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From open areas to forests? The evolutionary history of *Philodendron* subgenus *Meconostigma* (Araceae) using morphological data

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Abstract

Due to its wide distribution covering three of the largest Neotropical biomes, Philodendron subgenus *Meconostigma* is an interesting model to discuss the diversification of Neotropical plants. The aim of this study was to test a previous hypothesis that the Eastern and Southern species of *P.* subg. *Meconostigma* have plesiomorphic gynoecial structure while in Amazonian species they are apomorphic. To this end, we conducted an analysis of maximum parsimony with generalized frequency coding method using a matrix with 59 morphological characters and 90% of the species of *P.* subg. *Meconostigma*. The phylogenetic reconstruction suggests that the subgenus is monophyletic and originates from open areas of Cerrado. Four morphological synapomorphies support the monophyly of the subgenus and seven synapomorphies support four minor clades within it. Our results also include characterization of three new gynoecial subtypes (A1, A2 and A3) within the subgenus. Subtype A2 (undeveloped stylar body with long stylar canals, absent central stylar dome, shallow compitum) is basal and represents the ancestral gynoecium in the group. These

findings suggest that the balance between pollen uptake and accessibility of the locules were decisive to drive gynoecium evolution in the subgenus *Meconostigma*.

Introduction

Neotropical plants make up around 37% of the world's total flora and this hyperdiversity has intrigued plant evolutionary biologists (Antonelli and Sanmartín, 2011). Data on evolution of South America plants are fundamental to provide new insights into the patterns of Neotropical plant diversification.

Philodendron Schott is exclusively Neotropical and the second largest genus (ca. 500 species) of Araceae (Boyce and Croat, 2012), an ancient family within monocots (Friis et al., 2004, Cusimano et al., 2011). The infrageneric classification in three subgenera, *Philodendron, Pteromischum and Meconostigma*, is supported by morphological and anatomical characters (Mayo, 1988), and molecular data (Gauthier et al., 2008). The subgenus *Meconostigma* is an interesting model to understand the diversification of Neotropical plants because of its wide distribution including Amazonia, Atlantic Forest, and Cerrado biomes and the small number of species – 21 – which facilitates morphological phylogenetic studies. Despite this, no comprehensive phylogenetic study has previously been carried out.

The taxonomy of *P.* subgenus *Meconostigma* was revised by Mayo (1991) and Gonçalves and Salviani (2002), and a series of anatomical and morphological studies focused on floral traits of *Philodendron* have been published (Mayo, 1988, Mayo, 1989). Mayo (1988) hypothesized that *P.* subg. *Meconostigma* was the first of the subgenera to emerge as a distinct clade from ancestral *Philodendron*, that the Eastern and Southern species would present a higher number of plesiomorphic gynoecial characters (low number of locules and simple style), and Amazonian species would have apomorphic characters (high number of locules and elaborated style). However, these hypotheses were based mainly on data from four species and therefore, it remained unclear whether or not they hold true for the whole subgenus.

The aim of the present study was to infer the evolutionary history of *Philodendron* subg. *Meconostigma* using morphological characters. To this end, we described three new subtypes of gynoecium and analyzed a meristic and polymorphic character matrix using generalized frequency coding (GFC). This is the first phylogenetic study of *Philodendron* using morphological characters and partially confirmed Mayo's evolutionary hypothesis.

Section snippets

Taxon sampling

The ingroup comprised 19 out of the 21 currently recognized species of subgenus *Meconostigma* (Gonçalves and Salviani, 2002, Croat et al., 2002), two species of subgenus *Philodendron* and one species of subgenus *Pteromischum*. *Philodendron petraeum* Chodat & Vischer, a species currently synonymized in *P. tweedianum* Schott, was included as a distinct species. *Philodendron leal-costae* Mayo & G.M. Barroso and *P. xanadu* Croat, Mayo & J. Boos were not found in flower and therefore were excluded from the …

Gynoecial subtypes in *Philodendron* subg. *Meconostigma*

Six morphological types of gynoecium (A–F) were previously recognized by Mayo (1989). The author found that type A was unique to subgenus *Meconostigma*, presenting as diagnostic characters a well developed compitum and stylar lobes. The analysis of the gynoecium allowed us to recognize three subtypes within type A basic morphology. Subtype A1: stylar body absent and stylar canals short, central stylar dome absent, and compitum deep (*P. adamantinum*, *P. dardanianum*, *P. speciosum*, and *P. williamsii*…

Discussion

The present report fills the gap concerning the evolutionary history of the subgenus *Meconostigma* of *Philodendron*, an interesting study model of the diversification of Neotropical plants. Our phylogenetic reconstruction suggests that this subgenus is monophyletic and originated in open areas of the Cerrado biome *s.l.*. We also identified three subtypes within type A of gynoecium originally described by Mayo (1988), a finding that when combined with the phylogenetic reconstruction results allowed …

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Floral scent chemistry of sympatric species of Philodendron (Araceae) sharing a common pollinator in the fragmented coastal Atlantic Forest of southeastern Brazil

2023, Flora: Morphology, Distribution, Functional Ecology of Plants

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New insights on the phylogenetic relationships among the traditional Philodendron subgenera and the other groups of the Homalomena clade (Araceae)

2018, Molecular Phylogenetics and Evolution

> *Citation Excerpt :*
>
> …Instead, Oliveira et al. (2014) observed the clade formed by T. spruceanum (as P. goeldii) and T. solimoesense (as P. solimoesense) as the first diverging lineage of Thaumatophyllum (as P. subg. Meconostigma), besides the clustering of T. venezuelense (as P. venezuelense) within the heliophytes clade, as sister to T. williamsii (as P. williamsii), similarly to the results obtained by Calazans et al. (2014) in a phylogenetic analysis based on the morphology of reproductive characters. However, it is

important to notice the robustness of our results towards the cohesion of the heliophytes clade without any of the Amazonian species, mainly regarding the cpDNA and concatenated matrixes, also containing T. williamsii (which is the same sample used by Oliveira et al., 2014), besides including three different specimens of T. venezuelense.…

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Floral structure of Philodendron propinquum (Araceae) and a comparative study of the Philodendron subgenera

2018, Flora: Morphology, Distribution, Functional Ecology of Plants

Citation Excerpt :

…Species of Philodendron are traditionally classified under three subgenera, P. subgenus Philodendron (Schott), P. subgenus Meconostigma (Schott) Engler, and P. subgenus Pteromischum (Schott) Mayo (Mayo, 1989). The evolutionary relationships among the three subgenera, as well as the monophyly of the genus Philodendron, have been widely discussed in recent years (Calazans et al., 2014; Cusimano et al., 2011; Gauthier et al., 2008; Loss-Oliveira et al., 2016a, 2016b; Yeng et al., 2013). The most recent phylogenetic hypothesis suggests that P. subgenus Meconostigma is monophyletic, as well as the subgenera [Philodendron + Pteromischum] (Loss-Oliveira et al., 2016a, 2016b).…

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2022, SSRN

Out of amazonia and back again: Historical biogeography of the species-rich neotropical genus philodendron (araceae) ↗

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