

Research Article

***Paeonia rotundiloba* (D. Y. Hong) D. Y. Hong: A new status in tree peonies (Paeoniaceae)**

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Abstract *Paeonia decomposita* Hand.-Mazz. subsp. *rotundiloba* D. Y. Hong is here raised to the specific rank, *P. rotundiloba* (D. Y. Hong) D. Y. Hong, based on its distinctiveness of four diagnostic characters: number of carpels; height of disk; number of leaflets of the lower leaves, and shape of the terminal leaflets; and unpublished molecular data. *Paeonia rotundiloba* differs distinctly from *P. decomposita* in having carpels mostly 3, less often 2 or 4, very rarely 5 (vs. almost always 5, very occasionally 4 or 3), disk 8–15 mm high (vs. 4–9.6 mm), leaflets mostly 19–39 (vs. 29–63) in number, and ratio of length to width of the terminal leaflets 1.09–1.93 (vs. 1.81–2.99).

Key words China, new status, *Paeonia decomposita*, *Paeonia rotundiloba*, Sichuan, statistical analysis.

Hong (1997) described *Paeonia decomposita* Hand.-Mazz. subsp. *rotundiloba* D. Y. Hong as new, based on two facts. The first, the two entities were found to be allopatric: *P. decomposita* subsp. *decomposita* in the Dadu Valley; and subspecies *rotundiloba* in the Minjiang Valley, isolated by the Qionglai Range. It was thought that this distribution pattern was in accordance with differentiation pattern of subspecies. The second, the two entities are rather similar to each other in appearance. They both have decomposite lower leaves with leaflets 19–63 in number, red flowers, and a yellow and leathery disk that envelops carpels halfway, but it was found that the tree peony in the Minjiang Valley differed in having carpels mostly 2–4, rarely 5 in number (vs. almost always 5), and the terminal leaflets broad-ovate to orbicular rather than elliptic to ovate.

However, our recent study in author's laboratory on the molecular systematics of tree peonies using multiple nuclear genes has resulted in a very solid gene tree which shows that the two entities neither form a single clade nor form sister clades. Instead, the subspecies *rotundiloba* forms a clade sister to *Paeonia rockii* instead of *decomposita* (unpublished data). It is apparent that if we keep the two entities in a single species, *P. decomposita*, the species would be a paraphyletic group. This result led me to reexamine morphological characters of the two entities. In addition to the number of carpels and the shape of the terminal leaflets, which I used for distinguishing the two subspecies, the number of leaflets of

the lower leaves and particularly the height of disk were found to be valuable for distinguishing the two entities. Here I report the variations of these four characters and their significance for delimiting the entities.

1 Material and methods

All the specimens housed in the Herbarium, Institute of Botany, Chinese Academy of Sciences (PE), were examined. Four characters, number of leaflets of the lower leaves, shape of the terminal leaflets, number of carpels, and height of disk, were measured. The lowermost two or three leaves on a tree peony shoot are best developed and comparable, and their number of leaflets can be used as a diagnostic character. We used the ratio of length to width to depict the shape of terminal leaflets.

Among the four characters, two are ordinal (numbers of leaflets and carpels), and the other two are continuous. For variability evaluation, the number of leaflets of the lower leaves and ratio of width : length of the terminal leaflets were based on 41 sheets identified to be *P. decomposita* subsp. *decomposita* and on 94 sheets to be *P. decomposita* subsp. *rotundiloba*. For the number of carpels and the height of floristic disks, evaluation was based on 25 sheets of the first subspecies and 18 sheets of the second subspecies. For principal coordinate analysis, only the specimens without missing data were used. The ratios were transformed to meet the requirement of normal distribution and standardized. Principal coordinate analysis was carried out using MVSP version 3.13b (Kovach, 1999).

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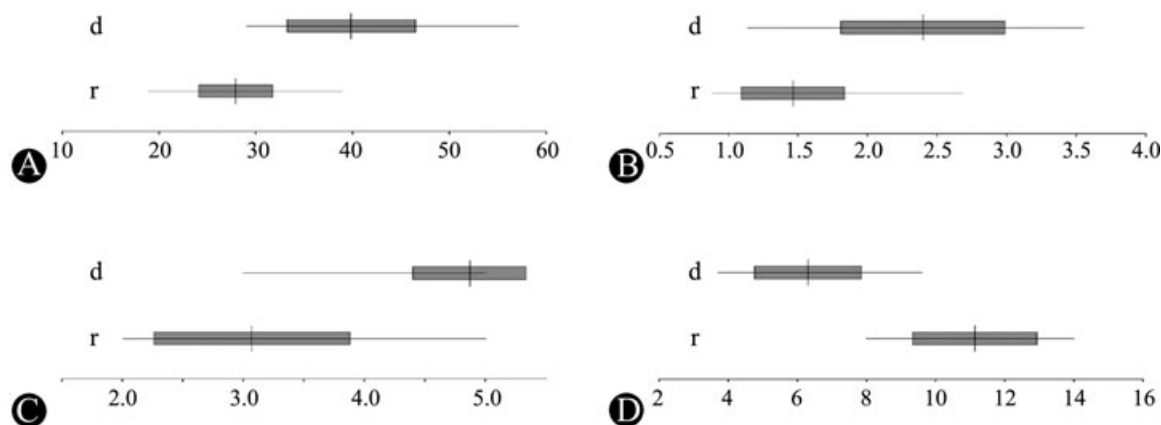


Fig. 1. Variations of four diagnostic characters in *Paeonia decomposita* subsp. *decomposita* (d) and *P. decomposita* subsp. *rotundiloba* (r). The thin line represents the range from minimum to maximum, and the thick line represents mean \pm SE. **A**, Number of leaflets of the lower leaves. **B**, Ratio of the terminal leaflets (length : width). **C**, Number of carpels. **D**, Height of disk (mm).

2 Results and discussion

The variations (minimum value, mean \pm SE, maximum value, Fig. 1) show that the two subspecies are apparently different in the number of leaflets of the lower leaves (Fig. 1: A) and in the shape of the terminal leaflets (Fig. 1: B). However, the variation ranges of the two characters represented by standard deviations are continuous or nearly continuous. The number of carpels and height of disk in the two subspecies are clearly discontinuous (Fig. 1: C, D). It is clear from the scatter plot (Fig. 2) that all the individuals involved in the analysis fall into two distinct groups. There is no individual intermediate between them, and the gap is clear and large. This indicates that there has been no gene flow

between them and that no introgression or hybridization has happened, and implies that the two entities have evolved separately for a long time. Therefore, the two entities can be considered as two independently evolving groups of populations, and it is justified to raise them to the specific rank.

3 Taxonomic treatment

Paeonia rotundiloba (D. Y. Hong) D. Y. Hong, stat. nov. Fig. 3 — *Paeonia decomposita* Hand.-Mazz. subsp. *rotundiloba* D. Y. Hong, Kew Bull., 52(4): 961, fig. 1: A. 1997; D. Y. Hong, Peonies of the World, Taxonomy and Phytogeography, 75. 2010. Type: China, NW Sichuan:

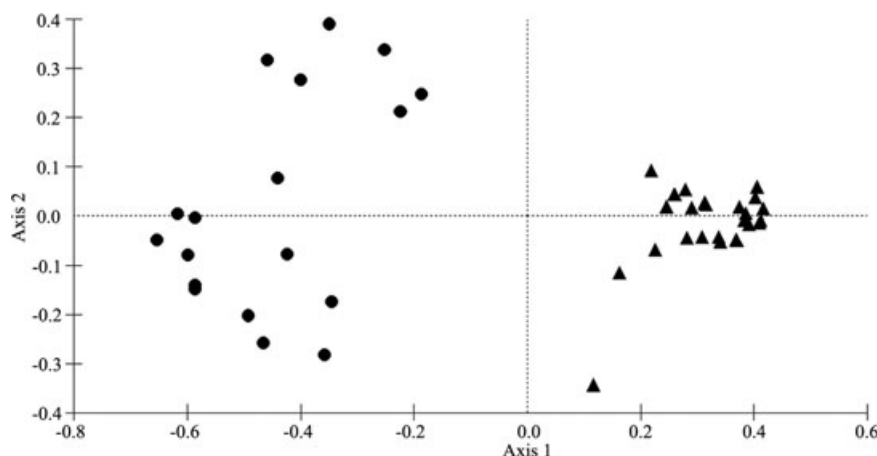


Fig. 2. Scatter plot of principal coordinate analysis of *Paeonia decomposita* subsp. *decomposita* (triangles) and *P. decomposita* subsp. *rotundiloba* (black dots). The Gower general similarity coefficient was used in axes 1 and 2 to represent the principal coordinate analysis case scores. Operational taxonomical units and characters used are explained and described in the text. Axis 1 expresses 53.6% of the total variation; Axis 2 represents 8.1% of the variation.



Fig. 3. *Paeonia rotundiloba* (D. Y. Hong) D. Y. Hong. **A**, Lower part of shoot. **B**, Upper part of shoot, showing lacerate disk. **C**, Mature follicles. Drawn by Miss LI Ai-Li.

Lixian, 31.4°N, 103°E, 2200 m, *Cupressus chengiana* forests, 18 Aug. 1995, D. Y. Hong, Y. B. Luo & Y. H. He H95033 (holotype PE!; isotypes A!, K!, MO!, US!).

Shrubs up to 2.5 m tall, 3 cm in diameter at the base, glabrous throughout. Stems grey-black. Lower leaves mostly biternate-pinnate or ternate-pinnate, with 19–39 leaflets; leaflets not decurrent; terminal leaflets rhomboid to orbicular, 2.1–5.5 cm long, 1.5–4.8 cm wide, 3-partite to the base or 3-fid, terminal lobes 3-lobed. Flowers solitary, terminal, 10–15 cm broad. Involucre bracts 2–5, mostly 2 or 3, unequal in size, linear-lanceolate to broad-elliptic, lobed or segmented. Sepals 3–5, green, broadly obovate or nearly orbicular, unequal in size, 1.5–3 cm long, 1.5–2.5 cm wide, all caudate at the apex. Petals obovate or oblong, incised at the apex, 3.5–6.5 cm long, 2–4.6 cm wide. Disk leathery, pale yellow, enveloping carpels nearly to the base of style at

anthesis, 8–15 mm high, with triangular teeth. Carpels mostly 3, less often 2 or 4, very rarely 5; styles 1–1.3 mm long; stigma red. Follicles brown or grey-brown when mature, ellipsoid, 2.2–3.5 long, 1.2–1.6 cm in diameter. Seeds black, glossy, broadly ellipsoid or nearly globose, 8–10 mm long, 6–8 mm in diameter.

Phenology: Flowering in May; fruiting from late August to September.

Chromosomes: $2n = 10$ (Hong, 1997)

Habitat: Well-developed thickets, young secondary forests or sparse *Cupressus chengiana* forests, often associated with *Rosa multibracteata* Hemsl. & E. H. Wilson, *Cotoneaster soongaricus* Popov, *Ostryopsis davidiana* Decne, *Cotinus coggygria* Scop., as well as species of *Quercus* L., *Rhamnus* L., *Ribes* L., and *Spiraea* L., etc. The species was usually found on rocks at altitudes of 1700–2700 m.

Distribution: Confined to the Minjiang Valley of northern Sichuan Province (Hong, 2010) and Têwo County of southeastern Gansu Province, China.

The new species, *P. rotundiloba*, very much resembles *P. decomposita* Hand.-Mazz. in appearance. However, the former differs from the latter in having carpels mostly 3, less frequently 4 or 2, rarely 5 (vs. almost always 5, very occasionally 4 or 3) and disk 8–15 (mostly 9.5–13.3) mm high (vs. 4–9.6, but mostly 5.3–8.2 mm). The two species are statistically distinctly different in these two characters. In addition, they are apparently different in number of leaflets of the lower leaves and shape of the terminal leaflets, although variation ranges of these two characters are not discontinuous. For example, the lower leaves are usually ternate-pinnate or biternate-pinnate with leaflets up to 39 in number in *P. rotundiloba*, whereas they are usually biternate-bipinnate, or even quartiternate-pinnate with leaflets up to 63 in number in *P. decomposita*.

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References

- Hong DY. 1997. Notes on *Paeonia decomposita* Hand.-Mazz. Kew Bulletin 52: 957–963.
- Hong DY. 2010. Peonies of the world, taxonomy and phylogeography. London: Royal Botanical Gardens Kew; St. Louis: Missouri Botanical Garden. x+302.
- Kovach WL. 1999. MVSP—A multivariate statistical package for Windows, ver. 3.1. Wales, U.K: Kovach Computing Services, Pentraeth.