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New Species - *Lilium procumbens* and its Allies in the Flora of Vietnam

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ABSTRACT: *Lilium procumbens* – a new species discovered at a limestone ridge in northern Vietnam is unique in having a slender procumbent stem. This paper presents a detailed taxonomic account of the species including a description, illustrations, information on the type, ecology, phenology and distribution, affinity with other congeners, and expected conservation status. A key to all the known *Lilium* species from Vietnam and an annotated list of them are also provided.

KEY WORDS: *Lilium*, nature protection, new species, plant diversity, plant taxonomy, Vietnam.

INTRODUCTION

The genus *Lilium* L. consists of approximately 100 to 175 species distributed over the temperate zone of the Northern Hemisphere and mountainous areas of the subtropics and tropics in continental Southeast Asia and Philippines (Mabberley, 2000, Liang and Tamura, 2000, Govaerts, 2011). The number of species of *Lilium* is the largest in eastern Asia, particularly in China. Lilies become uncommon towards the south and only a small number of species occur in the tropics where they are more or less confined to high mountains. So far three native species, *L. brownii*, *L. eupetes* and *L. poilanei*, and three cultivated and occasionally naturalized species, *L. concolor*, *L. lancifolium* and *L. longiflorum*, have been recorded from Vietnam (Gagnepain 1934, Nguyen Thi Do, 2005).

In our field survey in northern Vietnam, we found a very unusual lily not matching any of the known congeners. After a thorough study, we found a new lily species, namely *Lilium procumbens*. Unlike other lilies, the new species has a slender procumbent stem. In this paper, we describe this species with illustrations and provide data on its ecology, phenology, distribution and affinities to other congeners. A key to all the known *Lilium* species from Vietnam, including the new one, and an annotated list of them are also provided.

TAXONOMIC TREATMENT

***Lilium* L.**1753, Sp. Pl. 1: 302; Gagnep., 1934, Fl. Indo-Chine 6, 6: 808–811; Ohwi, 1965, Fl. Japan, Engl. ed.: 296–298; Lee T.B., 1989, Illustr. Fl. Korea: 206-209; Ying S.-S., 2000, Fl. Taiwan 5: 49–52; Ho P.H., 2000, Ill. Fl. Vietnam 3: 480–481, fig. 9618–9622; Liang S.Y., Tamura M.N., 2000, Fl. China 24: 135–149; Nguyen Thi Do, 2005, Checklist Pl. Sp. Vietnam 3: 455.

Lectotype: *L. candidum* L. (N.L. Britton, A. Brown, 1913, Ill. Fl. N. U.S. ed. 2. 1: 502).

115–120 species. Temperate zone of the Northern Hemisphere, subtropical and tropical highlands of mainland SE. Asia and Philippines, with the highest species diversity in continental East Asia. In Vietnam 4 native species, 3 species cultivated and occasionally naturalized.

Key to known *Lilium* species from Vietnam

The name of cultivated species is marked with an asterisk*

1a. Plant epiphytic……..…… 2. *L. eupetes*
1b. Plant terrestrial or lithophytic……..……2
2a. Flowers directed upwards……..…… 5. *L. concolor**
2b. Flowers horizontally spreading or nodding…….……3
3a. Stem slender, less than 6 mm in diam. near base, procumbent, climbing or pendulous; pistil shorter than stamens ……..…… ……..…….. 1. *L. procumbens*
3b. Stem moderately thick or stout, more than 6 mm in diam. near base, erect or suberect; pistil longer than stamens ……..…….. 4
4a. Bulbils formed in distal leaf axils .....…… 7. *L. lancifolium**
4b. Bulbils not formed in leaf axils …… 5
5a. Tepals shorter than 10 cm ……..... 3. *L. poilanei*
5b. Tepals longer than 13 cm ……..……..… 6
6a. Stem ca. 0.7–2 m tall; tepals white, tinged purple externally; nectary glands (on inner side of tepals) papillose; filaments usually puberulous below……..... 4. *L. brownii*
6b. Stem ca. 0.3–1 m tall; tepals white exclusively; nectary glands glabrous; filaments glabrous …….....6. *L. longiflorum**

1. *Lilium procumbens* Aver. & N.Tanaka, ***sp. nov.***

Plant was collected in northern Vietnam (“Cao Bang province, Nguyen Binh district, Ca Thanh municipality, Ta Pin village, around point 22°43'56.4"N, 105°51'16.4"E, primary coniferous forest with *Pseudotsuga sinensis* along highly eroded rocky limestone ridge at elevation about 1400 m a.s.l., terrestrial or lithophytic climbing vine-like unbranched herb with a slender shoot to 2 m long on shady very steep mossy rocky slope, rare, 3 October

臺灣大學學術期刊資料庫



Fig. 1. Scenery of habitats of ***Lilium procumbens***. Photos by L. Averyanov and Khang Sinh Nguyen.

2013, *L. Averyanov, N.T. Hiep, L.M. Tuan, N.S. Khang, T. Maisak, L. Osinovets, CPC 5359a/TM 1035*"). Herbarium type specimen was prepared from cultivated plant in July 2015. Type ("27 July 2015, *L. Averyanov, CPC 5359a/TM 1035*") – LE (Holotype). Figs. 1, 2, 3, 4A.

Herb terrestrial or lithophytic, bulbiferous, perennial. Bulb situated at 8–12 cm below the surface of the ground, subglobose to ovoid, (2)2.5–3(4) cm in diam., without a tunic; scales many, narrowly ovate to broadly lanceolate, white, fleshy, imbricate, (1.5)2–2.5(3) cm long. Aerial stem slender, unbranched, procumbent, pendulous or climbing, 1–1.5(2) m long, 3–5(6) mm in diam., leafy throughout, sparsely papillose in apical third, with whorls of many dense roots and few bulbils at nodes above the bulb; internodes (1.5)2–4(5) cm long. Leaves many, alternate, distant, more or less horizontal (to stem), broadly lanceolate to narrowly ovate, (6)8–16(18) cm long, (1.5)2–2.5(2.8) cm wide, glabrous, abaxially with 3 prominent veins, apex attenuate or acute, base sessile or subsessile, often narrowed into short petiole (1)2–5(6) mm long, 1.5–2 mm wide. Flowers solitary (or 2 to 3 in terminal raceme), campanulate-funnel form, nodding, slightly zygomorphic, white with green tint, rarely with very few sparse purple marks along margin near the base of outer tepals (sepals). Tepals 6, free, spatulate or narrowly obovate, (4.6)4.8–5.2(5.4) cm long, (1.3)1.4–1.5(1.6) cm wide; in adaxial proximal half involute laterally and medial longitudinal narrow part (midrib zone) green, glabrous and nectariferous; in distal half nearly flat and not strongly recurved; the inner 3 (petals) slightly wider than the outer 3 (sepals); medial portion prominently keeled abaxially; the keel rectangular in cross section. Stamens 6; filaments light greenish to almost white, filiform, glabrous, recurved distally, 3.5–4 cm long; anthers narrowly oblong-ellipsoid, slightly arcuate, dorsifixed, rotatable, brown-orange, 6–7 mm long, 2.5–3 mm in diam. Pistil slightly shorter than stamens; ovary erect, straight, narrowly conoid, longitudinally shallowly grooved, 9–10 mm long, 1.5–2(2.5) mm in diam. near base, 3-loculed; ovules many per locule; style slender, gradually slightly broadened towards apex, slightly curved upward, 2.2–2.4 cm long; stigma subcapitate, apically subtruncate, 3-lobed, 4–4.5 mm across, light greenish to white, densely papillose. Fruit a light brownish capsule; seeds numerous, flat, winged around.

Etymology: The specific epithet refers to the procumbent habit of the plant.

Distribution: Endemic to VIETNAM, Cao Bang province (Nguyen Binh district, Ca Thanh municipality). Fig. 4A.

Habitat, phenology and conservation status: Terrestrial or lithophytic, bulbiferous herb with a climbing or procumbent to pendulous slender stem. Primary mixed forests of broad-leaved trees and conifers like *Pseudotsuga sinensis* on karstic rocky limestone, common on very steep rocky slopes and on shelves of shady cliffs near mountain tops. 1300–1500 m a.s.l. Flowers in July in cultivation. This species is rare and is regarded as endangerous (EN) according to IUCN Red List criteria. Fig. 1.

Notes: *Lilium procumbens* is morphologically similar to *L. poilanei* Gagnep. described from northwestern Vietnam and northern Laos and also to *L. primulinum* var. *ochraceum* (Franch.) Stearn known from Guizhou, Sichuan and NW Yunnan in China (Liang and Tamura, 2000). It markedly differs from them in having a more slender, procumbent stem, and smaller, white, stellately campanulate-funnel form flowers with slightly or moderately recurved, narrowly obovate tepals and a pistil shorter than the stamens. In natural habitats, the new

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Fig. 2. ***Lilium procumbens*** sp. nov. Digital epitype, L. Averyanov *CPC 5359a/TM 1035*. Photos, correction and design by L. Averyanov.

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Fig. 3. ***Lilium procumbens***. **A**: Bulbils developing at the nodes of aerial stem above the bulb, **B**: Apical part of stem with bulbils; **C, D**: individual bulbils in the leaf axills at the end of vegetative period (L. Averyanov *CPC 5359a/TM 1035*). Photos, correction and design by L. Averyanov.

species grows on very steep rocky slopes and on shelves of vertical cliffs of limestone near mountain tops. The slender stem was climbing among dense shrubs or procumbent or drooping among mossy cliffy rocks. The slender, procumbent habit of the stem is stably retained in cultivation. Sterile stems to the end of vegetative period commonly form persistent bulbils in axils of apical leaves (Fig. 2).

2. ***Lilium eupetes*** J.M.H. Shaw, 2008, Plantsman n.s., 7: 39.

Described from NW. Vietnam ("Làо Cai province"). Type ("22 Nov. 2006. *B & S Wynn-Jones 11721*") – WSY (Holotype) [WSY0101055]. Fig. 4B.

Distribution: Endemic to VIETNAM, Lao Cai province (Hoang Lien Son Range).

Habitat, phenology and conservation status: Bulbiferous epiphytic herb with an erect stem occurring in mosses on vertical trunks and horizontal branches of large forest trees well above the ground at altitudes of 1900–2000 m. Primary montane forests of broad-leaved trees on granite. Flowers in October in cultivation. This is very rare and is regarded as endangerous according to IUCN Red List criteria.

Notes: A fairly unique species for its epiphytic habit and axillary bulbils which are buoyed on air currents by the dead leaf serving as a wing (Shaw, 2008). This rare species is known until now only by type collection.

3. ***Lilium poilanei*** Gagnep., 1934, Fl. Indo-Chine 6: 810, fig. 80, 1; Synge P.M., 1980, Lilies: 152; Ho P.H., 2000, Ill. Fl. Vietnam 3: 480, fig. 9620; Nguyen Thi Do, 2005, Checklist Pl. Sp. Vietnam 3: 455.

Described from northern Laos and northwestern Vietnam ("TONKIN: kilom. 8, au col de Lo-qui-ho, près Chapa (*Poilane*). – LAOS: entre Muong-het et M. Seng (*Poilane*)"). Syntypes ("Laos, entre Muong-het et M. Seng, 1400 m alt., 12-9-1929, *Poilane 16929*" [P-P00730969] and "Tonkin, Lo qui Ho près Chapa, 1400 m alt., 4-8-1926, *Poilane 12811*" [P00730970; P-P00730971]) – P. Fig. 4C.

Distribution: **VIETNAM**: Cao Bang province (Bao Lac district, Ca Thanh municipality); Ha Giang province (Dong Van district, Sinh Lung municipality; Meo Vac district, Shung Cha municipality; Quan Ba district, Can Ty municipality; Yen Minh district, Lao Va Chai municipality); Lai Chau province (Sin Ho district, Xa De Phin municipality); Lao Cai province (Sa Pa town); Son La province (Moc Chau district, Van Ho municipality). **LAOS**: Houaphanh, Oudomxai, Louangphabang and Luang Namtha? Fig. 4C.

Habitat, phenology and conservation status: Terrestrial or lithophytic, bulbiferous herb with an erect stout stem to 2 m tall. Primary or secondary mossy mixed forests of broad-leaved trees and conifers (like *Pinus wangii*, *Podocarpus pilgeri*, *Pseudotsuga sinensis* and *Tsuga chinensis*) on karstic rocky

臺灣大學學術期刊資料庫

limestone, common on very steep rocky slopes and on shelves of shady cliffs near mountain tops, 1200–1600 m a.s.l. Flowers in June–August under cultivation. This species is rare and is regarded as endangerous according to IUCN Red List criteria.

Notes: *Lilium poilanei* is a rare, integral element of highly endangered coniferous forests on limestone. It is very sensitive for forest logging and highly endangered by the quick loss of its habitats. Besides, the bulbs of this plant have often been collected from natural habitats for exports to China where they are medicinally used. These factors are plunging the species into the verge of extinction. Photographs of this rare species are available at the web-site "The Genus *Lilium*'- http://www.the-genus-lilium.com /images/Lilium/poilanei06.jpg – 09.jpg (Hohenegger, 2011).

This species was once collected at "entre Muong-het et M. Seng" (syntype) in Laos. This habitat is presently not precisely located, but may be in Houaphanh, Oudomxai, Louangphabang or Luang Namtha province. It was casually overlooked in the latest treatise of the Laotian flora by Newman *et al.* (2007).

Studied specimens: **VIETNAM**: Lao Cai province – Chapa, 1600 m a.s.l., July, 1925, *Pételot sine no* (P); Chapa, 1500 m a.s.l., July, 1930, *Pételot 3738* (P); Chapa, 17 May 1961, sine coll. *no 2283* (LE); Cao Bang province, Nguyen Binh district, Ca Thanh municipality, about 3 km to SW from Yen Lac village (22°44'N 105°50'E), about 42 km to NW from Cao Bang town, 1400–1450 m a.s.l., 18 November 1998, *Averyanov L., P.K. Loc, N.X. Tam, CBL 383* (HN, LE, MO, P); Ha Giang province – Yen Minh district, Lao Va Chai municipality, vicinities of Ngan Chai village, 6 km to W of Yen Minh town (23°07'N 105°08'E), 1500–1600 m a.s.l., 1 May 1999, *P.K. Loc, P.H. Hoang, Averyanov L., CBL 1961* (HN, MO); Meo Vac district, Shung Cha municipality, Lo Loi Phin village (23°11'N 105°17'E), 1200–1250 m a.s.l., 5 October 1999, *N.T. Hiep, N.Q. Binh, L. Averyanov, P. Cribb, NTH 3332* (HM); Quan Ba district, Can Ty municipality, in the vicinity of Lung Vai village at left side of Mien River, 23°05'09"N 105°03'23"E, 1440 m a.s.l., 8 May 2002, *P.K. Loc, L. Averyanov, N.T. Vinh, HAL 1438* (HN); Dong Van district, Sinh Lung municipality, vicinities of Ha De village around point 23°12'23"N 105°17'18"E, 1450 m a.s.l., 15 December 2005, *L. Averyanov, T.V. Thao, P.V. The, HAL 8617* (HN); Lai Chau province – Sin Ho district, Xa De Phin municipality, Mao Xa Phin village, 22°18'49"N 103°15'18"E, 1828 m a.s.l., 8 June 2006, *P.K. Loc, N.T. Vinh, N.S. Khang, P.N. Quan, T.A. Suu, HAL 8738* (HN, MO); Son La province – Moc Chau district, Van Ho municipality, Hua Tat village, 20°46'16"N 104°47'44"E, 1200–1350 m a.s.l., 29 October 2006, *N.T. Hiep, L. Averyanov, P.V. The, HAL 9363* (LE).

4. *Lilium brownii* F.E. Brown ex Miellez, 1841, Cat. Expos. Soc. Hort. Lille; id., 1845, Ann. Soc. Roy. Agr. et Bot. Gard. (1845), pl. 41; Elwes, 1880, Monogr. Lilium, pl. 19; Wilson E.H., 1925, Lilies East. Asia: 28; Synge, P.M., 1980, Lilies: 61; Gagnep., 1934, Fl. Indo-Chine 6, 6: 808; Liang S.Y., Tamura M.N., 2000, Fl. China 24: 146; Ho P.H., 2000, Ill. Fl. Vietnam 3: 480, fig. 9619; Nguyen Thi Do, 2005, Checklist Pl. Sp. Vietnam 3: 455.

Described from China ("… plant was introduced to Europe from China, as long ago as 1804, by Capt. Kirkpatrick of the East-India Company's service …"). Type – location unknown. Fig. 4D.

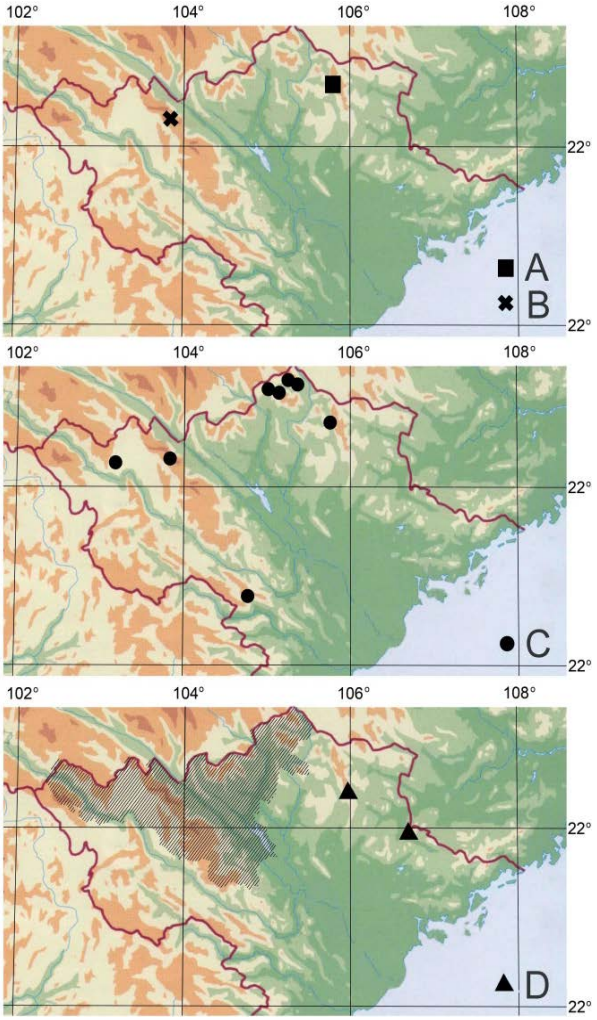


Fig. 4. The distribution of wild *Lilium* species in northern Vietnam. **A**: ***L. procumbens*** (square dot). **B**: ***L. eupetes*** (cross dot). **C**: ***L. poilanei.*** (round dots). **D**: ***L. brownii*** (triandular dots). Black marks designate localities verified by herbarium specimens, the shaded portion designates the area of ***L. brownii*** distribution reported without a citation of herbarium material.

Distribution: VIETNAM: Bac Kan (Ngan Son district, Ngan Son town); Ha Giang?; Kon Tum (Ngoc Linh mountains); Lai Chau?; Lao Cai?; Lang Son (Cao Loc district, Dong Dang town), Yen Bai. MYANMAR. CHINA (Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Shanxi, Sichuan, Yunnan, Zhejiang)., KOREA. Fig. 4D.

Habitat, phenology and conservation status: Terrestrial bulbiferous herb with an erect stout stem to 1.5 m tall. Secondary thickets or scrub, wet grasslands on alluvial hill slopes along ravines or streams usually in lime-soil areas. 800–900(1000) m a.s.l. Flowers in May–June. This species is rare and is regarded as vulnerable according to IUCN Red List criteria.

Notes: Records of *Lilium brownii* from Lai Chau, Lao Cai (Sa Pa), Yen Bai and Ha Giang provinces without a citation of voucher specimens (Ho, 2000;

臺灣大學學術期刊資料庫

Nguyen Thi Do, 2005,) remain questionable. Gagnepain (1934) cited specimens from "Tonkin: Dong-dang, sur les collines" (*Balansa*), and "vers Langson et Long-tcheou [Longzhou]" (*Simond*). These habitats are located in Lang Son province in Vietnam bordering on China. Unfortunately, we have been unable to locate the specimens. Furthermore, data on the occurrence of this species in Myanmar and Korea is provided by a database e-Monocot (http://e-monocot.org/taxon/urn:kew.org:wcs:taxon: 280724, accessed on 13 August 2015). However, we have not seen any materials of this species from these countries.

In Vietnam and China, the bulbs of *L. brownii* are exploited for eating and medicinal purpose. The plant is now becoming rare due to overcollecting. The rapid degradation of its habitat is also endangering it.

Studied specimens: **VIETNAM**: Lang Son province – Cao Loc district, Dong Dang town, May 1908, *d'Alleizette, sine no* (P); Bac Kan province, Gio Pass on car road from Hanoi to Cao Bang city near Ngan Son town, 800–900 m a.s.l., 28 May 1997, *L. Averyanov, N.T. Hiep, VH 4995* (HN, LE); Kon Tum province – Ngoc Linh mountains, 1 December 2015, *Vo Van Cong, L. Averyanov, T. Maisak, AL 133* (LE).

5. *Lilium concolor* Salisb.*, 1806, Parad. Lond. t. 47; Wilson E.H., 1925, Lilies East. Asia: 56; Ohwi J., 1965, Fl. Japan, Engl. ed.: 297; Synge P.M., 1980, Lilies: 66; Lee T.B. 1989, Illustr. Fl. Korea: 207; Liang S.Y., Tamura M.N., 2000, Fl. China 24: 139; Ho P.H., 2000, Ill. Fl. Vietnam 3: 481, fig. 9622; Nguyen Thi Do, 2005, Checklist Pl. Sp. Vietnam 3: 455.

The origin of authentic specimens is unknown ("… no other collection yet than the Right Honbie Charles Greville's, who does not know from whence he received it."). **Type** not located (BM?).

Distribution: VIETNAM (occasionally cultivated as an ornamental plant in northeastern provinces). RUSSIA (Far East, Eastern Siberia). MONGOLIA. CHINA, (Hebei, Heilongjiang, Henan, Hubei, Jilin, Liaoning, Shaanxi, Shandong, Shanxi, Yunnan), KOREA, JAPAN.

Habitat and phenology: In the native area it grows in open humid forests, scrub, or moist meadows. 300–2200 m a.s.l. Flowers in May–July.

6. *Lilium longiflorum* Thunb.*, 1794, Trans. Linn. Soc. London 2: 333; Wilson E.H., 1925, Lilies East. Asia: 23; Ohwi J., 1965, Fl. Japan, Engl. ed.: 298; Synge P.M., 1980, Lilies: 96; Lee T.B., 1989, Illustr. Fl. Korea: 209; Ying S.-S., 2000, Fl. Taiwan 5: 52; Liang S.Y., Tamura, M.N., 2000, Fl. China 24: 148; Ho P.H., 2000, Ill. Fl. Vietnam 3: 480, fig. 9618; Nguyen Thi Do, 2005, Checklist Pl. Sp. Vietnam 3: 455. – *L. candidum* auct. non L.: Thunb., 1784, Fl. Japonica: 133.

Described from southwestern Japan ("Crescit in Nagasaki, Miaco, alibi"). Type – UPS-THUNB 8140 [V-008140].

Distribution: VIETNAM (widely cultivated throughout the country, particularly in Central Highlands). JAPAN. TAIWAN.

Habitat and phenology: In the native area it grows in open scrub, or moist meadows. 0–500 m a.s.l. Flowers in May–July.

7. *Lilium lancifolium* Thunb.*, 1794, Trans. Linn. Soc. London 2: 333; Ohwi J., 1965, Fl. Japan, Engl. ed.: 297; Ho P.H., 2000, Ill. Fl. Vietnam 3: 480, fig. 9621; Nguyen Thi Do, 2005, Checklist Pl. Sp. Vietnam 3: 455. – *L. tigrinum* Ker Gawl. 1809, Bot. Mag. 31: t. 1237; Synge P.M., 1980, Lilies: 135; Lee T.B., 1989, Illustr. Fl. Korea: 209; Liang S.Y., Tamura M.N., 2000, Fl. China 24: 146. – *L. bulbiferum* auct. non L.: Thunb., 1784, Fl. Japonica: 134.

Described from Japan with no locality. Type - UPS-THUNB 8139 [V-008139].

Distribution: VIETNAM (occasionally cultivated as an ornamental plant in northeastern provinces). CHINA (Anhui, Gansu, Guangxi, Hebei, Henan, Hubei, Hunan, Jiangsu, Jiangxi, Jilin, Qinghai, Shaanxi, Shandong, Shanxi, Sichuan, Xizang, Zhejiang). KOREA. JAPAN.

Habitat and phenology: In the native area, it grows in open scrub, or moist meadows. 400–2500 m a.s.l. Flowers in July–August.

Notes: In China the plant is widely cultivated for eating and medicinal use of its bulbs.

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