

## *Hydrangea macrophylla* and *serrata* – Should we Lump ‘em or Split ‘em?

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**Significance to Industry:** There is confusion among the industry and scientists as to whether *H. macrophylla* subsp. *serrata* or *H. serrata* is the correct scientific name for the mountain hydrangea. This study used morphological, molecular and hybridization data to address this issue. While morphological data could support elevating the *serrata* form to species level, molecular and hybridization data do not support separating *macrophylla* and *serrata* into separate species. We recommend use of the *H. macrophylla* subsp. *serrata* designation as it is more appropriate from a breeding perspective.

**Nature of Work:** The taxonomic treatment of *Hydrangea serrata* has long been disputed. While initially considered to be a separate species, McClintock (7) classified it as a subspecies of *H. macrophylla*. However, recent publications on *Hydrangea* and many nursery catalogs have reverted back to the *H. serrata* designation (2, 4, 5, 11). The objective of this study was to evaluate the validity of separating *macrophylla* and *serrata* into different species using a combination of morphological, molecular and hybridization data.

**Results and Discussion:** There are several definitions of a species, which are based on morphological differences, ability to hybridize or phylogeny. We compiled previously published and new morphological, molecular and hybridization data on *H. macrophylla* subsp. *macrophylla* and *serrata*, and evaluated the data in respect to some of the definitions of a species.

*Morphological data.* *Hydrangea macrophylla* subsp. *serrata* is distinguished from subsp. *macrophylla* by its smaller foliage and flower parts (7). The two subspecies could be separated using a combination of 28 qualitative and 5 quantitative morphological criteria (1). Using the phenetic concept of a species, which is based on morphological differences, the separation of *macrophylla* and *serrata* into separate species can be justified; however, the subspecies designation would not be incorrect.

*Genome size.* Subsp. *macrophylla* cultivars were found to have 5.8% more nuclear DNA than subsp. *serrata* cultivars; this data was used to support the species designation for *serrata* (11, 12). However, intraspecific differences in genome size among populations of plant species collected from different geographical areas are not uncommon (3). Therefore, this data does not support making *H. serrata* a separate species.

**Molecular markers.** We tested 14 microsatellite (SSR) markers against a panel of 79 taxa, representing 12 *Hydrangea* species (9, 10). Genetic similarity between *H. macrophylla* ssp. *serrata* and other *Hydrangea* species was found to be comparable to that between *H. macrophylla* ssp. *macrophylla* and those species (Table 1). We feel that this data is consistent with the subspecies designation for *serrata*. In a separate study, 39 SSR markers were tested against 84 subsp. *macrophylla* and 20 subsp. *serrata* taxa. Seven cultivars for which authorities disagreed as to subspecies assignment or speculated on a hybrid origin were also included. The principle component analysis based on gene frequencies of these taxa tested is presented in Figure 1. Two main clusters were discernable, one containing *serrata* and the other *macrophylla* cultivars. This data indicates that there are genetic differences between *macrophylla* and *serrata* but that intermediate forms, which may represent hybrids, exist. Morphological data were unable to predict all of the intermediate forms.

**Hybridization.** The classical definition of a species is based on the biological species concept (BSC), which states that a species is an actual or potentially inbreeding group of organisms (6). Under this definition, morphologically distinct populations that produce viable, fertile hybrids should be considered to be subspecies. Hybridization records produced over the last nine years showed that *H. macrophylla* subsp. *macrophylla* 'All Summer Beauty', 'Blauweise', 'Horben', 'Masja', 'Pia' successfully hybridized to *H. macrophylla* subsp. *serrata* 'Blue Bird' and/or 'Blue Billow'; reciprocal hybrids between *H. macrophylla* subsp. *macrophylla* 'Madame Emile Mouillere' and *H. macrophylla* subsp. *serrata* 'Grayswood' were also obtained (Reed, unpublished data). Most of the hybrids between the two subspecies are no longer available for analysis of fertility. However, fertility of a 'Pia' × 'Blue Billow' hybrid had previously been demonstrated to be similar to that of several *H. macrophylla* subsp. *macrophylla* cultivars (8). Both 'Preziosa' and 'Tokyo Delight', which appear to be hybrids using both morphological and molecular data, produced over 95% stainable pollen (Jones, personal communication). Additional hybridization and fertility data are needed, especially involving a wider range of subsp. *serrata* cultivars. However, at this point, hybridization and fertility data do not support elevating *serrata* to the species level based on the BSC definition of a species.

In conclusion, the decision as to whether it is valid to consider *H. serrata* a separate species from *H. macrophylla* depends on how one defines a species. Using morphological criteria, the separation of the species could be justified. While this might be convenient from a horticultural perspective, we suggest keeping *serrata* at the subspecies level. This is more appropriate from a breeding standpoint and might lessen confusion in the future if new cultivars are developed from hybridization of *macrophylla* and *serrata* taxa.

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**Table 1.** Allele sharing distances between two subspecies of *Hydrangea macrophylla* and eleven other *Hydrangea* species.

	<i>H. macrophylla</i> ssp. <i>macrophylla</i>	<i>H. macrophylla</i> ssp. <i>serrata</i>
<i>H. anomala</i>	0.868175	0.837373
<i>H. arborescens</i>	0.858754	0.918000
<i>H. aspera</i>	0.908121	0.917714
<i>H. heteromalla</i>	0.895931	0.867574
<i>H. involucrata</i>	0.897871	0.891669
<i>H. paniculata</i>	0.899819	0.929760
<i>H. quercifolia</i>	0.824333	0.801392
<i>H. scandens</i>	0.421015	0.385957
Section Cornidia species	0.906067	0.903134

*(H. seemanii, H. serratifolia, H. integrifolia)*

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**Figure 1.** Principle Coordinate Analysis of 111 *H. macrophylla* taxa based on 44 SSR markers. Circles indicate subsp. *macrophylla*, and squares indicate subsp. *serrata*. Cultivars whose subspecies assignment is disputed or that have been speculated to be of hybrid origin are indicated by triangles. Some symbols represent more than one taxa.

