Two unrecorded *Elymus* taxa (Poaceae) newly added to Korean flora: *E. humidus* and *E. shandongensis*

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ABSTRACT: Given that the Korean genus *Elymus* L. (Poaceae) is often confused with *Agropyron* Gaertn., the categories and characteristics of *Elymus* s.l. have been reviewed morphologically. Two unrecorded taxa of *Elymus*, *E. humidus* (Ohwi & Sakam.) T. Osada and *E. shandongensis* B. Salomon, not previously recorded in Korean flora to date, we report here as an unrecorded species based on samples collected from Chungcheongbuk-do, Gyeongsangnam-do, Jeollanam-do, and Jeollabuk-do. *E. humidus* is distinguished from other taxa in terms of its habitat around riversides, erect inflorescences, spikelets appressed to rachides of inflorescence, and new individuals asexually propagated at the lower nodes of aerial stems. *E. shandongensis* is similar to *E. tsukushiensis* var. *transiens* (Hack.) H. Osada but is distinguished by the flowering time, slightly curved inflorescences, number of veins of the glumes, and spikelets appressed to the rachides. Descriptions of the two unrecorded Korean taxa, photographs, and keys to neighboring taxa are presented.

Keywords: unrecorded taxa, Poaceae, *Elymus*, *E. humidus*, *E. shandongensis*, Korea

Poaceae is known to be distributed in 700–771 genera and 11,000–12,000 species worldwide (Chen et al., 2006; Soreng et al., 2015), and is a large taxon consisting of 12 subfamilies and 51 tribes taxonomically (Soreng et al., 2015). Poaceae growing on the Korean peninsula differ in the list and number of taxa by authors because it is difficult to accurately determine the number of taxa, including plants distributed in North Korea, which cannot be investigated, as well as due to the number of newly introduced and added foreign species each year. Park et al. (2011) recorded 96 genera and 252 taxa, including foreign taxa, except for the northern region, while Lee (2018) mentioned 94 genera and 212 taxa, which were missing a number of foreign species. Therefore, Poaceae distributed on the Korean peninsula is expected to comprise over 300 taxa (Cho et al., 2016), including species distributed only in the northern region, and foreign species.

As part of a recent national survey of the natural environment, we collected *Elymus humidus* (Ohwi & Sakam.) T. Osada and *E. shandongensis* B. Salomon, which has not been recorded

before in Korea, in several regions, including Jeollanam-do.

In this study, the two taxa that are to be presented as unrecorded plants in Korea are included in the tribe Triticeae Dumort within the subfamily Pooideae Benth. (Osada, 1989; Chen and Zhu, 2006). The tribe Triticeae is mainly distributed in the temperate zone of the Northern Hemisphere, and, taxonomically, consists of as few as 330 species in 20 genera to as many as 503 species in 27 genera, except nothogenera (Chen and Zhu, 2006; Cabi, 2010; Soreng et al., 2015). The tribe contains economically important cereals, such as wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), and rye (*Secale cereale* L.). *Elymus* sensu lato, consists of 170–180 species worldwide and is the largest taxon within the tribe (Chen and Zhu, 2006; Cabi, 2010). However, most Korean authors have divided the taxa related to the *Elymus* s.l. into two genera according to the traditional genus concept, which has been treated as an *Agropyron* Gaertn. with a 1-spikelet at each node of the inflorescence rachides and an *Elymus* with 2-spikelets at each node of the rachides (Lee, 1989; Lee, 1996; Lee, 2018).

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In this paper, we review the taxonomy of Korean *Elymus*, including descriptions and key to the genera in tribe Triticeae, and present a revised key to the taxa of Korean *Elymus* s.l., that includes two newly recorded species in this study.

Delimitation of Korean *Elymus* s.l.

Elymus L., Sp. Pl. 83, 1753.—TYPE: *E. sibiricus* L. (Lectotype designated by Hitchcock, 1929).

Roegneria K. Koch, Linnaea 21: 413, 1848; *Campeiostrachys* Drobow, Fl. Uzbekistan 1: 300, 540, 1941; *Semeiostrachys* Drobow, Fl. Uzbekistan 1: 281, 539, 1941.

Korean name: 갯보리속 (Gaet-bo-ri-sok).

Herbs perennial, caespitose, rarely with rhizomes. Culms obliquely ascending to erect. Leaf blades linear, flat or rolled. Inflorescences with spikes, usually long and loose, linear. Spikes erect to nodding. Spikelets 1(–2) or 2(–4) at each nodes of rachides, sessile, usually appressed to rachides, with 2–10 or more florets. Glumes 2, subequal, well developed, linear-lanceolate to ovate, smaller than lemmas, (1–)3–9(–11) veined, veins converging to apices, not keeled, apices unawned or shortly awned. Lemmas as long as paleas, 5 veined, usually with long awned apices. Caryopses adherent to lemmas and paleas.

Taxa of the tribe Triticeae in Korea are distinguished from other tribes within the subfamily, in that they have spike inflorescences, most of them have spikelets composed of two or more florets, and each spikelets are sessile or rarely very short stalks (Lee, 2018). Triticeae consist of seven genera, namely *Secale* L., *Triticum* L., *Hordeum* L., *Aegilops* L., *Hystris* Moench, *Leymus* Hochst., and *Elymus* s.l. Most of these taxa are directly or indirectly related to the *Elymus* taxonomically, with the exception of *S. cereale* L., *T. aestivum* L., and *H. vulgare* L., which are planted as annual crops. According to major domestic literature (Lee, 1989; Lee, 1996; Lee, 2018), Korean *Elymus* s.l. has traditionally been recognized as *Elymus* if there are two or more spikelets at each node of the inflorescence rachides, and *Agropyron* if there is one spikelet at the node of the rachides. Meanwhile, among the taxa with two spikelets at each node of the rachides, some taxa with weakly developing nearly veinless glumes have been treated as *Hystris* (or *Asperella* Humb., illegitimate name) (Table 1).

As shown in Table 1, *Agropyron* has been known to be distributed in approximately 5 species in Korea. However, in many studies on the taxonomy of tribe Triticeae, accepting the view of Nevski (1934), the genus *Agropyron* s.s. was morphologically limited to include only taxa with one spikelet at each node of the rachides and with distinct 1-keeled glumes. As a result, approximately 10–15 *Agropyron* species are distributed worldwide

(Dewey, 1986; Chen and Zhu, 2006). In addition to the characteristics of the glumes described above, this taxon usually has short oblong inflorescences and short internodes of the inflorescence rachides. On the other hand, *Elymus* s.l. can be distinguished from *Agropyron* s.s. in that each node of the inflorescence rachides has one or two spikelets, there is no distinct keel in glumes, and the linear or broad linear inflorescences have long internodes.

According to the current taxonomic studies, most taxa treated as *Agropyron* in Korea are included in the *Elymus*; *Elymus ciliaris* (Trin.) Tzvelev [= *Agropyron ciliare* (Trin.) Franch.], *E. tsukushiensis* var. *transiens* (back) Osada [= *A. tsukushiense* var. *Transiens* (back) Ohwi], *E. gmelinii* (Ledeb.) Tzvelev [= *A. gmelinii* (Ledeb.) Scribn. & J. G. Sm., *A. turczaninowii* Drobow], *E. nakaii* (Kitag.) S. L. Chen [= *A. nakaii* Kitag.], and *E. repens* (L.) Gould [= *A. repens* (L.) P. Beauv.]. On the other hand, among the taxa treated as *Elymus* or *Agropyron* in Korea, some taxa belong to the genera *Leymus* and *Hystris*; *Leymus mollis* (Trin.) Pilg. [= *E. mollis* Trin.], *L. chinensis* (Trin. ex Bunge) Tzvelev [= *A. chinense* (Trin. ex Bunge) Ohwi], and *Hystris coreana* (Honda) Ohwi [= *E. coreanus* Honda].

Therefore, the taxa belonging to the *Agropyron* s.s. were not distributed in Korea (Table 1). According to the flora of China (Chen and Zhu, 2006), it was mentioned that *A. cristatum* (L.) Gaertn. was also distributed in Korea, but it has not been confirmed. Considering the geographical distribution, this taxon may be distributed in the northern region, but has not been mentioned in the flora of North Korea (Kim, 2000). As a result, according to the related literature (Chung, 1957; Chung, 1965; Lee, 1989; Lee, 1996; Kim, 2000; Park et al., 2011; Cho et al., 2016; Lee, 2018), there are currently 14 species and seven varieties of three genera directly and indirectly related to the *Elymus* s.l. within tribe Triticeae in the Korean peninsula; *E. ciliaris* var. *amurensis* (Drobow) S. L. Chen, *E. ciliaris* var. *hackeliamus* (Honda) G. H. Zhu & S. L. Chen, *E. ciliaris* var. *lasiophyllus* (Kitag.) S. L. Chen, *E. ciliaris* var. *submuticus* (Honda) S. L. Chen, *E. dahuricus* Turcz. ex Griseb., *E. dahuricus* var. *cylindricus* Franch. (northern), *E. excelsus* Turcz. ex Griseb. (northern), *E. gmelinii*, *E. mayebaranus* (Honda) S. L. Chen (unconfirmed), *E. nakaii* (northern), *E. sibiricus* L. (northern), *E. tsukushiensis* var. *transiens*, *E. yezoensis*, *E. yezoensis* var. *koryoensis*, and foreign species *E. repens* (L.) Gould; *Hystris coreana*, *H. longearistata* (Hack.) Honda; *Leymus chinensis* (northern), *L. mollis*, and *L. secalinus* (Georgi) Tzvelev (northern).

In particular, *Hystris* is included in the *Elymus* by some authors (Soreng et al., 2015), but it is also distinguished in that the glumes are weakly developed or sometimes absent, the

Table 1. Categories of Korean *Elymus* s.l. and related taxa by authors and countries.

Characteristics ^a	Specific epithets of Korean <i>Elymus</i> & related taxa	Flora of Korea						Flora of Japan		Flora of China	Flora of N. America	This study
		Chung (1965)	Lee (1989)	Lee (1996)	Lee (2018)	Park et al. (2011)	Cho et al. (2016)	Ohwi (1984)	Osada (1989)	Chen et al. (2006)	Barkworth et al. (2007)	
1	<i>ciliare</i> or <i>ciliaris</i>	Agr	Agr	Agr	Agr	Ely	Agr	Agr	Ely	Ely	Ely	Ely
	<i>tsukushiensis</i> var. <i>transiens</i>	Agr	Agr	Agr	Agr	Ely	Agr	Agr	Ely	Ely (as <i>kamoji</i>)	Ely	Ely
	<i>turczaninowii</i>	Agr	Agr	Agr (as <i>gmelinii</i>)	Agr	-	Agr	Ag	Ely (as <i>gmelinii</i>)	Ely (as <i>gmelinii</i>)	-	Ely (as <i>gmelinii</i>)
	<i>repens</i>	-	-	-	-	Ely	Agr	Agr	Ely	Ely	Ely	Ely
	<i>yesoense</i> or <i>yesoensis</i>	Agr	Agr	Agr	Ely	Ely	Agr	Agr	Ely	-	-	Ely
	<i>shandongensis</i> ^b							-	-	Ely	-	Ely
	<i>humidus</i> ^b							Agr	Ely	Ely	-	Ely
2 or more	<i>chinense</i> or <i>chinensis</i>	Agr	Agr	Agr	Agr	-, Ley?	Ley	-	-	Ley	-	Ley
	<i>mollis</i>	Ely	Ely	Ely	Ely	Ely	Ley	Ely	Ley	Ley	Ley	Ley
	<i>dahuricus</i>	Ely	Ely	Ely	Ely	Ely	Ely	Ely	Ely	Ely	-	Ely
	<i>sibiricus</i>	Ely	Ely	Ely	Ely	Ely	Ely	Ely	Ely	Ely	Ely	Ely
	<i>longearistata</i>	Asp	Asp	Asp	Asp	Hys	Hys	Asp	Hys	-	-, Ely?	Hys
	<i>coreanus</i> or <i>coreana</i>	Ely	-	Ely	Ely	-, Hys?	Hys	-	-	Hys	-, Ely?	Hys

Generic name: Agr, *Agropyron*; Asp, *Asperella* nom illeg.; Ely, *Elymus*; Ley, *Leymus*; Hys, *Hystrix* including *Asperella*.^aSpikelet number at each node of the inflorescence's rachides. ^bUnrecorded taxon in Korea.

Table 2. Comparison of some characteristics of Korean *Elymus* taxa with 1 spikelet at each node of the inflorescence.

Characteristics	<i>Elymus</i> (formerly known as <i>Agropyron</i> in Korea)						
	<i>ciliaris</i>	<i>tsukuensis</i> var. <i>transiens</i>	<i>yezoensis</i>	<i>gmelinii</i>	<i>humidus</i>	<i>shandongensis</i>	<i>repens</i>
Creeping rhizomes	×	×	×	×	×	×	o
Asexual propagation at nodes of lower stems	×	×	×	×	o	×	×
Spikes at anthesis	Nodding	Curved	Nodding	Slightly curved	Erect	Slightly curved	Erect
Spikelets length (cm)	1.0–2.0	1.5–2.5	1.5–2.0	1.5–2.0	1.7–2.2	1.2–2.0	0.8–1.7
Florets (no.)	5–12	5–10	3–7	5–7	4–7	5–8	5–7
Glume length (cm)	0.5–1.0	0.5–0.8	0.6–0.8	0.6–1.2	0.6–0.8	0.6–0.9	0.5–1.5
Veins (no.)	5–7	3–5	3–5	5–7	3–5	5–7	5–7
Calluses	Smooth	Smooth	Hairy	Hairy	Smooth	Smooth	Smooth
Lemma length (cm)	0.7–1.2	0.8–1.2	0.7–1.0	0.7–1.2	0.8–1.2	0.9–1.0	0.6–1.2
Veins (no.)	5	5	5	5	5	5	5
Awns (cm)	1.5–3	1.5–3	1.5–2.5	2.5–3.5	2–3	2–3	0–ca. 0.2
Lemma's awns at fruiting period	Recurved	Erect	Erect	Recurved	Erect	Erect	Erect
Length ratio of lemmas and paleas	Lemma > palea	Subequal	Subequal	Subequal	Subequal	Slightly lemma > palea	Subequal
Habitats	Roadside or meadow	Roadside or meadow	Mountain	Mountain	Riverside	Roadside or meadow	Roadside or meadow
Flowering	May to Jun	May to Jun	Jun to Jul	Jun to Jul	May to Jun	Jul to Aug	May to Jun

glumes have nearly no veins, and the leaf blades are herbaceous and flexible (Osada, 1989; Chen and Zhu, 2006; Lee, 2018). Taxa belonging to the *Leymus* are usually included in the *Elymus* in Korea, but many authors (Osada, 1989; Chen and Zhu, 2006; Cabi, 2010; Soreng et al., 2015) have treated it as a separate genus from other genera.

The key to the genera of tribe Triticeae within subfamily Pooideae growing in Korea, including *Elymus* s.l., is described below.

Key to the Korean tribe Triticeae including genus *Elymus* s.l. within subfamily Pooideae

1. Spike inflorescences with 2 or more spikelets at each node of the rachides.
2. Spikelets with 1(–2) florets, three at each node of the rachides, usually central spikelets sessile and fertile, lateral ones pedicellate and sterile, sometimes all sessile in cultivated plants *Hordeum* 보리속
2. Spikelets with (1–)2–10 florets, 2–3 [sometimes 4–6] at each node of rachides, usually all sessile.
3. Internodes of rachides easily visible; spikelets with (1–)2–4 florets; glumes nearly vestigial or weakly

developed, subulate to linear .. *Hystrix* 수염개밀속

3. Internodes of rachides hardly visible; spikelets with 2–10 florets; glumes well developed, linear-lanceolate to ovate.

4. Plants usually tufts, rarely with rhizomes; distal glumes usually at least 3–7(–9) veined, generally not keeled; lemmas usually with long awned apices *Elymus* 갯보리속

4. Plants usually rhizomatous; glumes 1–3(–5) veined, often keeled; lemmas with unawned or shortly awned apices *Leymus* 갯그렁속

1. Spike inflorescences with generally 1 spikelet at each node of the rachides.
5. Glumes 1 or 3–9 veined, veins converging toward apices, acute to shortly awned apices.
6. Plants perennial; spikes somewhat lax; glumes usually lanceolate to narrowly ovate and 3–9 veined; spikelets with usually 5–10 or more florets *Elymus* (formerly known as *Agropyron* in Korea) 갯보리속
6. Plants annual; spikes dense; glumes linear or subulate and 1 veined; spikelets with 2 florets *Secale* 호밀속

5. Glumes 3–10 veined, veins parallel or divergent, truncate, or toothed with at least 1 long awned apices.
7. Spikes somewhat dense; internodes of rachides short, not easily visible; glumes keeled and 3–10 veined ..
..... *Triticum* 밀속
7. Spikes lax; internodes of rachides are 0.6–1.2 cm long, somewhat long, easily visible; glumes not keeled and 7–10 veined *Aegilops* 염소풀속

Taxonomic Treatments

1. *Elymus humidus* (Ohwi & Sakam.) T. Osada, Illustr. Grasses of Japan 426, 738, 1989; *Agropyron humidum* Ohwi & Sakam., J. Jap. Bot. 39: 109, 1964; *Elymus humidus* (Ohwi & Sakam.) Á. Löve, Feddes Repert. 95: 457, 1984; *Campeiostrachys humidora* (Ohwi & Sakam.) B. R. Baum, J. L. Yang & C. Yen, J. Syst. Evol. 49: 153, 2011.—TYPE: Japan. Honshu: Koshigaya, in paddy field, 8 May 1950, *J. Ohwi TNS (NSM) No. 5* (TNS, not seen) (Fig. 1).

Korean name: 둔치개밀 (Dun-chi-gae-mil).

Herbs perennial. Culms tufted, erect and geniculate at bases, 40–80 cm tall; new branches and roots emerge from lower nodes of ground fallen stems after anthesis and proliferate new individuals next year asexually. Leaf sheaths glabrous. Leaf blades 7–20 × 0.3–0.7 cm, flat, scaberulous on upper surfaces and at margins, glabrous on lower surfaces; ligules ca. 0.7 mm tall, glabrous, hyaline membranous, erose margins. Inflorescences with erect and straight spikes; spikes 10–20 cm long, somewhat sparsely spikelets, sessile; internodes of rachides scaberulous, ca. 1–1.3 cm long (the lowest up to 2.5–3.3 cm). Spikelets 1 at each nodes of rachides, tightly appressed to rachides even in anthesis, 1.7–2.2(–2.5) cm long, with 4–7 florets, pale green or purple-tinged or brown. Glumes 2, widely lanceolate, subequal, 6–8 mm long, 3–5(–7) veined, apices acuminate or sometimes shortly awned, scaberulous along upper mid-veins. Lemmas lanceolate, 0.8–1.2 cm long, scaberulous along upper veins or nearly so, 5 veined, with stout and straight awned apices, awns up to 3 cm long; calluses glabrous. Paleas nearly equal to lemmas, scaberulous at margins. Anthers yellow, ca. 2.5 mm long.

Flowering: May to June.

Habitat: Hundreds of individuals grow along the humid grassland around the slightly raised edges of the riverside (Fig. 1E). The habitat is an area where water can easily overflow during the summer flood, and seeds are expected to be relatively easily dispersed by the flow of the water. However, this taxon is known to grow in humid places around paddy

fields where there is a lot of artificial interference in Japan.

Considering the characteristics of its habitat, population, and individuals, we believe it is worth being considered a domestic legally protected species. In Japan, it is treated as a vulnerable species (Environment Agency of Japan, 2000; Ibaragi et al., 2009).

Distribution: Japan (Honshu, Kyushu, Shikoku) [from Ohwi and Sakamoto, 1964; Ibaragi et al., 2009], Korea (Hwasung-gun, Jeollanam-do); Japanese populations are naturalized, according to Ohwi and Sakamoto.

Specimens examined: KOREA. Jeollanam-do: Hwasung-gun, Nam-myeon, riverside in Jusan-ri, 4 Jun 2017, *J.H. Kim 174208* (2 sheets, JNU); Hwasung-gun, Nam-myeon, riverside in Sasu-ri, 12 Jun 2020, *C.H. Kim et al. 20200034* (5 sheets, JNU).

This species was treated as a part of *Elymus mayebaranus* [= *Agropyron mayebaranum* Honda] but was published as a new species based on type specimen collected from Honshu, Japan (Ohwi [TNS (NSM) 5]) by Ohwi and Sakamoto (1964). *Elymus mayebaranus* is a sterile species originating from the hybridization of *E. tsukushiensis* var. *transiens* and *E. humidus*, and has been known to be distributed in China, Taiwan, and Japan in the past (Ohwi, 1984; Osada, 1989). However, its distribution in China and Taiwan may be inaccurate due to misidentification with *E. shandongensis* B. Salomon or *E. tsukushiensis* var. *transiens*, and is now treated as endemic to Japan (Chen and Zhu, 2006; Jung and Chen, 2013).

According to IPNI (ipni.org), Ohwi (1965: 154) corrected the specific epithet *humidum* to *humidorum*, citing *Agropyron humidorum* Ohwi & Sakam., but the correction was rejected. Therefore all combinations with specific epithets “*humidorum*, *humidorus*, and *humidora*” are invalid.

Elymus humidus (Ohwi & Sakam.) T. Osada is significantly different from other taxa, including *E. dahuricus* with 2 spikelets at each node of inflorescence rachides, by having 1 spikelet at each node of the rachides. In addition, this species is easily distinguished from *E. ciliaris*, which is remarkably different in length, because of the similar lengths of lemmas and paleas. This taxon differs from *E. tsukushiensis* var. *transiens* and most other taxa, which have curved or nodding inflorescences in the flowering period, by having always erect inflorescences and relatively thicker rachides. In addition, this species always has spikelets appressed to the rachides of the inflorescence, while *E. tsukushiensis* var. *transiens* have spikelets that spread slightly or ascend from curved rachides during the flowering period. It is also distinguished from *E. gmelinii* and *E. ciliaris*, which have strongly recurved lemma awns in the fruiting period, and *E. yezoensis*, which has stiff

Fig. 1. *Elymus humidus* as a new record in the Korean flora. **A.** Habitat. **B.** Spike inflorescence with several spikelets. **C.** Node with new roots. **D.** Spikelet. **E.** Growing on a slightly raised edge of the riverside. **F.** Broken culms at uppermost nodes. **G.** Lemma with paleas.

hairy calluses, by having erect lemma's awns and smooth calluses (Table 1).

Meanwhile, as Ohwi and Sakamoto (1964) reported, since *E. humidus* grows only around the waterside, it is distinguished from taxa growing around roadsides or grassy fields in lowlands, such as *E. tsukushiensis* var. *transiens*, and taxa in mountainous areas, such as *E. yezoensis*.

In particular, *E. humidus* propagates asexually in addition to normal seed dispersal (Ohwi and Sakamoto, 1964; Osada, 1989; Ibaragi et al., 2009). This species is cut off the uppermost nodes of stems including inflorescence by wind or physical forces after maturation (Fig. 1F). It has been confirmed that new shoots and roots emerged from the nodes of the lower aerial stems that fell to the ground and propagated as new individuals the following year (Fig. 1C). Among the tribe Triticeae, *E. humidus* is the only species that produces individuals using this asexual method.

According to Ohwi and Sakamoto (1964), it was analyzed that *E. humidus* had previously been introduced into Japan from China with seeds of *Astragalus sinicus* L. [Fabaceae] or forage crops; however, this species is not mentioned in the flora of China (Chen and Zhu, 2006). Therefore, this species is currently distributed only in Korea and Japan. As Ohwi and Sakamoto pointed out, if it is true that Japanese populations originated from other countries, and it is not distributed in geographically adjacent China or Taiwan, the possibility of it being endemic to Korea must be carefully considered.

The Korean name of this species was given “Dun-chi-gae-mil” due to its habitat being found on a slightly raised edge of the riverside, known as Dun-chi in Korean.

2. *Elymus shandongensis* B. Salomon, Willdenowia 19: 449, 1990; *Roegneria shandongensis* (B. Salomon) J. L. Yang, Y. H. Zhou & C. Yen, Guihaia 17: 22, 1997.—TYPE: China. Shandong province, Qingdao, *F. C. Keng* 6507 (N, not seen) (Fig. 2).

Korean name: 여름개밀 (Yeo-reum-gae-mil).

Herbs perennial. Culms laxly tufted, erect or slightly geniculate at bases, 0.6–1 m tall. Leaf sheaths somewhat long hairy at margins; ligules ca. 0.6 mm long. Leaf blades 10–25 × 0.4–0.8 cm, flat or involute and scaberulous at margins, both surfaces scaberulous or nearly so. Inflorescences with early erect and slightly curved spikes at anthesis, spikes 5–20 cm long, somewhat sparsely spikelets, sessile; internodes of rachides scaberulous, ca. 1–2 cm long. Spikelets 1 at each nodes of rachides, appressed to rachides, 1.2–2.0 cm, with 5–8 florets. Glumes 2, oblong-lanceolate, subequal, proximal glumes 6–9 mm long, distal ones 7–9 mm long, 5–7(–9)

veined, apices acute or shortly awned. Lemmas oblong-lanceolate, 9–10 mm long, margins membranous, awn erect, 15–30 mm; calluses smooth or nearly so. Paleas slightly small to lemmas, margins scabrous.

Flowering: July to August.

Habitat: A large number of individuals grow on sunny roadsides around agricultural lands where there is a lot of artificial interference (Fig. 2E), sometimes growing together with *E. ciliaris* and/or *E. tsukushiensis* var. *transiens*.

Distribution: China (central and southeastern region) (Chen and Zhu, 2006; Jung and Chen, 2013), Korea.

Specimens examined: KOREA. Chungcheongbuk-do: Jecheon-si, Susan-myeon, Wondae-ri, alt. 261 m, 25 Aug 2017, *Kim J. H.* 174432 (1 sheet, JNU). Jeollabuk-do: Jinan-gun, Jucheon-myeon, Unbong-ri, alt. 313 m, 14 Jul 2017, *Kim J. H.* 174296 (1 sheet, JNU); Kunsan-si, Napo-myeon, roadside in Jugok-ri, elev. 30 m, 17 Jul 2020, *Kim, C. H. & S. S. Choi* 20200035 (7 sheets, JNU). Gyeongsangnam-do: Uiryeong-gun, Daeui-myeon, Haengjeong-ri, elev. 203 m, 23 Jul 2017, *Kim J. H.* 174321 (1 sheet, JNU).

This species was published as *E. shandongensis* based on the type specimen (*F.C. Keng* 6507, N) collected from Qingdao, Shandong province in northeastern China (Salomon, 1990), and is recognized as an endemic species that is mainly distributed in the central and southeastern regions of mainland China, including Shandong (Chen and Zhu, 2006; Jung and Chen, 2013). This species was recognized as *E. mayebaranus* (a hybrid species of *E. tsukushiensis* var. *transiens* and *E. humidus*) in China until it was published as a new species (Chen and Zhu, 2006), and is known to be distributed in North Korea (Kim, 2000). As in China, *E. mayebaranus*, which is known to be distributed in the northern region of Korea, is considered to be very likely to be *E. shandongensis*.

This species is easily distinguished from taxa with 2 spikelets at each node of inflorescence rachides by having 1 spikelet at each node of rachides, similar to *E. humidus*, as mentioned above. Not only is this species the most similar in morphology to *E. tsukushiensis* var. *transiens* [it is treated as the same taxa as *E. kamoji* (Ohwi) S. L. Chen in China], but also in the characteristics of its habitats. However, *E. shandongensis* has spike inflorescences that curve slightly laterally in the flowering period, spikelets that always appressed to the rachides, and glumes that are usually 5–7(–9) veined, whereas *E. tsukushiensis* var. *transiens* has spikes that nod strongly toward the ground during flowering, spikelets diverging or ascending from the rachides, and glumes that are 3–5 veined. In addition, this species is also distinguished from other taxa such as *E. humidus*, which always has erect inflorescences, *E.*

Fig. 2. *Elymus shandongensis* as a new record in the Korean flora. **A.** Habitat. **B.** Inflorescence with several spikelets. **C.** Ligule. **D.** Spikelet. **E.** Growing on the roadside around the farmland. **F.** Glume. **G.** Lemmas with paleas.

ciliaris and *E. gmelinii*, which have strongly recurved lemma awns during the fruiting period, and *E. yezoensis*, which has stiff hairy calluses (Table 1).

The Korean name of this species was given “Yeo-reum-gae-mil” due to the fact that the flowering period is July, unlike other taxa that bloom in May, including *E. ciliaris*. Based on the data of our research team, the Korean and scientific names were known to the public through a press release of the National Institute of Biological Resources (NIBR) on June 21, 2019.

As a result, 11 species and 7 varieties of *Elymus* s.l., including two unrecorded species, are known to be growing on the Korean peninsula. The following key to the species was prepared for them, however, three species and six varieties have been excluded; *E. excelsus* and *E. nakaii*, which are known to be distributed in the northern region of the Korean peninsula, *E. mayebaranus* of uncertain distribution in Korea, and the remaining varieties, except for *E. tsukushiensis* var. *transiens*, where the type variety is not distributed in Korea.

Key to the taxa of Korean *Elymus* s.l.

1. Spike inflorescences with 2–3 spikelets at each node of the rachides.
 2. Spikes erect, somewhat dense; glumes equaling or slightly shorter than lemmas ······ *E. dahuricus* 갯보리
 2. Spikes nodding to pendulous, loose; glumes much shorter, nearly 1/2 length of lemmas ······ *E. sibiricus* 개보리
1. Spike inflorescences with 1 spikelet at each node of the rachides.
 3. Plants with long creeping rhizomes not forming tufts; lemmas awnless to short awned apices, awns up to ca. 0.2 cm long (up to ca. 1 cm in some varieties) ······ *E. repens* 구주개밀
 3. Plants forming tufts without long creeping rhizomes; lemmas long awned apices, 1–4 cm long (rarely a variety of *E. ciliaris*, 1–7 mm).
 4. Lemmas with recurved awns at fruiting period.
 5. Paleas distinctly shorter than lemmas (1/2–2/3), slightly oblanceolate with rounded or emarginate apices; calluses nearly smooth or glabrous; habitats mainly grassy fields or roadsides in cultivated areas or low mountains ······ *E. ciliaris* 속털개밀
 5. Paleas nearly equaling or slightly shorter than lemmas (3/5–4/5), oblong with rounded apices; calluses stiff hairy; habitats woods in high mountains ······ *E. gmelinii* 털개밀
 4. Lemmas with always erect awns.
 6. Spikes always erect; new branches and roots emerge from lower nodes of ground fallen stems and propagate new individuals asexually; habitats wet riverside edges ······ *E. humidus* 둔치개밀
 6. Spikes strongly nodding or slightly curved at anthesis; not propagate asexually at nodes of ground stems; habitats mostly dry roadsides or grassy fields in cultivated areas, low mountains, or woods in high mountains.
 7. Calluses distinctly stiff hairy; habitats woods in high mountains ······ *E. yezoensis* 자주개밀
 7. Calluses smooth or nearly so; habitats roadsides or grassy fields in cultivated areas or low mountains.
 8. Spikes strongly nodding at anthesis; spikelets ascending at anthesis, appressed to rachides before and after anthesis; glumes (2–)3–5(–7) veined, much smaller than lemmas; flowering in May and maturing in July ······ *E. tsukushiensis* var. *transiens* 개밀
 8. Spikes slightly curved at anthesis; spikelets always appressed to rachides; glumes are 5–7(–9) veined, slightly smaller than lemmas; flowering in July and maturing in August or September ······ *E. shandongensis* 여름개밀

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Conflict of Interest

The authors declare that there are no conflicts of interest.

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한국 식물상에 새로이 추가되는 벼과 갯보리속의 2개 미기록 분류군: 둔치개밀, 여름개밀

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적 요: 한국산 갯보리속은 개밀속과 혼돈하여 사용하여 온 바, 형태적으로 갯보리속의 범주 및 특성을 재검토하였고, 이때까지 한반도 식물상에 기록된 바 없는 갯보리속의 2개 미기록 분류군, 둔치개밀과 여름개밀을 각각 전라남도과 전라북도에서 채집된 표본을 근거로 보고하였다. 둔치개밀은 강가 주변의 생육지, 항상 곧추서는 꽃차례, 화서에 밀착된 소수, 지상부 아래쪽 마디에서 새로운 개체를 무성적으로 증식하는 점에서 다른 분류군과 구별되고, 여름개밀은 개밀과 비슷하지만 개화시기가 여름철이고, 옆으로 약간 휘는 꽃차례, 포령의 맥수, 화서에 밀착된 소수와 같은 특징에 의해 구별되었다. 한국산 두 미기록 분류군에 대한 기재, 사진 및 근연 분류군간의 검색표를 제시하였다.

주요어: 미기록종, 벼과, 갯보리속, 둔치개밀, 여름개밀, 한국산