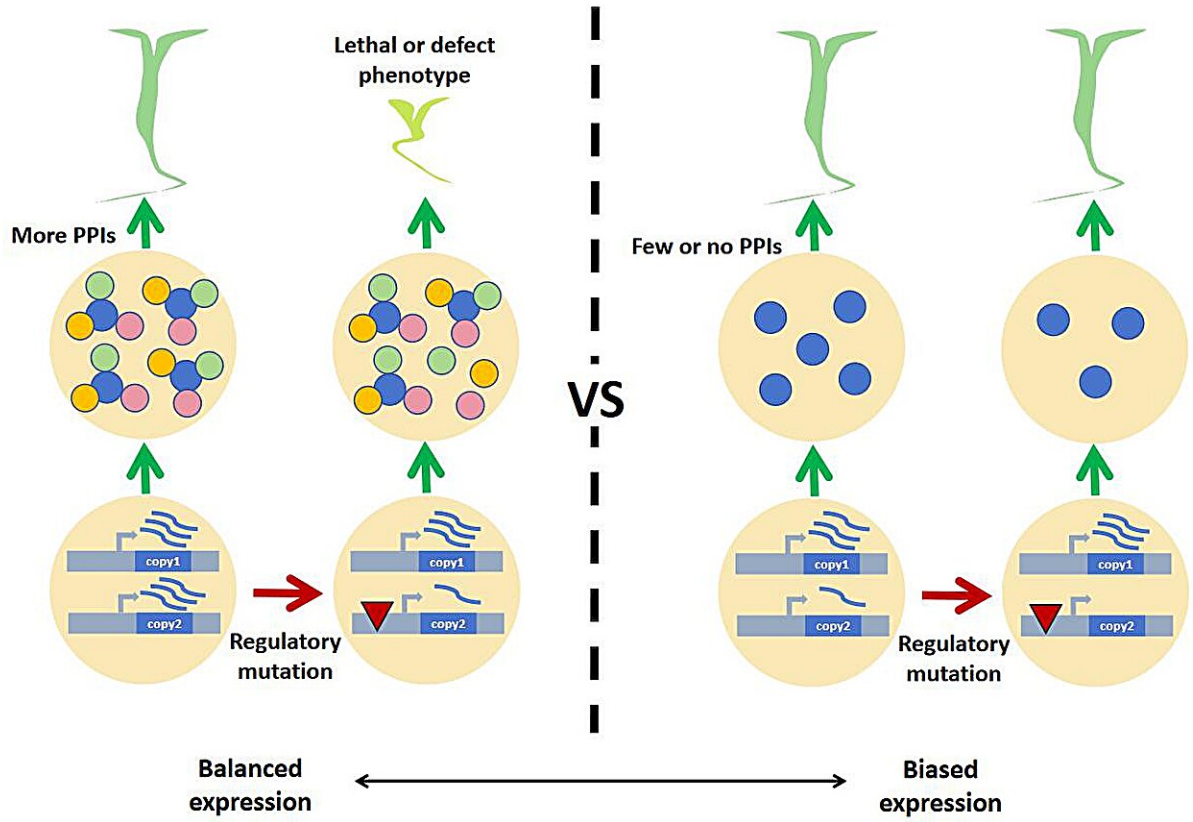

Model depicting how balanced expression of duplicate genes from a whole-genome duplication is associated with dosage-balance contraints. Credit: Prof. SHI et al.

Whole-genome duplication (WGD, or polyploidy) is a common and frequent occurrence in plants, providing raw genetic material for evolution. Homoeologs (duplicate genes from a WGD) often diverge in expression levels, while some still maintain similar (balanced) expression levels between the two copies even after tens of millions of years.

A recent study by research teams from Wuhan Botanical Garden of the Chinese Academy of Sciences and Ghent University in Belgium provides insights into genome evolution after whole-genome duplications in plants.

Results of the study, titled "Dosage Sensitivity Shapes Balanced Expression and Gene Longevity of Homoeologs after Whole-Genome Duplications in Angiosperms," were published in *The Plant Cell*.

Dosage-balance constraints, which ensure the proper stoichiometry of protein complex subunits, play a crucial role in retaining both copies of homoeologs from the protein complex after a WGD.

But do dosage balance constraints also play an important role in shaping similar expression levels for the homoeologous gene copies after ancient WGDs, as the stoichiometry of interacting proteins is maintained by ensuring the expression of the proper amounts of gene products?

By analyzing homoeologs in Nymphaea, Nelumbo, and Acorus, three plant species that each underwent a single WGD since the origin of angiosperms, the research team led by Prof. Shi Tao and Prof. Yves Van de Peer observed convergent expression balance/bias between homoeologous gene copies following independent WGD events.

Their results showed that homoeologs with balanced expression levels indeed exhibit characteristics indicative of stronger selective pressures related to dosage balance, and their putative orthologs are more likely to

be retained after WGDs in other angiosperm lineages.

Homoeologous genes with similar expression levels exhibit relatively less regulatory differentiation between species of Nelumbo, suggesting that dosage balance constraints also play a role in recent gene expression evolution, the researchers found.

The lower-expression copy of homoeologs is more prone to becoming nonfunctional, according to the researchers.

Understanding the expression divergence and fate of homoeologs that have undergone multiple WGDs is a more complex task that necessitates further analysis of evolutionarily close taxa with varying numbers of WGD events, said Professor Shi Tao.

More information: Tao Shi et al, Dosage sensitivity shapes balanced expression and gene longevity of homoeologs after whole-genome duplications in angiosperms, *The Plant Cell* (2024). DOI: 10.1093/plcell/koae227

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