



Diplazoptilon (Asteraceae) is merged with *Saussurea* based on evidence from morphology and molecular systematics

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Abstract

Diplazoptilon is a monotypic genus belonging to the *Saussurea* group (Asteraceae, Cardueae). We undertake micromorphological and molecular studies to discuss the systematic position of this genus. The achene of *Diplazoptilon picridifolium* is obconical, 4-angled, with a small crown on the apical rim. The pollen of *D. picridifolium* are spheroidal, narrowly tricolpate, with the exine reticulate and shortly spinulate. The micromorphological characters of *D. picridifolium* are well in accordance with those of the genus *Saussurea*. Our molecular analyses demonstrate that *Diplazoptilon* and *Saussurea* form a strongly supported clade. Taking into account the great similarities in achene, pappus and pollen morphology between *Diplazoptilon* and *Saussurea*, it is reasonable to merge *Diplazoptilon* with *Saussurea*. From our molecular work and the gross-morphological characters, *D. picridifolium* should be a member of *Saussurea* subgen. *Saussurea* sect. *Strictae*. There are more than one species with a plumose outer pappus in the genus *Saussurea*, and the occurrences the plumose outer pappus in the genus *Saussurea* may have had parallel origins.

Key words: Cardueae, Compositae, morphology, phylogeny

Introduction

The tribe Cardueae is one of the largest tribes in Asteraceae, with about 2400 species in about 73 genera, which mainly occur in temperate regions of Eurasia (Susanna & Garcia-Jacas 2009). In the earliest classification (Cassini 1819), Cardueae were divided in three tribes: Echinopeae, Carlineae and Cardueae. Bentham (1873) and Hoffmann (1893) proposed to group the three tribes into a single tribe, Cardueae, including four subtribes. In recent years, a great progress has been made toward elucidating phylogenetic relationships within the tribe Cardueae using DNA sequence data (e.g., Susanna *et al.* 1995; Garcia-Jacas *et al.* 2002; Raab-Straube 2003; Susanna *et al.* 2006; Barres *et al.* 2013; Wang *et al.* 2013). Mainly based on molecular phylogenetic results, Susanna & Garcia-Jacas (2007) recognized five subtribes in tribe Cardueae. All molecular analyses concluded that Cardueae is monophyletic, including the most often segregated subtribes Carlininae and Echinopsinae (Garcia-Jacas *et al.* 2002; Susanna *et al.* 2006; Susanna & Garcia-Jacas 2009; Barres *et al.* 2013). However, generic delimitations and phylogenetic relationships remain unresolved for some groups, in particular, the *Saussurea* group (Wang *et al.* 2013). Susanna & Garcia-Jacas (2007) only recognized four genera in the *Saussurea* group, but Shi & Raab-Straube (2011) recognized 15 genera. Recently, Wang *et al.* (2013) described the new genus *Shangwua* Wang *et al.* to accommodate all the species formerly placed in *Saussurea* sect. *Jacea* Lipschitz. Wang *et al.* (2013) suggested that *Shangwua* is not a member of the *Saussurea* group, but a member of the *Xeranthemum* group.

The genus *Diplazoptilon* Ling belongs to the *Saussurea* group in tribe Cardueae (Shi & Raab-Straube 2011). It was established by Ling (1965) based on *D. picridifolium* (Handel-Mazzetti) Ling, a species occurring in northwestern Yunnan and southeastern Xizang (Zayü), China. He pointed out that the genus was intermediate between *Saussurea* and *Vladimiria* Iljin in many morphological characters, but differed from them by its plumose pappus with two series of subequal length, which are both connate into a ring at base. Shih in Shih & Jin (1983) added *D. cooperi* (Anthony)