

Adaptation to polyploidy in Siberian *Arabidopsis lyrata*

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Motivation and Aim: Polyploid organisms have more than two sets of chromosomes due to either whole-genome duplication (WGD) in the same species, giving rise to autopolyploids or whole-genome hybridization in allopolyploids formed from the combination of more than two sets of chromosomes from different species. Polyploidy is a recurrent evolutionary process: most eukaryotes had at least one round of WGD in their ancestry [1] and about 30 % of flowering plants [2] are contemporary polyploids. However, new polyploids are rarely successful in the long run [3, 4], with the majority becoming quickly extinct [5] due to immediate reproductive disadvantages. Using widespread *Arabidopsis lyrata* species with varying ploidy levels as a model, we investigate what makes a polyploid successful and determine how they overcome challenges ranging from cellular to population levels.

Methods and Algorithms: We obtained whole-genome sequencing data from herbarium and live samples of *A. lyrata* covering the entire distribution of the species in Eurasia. Using bioinformatic inferences (allele frequencies and S-locus genotyping) and cytological measurements (flow cytometry and karyotyping) we identified ploidy and mating-type of each sample. Using phylogenomic and population genetic approaches we describe evolutionary history of polyploid lineages in *A. lyrata* and *A. kamchatica*. And finally, we performed selection scans measuring divergence between diploid and tetraploid lineages and diversity within the tetraploid lineage to identify potentially adaptive changes linked to increased ploidy level.

Results: Our results suggests that *A. lyrata* is the most polyploidy-rich species in *Arabidopsis* genus, and includes multiple autopolyploid lineages in Europe and Siberia. We show that *A. lyrata* lineage that contributed to the origin of *A. kamchatica* was self-compatible, which promoted the establishment of the new allopolyploid. We describe the mechanism of self-incompatibility loss in both *A. lyrata* (Siberian selfing lineage) and *A. kamchatica*. We also show that adaptation to autopolyploidy in Siberian *A. lyrata* took place and involved meiotic pathways, similarly to tetraploid *A. arenosa* in Europe. **Conclusion:** *A. lyrata* is a new exiting model to study how polyploids originate, survive and succeed.

References

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