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Analysis of genetic diversity among European and Asian fig varieties (*Ficus carica* L.) using ISSR, RAPD, and SSR markers

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**Abstract** Nineteen fig varieties and lines from Europe and Asia have been fingerprinted by ISSR, RAPD, and SSR markers, respectively, using 13, 19, and 13 primer combinations. All primers produced 258 loci, with the highest number of loci (119) generated by RAPD ( $R_p$ : 48.42). Clustering analysis was applied to the three marker datasets to elucidate the genetic structure and relationships among these varieties. Mean genetic similarities were 0.787, 0.717, and 0.749, respectively, as determined using ISSR, RAPD, and SSR. Each marker system produced incompletely separated clusters, although a weak binding group based on race type appeared in the combined dataset. Comparisons of coefficients revealed no correlation between different similarity matrices; congruence was observed between similarity matrices and co-phenetic matrices in all markers. Analysis of molecular variance (AMOVA) showed that most of the total polymorphism was attributable to within-group variance (ISSRs + RAPDs, 97.41%; SSRs, 90.18%). These results suggest that the genetic diversity of this fig population is low and that multiple marker utilization is critical to estimate the relatedness of figs at the variety level. Additionally, it was presumed that 'Houraihi', the oldest variety in Japan, was disseminated independently of other foreign varieties in the 17th century or before then.

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- Ruan, Cheng-Jiang (2009) Characterization and identification of ISSR markers associated with resistance to dried-shrink disease in sea buckthorn. *Molecular Breeding* [CrossRef]

**Keywords** *Ficus carica* L. - Genetic diversity - ISSR - RAPD - SSR - Varietal relation

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RESEARCH ARTICLE

## Analysis of genetic diversity among European and Asian fig varieties (*Ficus carica* L.) using ISSR, RAPD, and SSR markers

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### Introduction

Common fig (*Ficus carica* L.) is a traditional fruit in western Asia. Its historical origin is presumably southern Arabia (Condit 1947; Zuckovskij 1950; Storey 1975) or the eastern part of the Mediterranean area including Turkey and Iran where wild forms of fig trees can be observed (Khoshbakht and Hammer 2006). Fig cultivation has come to be most common in areas near the Mediterranean Sea (IBPGR 1986; Khoshbakht and Hammer 2006). Figs have become economically important throughout the world as an agricultural product.

The spread of cultivation to the east has been rather slow (Aksoy 1998). The first common fig is presumed to have come to China during the 8–14th centuries, but the details remain unknown. Some documents have shown that several cultivars were introduced into Southeast Asia for cultivation from other countries in the 17th century. The first

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