

Morphological Variation and Palynomorphology of *Rosa laxa* in Xinjiang, China

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ABSTRACT. *Rosa laxa* is widely distributed in the Xinjiang Uygur Autonomous Region of China and is highly adaptable and rich in variation. In this study, we investigated the morphology, habitats, and palynomorphology of *R. laxa* botanical varieties from Xinjiang, China. In addition to *R. laxa* var. *laxa*, there were three other botanical varieties of *R. laxa* growing in southern Xinjiang, including var. *mollis*, var. *kaschgarica*, and var. *tomurensis*. Together, these four botanical varieties exhibited morphological variation, mainly in the morphology of prickles and the glandular trichome and in flower color. The pollen grains of the *R. laxa* botanical varieties, all medium in size (21.77–48.39 μm), came in three shapes: perprolate, prolate, and subspheroidal. Their pollen exine sculptures were characterized by either a striate-perforation pattern or striate pattern, but perforation varied in terms of diameter and density and striae varied in depth and density. Palynomorphological assessment showed that three types of evolution, i.e., primitive, transitive, and evolved, were present among *R. laxa* botanical varieties, and pollen dimorphism was observed in the same botanical variety. Perprolate pollen with a dense striate pattern was the most evolved type. Based on morphological and palynomorphological investigations, var. *tomurensis* was considered to be the most evolved one among the studied botanical varieties.

As one of the biodiversity centers of wild *Rosa*, China is home to 95 species (65 endemic) of *Rosa*, accounting for nearly half of the world total (Ku and Kenneth, 2003). The Xinjiang Uygur Autonomous Region is a large and sparsely populated area located in the northwest of China covering 1.6 million km^2 (about one-sixth of the total land area of China). Separated by the Tianshan Mountains, north Xinjiang is characterized by temperate climate, whereas south Xinjiang possesses a warm temperate climate. These complex environments make Xinjiang host to a rich variety of plant species. Although officially 14 species (including three botanical varieties) of wild *Rosa* are found in this region (Ku and Kenneth, 2003), there may be as many as 22 wild *Rosa* species in the region (Bao, 1993; Liu, 1993; Liu and Cong, 2000; Ma and Chen, 1990).

There are about 50 species of *Rosa* section *Cinnamomeae*, 36 of which are in China (26 endemic) (Ku and Kenneth, 2003; Yu et al., 1985). *Rosa laxa* var. *laxa* is one of these 36 species, and it grows extensively in the Xinjiang region only. In addition to the var. *laxa*, three other botanical varieties of *laxa* are also known to grow in Xinjiang (Liu and Cong, 2000), although only *R. laxa* var. *mollis* is recorded in the *Flora Republicae Popularis Sinicae* (Yu et al., 1985) and *Flora of China* (Ku and Kenneth, 2003). In the *Flora of China*, *R. laxa* is described as follows:

Shrubs 1–2 m tall. Branchlets terete, straight or slightly curved, glabrous; prickles in pairs below leaves or scattered. Leaves including petiole 4.5–10 cm; leaflets 7–9, elliptic, oblong, or ovate, rarely obovate, 1.5–4 cm long, 1–3 cm wide, glabrous or pubescent. Flowers often 3–6 in corymb, sometimes solitary, 1.5–3 cm in diam.; pedicel 1–1.8 (–3) cm, glandular; bracts ovate, pubescent, glandular hispid, apex acuminate. Sepals 5, ovate-lanceolate, leaflike, abaxially sparsely pubescent and glandular hispid, adaxially densely pubescent, margin entire. Petals 5, white or pink, obovate, apex erose. Hip red, oblong or ovoid, 1–1.8 cm in diameter, glabrous, often shiny, apex with a short neck and persistent, erect sepals.

Other recorded botanical varieties of *R. laxa* include 1) var. *mollis*, 2) var. *kaschgarica*, and 3) var. *tomurensis*. *Rosa laxa* varies considerably in terms of morphological characteristics. There is abundant inter- and intrapopulation genetic diversity among six natural populations of *R. laxa* var. *laxa* in the Tianshan Mountains of north Xinjiang (Guo, 2010). However, there is little information in the literature focused on the detailed descriptions (and specimens) of these botanical varieties in the Xinjiang region. Furthermore, only a relatively small area has been previously surveyed for *R. laxa*, although it is well known that Xinjiang is a biodiversity center of *Rosa*.

In this study, we reported the results of a recent survey (2007–18) of the distribution of *R. laxa* botanical varieties and their morphological characteristics in the Xinjiang region. In addition to the usual morphological characters, we also measured pollen traits. Because the morphological characteristics of pollen grains are generally unaffected by environmental factors but exhibit strong genetic stability, considerable evolutionary information regarding species and botanical varieties may be inferred from

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