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Highly rearranged and size-variable chloroplast genomes in conifer II clade (cupressophytes): selection toward shorter intergenic spacers

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Abstract

Although conifers are of immense ecological and economic value, bioengineering of their chloroplasts remains undeveloped. Understanding chloroplast genomic organization in conifers can facilitate their bioengineering. Members of the conifer II clade (or cupressophytes) are highly diverse in both morphologic features and chloroplast genomic organization. We compared six cupressophyte chloroplast genomes (cpDNAs) that represent four of the five cupressophyte families, including three genomes that are first reported here (*Agathis dammara*, *Calocedrus formosana*, and *Nageia nagi*). The six cupressophyte cpDNAs have lost a pair of large inverted repeats (IRs) and vary greatly in size, organization, and tRNA copies. We demonstrate that cupressophyte cpDNAs have evolved toward reduced size, largely due to shrunken intergenic spacers. In cupressophytes, cpDNA rearrangements are capable of extending intergenic spacers, and synonymous mutations are negatively associated with the size and frequency of rearrangements. The variable cpDNA sizes of cupressophytes may have been shaped by mutational burden and genomic rearrangements. Based on cpDNA organization, our analyses reveal that in gymnosperms, cpDNA rearrangements are phylogenetically informative, which supports the "gnepines" clade. As well, removal of a specific IR influences the minimal rearrangements required for the gnepines and cupressophyte clades, whereby Pinaceae favors removal of IRB but cupressophytes exclusion of IRA. This result strongly suggests that different IR copies have been lost from conifers I and II. Our data helps understand the structural complexity and evolution of cupressophyte cpDNAs.

Biography

Shu-Miw Chaw has completed her Ph.D at the age of 30 years from Tulane University and postdoctoral studies from Institute of Plant and Microbial Biology, Academia Sinica. She is a Distingusihed Research Fellow of Biodiversity Research Center, Academia Sinica, a premier research organization in Taiwan. She has published more than 50 papers in reputed journals and serving as an editorial board member of the Journal "Genome Biology and Evolution".