Phytotaxa 224 (2): 185–195
www.mapress.com/phytotaxa/

Article

ISSN 1179-3155 (print edition)
PHYTOTAXA
ISSN 1179-3163 (online edition)

http://dx.doi.org/10.11646/phytotaxa.224.2.5

Eutrema racemosum (Eutremeae, Brassicaceae), a new tetraploid species from southwest China

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Abstract

The new species *Eutrema racemosum* is described, and its relationship to the closely related *E. heterophyllum* and *E. edwardsii* are discussed based on morphological, cytological, and molecular data. The novelty differs from *E. heterophyllum* by having elongated racemes and from *E. edwardsii* by somewhat reflexed fruiting pedicels. Four chloroplast DNA fragments and nuclear ITS region were sequenced for multiple individuals of each species. Three species show distinct and stable sequence variations. *Eutrema racemosum* and *E. heterophyllum* form a clade sister to that of *E. edwardsii* in phylogenetic analyses of sequence variations. Our cytological studies revealed that *E. heterophyllum* is a diploid with the small genome size, while *E. racemosum* is a tetraploid with duplicate genomes. These available data support the recognition of *E. racemosum* as a distinct species well differentiated morphologically and genetically, as well as well-isolated reproductively from its sister species *E. heterophyllum*. We further found some interspecific triploid hybrids between tetraploid *E. racemosum* and diploid *E. heterophyllum*, which seem to be sterile according to our germination experiments.

Introduction

Eutrema Brown (1823: 9), comprises some 26 species, including the model plant for salt-tolerance *E. salsugineum* (Pallas 1773: 446) Al-Shehbaz & Warwick (2005: 134) and the economically important wasabi plant *E. japonicum* (Miquel 1866: 74) Koidzumi (1930: 22). Although *Eutrema* has been extensively studied (Al-Shehbaz, 2007; Al-Shehbaz & Warwick, 2005; Warwick *et al.*, 2006), it remains poorly understood in China because of incomplete field explorations. During the recent field investigations by one of us (Hao), a new species within *Eutrema,* hereafter *E. racemosum* Al-Shehbaz, G.Q. Hao & J.Q. Liu (Figs. 1–3), was discovered. It was immediately believed to be related to *E. heterophyllum* (Smith 1919: 201) Hara (1973: 97) due to similar morphological traits, though differed by the enlonged racemes. Morphological, cytological, and molecular studies on both of them and another related species *E. edwardsii* were dealt with herein.

Materials and methods

For morphological comparisons and taxonomical treatments, we examined more than ten living individuals from each population to assess consistency of morphological differences between species. We also examined the differences between them and their putative hybrids with intermediate morphology.

We followed Hu & al. (2015) in examining the genetic differences between two morphological groups and their putative hybrids. For each groups, two or three individuals were studied from each population. In addition, we sampled two accessions of *Eutrema edwardsii* Brown (1823: 9) and one individual for each of *E. salsugineaum*, *E. janponicum,* and *E. verticillatum* (Jeffrey & Smith 1913: 120) Al-Shehbaz & Warwick (2005: 134). We downloaded from GenBank the corresponding sequences of *Brassica rapa* Linnaeus (1753: 666) and *Arabidopsis thaliana* (Linnaeus 1753: 665) Heynh in Holl & Heynhold (1842: 538) as outgroups (Table 1).

Accepted by Karol Marhold: 3 Jun. 2015; published: 28 Aug. 2015