A new record of a Plantaginaceae alien plant in the Republic of Korea: Chaenorhinum minus

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ABSTRACT: Chaenorhinum minus (L.) Lange of the family Plantaginaceae was discovered in Dangjin-si, Chungcheongnam-do, Republic of Korea. This species is an invasive alien plant that originated in Europe and North Africa and that was introduced into North America and East Asia. The genus Chaenorhinum (DC.) Rchb., to which this species belongs, is most similar to Nuttallanthus D. A. Sutton among related genera of the tribe Antirrhineae distributed in the Republic of Korea. While the two genera share common morphological features in the leaf and flower, Chaenorhinum is distinguished from Nuttallanthus by glandular hairs on the plant; monomorphic, fertile, and erect stems; 9.6–14.1 mm long pedicels; corolla as short as 5.6–7.9 mm; white corolla lower lips; and widely ovoid or oblong seeds. This study presents morphological descriptions and a genus key for the tribe Antirrhineae of the Republic of Korea for the identification of C. minus together with distribution information, voucher specimens, and photographs of this species.

KEYWORDS: alien plant, Chaenorhinum, Chaenorhinum minus, Plantaginaceae, unrecorded

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INTRODUCTION

Previously, Plantaginaceae only included the genus Plantago L. (Huisinga and Ayers, 1999). However, recent molecular phylogenetic studies have resulted in the inclusion of several genera from the Scrophulariaceae, such as Antirrhinum L., Digitalis L., and Linaria Mill., as well as the genera of Haloragaceae and Callirichaeae in the Plantaginaceae (Albach et al., 2005; The Angiosperm Phylogeny Group, 2009; Güemes et al., 2016; Yousefi et al., 2016; Kim et al., 2021); thus, Plantaginaceae currently contains 94 genera of 12 tribes, with approximately 1900 taxa (Albach et al., 2005; Xu and Chang, 2017).

Chaenorhinum (DC.) Rchb. belongs to the tribe Antirrhineae, which is known as one of the groups for its taxonomical stability (Albach et al., 2005; Yousefi et al., 2016). Chaenorhinum was initially recorded as a section of Linaria (Candolle, 1815), but it has since been recognized as a distinct genus of the tribe Antirrhineae (Reichenbach, 1828; Lange, 1870; Davis, 1978a; 1978b; Yildirim et al., 2010; Zare et al., 2018). There are approximately 25 species in the Chaenorhinum, which are native to Europe, North Africa, and Southwest Asia, but which have also been introduced into North America and East Asia (Arnold 1991; Güemes et al., 2016; Zare et al., 2018). Among them, Chaenorhinum minus (L.) Lange, due to its short fruiting period and rapid colonization through the spread of seeds along railroads, is known as an invasive alien plant (Arnold 1991; Güemes et al., 2016; Zare et al., 2018; GBIF, 2024). There has been no report of Chaenorhinum plants in the Republic of Korea, while there are five related genera in the same tribe, Antirrhinum, Cymbalaria Hill, Kickxia Dumort., Linaria, and Nuttallanthus D.A. Sutton (Kim et al., 2021; Korea National Arboretum 2024a, 2024b).

The goal of this study is to report an unrecorded alien plant, C. minus, which was identified in Dangjin-si, Chungcheongnam-do, Republic of Korea (Fig. 1). We present photographs and distribution information of C. minus, along with a morphological description. A taxonomic key of the tribe Antirrhineae in Korea is also presented. The results are expected to serve as foundational data for the identification of species in
the tribe Antirrhineae, as well as for establishing plans for researching and managing alien plants in the Republic of Korea.

MATERIALS AND METHODS

To accurately identify C. minus and provide morphological descriptions and a taxonomic key, we observed herbarium specimens by referring to related studies in the literature (Fernandes, 1971, 1972; Davis, 1978a, 1978b; Kuprianova, 1997; Rodríguez et al., 1997; Yıldırım et al., 2010; Güemes et al., 2016; Zare et al., 2018; Kim et al., 2021; Rink, 2023; POWO, 2024). The external morphological characteristics of this species were observed using live and dried specimens collected from Dangjin-si. Their features were measured using an electronic Vernier caliper (Mitutoyo 500-196-30 absolute digital Vernier caliper, Kawasaki, Japan), and the micro features (such as plant hairs and seed surfaces) were observed using a stereoscopic microscope (Leica MZ7.5, CLS 150 X Microscope Cold Light Source, Wetzlar, Germany). Thereafter, the materials were deposited as voucher specimens in the herbarium of the Korea National Arboretum Herbarium (KH) (Fig. 2). Photographs of the habitats and morphological features were acquired using a digital camera (Nikon D810, Nikon 105 mm AF Micro-Nikkor, Tokyo, Japan) to create a plate. For a micromorphological observation, specimens were attached to a microscope slide and coated with Au in a sputtering coater (Sputter Coater 108auto, Cressington Scientific Instruments, Watford, UK) for approximately 30 s, after which they were imaged with a scanning electron microscope (SEM; MIRA3 FE-SEMs, Tescan Korea, Seoul, Korea).

RESULTS AND DISCUSSION

*Chaenorhinum* (DC.) Rehb., *Consp. Regn. Veg.* 123, 1828

![Fig. 1. Location of the record of *Chaenorhinum minus* (L.) Lange. A. Map of the collection site (black dot). B. Satellite photograph of the collection site (yellow line, discovered site).](image)

Korean name: Ja-gal-pul-sok.

Herbs annual or perennial. Stems erect, simple or branched, glandular hairs, sometimes glabrous. Leaves opposite at lower, alternate at upper, sessile, linear or ob lanceolate, margin entire. Inflorescences axillary or solitary. Flowers bisexual, zygomorphic; calyx 2–5-lobed; corolla bilabiate, spurred; upper lip 2-lobed, lower lips 3-lobed; stamen 4, didynamous;

![Fig. 2. Voucher specimen of *Chaenorhinum minus* (L.) Lange (KH).](image)
Capsules ovoid to subglobose, poricidal dehiscence. Seeds 40–60, ovoid to truncate-conical, brown to blackish brown, ribbed longitudinally.

**Distribution:** Europe, North America, North Africa, Southwest Asia, East Asia (Russia, China, Japan, Republic of Korea).

*Chaenorhinum minus* (L.) Lange, Prodr. Fl. Hispan. 2: 577, 1870 (Figs. 2–4).


**Korean name:** Ja-gal-pul.

**English name:** Dwarf snapdragon.

*Herbs* annual, 17.9–24.5 cm tall. *Stems* monomorphic, fertile, erect, simple or branched, yellowish green or purplish brown at base, glandular hair. *Leaves* opposite at lower, alternate at upper, sessile, 1–2.3 cm × 1.3–4 mm, linear, oblanceolate, spatulate, apex acute or obtuse, margin entire, base attenuate, green, glandular hair, slightly recurved. *Inflorescence* axillary; pedicel 9.6–14.1 mm long, yellowish green, glandular hair. *Flowers* bisexual, zygomorphic; calyx 5-lobed, 1.7–3.3 × 0.3–0.7 mm, linear or oblong, apex acute or obtuse, margin entire, yellowish green, glandular hair; corolla bilabiate, spurred, 5.6–7.9 mm long including spur; tube tubular, 2–4.5 mm diam., whitish purple to purple, glabrous on inside, hair on outside; upper lip 2-lobed, 1.5–2.6 mm long, pale purple to purple at adaxial surface, glabrous on inside, hair on outside; lower lip 3-lobed, 1–2 mm long, white, slightly hairs on palate, glabrous on inside, hair on outside; spur 1.2–1.6 mm long, conical, pale purple to purple; stamens 4, didynamous; filament linear, longer filament 2.5–4.3 mm long, shorter filament 1.3–2.7 mm long; anther 0.6–0.8 mm long, ellipsoid, purple, dorsifixed; pistil 1, ovary 1.4–1.6 mm long, ellipsoid, purple, glandular hair; style 2.5–2.7 mm long, filiform, glandular hair at base, persistent. Capsules 4.8–5.5 × 3.3–4.4 mm, ovoid, yellowish green or reddish brown, glandular hair, poricidal dehiscence. Seeds 0.7–1 × 0.5–0.7 mm, widely ovoid or oblong, brown to blackish brown, ribbed longitudinally, tuberculate between ribs.

**Flowering and fruiting:** May to October.

**Origin:** Europe, North Africa.

**Distribution:** Europe (Fernandes, 1971, 1972), North Africa (Davis, 1978a, 1978b; Benediti and Güemes, 2009), North America (Arnold 1991; Güemes et al., 2016), East Asia (Russia, China, Japan, Republic of Korea) (Craig and Richard, 2019; Kim et al., 2019; POWO, 2024).

**Distribution in the Republic of Korea:** Chungcheongnam-do (Dangjin-si).

**Specimens examined:** Chungcheongnam-do, Dangjin-si, Songsan-myeon, Gagok-ri, 28 Jun 2021, J.S. Kim KJS0844 (KH); same locality, 10 Oct 2021, J. S. Kim KJS1004, KJS1005 (KH); same locality, 16 Oct 2021, KJS1327 (KH); same locality, 16 Jun 2023, E. S. Kang and Y. K. Joung Gagokri-230616-009, Gagokri-230616-010, Gagokri-230616-011 (KH).

**Taxonomic note:** The genus *Chaenorhinum*, to which *C. minus* belongs, has a morphology similar to that of *Nuttallanthus* among related genera in the Republic of Korea. The common features of the two genera include linear or oblong leaves, an axillary five-lobed calyx, pale purple corolla, and white lower lip palates (Ji et al., 2012; Conn and Murray, 2015). However, this genus differs from *Nuttallanthus* as it has glandular hairs on the plant (Figs. 3D, 4A, B); monomorphic, fertile, and erect stems; long inflorescences of 9.6–14.1 mm; a short corolla of 5.6–7.9 mm; a white base of the corolla lower lips; and widely ovoid or oblong seeds, making them easily distinguishable (Fig. 3C–G, K).

![Fig. 4. Scanning electron microscope photographs of *Chaenorhinum minus* (L.) Lange. A. Calyx. B. Calyx lobe margin glandular hair. C. Seed. D. Seed surface.](image-url)
Chaenorhinum minus is known to thrive in sunny, dry soils and to be primarily found on rocks, railroads, cultivated fields, and sandy and gravelly areas (Fernandes, 1972; Beckett, 2000; Benedí and Güemes, 2009; Starichenko and Darman, 2017). The Chaenorhinum minus discovered in Dangjin-si, was also found growing in a gravel-covered vacant lot near a port (Figs. 1, 3A). Referring to such growth characteristics, the assigned name of this species in Korea is 'Ja-gal-pul.'

In 2021, approximately 40 individuals of C. minus were discovered for the first time in Dangjin-si. However, by 2023, the number had increased to approximately 100 individuals, suggesting gradual growth of the population of this species. Currently, C. minus occupied an area of around 12,000 m² at the habitat, and in the area, there was an abundance of alien plants or cultivated plants compared to native plants. Native plants consisted of a total of nine taxa, including Albizia julibrissin Durazz., Artemisia indica Willd., Astr hispidus Thunb., Bromus japonicus Thunb., Calamagrostis epigejos (L.) Roth, Lactuca indica L., Miscanthus sinensis Andersson var. parparascens (Andersson) Matsum., Rosa luciae Franch. & Rochebr. ex Crép., and Vicia cracca L., whereas alien or cultivated plants consisted of a total of 16 taxa, including Chloris virgata Sw., Cirsium vulgare (Savi) Ten., Coreopsis lanceolata L., C. tinctoria Nutt., Erigeron annuus (L.) Desf., Lepidium virginicum L., Medicago lupulina L., M. polymorpha L., Mellilotus suaveolens Ledeb., Oenothera biennis L., Papaver rhoas L., Symphyotrichum pilosum (Willd.) G. L. Nesom, Tamarix chinensis Lour., Trifolium pratense L., T. repens L., Veronica persica Poir.

Chaenorhinum minus, originating from Europe and North Africa, has been introduced into North America and East Asia (Widrlechner, 1983; Arnold 1991; Güemes et al., 2016; Zare et al., 2018; POWO, 2024). In the United States, there was a case speculated to have spread along railroads after its initial introduction by a ship (Widrlechner, 1983). Considering the surrounding environment, it is postulated, based on this case and other reports on the invasion of alien plants in the Republic of Korea, that C. minus was intentionally introduced to Dangjin-si by transportation vehicles and materials traveling to and from the aforementioned port during road construction in the vacant lot (Kang et al., 2022).

Chaenorhinum minus have been introduced not only into Dangjin-si, but also into the Baekdusan Mountain (China) (Kim et al., 2019). While currently found only in Dangjin-si in the Republic of Korea, it could spread to environments similar to its habitat and other areas via human activities. This possibility is supported by the previously mentioned case in the United States, the environmental conditions of its habitat, and the observed increase in the number of plants in the Republic of Korea.

Key for identification of genera of the tribe Antirrhineae in the Republic of Korea
1. Stem prostrate.
2. Plant usually pubescent, rooting at node; leaf hastate or sagittate \( ...... \) Kickxia Dumort. 해란초아재비속
2. Plant usually glabrous, not rooting at node; leaf reniform or orbicular \( ...... \) Cymbalaria Hill 덩굴해란초속
1. Stem erect.
3. Corolla tube base saccate \( ...... \) Antirrhinum L. 긴어초속
3. Corolla tube base obconic.
4. Corolla upper lip white; lower lip palate orange \( ...... \) Linaria Mill. 해란초속
4. Corolla upper lip pale purple to purple; lower lip palate white.
5. Plant glabrous; stems heteromorphic, sterile prostrate or decumbent, fertile erect; inflorescence pedicel 2–8 mm long; corolla 8–13 mm long, limb lower lips pale blue to pale purple; seed triangular or subglobose \( ....... \) Nattallanthus D. A. Sutton 손잎해란초속
5. Plant with glandular hair; stems monomorphic, fertile erect; inflorescence pedicel 9.6–14.1 mm long; corolla 5.6–7.9 mm long, limb lower lips white; seed widely ovoid or oblong \( ....... \) Chaenorhinum (DC.) Reichb. 자갈풀속

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CONFLICTS OF INTEREST
The authors declare that there are no conflicts of interest.

LITERATURE CITED


