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A Taxonomic Reappraisal of *Neottia* (Orchidaceae) from East Asia

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Abstract Two taxonomic problems in the genus *Neottia* (Orchidaceae) are elucidated. (1) *N. kiusiana* T. Hashim. et Hatus. and *N. hypocastanoptica* Y. N. Lee are rare and obscure entities previously known only from the type collections. We examined new material referable to these species in Japan and Korea and concluded that they are conspecific. *Neottia kiusiana* becomes a correct name due to the priority of publication. (2) We found that *Archineottia japonica* M. Furuse should be transferred to the genus *Neottia*. However, the combination *N. japonica* was already used for a different species. We therefore named *N. furusei* T. Yukawa et T. Yagame for this entity.
Key words : Japan, Korea, *Neottia*, new combination, Orchidaceae, taxonomy.

Identification of two obscure species of *Neottia*

The genus *Neottia* Guett. comprises about 10 species distributed widely in the temperate zone of Eurasia and adjacent regions. The genus is circumscribed by a combination of characters, such as 1) achlorophyllous habit, 2) densely crowded, fleshy, short roots, 3) an erect stem covered with clasping sheaths, 4) an elongated column with a suberect anther, 5) two, soft, mealy pollinia, and 6) a sensitive rostellum. In Japan, the following taxa are recognized: *N. asiatica* Ohwi, *N. inagakii* Yagame, Katsuy. et T. Yukawa, *N. kiusiana* T. Hashim. et Hatus., *N. nidus-avis* (L.) Rich. var. *nidus-avis*, and *N. nidus-avis* (L.) Rich. var. *mandshurica* Kom.

Among them, *Neottia kiusiana* is an obscure entity previously known only from the type collection. The species was described in 1991 on the basis of a specimen collected in Kagoshima Prefecture, southern part of Kyushu Island, Japan (Hashimoto and Hatusima, 1991).

Subsequently, *Neottia hypocastanoptica* Y. N. Lee (Lee, 2002) was described from Jeju Island, Korea. Although the author did not compare the new species with *N. kiusiana* in the protologue, the description suggests its close affinity with *N. kiusiana*. We compared several flowering samples collected at the type locality of *N. hypocastanoptica* with *N. kiusiana*.

Furthermore, we found two more Japanese collections possibly referable to *N. kiusiana*. One is a herbarium specimen collected by Daisuke Shimizu in Chiba Prefecture, southeastern part of Honshu Island, Japan. The other is herbarium and spirit material collected by Jun-nosuke Ôhara in Aichi Prefecture, central part of Honshu Island, Japan.

We compared morphological characters of these specimens. Figure 1 shows a flowering plant from the type locality of *Neottia hypocastanoptica* in Jeju Island. Both vegetative and reproductive characters are consistent among the specimens observed except for the shape of epichile of lip (Fig. 2). However, we found this character variable even among individuals in the same population. As shown in Figures 1G and 2D, two individuals of Jeju population exhibit different shape of epichile lobe: one is rectangular and the other is transversely rectangular. With respect to the type material of *N. kiusiana*, although the holotype has a transversely oblique-rectangular epichile lobe (Fig. 1I in Hashimoto and Hatusima, 1991), the relevant part of the iso-

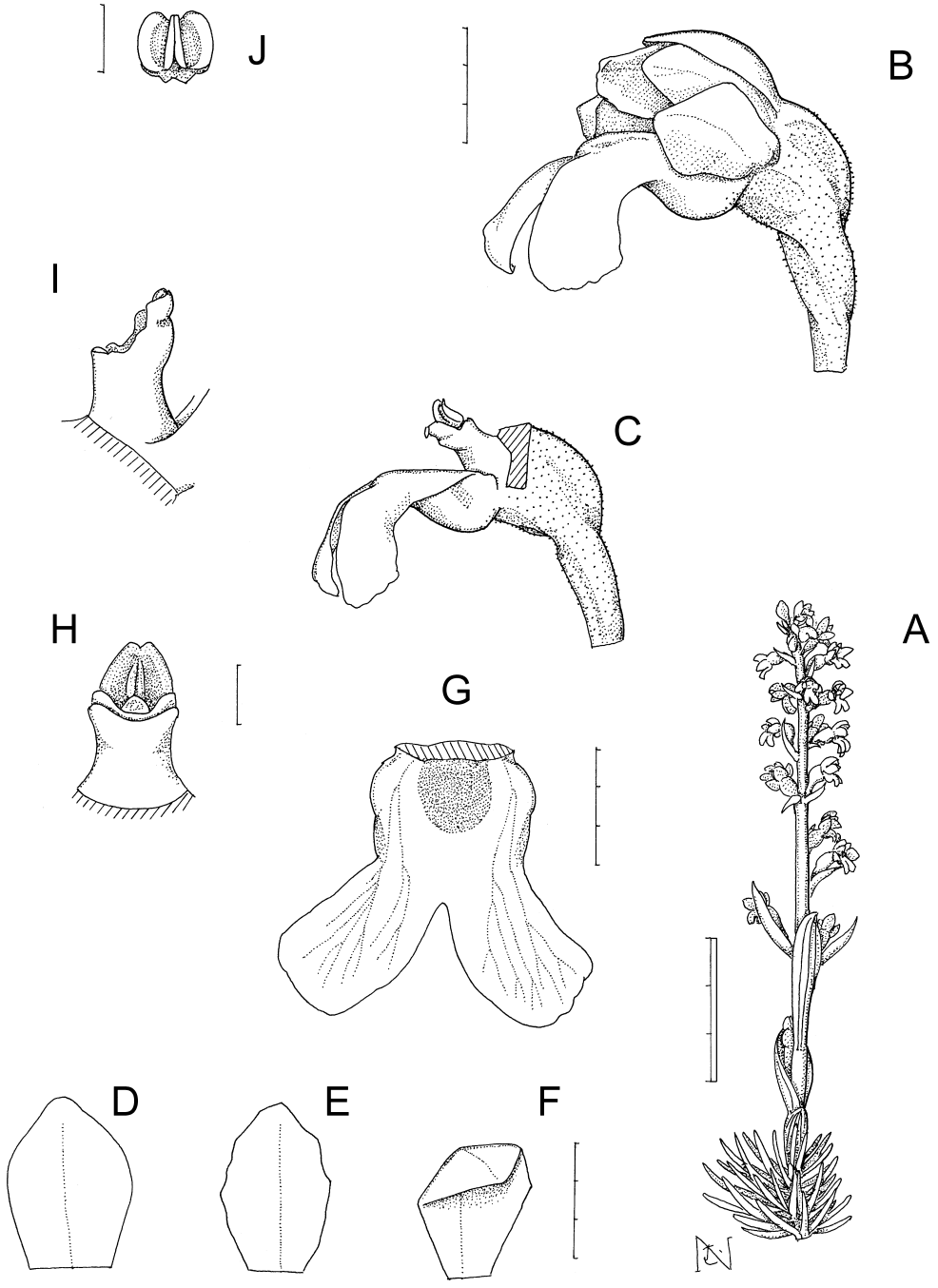

Fig. 1. *Neottia kiusiana* T. Hashim. et S. Hatus. A. Habit. B. Flower, side view. C. Lip and column, side view. D. Dorsal sepal. E. Petal. F. Lateral sepal. G. Lip. H. Column, from below. I. Column, side view. J. Anther cap. Drawn from *N. S. Lee & C. S. Lee D-241* (A) and *N. S. Lee & C. S. Lee L-016* (B–J: topotype of *N. hypocastanoptica*) by M. Nakajima. Scale bar = 3 cm (A), 3 mm (B–G), or 1 mm (H–J).

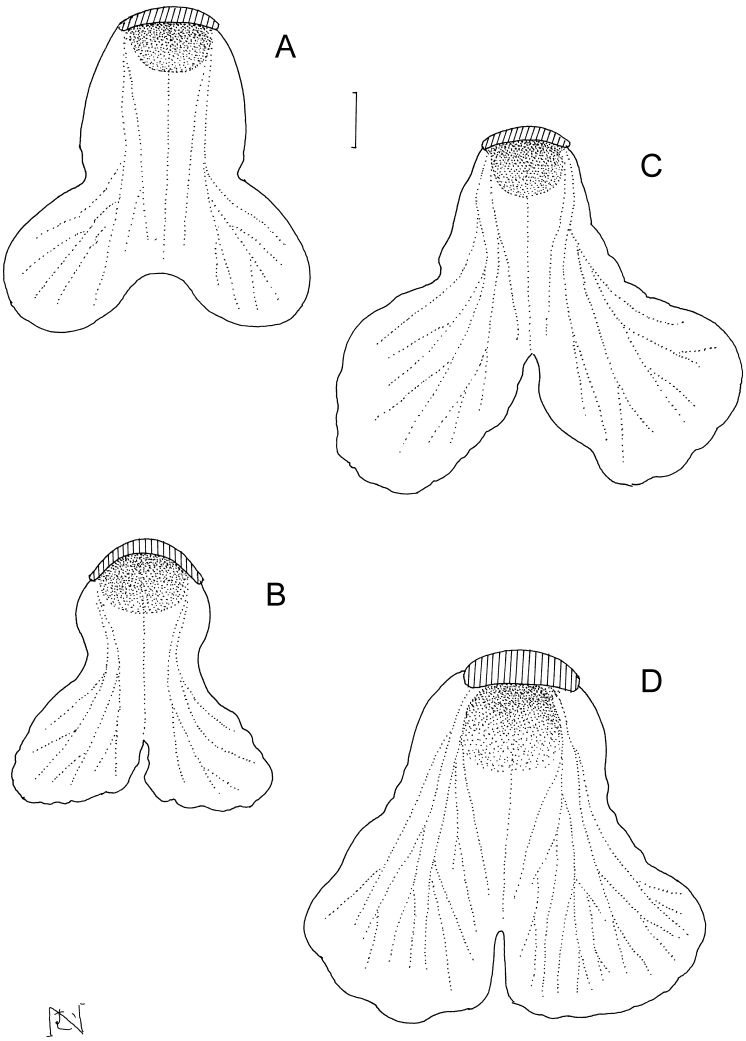

Fig. 2. Variations of lip in *Neottia kiusiana* T. Hashim. et S. Hatus. Drawn from *Y. Ôhira s.n.* (A: isotype of *N. kiusiana*), *J. Ôhara s.n.* (B), *D. Shimizu s.n.* (C), and *Yukawa 08-9* (D: in the vicinity of the type locality of *N. hypocastanoptica*) by M. Nakajima. Scale bar = 1 mm.

type is oblong (Fig. 2A). This variation of lip indicates that taxonomic subdivision on the basis of epichile shape is not appropriate. Consequently, we concluded that all of the material used in this study belongs to the same single species. Since the publication of *N. kiusiana* precedes that of *N. hypocastanoptica*, the former becomes a correct name.

These findings shed more lights on the geographical and ecological features of the species. The distribution range is from Jeju Island in the west to Kyushu Island, central and southeastern parts of Honshu Island in the east. These records also indicate very rare, scattered distribution of the species. Hashimoto and Hatusima (1991) did not provide ecological information on the type locality of *Neottia kiusiana* except for its occurrence below 100 m above sea level where it is assumed to develop warm-temperate evergreen broad-leaved forest. The habitat in Jeju Island is a similar forest type dominated by *Castanopsis* trees at 300–330 m altitude high (Lee, 2002; T.

Yukawa, unpublished). Ôhara (1967) recorded that the Aichi plant was collected in a forest dominated by *Quercus* spp., *Litsea coreana* H. Lév., *Daphniphyllum macropodum* Miq., and *Aucuba japonica* Thunb. at 500 m altitude high. The collector's notes on the sheet of Chiba material stated that the habitat is a humus-rich forest floor on the northeast slope where the vegetation is composed of *Castanopsis sieboldii* (Makino) Hatus. ex T. Yamaz. et Mashiba, *Quercus glauca* Thunb., *Camellia sasanqua* Thunb., and *Illicium anisatum* L.

Therefore, the vegetation type associated with this species is likely confined to warm-temperate evergreen broad-leaved forest. By contrast, *Neottia nidus-avis*, a closely related species to *N. kiusiana*, inhabits subarctic coniferous forest and cool temperate deciduous broad-leaved forest. The vegetation type is crucial for establishment of *Neottia* species because they represent obligate mycoheterotrophy and at least, *N. nidus-avis* is known to obtain nutrients from *Sebacina* spp., a group of tree ectomycorrhizal fungi, nutritionally dependent on particular tree species (McKendrick *et al.*, 2002; Selosse *et al.*, 2002). In this respect, habitat differentiation between the two species infers a shift of mycorrhizal fungi between them.

Neottia kiusiana is most closely related to *N. inagakii*, but they can separate each other by the following combinations of characters; 1) the lip of *N. kiusiana* is longer and wider than that of *N. inagakii*; 2) the lip of *N. kiusiana* is inversely-trapeziform in outline and 2-lobed, whereas that of *N. inagakii* is oblong in outline and 2- or 3-lobed; 3) the epichile is well-developed and opens flat in *N. kiusiana* but is ill-developed and folded adaxially in *N. inagakii*; 4) the anther of *N. kiusiana* bears a short filament, while that of *N. inagakii* does not have a filament.

Neottia kiusiana T. Hashim. et S. Hatus., Ann. Tsukuba Bot. Gard. (10): 41 (1991). TYPE: JAPAN: Kyushu, Kagoshuma Pref., Satsuma-gun, Tsuruda-cho, Tsuruda, south from Tsuruda Dam, 13 May 1991, *Yutaka Ôhira s. n.* (TNS–holotype).

Neottia hypocastanoptica Y. N. Lee, Fl. Korea, ed. 4: 1167 (2002), **syn**. **nov**. TYPE: KOREA: Jeju Is., Mt. Halla, alt. 300 m, 2001, *Y. Lee, Y. Shin et K. Lee s. n.* (Korean Plant Research Institute–holotype).

Neottia nidus-avis (L.) Rich. var. *mandshurica* auct. non Kom.; Ôhara, Shokubutsu Kenkyû Shûroku **11**: 48 (1967).

Plant terrestrial, achlorophyllous, glossy light brown, 6–21 cm tall. Roots fascicled, ageotropic, facing upward, cylindrical–slightly fusiform, up to 2.7 cm long, 2–2.3 mm in diameter. Stem erect, terete, glabrous, ivory white, 3.5–4 mm in diameter, dark brown when dried. Sheaths 3–5, foliaceous, spathulate, subacute, glabrous, tubular, membranaceous, upper ones much longer than lower ones, up to 25 mm long. Inflorescence terminal, erect, racemous, with 10–28 flowers, 4.6–13 cm long, rachis sparsely glandular hairy. Floral bracts membranaceous, lowermost ones much longer than flowers, gradually diminishing in upper ones of which shorter than ovaries, linear, ovate-lanceolate, obtuse to subacute, 1- to 4-nerved, 3–20 mm long, 1.8–12 mm wide. Flowers brownish ivory, porrect. Pedicel and ovary suberect in flowering, 6–15 mm long, 3–4.5 mm in diameter; pedicel terete, glaborous; ovary clavate-obovoid, glandular hairy, longer than pedicel except for the lowermost. Dorsal sepal oblong-obovate, obtuse, cucullate, 1-nerved, 3.5–4 mm long, 2.2–2.7 mm wide when spread out. Lateral sepals obliquely oblong-obovate, obtuse, strongly cupped, cucullate, 1-nerved, 3.2–4.3 mm long, 2.1–2.4 mm wide when spread out. Petals obliquely obovate-ovate, obtuse, 1-nerved, 3.5–5.2 mm long, 2.2–2.7 mm wide. Lip inversely trapeziform in outline, anteriorly 2-lobed, 5.2–8 mm long, 5.5–7.5 mm wide when spread out; hypochile rectangular-inversely trapeziform, shallowly concave at base, adaxially purple-dotted; epichle 2-lobed, lobes transversely oblique-rectangular, rectangular, or oblong. Column cylindrical-slightly conical, 1.7–3.5 mm long; stigma lamellate, erect in flowering, 2- to 3-lobed, inveresely trapeziform-transversely rectan-

gular in outline; rostellum erect in flowering, oblong-narrowly triangular, obtuse. Anther erect-decumbent in flowering with a short, often insignificant filament.

Japanese name: Tsukushi-sakane-ran.

Flowering period: Mid-May to June.

Distribution: Japan: Honshu (Chiba Pref., Aichi Pref.), Kyushu (Kagoshima Pref.); Korea: Jeju-do, Seogwipo-si.

Habitat: Floor of warm temperate evergreen broad-leaved forest.

Other specimens examined: JAPAN, Honshu: Chiba Pref., Mt. Kiyosumiyama, alt. ca. 430 m [sic], 15 June 1958, D. Shimizu s. n. (TNS 307293); Aichi Pref., Higashikamo-gun, Asahimura, Ikuma, alt. ca. 500 m, June 1966, J. Ôhara s. n. (AICH, TNS 287241); KOREA, Jeju-do: Seogwipo-si, Seon-dol, 19 May 2004, N. S. Lee & C. S. Lee D-241 (Plant Systematics Laboratory of Ewha Womans University); Seogwipo-si, Don-nae-ko (topotype of *N. hypocastanoptica*), 19 May 2004, N. S. Lee & C. S. Lee L-016 (Plant Systematics Laboratory of Ewha Womans University); Seogwipo-si, Seon-dol, alt. 330 m, 25 May 2008, Yukawa 08-9 (TNS 8501018).

Nomenclatural problem of *Archineottia japonica*

Chen (1979) emphasized primitive status of a terminal stigma, an erect stamen with its free filament, and absence of clinadrium and rostellum shared by several *Neottia* species in line with his phylognetic hypothesis of Orchidaceae. He thus segregated these species from *Neottia* and established a new genus *Archineottia*. Subsequently, Furuse and Chen (1988) found a new species exhibiting the above-mentioned characters and named *Archineottia japonica* M. Furuse.

Hashimoto and Hatusima (1991) suspected the independent status of *Archineottia* because a filament, an important diagnostic character of the genus, is also found in several *Neottia* species. Inoue and Ikegami (1997) and Imai and Inoue (1998) adopted this view and proposed a new combination, *Neottia japonica* (M. Furuse) K. Inoue. Molecular phylognetic analyses of tribe Neottieae also confirmed the inclusion of *Archineottia* into *Neottia* (Yukawa and Yagame, unpublished data). Unfortunately, the combination *Neottia japonica* was already used by Szlachetko (1995) for an entity on the basis of a different type, thereby rendering *N. japonica* (M. Furuse) K. Inoue illegitimate as a later homonym. A new name is therefore needed for the latter species when we treat this in the genus *Neottia*.

Neottia furusei T. Yukawa et Yagame, **nom. nov**.

Archineottia japonica M. Furuse in Acta Phytotax. Sin. **26**: 69 (1988). TYPE: JAPAN: Honshu, Nagano Pref., Kami-ina-gun, Hase-mura, Todai, alt. 1200 m, on limestone rocky slope in broad-leaved deciduous forest, 4 September 1977, *Miyoshi Furuse 12452* (PE–holotype).

Holopogon japonicus (M. Furuse) S. C. Chen in Acta Phytotax. Sin. **35**: 180 (1997).

Neottia japonica (M. Furuse) K. Inoue in Acta Phytotax. Geobot. **49**: 199 (1998), non *Neottia japonica* (Blume) Szlach. in Fragm. Florist. Geobot., Suppl. **3**: 117 (1995).

The species epithet refers to the late Mr. Miyoshi Furuse, a prominent plant collector, who discovered and described this species.

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