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Original Research Article

New Report of *Vicia grandiflora* Scop. in Korea

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Abstract - We have discovered *Vicia grandiflora* Scop., a newly invasive alien species in Baekun-ri, Okcheon-gun, Chungcheongbuk-do, Korea. This species is native to regions from Central and Southeast Europe to Central Asia and Iran and is reported as an invasive species in North America and Japan. This species is similar to the *Vicia sativa* complex (*V. sativa* subsp. *sativa*, *V. sativa* subsp. *nigra*) but can be readily distinguished by the undivided ovate to semi-hastate stipules of the upper leaves, yellowish petals, large size of its flower, and elongated hilum. In the field, *V. grandiflora* grows in disturbed sites near cultivated land, suggesting that their seeds are typically transported by vehicles along with fertilizer or livestock feed. Here, we present the morphological description, photographs, and sites of *V. grandiflora* growth, which will be useful in guiding the management of this invasive alien plant.

Key words – Fabaceae, Invasive alien plant, Large yellow vetch, Unrecorded species

Introduction

The genus *Vicia* L. belongs to the Fabaceae (Leguminosae) family, with approximately 150-210 species distributed across Europe, Asia, and North America, most of which are found in the Mediterranean (Al-Joboury, 2017; Cacan *et al.*, 2016). Traditionally, species in the genus *Vicia* are economically important as medicine, food, feed, ground cover, and ornamental plants (Hanelt and Mettin, 1989).

The genus *Vicia* is distinguished from the related genera *Pisum* L., *Lens* Mill., and *Lathyrus* L. in the tribe *Vicieae* DC. by style shape and style pubescence (Choi *et al.*, 2006; Endo and Ohashi, 1995; Kupicha, 1976). Furthermore, the genus *Vicia* is divided into two subgenera, subgenus *Vicia* (17 sections) and subgenus *Cracca* (Dumort.) Peterm. [= *Vicilla* (Schur) Rouy, 5 sections], based on the presence of stipule nectaries, relative peduncle length subtending leaves, and the number of flowers per inflorescence (Kupicha, 1976; Leht, 2009). In Korea, 17-25 species of *Vicia* have been recognized, and among them, *Vicia sepium* L., *Vicia villosa* Roth. and *Vicia dasycarpa* Ten. are reported as naturalized species (Choi, 2018; Korea National Arboretum, 2021a; 2021b).

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Vicia grandiflora Scop., commonly known as large yellow vetch, is an annual herb that is distributed from Central and Southern Europe to Central Asia and Iran (Ball, 1968; Rhodes, 2016). This plant was introduced into North America, probably as a forage material for grazing animals. It has spread throughout the southeast and is found in disturbed habitats in North America (Native Plant Trust, 2021). It has also been reported as a naturalized plant in Japan (Mito, 2004; Okuyama, 1963). Recently, this species has been found in Baekun-ri, Okcheon-gun, Chungcheongbuk-do, Korea (Fig. 1), and it has not been reported previously. In this study, we provide information about its habitat and distribution in Korea, a description of the morphological characteristics, and photographs to help manage this potentially invasive alien plant.

Materials and Methods

Morphological observations of the new alien species were conducted using living plants and herbarium specimens in 2021. Field photographs were captured using a Nikon Coolpix P510 camera (Tokyo, Japan). Morphological characteristics were measured using a Mitutoyo 500-196-30 Absolute Digimatic Vernier caliper (Kanagawa, Japan), and the data were derived from field notes. The examined material was deposited

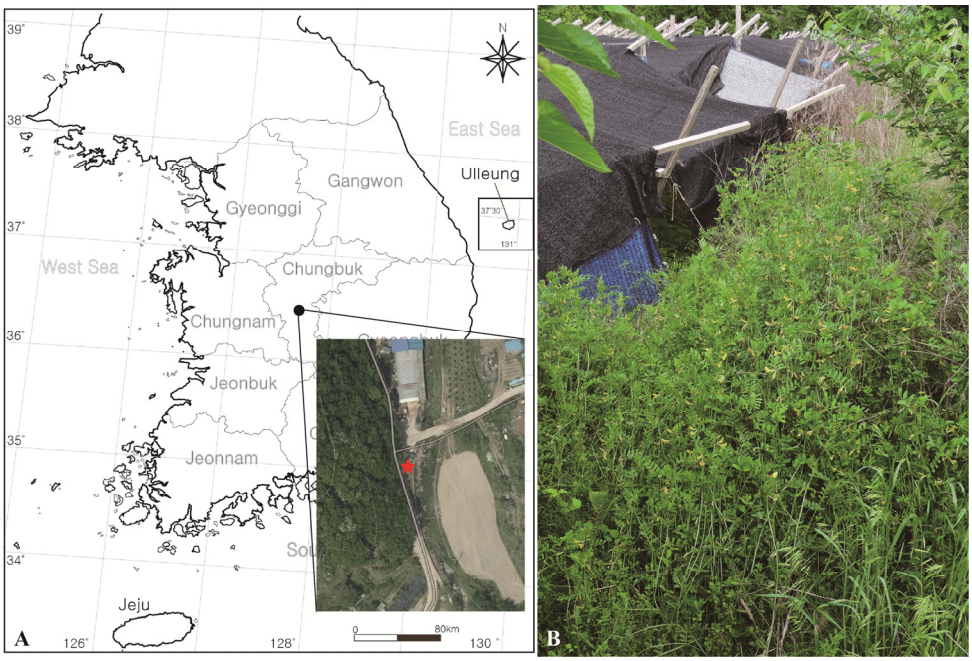

Fig. 1. Location of the first record of *Vicia grandiflora* Scop. **A.** Collection site (Baekun-ri, Okcheon-gun, Chungcheongbuk-do). **B.** Habitat.

in the Korea National Arboretum (KH). To construct a key for the identification of the genus *Vicia* in Korea, reference was made to Choi (2018) and Ohwi (1965).

Results

Taxonomic Treatment

Vicia grandiflora Scop., Fl. Carniol., ed. 2. 2:65, 1772. - TYPE: [Yugoslavia] Carniolia, Tergestus, *D. D. Krapf.*

Cujunia grandiflora (Scop.) Alef., Bonplandia 9: 101, 1861

Korean name: Keun-no-rang-kkot-gal-kwi (큰노랑꽃갈퀴)

Annual herb, 30-60 ㎝ in height. **Stem** ascending or climbing, pubescent or subglabrous. **Stipule** ovate to semi-hastate, tapering, entire or few-toothed at base, with an abaxial nectary, 3-5 ㎜ long. **Leaves** even-pinnate, terminal leaflet replaced by a branched tendril; leaflets 3-7 pairs, obovate to oblong or even linear, 10-30 × 4-10 ㎜, apex retuse to obtuse, entire, both surfaces glabrescent. **Inflorescence** axillary, reduced raceme, 1-3 flowers; peduncle very short. **Flowers** cream or yellow, 23-32 ㎜ long; pedicels much shorter than calyx; calyx tubular, slightly tapering, light green, 10-15 ㎜ long; lobes 5, subequal, lanceolate to subulate, shorter than tube, abaxial surface densely pubescent; standard petals stenonychioid, apex emarginate, yellow sometimes violet-tinged, abaxial surface glabrous; wing petals much shorter than standard but longer than keel; keel petal obtuse at apex, black at tip; stamens 10, diadelphous (9 + 1); pistil linear, style dorsiventrally compressed, bearded abaxially below stigma. **Legumes** broadly linear, compressed, glabrous or sparingly pubescent, apex acuminate, black, 3.5-5 ㎝ long. **Seed** reniform, glabrous, brown, 4-6 ㎜ wide; hilum 2/3-3/4 of seed circumference.

Phenology: April to June.

Habitat and ecology: *Vicia grandiflora* occurs in shrubby areas, fields, herbaceous glades, rarely in forests, mountains up to 1,800 m and in other disturbed sites (Fedchenko, 1972; Maxted, 1995). In Korea, based on field observations, this species was found in disturbed sites near cultivated land along with *Galium spurium* L. and *Bothriospermum tenellum* (Hornem.) Fisch. & C.A.Mey., *Stellaria media* (L.) Vill., *Calystegia pubescens* Lindl., *Rubia cordifolia* L., *Bromus japonicus* Thunb., *Morus alba* L, *Amorpha fruticosa* L., and *Humulus scandens* (Lour.) Merr..

Specimens examined: Korea. Chungcheongbuk-do: Okcheon-gun, Baekun-ri, 28 May 2021, *K. H. Lee and D. H. Kim*

210528-1, 210528-2, 210528-3 (KH)

Taxonomic note: *Vicia grandiflora* shows morphological similarities with *Vicia sativa* complex (*V. sativa* subsp. *sativa*, *V. sativa* subsp. *nigra*) in being annual and having leaves with a branched tendril at apex and stipules with nectariferous spot on the abaxial side. Despite these similarities, there are clear differences between these two species as *V. grandiflora* has undivided ovate to semi-hastate stipules of the upper leaves, yellowish petals, large size of flower, and elongated hilum (Fig 2; Table 1).

Key to the species of *Vicia* in Korea

1. Stipules with nectariferous spot on abaxial surface; flowers solitary or in reduced racemes; style bearded abaxially below stigma (Subgenus *Vicia*).
 2. Annual herbs; calyx teeth subequal.
  3. Stipule of the upper leaves semi-hastate to sagittate, bifid; petals reddish purple; flowers about 1.5 ㎝ long; hilum less than half of seed circumference.
   4. Leaflets of upper leaves obovate or oblong, 15-30 ㎜ long, 2-6 ㎜ wide; flowers about 2 cm long; legumes 5-8 ㎝ long ····· *V. sativa* subsp. *sativa* 살갈퀴
   4. Leaflets of upper leaves linear or oblong, 15-25 ㎜ long, 4-6 ㎜ wide; flowers about 1.5 ㎝ long; legumes 3-5 ㎝ long ····· *V. sativa* subsp. *nigra* 가는살갈퀴
  3. Stipule of the upper leaves ovate to semi-hastate, undivided; petals cream to yellow; flowers about 3 ㎝ long; hilum over half of seed circumference ····· ***V. grandiflora* 큰노랑꽃갈퀴**
 2. Perennial herbs; calyx teeth unequal, lowermost much longer than others ····· *V. sepium* 구주갈퀴덩굴
1. Stipules without nectariferous spot; flowers in pedunculate racemes; style pubescent all around (Subgenus *Cracca*).
 5. Racemes few-flowered; flowers small, 3-7 ㎜ long.
  6. Flowers 1-3 per raceme, pale bluish purple; calyx teeth shorter than tube; legumes glabrous; seeds 3-6 per legume ····· *V. tetrasperma* 얼치기완두
  6. Flowers 3-7 per raceme, whitish purple; calyx teeth longer than tube; legumes pubescent; seeds 1 or 2 per legume ····· *V. hirusta* 새완두
 5. Racemes many-flowered; flowers larger, 10-20 ㎜ long.
  7. Erect or ascending herbs; leaves without tendrils or nearly so.
   8. Leaflets 2 ····· *V. unijuga* 나비나물
   8. Leaflets more than 4.
    9. Leaflets apex spine-like point developed, elliptic or obovate, broadest at middle, rather thick ····· *V. nipponica* 네잎갈퀴나물
    9. Leaflets apex spine-like point undeveloped, ovate to lanceolate, broadest near base, rather thin.
     10. Leaflets 4-8; stipules deciduous; petals purplish yellow ····· *V. chosenensis* 노랑갈퀴
     10. Leaflets 6-14; stipules persistent; petals purple.
      11. Leaflets ovate to narrowly ovate, apex acute in Korean plants; racemes 2-4 ㎝ long, loosely flowered; flowering Jun. to Jul. in Korea ····· *V. venosa* var. *cuspidata* 광릉갈퀴
      11. Leaflets lanceolate, apex acuminate or acute; racemes 1-2 ㎝ long, densely flowered; flowering May ····· *V. hirticalycina* 나래완두
  7. Climbing or prostrate herbs; leaves with tendrils.
   12. Leaflets 4-10.
    13. Tubers absent; leaflets ovate, 3-5 ㎝ long, apex acute or obtuse ····· *V. pseudorobus* 큰등갈퀴
    13. Tubers present; leaflets obovate or lanceolate, 1-2.5 ㎝ long, apex truncate or emarinate ····· *V. bungei* 들완두
   12. Leaflets 10-24.
    14. Leaflets 16-24, narrowly oblong to broadly linear; lowest calyx teeth as long as or longer than tube.
     15. Annual herbs; limb of standard shorter than claw.
      16. Stem villous; lower calyx teeth longer than tube; stipule ovate, up to 5 ㎜ wide ····· *V. villosa* 벳지
      16. Stem glabrous or appressed pubescent; stipules linear, less than 3 ㎜ wide ····· *V. dasycarpa* 각시갈퀴나물
     15. Perennial herbs; limb of standard as long as or longer than claw ····· *V. cracca* 등갈퀴나물
    14. Leaflets 10-16, oblong, elliptic, ovate; all calyx teeth shorter than tube.
     17. Stipules large; lateral nerves of leaflets forming

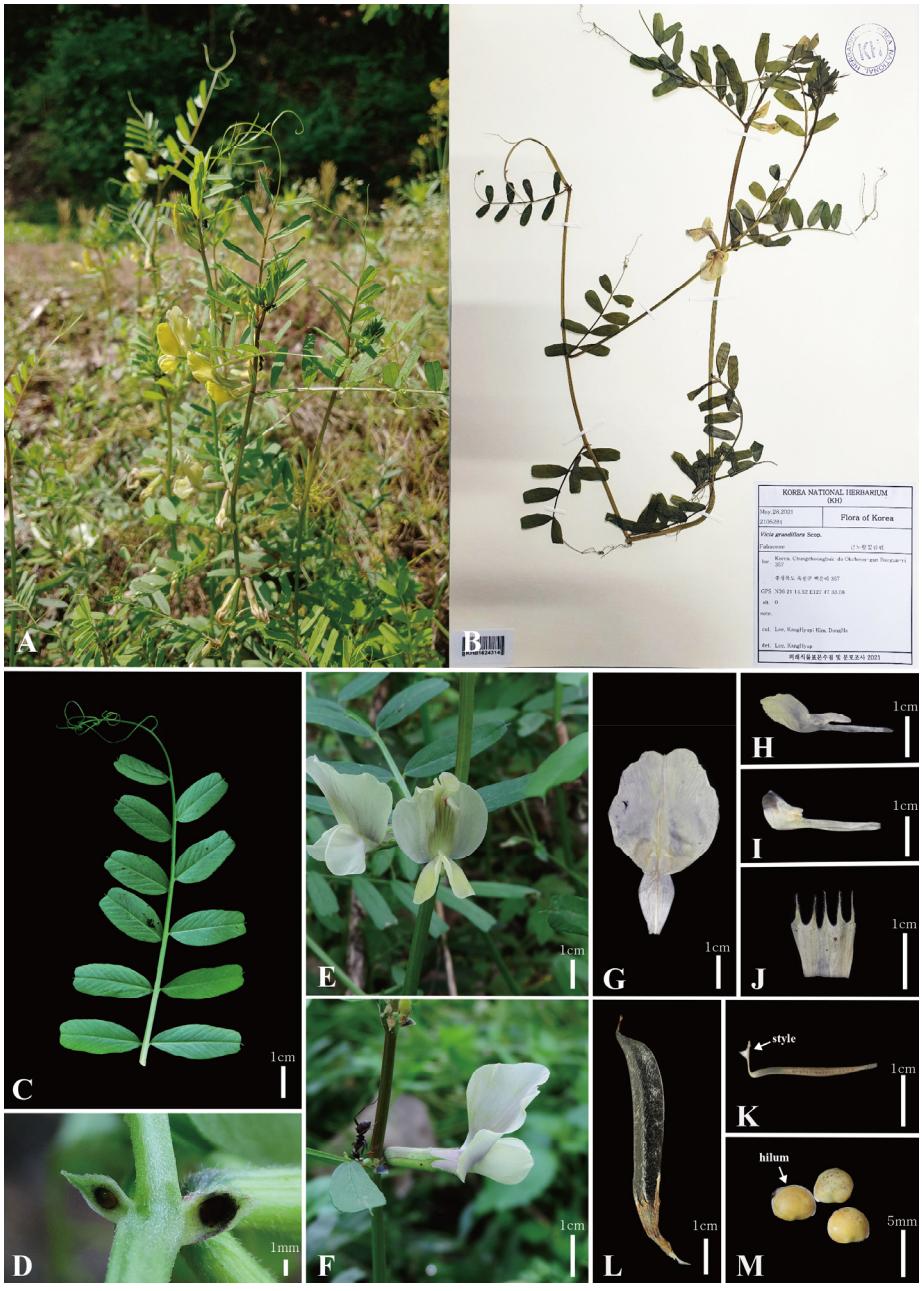

Fig. 2. Photographs of *Vicia grandiflora* Scop. **A.** Habit. **B.** Specimens examined. **C.** Leaf. **D.** Stipule (abaxial surface). **E.** Flower (frontal view). **F.** Flower (lateral view). **G.** Standard petal. **H.** Wing petal. **I.** Keel petal. **J.** Calyx. **K.** Pistil. **L.** Fruit. **M.** Seed.

Table 1. Morphological comparison between *Vicia grandiflora* and its related species *Vicia sativa* complex

Characters \ Taxon	*Vicia grandiflora*	*Vicia sativa* complex
Stipule shape of the upper leaves	ovate to semi-hastate, undivided, entire or few-toothed at base	semi-hastate to sagittate, bifid, dentate
Flower color	cream to yellow	reddish purple
Flower size	23-32 mm	12-18 mm
Hilum size	2/3-3/4 of seed circumference	1/6-1/5 of seed circumference

an angle of less than 30° with the midrib; plants dark brown when dry; rachis longer than peduncle; ovary covered with glandular hairs ····· ····· *V. amoena* 갈퀴나물

17. Stipules small; lateral nerves of leaflets forming an angle of more than 30° with the midrib; plants green or yellowish green when dry; rachis shorter than peduncle; ovary glabrous.
18. Leaflets pubescent; flowers 1.2-1.5 ㎝ long; calyx 6-7 ㎜ long, lateral teeth ca. 2 ㎜ long; style dorsally compressed ····· ····· *V. japonica* 넓은잎갈퀴
18. Leaflets nearly glabrous; flowers 0.8-1 ㎝ long; calyx 5-5.5 ㎜ long, lateral teeth ca. 1-1.5 ㎜ long; style terete ····· ····· *V. amurensis* 벌완두

Discussion

Vicia grandiflora is native to Central and Southeast Europe, Central Asia, and Iran. This species has been introduced into Eastern USA as a winter annual for green manuring and as a pasture crop. In North America, it has spread throughout the southeast and is found in disturbed habitats (Hanelt and IPK, 2001). Further, in Japan, its naturalization was reported in Chiba Prefecture in 1963 (Okuyama, 1963), and its additional distribution was reported in Mie Prefecture in 1997 (Ota, 1997). Therefore, this species has been managed as an invasive alien plant in the USA and Japan (Mito, 2004; Swearingen and Bargeron, 2016). In this study, *V. grandiflora* was found to be distributed mainly on a cultivated land and forming small populations (population size, < 100 mature individuals). Although it is difficult to trace how this species was introduced from its native location to Korea, considering the habitat environment, it is thought to have been unintentionally introduced with a fertilizer or livestock feed as *Kickxia elatine* (L.) Dumort. (Kim *et al.*, 2021).

Hence, it is a casual alien plant that is distributed mainly on cultivated land and forms small populations. It is unknown whether this species will continue to settle in Korea. However, there is a possibility that it will spread, as in USA and Japan, and it is necessary to monitor whether it spreads and how it will affect the ecosystem in the future.

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Conflict of interest

The authors declare that they have no conflict of interest.

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