Gene duplication and relax from selective constraints of *Gcyc* genes creates high floral diversity in Didymocarpoideae (Gesneriaceae)

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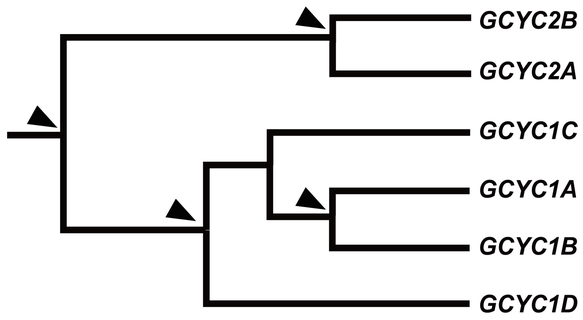
Introduction

Gene duplication in *CYCLOIDEA*(*CYC*)-like genes is regarded as the important precursor for the diversity of floral symmetry. Members of Gesneriaceae, especially in the old world subfamily Didymocarpoideae, have various floral symmetrical shapes from zygomorphy to actinomorphy.

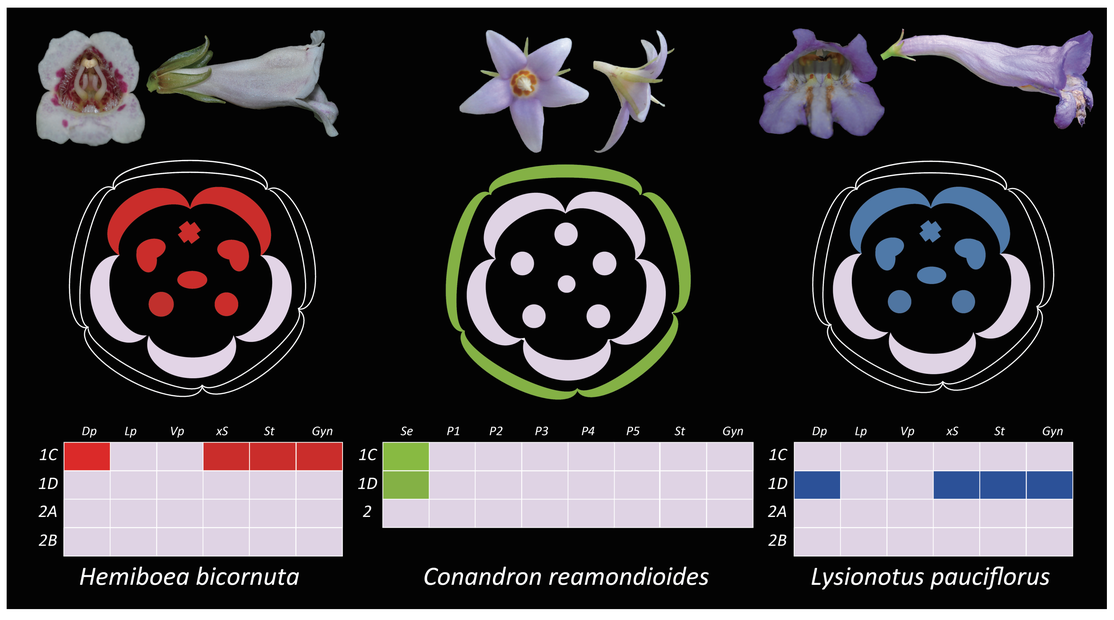
We aim to study whether the duplication of *GCYC1* genes in Didymocarpoideae correlates to floral symmetrical shapes. From reconstructed *GCYC1* phylogeny, we detected changes in selective pressure following duplication event (*GCYC1C* and *GCYC1D*); and this correlates to the shift of *GCYC1* expression patterns of these duplicates, so as to the floral symmetrical shapes. It is therefore quite likely that *GCYC1* duplication plays a role in generating floral symmetry diversity.

Gcyc duplications in Didymocarpoideae

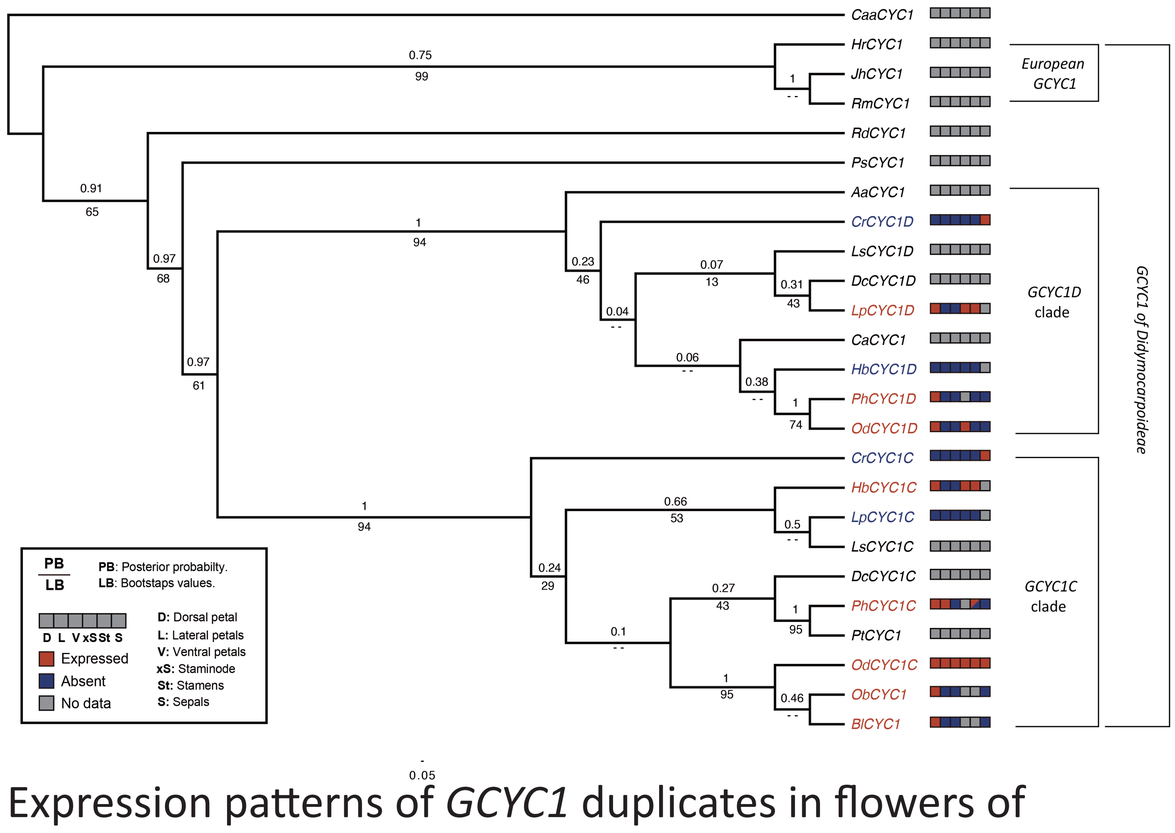


Multiple gene duplication events occurred in *Gcyc* genes. From the reconstructed phylogeny, four duplication events could be identified in Didymocarpoideae. Among them, *GCYC1C/1D* duplication is the Didymocarpoideae-specific (lineage-specific) event.

Expression patterns among species of different symmetrical shapes

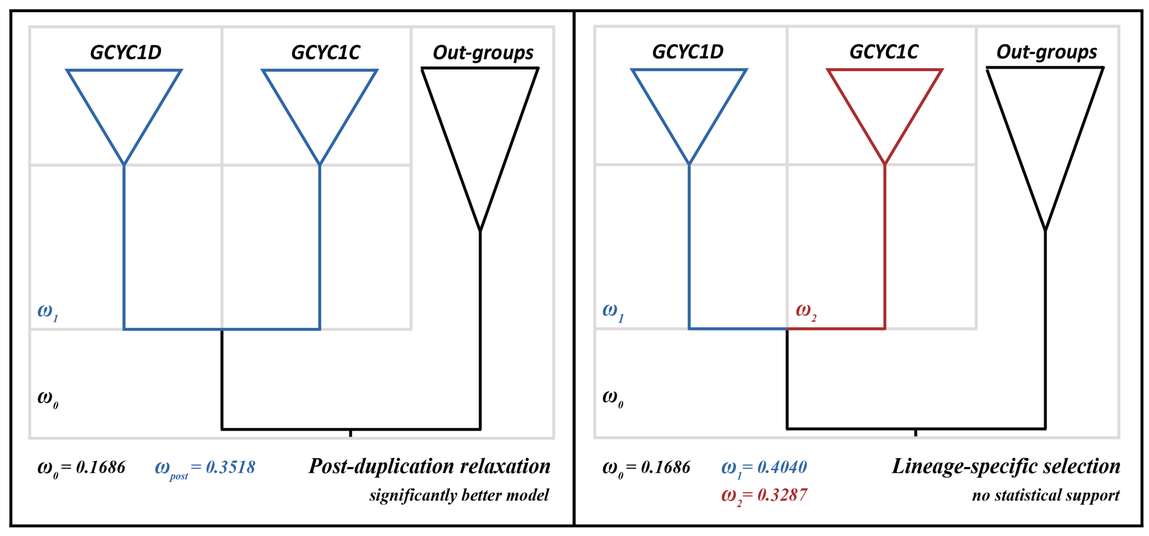


Diverse and non-congruent expression patterns in Didymocarpoideae



Expression patterns of *GCYC1* duplicates in flowers of Didymocarpoideae were summarized[1,2,3,4]. Expression patterns of *GCYC1C* and *GCYC1D* are not congruent but diversified. After duplication, some species retained one *GCYC1* copy expressed (*Hemiboea* and *Lysionotus*) while some species retained both copies (*Opitandra* and *Primulina*). Actinomorphic species even lost the expressions of both *GCYC1* copies in corolla and stamens (*Conandron*). Expression shifts of these *GCYC1* copies did not confine to particular clade or certain floral symmetry shapes. Instead, this shift is species-specific, indicating a random selection on expression of *GCYC1* duplicates.

Selective pressures in *GCYC1* duplication in Didymocarpoideae



Post-duplication relaxation (ω = 0.3518) can be detected among *GCYC1C* and *GCYC1D* but not in pre-duplication (ω = 0.1686, left figure). Between *GCYC1C* and *GCYC1D*, there is no statistical support for lineage-specific selection (ω = 0.3287 vs. ω = 0.4040, right figure). We modified the nested branch models using ML to detect selective pressures by Bielawski and Yang (2003)[5].

Conclusions

Based on the relaxation of duplicated *GCYC1C* and *GCYC1D* and species-specific expression patterns, it is suggested that the random fixation of *GCYC1* duplicates at species level generate a possible "evolutionary flexibility" on floral symmetry.

Acknowledgement

This work was supported by the Ministry of Science and Technology [Grant number: 103-2313-B-002-004-MY3].

References

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