

# #040

## Cytoplasmic evolution of Brassica genus and its significance for developing novel Brassica crops

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The genus Brassica mainly comprises three diploid and three recently derived allotetraploid species, most of which are highly important vegetable, oil or ornamental crops cultivated worldwide. Despite being extensively studied, the origination of the allotetraploid crops and the overall phylogeny of Brassica genus are still far from completely resolved. Here, we target the cytoplasmic DNA to investigate the genetic diversity in large plant populations centering on Brassica genus. The phylogenetic analysis based on a data set including 72 de novo assembled whole chloroplast genomes, delineated a comprehensive evolutionary atlas inside and around Brassica genus. The maternal origin of both *B. juncea* (AABB genome) and *B. carinata* (BBCC genome) are monophyletic from cam-type *B. rapa* (AA genome) and *B. nigra* (BB genome), respectively. Nonetheless, the current natural *B. napus* (AACC genome) contains three major cytoplasmic haplotypes: the cam-type, polima-type and nap-type. Polima-type are close to cam-type as its sister, both of them were derived from *B. rapa*. Amazingly, the worldwide predominant nap-type cytoplasm is found to be phylogenetically integrated with certain sparse C-genome wild species, thus which may have primarily contributed the cytoplasm and the corresponding C subgenome to the majority of current *B. napus*. These results finely clarified the multiple maternal origin of *B. napus*. Strong parallel (or convergent) evolutionary relationships among genera *Raphanus*, *Sinapis*, *Eruca*, *Moricandia* with Brassica were identified. Human creation of the *B. napus* cytoplasmic male sterile lines during the breeding dramatically disturbed the naturally concurrent inheritance between mtDNA and cpDNA. The overall variation data and elaborated phylogenetic relationships obtained herein can provide valuable guidances for developing novel Brassica crops in future and also for boosting the application of organelle biotechnology in Brassica crops.

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