The drivers of the adaptive radiation of persimmon trees on New Caledonia, a biodiversity hotspot

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Adaptive radiations are dynamic interplays between speciation, expansion and extinction, often starting from long distance migrations. However, it remains unclear whether such radiations are driven by a mere increase in ecological opportunity, or if an elevated 'genomic potential' is required, often linked to demographic events, hybridization and/or genome evolution. Due to its complex geological history, complemented by strong climatic zonation (dry East versus humid West) and sharp elevation gradient, New Caledonia hosts a rich and threatened biodiversity along its highly heterogeneous soils including ultramafic, serpentines, limestone and sedimentary. Diospyros (persimmon trees, Ebenaceae) colonized the archipelago four times during the last 20 million years, but only the second earliest long-distance dispersal event gave rise to a radiating clade of ca 35 extant species that at present take advantage of all niches within this biodiversity hotspot, except for mangroves. The other three New Caledonian Diospyros lineages remain highly restricted in area and types of habitats occupied. We show that, without a change in ploidy, the radiating group has on average twice the genome size and increased TE dynamics compared to non-radiating relatives. Using newly assembled genomes and whole genome resequencing data for over 350 accessions, we investigate the potential drivers of adaptive variation in this group, and found evidence for i) pervasive introgression across the history of the radiating group, including of adaptive alleles from related species that share similar environments, in particular those occupying heavy metal rich soils, ii) TE-induced structural variation with potential regulatory effects, iii) environment-specific sorting of ancestral genetic variation, and iv) lineage-specific de novo evolution of alleles. Although the evolution of island biotas is intuitively expected to be mainly shaped by drift rather than natural selection, our results suggest that adaptive processes, often linked to high genome dynamics, are playing important roles in the radiation of New Caledonian persimmons.

Keywords: introgression, genome evolution, structural variation, climate, serpetine soils