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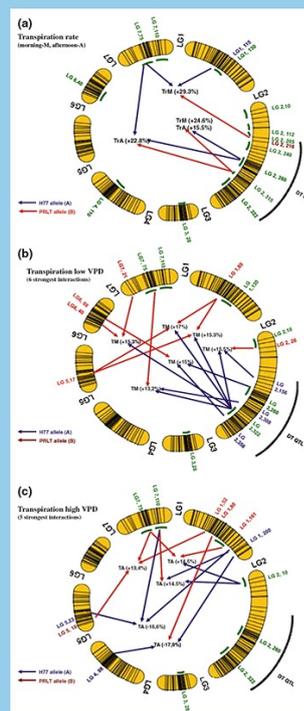
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Facilitating wide hybridization in *Hydrangea* s. l. cultivars: A phylogenetic and marker-assisted breeding approach

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Abstract *Hydrangea* s. l., belonging to the up-market segment of ornamental cultivars, currently faces a renaissance in horticulture. Hence, novel molecular-assisted breeding approaches are timely. Wide hybridization, i.e. crosses between distantly related species, has been shown to be problematic. Recent studies have considerably improved our knowledge of the phylogenetic relationships between the ornamental *Hydrangea* s. l. species. A fully resolved and highly supported phylogenetic tree is currently available, based on an extensive marker selection including 13 highly variable chloroplast markers. This robust phylogenetic framework includes the majority of widely cultivated *Hydrangea* s. l. species that have been the center of attention in a number of crossing projects. The present study is based on this highly supported phylogenetic hypothesis. Here, we aim to select the best candidates for future successful breeding projects, involving

interspecific crosses of both closely and distantly related *Hydrangea* s. l. lineages. Therefore, we integrated the phylogenetic relatedness of potential parental lines along with genetic distances calculated from a wide plastid marker selection. Direct crosses between two species were found to be successful up to an average genetic distance of 0.01065, while failure could be expected at an average genetic distance of 0.01385 and higher. In order to overcome this genetic distance threshold, we propose *Hydrangea arborescens*, *H. sargentiana*, *H. integrifolia*, and *H. seemanii* as the best candidates for future bridge-cross projects with currently available fertile hybrids. We expect that our results will allow breeders to overcome long-standing wide crossing difficulties and motivate breeding initiatives of potential economic value.

Keywords Hydrangeaceae · *Hortensia* · Chloroplast markers · Interspecific hybridization · Bridge-cross breeding · Genetic distances

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With more than two centuries of horticultural trade, *Hydrangea* s. l. cultivars are among the most popular ornamental shrubs worldwide (McClintock 1957; Kardos et al. 2009). The genus *Hydrangea* is the best-known member of Hydrangeaceae tribe Hydrangeae from the Asterid order Cornales. Recent studies have confirmed that *Hydrangea* as traditionally recognized (further referred to as *Hydrangea* s. s.) is paraphyletic with regard to the eight other genera of