



A new hybrid from Taiwan, *Elatostema* × *hybrida* (Urticaceae), is the first confirmed natural hybrid for Urticaceae

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Abstract

Explosive pollen dispersal is common in Urticaceae and they are thought to be wind-pollinated. Despite a lack of obvious mechanism for preventing cross-species pollination, putative hybrid species in Urticaceae are rarely documented. Here we described the first natural hybrid in Urticaceae *Elatostema* × *hybrida* from Taiwan. Morphological characters in *E.* × *hybrida* are intermediate between putative parental species: *E. lineolatum* var. *majus* and *E. platyphylloides*. Six hybrid populations of *E.* × *hybrida* were found in Taiwan that exhibited largely overlapping distribution patterns with its putative parents. Phylogenetic analysis of chloroplast DNA showed that the hybrid species is more closely related to *E. lineolatum* var. *majus* suggesting that the latter is the maternal parent and that hybridization is unidirectional. The chromosome number of *E.* × *hybrida* remains the same as its putative parents ($2n = 26$). We speculate that the examined hybrids are natural first-generation results of independent hybridization events. Based on the morphology, spatial distribution, DNA sequence data, pollen viability and cytological observations, we hypothesize that *E.* × *hybrida* is derived from natural hybridization events between *E. lineolatum* var. *majus* (♀) and *E. platyphylloides* (♂).

Key words: Natural hybridization, molecular data, morphology, nrITS, *trnH-psbA* spacer, first-generation hybrid, *Elatostema lineolatum* var. *majus*, *Elatostema platyphylloides*

Introduction

Hybridization has been demonstrated to be an important force in plant evolution for forming new species (Gross & Rieseberg 2005, Soltis & Soltis 2009). Compared to the more commonly occurring allopolyploid hybrid speciation (genome doubling), homoploidy hybrid speciation which has no impact on chromosome number is relatively rare (Abbott *et al.* 2010). Although the occurrence of natural hybridization is recognized as a common feature in many flowering plants, they are more commonly documented in some families: Asteraceae, Poaceae and Cyperaceae than in others: Santalaceae, Linaceae, Hydrocharitaceae and Urticaceae (Ellstrand *et al.* 1996, Whitney *et al.* 2010).

The Urticaceae consists of ca. 54 genera and 2,600 species (including Cecropiaceae) (APG II 2003, APG III 2009) and is widely distributed from tropical to temperate regions with a centre of diversity in tropical Asia. Most Urticaceae species have minute unisexual flowers with a reduced perianth, which makes hypotheses of morphological homology very difficult (Monro 2006). The majority of Urticaceae genera have stamens that are inflexed in bud and release pollen explosively through a dramatic reflex motion that may be facilitated by wind.

Despite a lack of obvious morphological mechanism for preventing cross-species pollination amongst the 2,600 Urticaceae species, only few possible hybrid species have been recorded in this poorly studied family. Yahara (1983) documented putative hybridization between *Boehmeria gracilis* Wright (1899: 485) and an apomictic race of *B. japonica* Miquel (1867: 131) on Mt. Higashiakashi, Japan, which included both triploid and tetraploid individuals. Another possible hybrid in *Elatostema* Forster & Forster (1776: 105) was recorded occurring in a greenhouse between two endemic Japanese species, *E. oshimense* (Hatusima) Takasi Yamazaki (1972: 180) and *E. yonakuniense* Hatusima (1963: 34) (Kanemoto 1997). Based on a survey of four North American regions, British

parental genome may be preserved in the hybrid. Therefore the maintenance of partial and uneven homogenization of parental sequences in the six populations of putative hybrid may be due to an unequal tempo of concerted evolution of nrITS sequences among different population and individuals.

The result from the chloroplast DNA phylogeny infers a possible direction of hybridization since the inheritance of chloroplast DNA is assumed to be maternal for most angiosperms (Gillham 1978, Sears 1980) and has been demonstrated for *Pilea* Lindley (1821: tab. 4) and *Urtica* Linnaeus (1753b: 983) of Urticaceae (Zhang *et al.* 2003). Although the direction of chloroplast inheritance in this instance cannot be confirmed, we postulate that *E. lineolatum* var. *majus* is the maternal parent and *E. platyphylloides* is the paternal parent for the reason given above.

Although *E. ×hybrida* is an F1 hybrid and the establishment of the F1 generation is only the first step in a possible speciation through hybridization, the reduction of fertility in F1 hybrids is a barrier to introgression between parental species. Novel fertile hybrid species may be established after backcrossing or interbreeding among F1 hybrids via the few viable gametes (Grant 1958, Arnold & Hodges 1997). Hybrid inviability and sterility can also play important roles in the process of speciation by acting as reproductive isolating barriers (Coyne & Orr 2004).

Each naturally occurring hybrid species needs individual evaluation in order to determine its conservation status if this hybridization event is not driven by anthropogenic activity and one of parental species involved is not endangered (Genovart 2009). Moreover, hybrids may contain the last remaining genes and perform the ecosystem function of parental species (Rhymer 2008). Arnold *et al.* (1999) also suggested that hybridization may result in genetic enrichment of the involved populations and facilitates habitat expansion. However, only six populations and less than 100 individuals of *E. ×hybrida* have been found in the field to date. Any conservation strategy would need to take into account on this threat-facing F1 status of the species.

Furthermore, *E. ×hybrida* is also the first confirmed natural hybrid in Urticaceae by the morphological, cytological and molecular data. Urticaceae has long been a taxonomically difficult group, presumably because of obscured morphological distinction and species richness. It should be noted that few and even absences of hybrid are found in herbarium collections and studies (Ellstrand *et al.* 1996, Whitney *et al.* 2010) probably because Urticaceae is a poorly studied family. Too little data are available to understand the occurrence of hybrid in Urticaceae and further research is needed in order to devise a proper conservation strategy. Accurate detection of hybrids has important implications for species conservation, but general botanical collecting maybe not be adequate to document hybridization events. An integrative approach combining morphological and molecular data will prove valuable in the analysis of potential hybridization events. In fact, there are some characters in Urticaceae taxonomy that likely provide clues about the presence of other potential hybrids. For example the morphologically diverse microspecies are easy to find in Urticaceae and these may be the result of introgression between hybrid and related species known to hybridize in nature. Apomictic plants have also been found in some genera of Urticaceae e.g. *Elatostema* and *Procris* (Fagerlind 1944), and the close association between hybridization and apomixis may also imply the existence of “cryptic” hybrids in Urticaceae.

Acknowledgements

We gratefully thank TAI, TAIF, HAST, FRIM, IBK, MO, TNM, K, BM herbaria for providing plant materials, Chun-Kuei Liao for the line drawing, and Bing-Ling Shih and Chien-Hung Yang for assistance in the fieldwork. We also thank Meng-Ying Tsai for the help of pollen viability test, Fen-Ming Lee for the advice of chromosome preparation, Huan-Yu Lin and Yi-Ru Cheng for assistance in data analysis.

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