

# Vascular plants of Poaceae (I) new to Korea: *Vulpia bromoides* (L.) Gray, *Agrostis capillaris* L. and *Eragrostis pectinacea* (Michx.) Nees

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Recent field and herbarium studies have yielded three vascular plant taxa of the family Poaceae that have been documented in Korea. All of the three species, collected from Jeolla-do and adjacent areas, were introduced and naturalized. Three species are identified as *Vulpia bromoides* (L.) Gray, *Agrostis capillaris* L. and *Eragrostis pectinacea* (Michx.) Nees. We provide the descriptions and descriptive photos of these species. Keys to the newly recorded species and related taxa are also provided.

Keywords: *Agrostis capillaries*, *Eragrostis pectinacea*, naturalized, Poaceae, *Vulpia bromoides*

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## INTRODUCTION

Poaceae Barnhart, a family of vascular plants, includes approximately 700 genera and 11,000 species in all regions of the world (Chen *et al.*, 2006). In eastern Asia, China has the biggest numbers, 1,795 species of the Poaceae and Japanese grasses without Bonin, Amami and Ryuku islands contain 330 taxa in numbers (Osada, 1989; Chen *et al.*, 2006). In Korea, numbers of grasses were counted to 212 (Lee, 2007), 252 (Korea National Arboretum, 2011) or 305 (Lee *et al.*, 2011). The number difference of grass taxa relies on what kind of criterion was applied at the time of counting. For example, Lee *et al.* (2011) included native Korean grasses, naturalized and cultivated ones in counting numbers. The current study provided three species included in the family Poaceae that were newly reported to Korean vascular plants. We also provide taxonomic keys to the Korean species of genera *Vulpia*, *Agrostis* and *Eragrostis*.

## MATERIALS AND METHODS

The three species were collected at southern parts of the Korea peninsula. *Vulpia bromoides* (L.) Gray was collected at wastelands near paved road at Yeongam-gun, Jeollanam-do, *Agrostis capillaris* L. at disturbed areas at

Gunsan-si, Jeollabuk-do, *Eragrostis pectinacea* (Michx.) Nees at disturbed areas at Sancheong-gun, Gyeongsangnam-do, respectively. All three species of the study were identified and checked against author's original descriptions (Linnaeus, 1753; Michaux, 1803; Gray, 1821; Nees von Esenbeck, 1841). Habits, spikelets and florets of these species are photographed (Fig. 1, Fig. 2 and Fig. 3). All the voucher specimens are deposited at the Herbarium (KB) of National Institute of Biological Resources (NIBR), Korea.

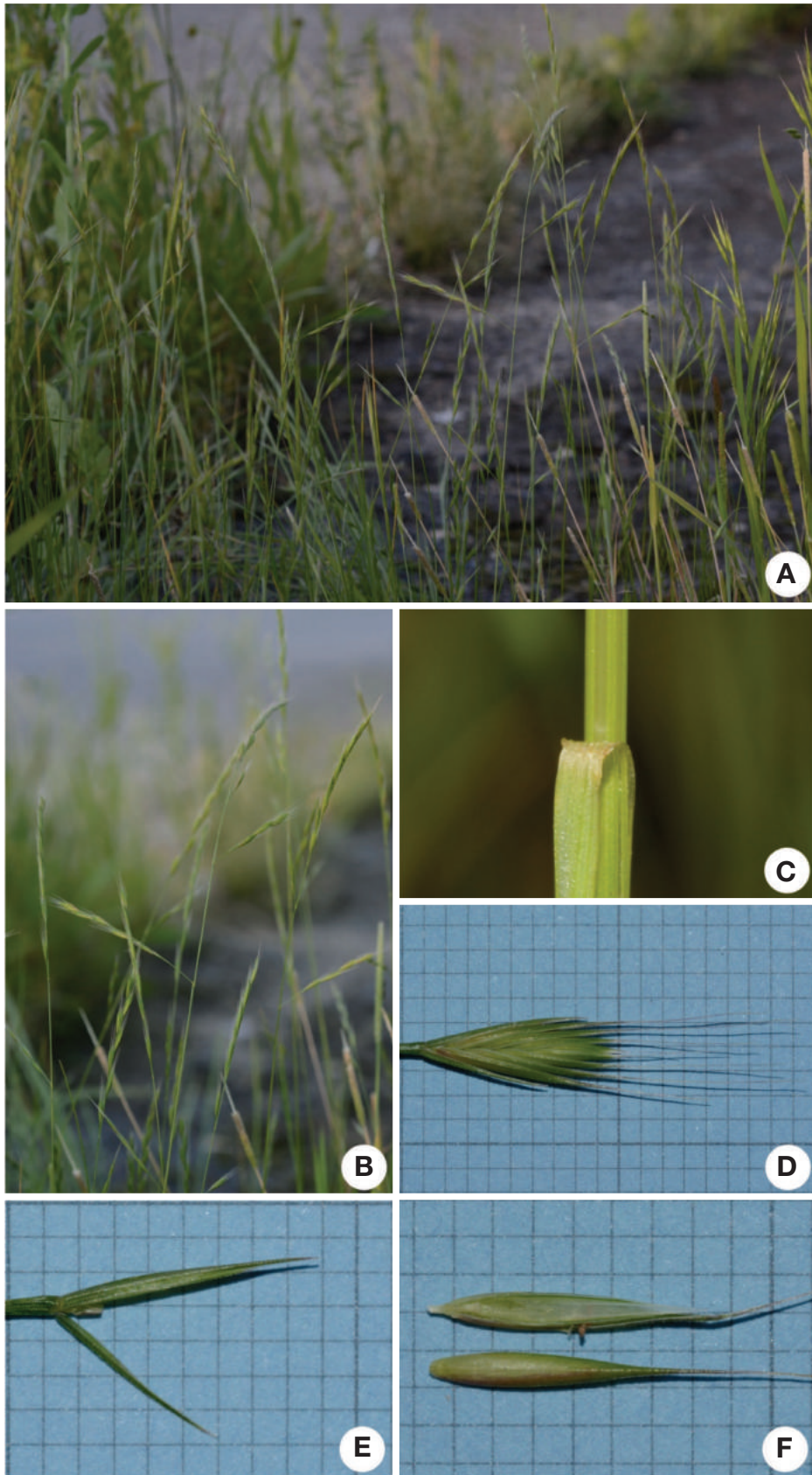
## DESCRIPTION AND DISCUSSION

### 1. *Vulpia bromoides* (L.) Gray, Nat. Arr. Brit. Pl. 2: 124, 1821.

Basionym: *Festuca bromoides* L., Sp. Pl. 1: 75, 1753.

Korean name: Deul-mug-sae-a-jae-bi (들묵새아재비)

Annual. Culms solitary or loosely caespitose, growing 15-40 cm in height, erect to decumbent, slender and hairless, unbranched. Leaf sheaths encloses the stem partially at base, glabrous, closely held to the stem, without keel, margins entire. Leaf blades flat or slightly involute, linear or filiform, apex attenuate, 5-10 cm long and 0.5-2.0 mm wide, surface glabrous or sparsely pilose, margins scaberulous, abaxially glabrous or sparsely pubescent, ligules eciliate membranous, 0.2-0.4 mm



**Fig. 1.** Photograph of *Vulpia bromoides* (L.) Gray. A. Habit. B. Inflorescence. C. Ligule. D. Spikelet. E. Glumes. F. Lemma and Palea.

long. Panicle exserted, open, or contracted, lanceolate or oblong, somewhat nodding, 1.5-8 cm long, 1-3 cm wide, with 1 branch per node, branches appressed or ascending, angular, scaberulous. Spikelets solitary, pedicelled, comprising 5-10 florets, oblong, or cuneate, laterally compressed, 5-10 mm long, not closely imbricated, disarticulating below each floret. Rhachilla internodes 0.5-0.8 mm, eventually visible between lemmas, scaberulous. Glumes persistent, similar, shorter than spikelet. Lower glume linear to lanceolate, 4-6 mm long, 1/2-4/5 length of upper glume, membranous, 1-veined, apex acute. Upper glume lanceolate, 5-8 mm long, as long as adjacent lemma, membranous, 3-veined, mid vein scabrous distally, apex attenuate. Lemma lanceolate, 6-8 mm long, chartaceous, 5-veined, scaberulous, apex acuminate, 1-awned, awn 5-10 mm long. Palea as long as lemma, 6-8 mm long, 2-veined, keels scaberulous, minutely bifid. Anthers 3, 0.3-1.2 mm long. Caryopsis 3.5-5 mm, with adherent pericarp, glabrous. Hilum linear, as long as caryopsis. Flowering at May, and Fruiting at May to June.

**Habitats.** Disturbed areas near paved roads.

**Distribution.** W, SE and S Asia, Africa, Europe, Australia, America.

**Specimens examined.** Haksong-ri, Yeongam-eup, Yeongam-gun, Jeollanam-do, N 34°78'75.04" E 126°73'78.091", 17 May. 2014. J. H. Kim and Cho Y. H. 140775 (2 sheets, KB).

*Vulpia* C.C. Gmel. is a widespread genus in Poaceae, including 26 species, native to many countries around the world, especially to Mediterranean regions and western America. The genus is one of the most common weeds found in temperate regions (Osada, 1989; Chen *et al.*, 2006; Lonard, 2007). However, many species of the genus were naturalized in many of the nations (Cotton and Stace, 1976). The genus *Vulpia* was considered to be closely related to the genus *Festuca* by sharing common characters such as spikelets 3 to 10 flowered, long or short awned at the tip of lemma, and callus glabrous (Osada, 1989). However, the former genus can be distinguished mainly by the annual habit from the latter one, and described as an independent genus in several flora and manuscripts (Cotton and Stace, 1976; Mabberley, 1997; Lu and Phillips, 2006). In Korea, 2 species of the genus (*V. myuros* and *V. megalura*) are known to be distributed, but both of them were arranged inside the genus *Festuca*, not *Vulpia* (Lee, 2007; Korea National Arboretum, 2011; Lee *et al.*, 2011). For convenience, the arrangement of these two taxa into *Vulpia* will be followed in this paper. In addition to these species, *Vulpia bromoides* (L.) Gray was collected at wastelands near paved roads at Yeongam-gun, Jeollanam-do. Mediterranean region was known as the area of the greatest ge-

netic diversity of the genus *Vulpia*, but several species of the genus are distributed throughout the most of Europe. Both *V. bromoides* and *V. myuros* native to Europe were introduced accidentally to Korea and Japan while *V. megalura* was naturalized in Korea, escaped from its origin, North America. These two European taxa, *Vulpia bromoides* and *V. myuros*, resemble to each other with the morphological differences as follows. The length of lower glumes of the former one is more than 1/2 of upper glumes, whereas lower glumes of the latter are much shorter, less than the half of the upper glumes in their length. The branch of inflorescence is only one in the former, not 2 as in the latter. *V. bromoides* is observed about 10 individuals in wastelands near paved roads. Morphological similarities between these two species lead lots of misidentification of herbarium specimens, and thus more careful examination of specimens of the genus *Vulpia* collected in Korea will be helpful in understanding exact distribution of the alien species.

#### A Key to *Vulpia* in Korea

1. Lower glumes 1/2 or more the length of the upper glumes ..... *V. bromoides* (들묵새아재비)
1. Lower glumes less than 1/2 the length of the upper glumes
  2. Lemmas glabrous ..... *V. myuros* (들묵새)
  2. Lemmas ciliate on upper part ... *V. megalura* (큰묵새)

#### 2. *Agrostis capillaris* L. Sp. Pl. 1: 75. 1753.

Korean name: Deul-gyeo-i-sak (들겨이삭)

Perennial. Rhizomes elongated, scaly, short. Culms tufted caespitose, erect to geniculate or decumbent ascending, 40-90 cm long, rooting at base, 3-5-noded; culm-internodes smooth. Leaf-sheaths without keel, smooth. Leaf-blades linear, flat or inrolled, 5-15 cm long, 2-4 mm wide, surface ribbed, smooth or scaberulous, apex acuminate. Ligules eciliate membrane, 0.5-2 mm long, truncate. Panicle open, oblong to ovate in outline, 10-25 cm long, 5-12 cm wide, very lax, branches 3-6 per node, primary branches whorled at lower nodes, spreading, capillary, terete, smooth, slightly flexuous, smooth or almost so, bare in lower half. Spikelets solitary, 1.5-2.5 mm, purplish brown, pedicelled, comprising 1 fertile florets, without rhachilla extension, lanceolate or oblong, laterally compressed, 2-3.5 mm long, disarticulating below each fertile floret. Glumes persistent, elliptic-lanceolate, similar, exceeding apex of florets, shiny. Lower glume lanceolate, 1-1.1 length of upper glume, membranous, 1-keeled, 1-veined, scabrid along keel distally, apex acute. Upper glume lanceolate, 1.3-1.5 length of adjacent fertile lemma, membranous, 1-keeled, 1-veined, apex acute, callus minutely hairy. Lemma elliptic to oblong, 2/3-3/4 spikelet length, 1.2-2.5 mm



**Fig. 2.** Photograph of *Agrostis capillaris* L. A. Habits. B. Inflorescence. C. Ligule. D. Rhizome. E. Spikelet. F. Lemma and Palea.

long, hyaline, without keel, 3-5-veined, usually awnless, apex truncate. Palea oblong, 1/2-3/4 length of lemma, hyaline, 2-veined, apex obtuse. Lodicules 2, lanceolate, membranous. Anthers 3, 1-1.5 mm long. Stigmas 2, laterally exerted. Caryopsis with adherent pericarp, ellipsoid, isodiametric, biconvex, estipitate, without sulcus, 1 mm long, smooth, apex unappendaged. Hilum linear, 0.9 length of caryopsis. Flowering and Fruiting at May to June.

**Habitats.** Disturbed area. cemetery sides, rough grassland, roadsides.

**Distribution.** W, M, S, and NE Asia, N Africa, Europe, America.

**Specimens examined.** Boseok-ri, Impi-myeon, Gunsan-si, Jeollabuk-do, N 35°96'24.53", E 126°85'82.58", 21 May. 2015. J. H. Kim 151911 (2 sheets, KB), Woryeon-ri, Hoehyeon-myeon, Gunsan-si, Jeollabuk-do, N 35°89'53.94", E 126°73'32.48", 03 Jun. 2015. J. H. Kim 152018 (2 sheets, KB), Eupnae-ri, Impi-myeon, Gunsan-si, Jeollabuk-do, N 35°98'26.03", E 126°85'17.00", 04 Jun. 2015. J. H. Kim 152029 (3 sheets, KB), Gunsan-Lake, Soryong-dong, Gunsan-si, Jeollabuk-do, N 35°93'62.81", E 126°74'70.50", 04 Jun. 2015. J. H. Kim 152033 (2 sheets, KB), Banwol-ri, Baekgu-myeon, Gimje-si, Jeollabuk-do, N 35°89'39.32", E 126°96'19.04", 05 Jun. 2015. J. H. Kim 152035 (2 sheets, KB).

The *Agrostis* L. a large cosmopolitan genus of the family Poaceae, found in nearly all the areas in the world, includes 249 species (Clayton, 2006). Some species of the *Agrostis* are used for pasture or lawn grasses. In Korea, numbers of *Agrostis* taxa were counted to seven (Lee, 2007) or nine (Korea National Arboretum, 2011; Lee *et al.*, 2011). Most distinguishing characters to identify the genus are spikelets consisting of one floret, and not deciduous as a whole, but disarticulating below each fertile floret at maturity. *Agrostis capillaries*, which is newly recorded to Korean vascular plants, resembles other *Agrostis* species such as *A. gigantea* or *A. stolonifera* already listed as members of "National List of Species of Korea, vascular plants" (Lee *et al.*, 2011). *A. capillaris* differs in having underground rhizomes and habitat to live in dry grass places from *A. gigantea* with aerial rhizomes and habitats of banks of lakes or rivers. *A. capillaris* differs from *A. stolonifera* in panicles and spikelets. The former species bears spikelets in the upper half of lax panicles whereas the latter have spikelets in lower 1/3 to base of narrowly compacted panicles.

#### A Key to *Agrostis* in Korea

1. Palea well-developed, more than 1/3 lemma length
2. Plant stoloniferous, rhizome absesnt .....  
..... *A. stolonifera* (애기겨이삭)

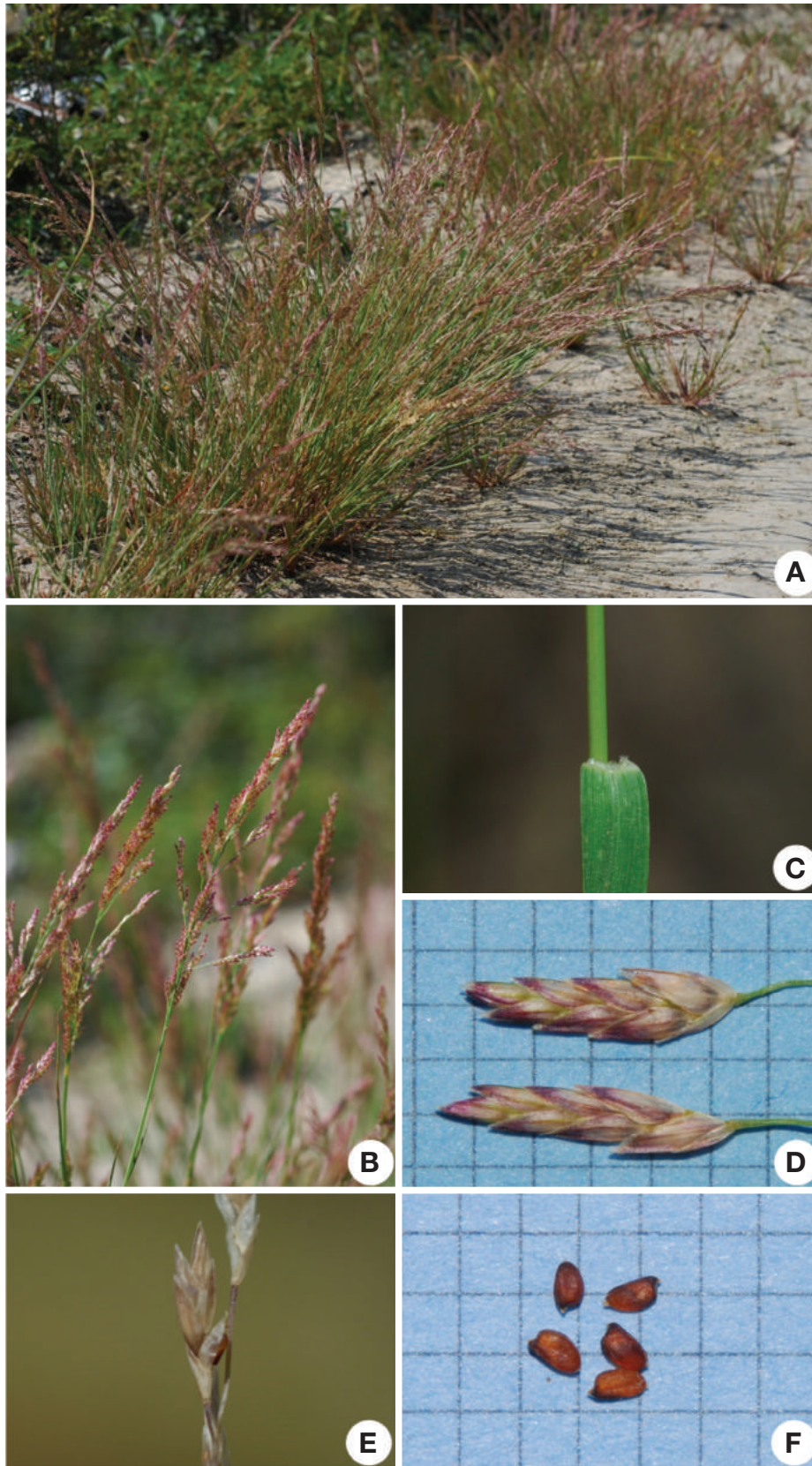
2. Plant turfed or rhizomatous, stolon absent
3. Panicle branches almost smooth .....  
..... *A. capillaris* (들겨이삭)
3. Panicle branches scabrid
4. Panicle green or violet tinged .....  
..... *A. gigantea* (흰겨이삭)
4. Panicle dark purple tinged brown .....  
..... *A. divaricatissima* (엉성겨이삭)
1. Palea small, 1/3 length of lemma or less
5. Lemma awnless, included within the spikelet .....  
..... *A. clavata* (겨이삭)
5. Lemma awned, exerted from spikelet
6. Plant with creeping surface stolons .....  
..... *A. canina* (검은겨이삭)
6. Plant with subterranean rhizomes or turfed.....  
..... *A. flaccida* (검정겨이삭)

#### 3. *Eragrostis pectinacea* (Michx.) Nees, Fl. Afr. Austral. III.: 406. 1841.

Korean name: Deul-bi-no-ri (들비노리)

Annual. Butt sheaths green, or purple. Culms erect to geniculate or decumbent, 10-30 cm long. Leaf-sheaths 3-6 cm long. hirsute at the apices, oral hairs bearded, to 2-2.5 mm long. Leaf-blades 5-10 cm long, 1-3 mm wide, abaxial surfaces glabrous and smooth, adaxial surface scaberulous; ligules fringe of hairs, 0.5-1 mm long. Panicle usually open, sometimes contracted, ovate, 5-10 cm long, 2-7 cm wide, branches simple and bearded in axils, primary branches 0.5-3 cm, solitary or paired at the lowest 2 nodes, flexible, appressed to widely divergent, sometimes capillary. Spikelets solitary, appressed, 4-7 mm long, 1-1.5 mm wide, pedicelled, comprising 5-10 fertile florets, linear-oblong to narrowly lanceolate, yellowish-brown or dark reddish-purple, laterally compressed, rachilla persistent, retaining paleas. Glumes deciduous, similar, sublate to ovate-lanceolate, shorter than spikelet. Lower glume 0.5-1.5 mm long, 1/2 length of upper glume, membranous, 1-keeled, 1-veined, primary vein scaberulous, apex acute. Upper glume 1-2 mm long, as long as adjacent lemma, usually broader than the lower glumes, membranous, grayish-green proximally, reddish-purple distally, 1-keeled, 1-veined, primary vein scaberulous, apex acute. Lemma ovate, 1.5-2 mm long, membranous, keeled, 3-veined, midvein scaberulous, lateral veins distinct, close to margins, extending close to apex, apex acute. Palea 1.5 mm long, keels scaberulous, apex obtuse. Anthers 3, 0.2-0.5 mm, purplish. Caryopsis 0.5-0.9 mm with adherent pericarp, ellipsoid, slightly laterally compressed, without sulcus, 0.5-1 mm long, brownish. Flowering and Fruiting at August to September.

**Habitats.** Disturbed areas. near paved roads, rice field



**Fig. 3.** Photograph of *Eragrostis pectinacea* (Michx.) Nees. A. Habits. B. Inflorescence. C. Ligule. D. Spikelet. E. Maturity spikelet. F. Caryopsis.

roads.

**Distribution.** NE Asia, SW Europe, America.

**Specimens examined.** Maechon-ri, Geumseo-myeon, Sancheong-gun, Gyeongsangnam-do, N 35°41'83.25", E 127°87'20.63", 16 Aug. 2014. J. H. Kim 141371 (2 sheets, KB).

The *Eragrostis* Wolf is a large and widespread genus of the family Poaceae and includes 412 species (Kew Grassbase, 2006). In Korea, numbers of *Eragrostis* taxa were counted to five (Lee, 2007) or seven (Korea National Arboretum, 2011; Lee *et al.*, 2011). The species in the *Eragrostis* are annual or perennial, rhizomes and stolons mostly absent. Most distinguishing characters are often glandular on the leaf sheaths and inflorescence, spikelets consisting of many-florets, and rachilla mostly persistent at maturity. The *Eragrostis* is commonly used as a livestock fodder. *E. pectinacea*, which is now added to the list of Korean vascular plants, is native to the Americas from southern Canada to Argentina (Peterson, 2003). This species is growing widely in open areas with diverse habitats and elevations, even in a disturbed grassland and roadsides. The forms of external morphology are similar to those of *E. multicaulis* Steud. The panicle of *E. pectinacea* is contracted, or somewhat open but contracted at maturity. However, panicles of *E. multicaulis* are always open. The color of inflorescence of this species is tinged purple while that of *E. multicaulis* is grayish green.

#### A Key to *Eragrostis* in Korea

1. Florets disarticulating from above downward, falling together with the rachilla joints ..... *E. japonica* (각시그령)
1. Florets disarticulating from below upward, usually leaving the rachilla entire
  2. Annual
    3. Plants glandular on the culms, leaf sheaths, and panicle
      4. Spikelets 2-3 mm broad, lower lemma 2.2-2.8 mm ..... *E. cilianensis* (참새그령)
      4. Spikelets 1.5-2.5 mm broad, lower lemma 1.5-2 mm ..... *E. minor* (좁새그령)
    3. Plants eglandular
      4. Lower glume 1-veined ..... *E. pectinacea* (들비노리)
      4. Lower glume without a vein
        5. Summit of sheaths pilose; panicles 3.5-14 cm wide, axils pilose; pedicels as long or longer than the spikelets ..... *E. pilosa* (큰비노리)
        5. Summit of sheaths glabrous; panicles 1.5-3 cm wide, axils glabrous; pedicels usually shorter than the spikelets ..... *E. multicaulis* (비노리)
  2. Perennial

6. Branchlets and pedicels distinctly or obscurely glandular ..... *E. ferruginea* (그령)
6. Branchlets and pedicels eglandular ..... *E. curvula* (능수참새그령)

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