

## Phylogenetic systematics of the tribe Cereeae Salm-Dyck (Cactaceae)

*Marlon Machado, Anita Lendel & Reto Nyffeler*

*Institut für systematische Botanik der Universität Zürich, Zollikerstrasse 107, CH-8008 Zürich, Switzerland.*

The tribe Cereeae Salm-Dyck has been variously circumscribed since its creation, from a highly artificial group encompassing all genera of columnar cactus species to more restricted views where the included taxa were considered related with basis on phenetic similarity of various characters. The current circumscription of the tribe includes those taxa of mostly South-American origin bearing more or less naked, tubular, nocturnal or diurnal flowers and more or less naked fruit. The object of this study was to test the delimitation of Cereeae and to investigate the phylogenetic relationships of the genera belonging to the tribe, besides also testing their circumscription. In order to achieve these objectives sequences of four regions of chloroplast DNA (intergenic spacers *trnS-trnG* and *trnS-trnT*, introns *rpl16* and *rps16*) were obtained for representatives of the tribe and closely related groups. The sampling included two or three species from every genus and subgenus of Cereeae, and also exemplars from genera that have formerly been placed in Cereeae or whose placement within the tribe was uncertain, in order to ascertain their phylogenetic relationships. Species of genera from tribes Browningieae and Trichocereae were used as primary outgroup taxa in the phylogenetic analyses in order to test the circumscription of the tribe. Species from tribe Notocactaceae were used as secondary outgroups for 'rooting' purposes. A total of 97 exemplars was sampled. The data-matrix with the aligned sequences was 5076 characters long, 894 of these being informative, and it was analyzed with cladistic and bayesian inference methods. The different analyses resulted in well-resolved consensus trees with similar topology. A low level of molecular divergence in the tribe was detected, and support for bootstrap and bayesian posterior probabilities for some of the clades encountered was consequently low. Besides the genera currently accepted, the tribe becomes monophyletic with the inclusion of *Discocactus*, *Espostoopsis*, *Facheiroa*, *Leocereus* and *Stetsonia*. *Discocactus* is placed as the sister group of *Melocactus*. *Arrojadoa*, *Cereus*, *Cipocereus*, *Pilosocereus*, *Micranthocereus* and *Stephanocereus* are polyphyletic in their current circumscription. *Cipocereus pusilliflorus* proved to be a distinct lineage not related to *Cipocereus*. *Cereus* subg. *Mirabella* is sister to the remainder of *Cipocereus*. *Micranthocereus* subg. *Siccobaccatus* is sister to *Coleocephalocereus*. *Pilosocereus* subg. *Gounellea* is sister to the remaining *Micranthocereus*. *Arrojadoa* excluding *A. bahiensis* is sister to *Stephanocereus leucostele*, this clade being sister to *A. bahiensis*, and the clade formed by these three taxa is sister to *Stephanocereus luetzelburgii*. The phylogeny of Cereeae will form the basis for future studies that will foster our understanding of historical, evolutionary and adaptative processes in the tribe and of Cactaceae in general.