

# Species subdivision of ramie (*Boehmeria nivea*; Urticaceae), a species with wild, domesticated and feral forms, based on integrative taxonomy

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## Abstract

Feralization, the re-establishment of wild populations from domesticated ancestors, can involve multiple parallel character reversions, and potentially also rampant gene flow with cultivated and/or naturally wild material. It hence poses great challenges for infraspecific classification, which may impede crop development, but studies on these issues are rare. Ramie (*Boehmeria nivea*; Urticaceae) is an important fiber crop worldwide. It has been traditionally divided into 2-4 varieties, but these are controversial. Here, 78 wild and feral individuals were sampled from 12 Chinese provinces, plus 11 cultivated individuals from farmland. We employed an integrative taxonomy approach combining multiple lines of evidence from morphology, phylogenomics, and ecology to investigate the intraspecific subdivision of *B. nivea*. A chi-square test of qualitative morphological traits significantly distinguished three varieties within *B. nivea*: var. *nivea*, var. *tenacissima* and the recently described, var. *strigosa*, comprising respectively mainly cultivated, mainly feralized, and only naturally wild material. The morphological PCoA and random forest analyses both indicated differences between var. *strigosa* and the other two varieties. However, quantitative traits cannot distinguish the three varieties. No variety was monophyletic according to phylogenetic analysis of plastome data, whereas var. *strigosa* was weakly supported as monophyletic based on nuclear ribosomal DNA (18S-ITS1-5.8S-ITS2-26S). Ecological niche simulation showed overlap between the potential distribution areas of var. *nivea* and var. *tenacissima*, but neither overlapped with var. *strigosa*. These analyses collectively demonstrate the distinctiveness of var. *strigosa*, but mostly did not fully separate var. *nivea* from var. *tenacissima*. Hence var. *strigosa* is a biologically meaningful variety, but var. *tenacissima* should, be synonymised within var. *nivea*. These results should aid the breeding and improvement of new varieties of ramie, and highlights the value of integrative taxonomic methods in examining infraspecific subdivisions within species that include cultivated and feralized material.

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