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Notes on Alien *Bromus* Grasses in Taiwan

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ABSTRACT: *Bromus carinatus* Hook. & Arn., *Bromus hordeaceus* L., *Bromus pubescens* Muhl. ex Willd. and *Bromus secalinus* L. were recently found at middle elevations of southern and central Taiwan, respectively. We present taxonomic treatments, distribution map, and line-drawings of these introduced alien brome grasses.

KEY WORDS: ***Bromus carinatus, Bromus hordeaceus, Bromus pubescens, Bromus secalinus,*** **Flora, Gramineae, Poaceae, Taiwan.**

INTRODUCTION

In participation of a long term project, we have been collecting many plant specimens in Taiwan for drug screening since 2002. Recently, we found several species new to the Flora of Taiwan. The genus *Bromus* L. has ca. 150 species in both hemispheres (Clayton and Renvoize, 1986), and four taxa were recorded in the Flora of Taiwan, including two naturalized species (Hsu, 1978; Kuoh and Chen, 2000; Huang et al., 2003). *Bromus formosanus* Honda, which was treated as endemic species in Taiwan, occurs in Sabah and New Guinea, too (J. F. Veldkamp, personal communication). *B. morrisonensis* Honda occurring in Malesia and Luzon was also treated as endemic species in Taiwan (Veldkamp et al., 1991). Besides, *B. rigidus* Roth in Roemer and Usteri. occurring at An-ma-shan forest trail 43 K (Kuoh and Chen, 2000) must be corrected to *B. diandrus* Roth.

We treated four additional alien grasses, i.e. *Bromus carinatus* Hook. & Arn., *Bromus hordeaceus* L., *Bromus pubescens* Muhl. ex Willd. and *Bromus secalinus* L. with distributional maps (Fig. 1) and illustrations. A key to brome grasses in Taiwan is also provided here.

TAXONOMIC TREATMENT

1. ***Bromus carinatus*** Hook. & Arn., Bot. Beechey Voy. 403. 1840; Hitchcock A. S., Manual of grasses of the United States, 35-36, t. 7. 1951; Osada T., Illustrated Grasses of Japan, 398-399, 1993. 長芒扁雀麥 Fig. 2

Culms erect, to 100 cm tall, 5-7-noded; nodes articulate, glabrous, exposed. Ligule triangular, ca. 3 mm long, membranous, abaxial surface pubescent; sheath glabrous to pubescent, shorter than blades; blade up to 30 × 0.5-1.5 cm, 11-veined with one main vein. Inflorescence a panicle, spreading, with ca. 4 nodes, 30-40 cm long; basal branches ca. 15 cm long. Spikelet oblong, 2-4 cm × 3-6 mm, with 2-7 florets. Lower glume lanceolate, 0.9-1.2 cm long, 3-veined, margin membranous, apex acuminate. Upper glume lanceolate, 1.2-1.4 cm long, margin membranous, 7-veined, apex acuminate or with one short awn. Lemma lanceolate, 1.5-1.8 cm long, 7-veined with keeled central vein, apex obtuse; awn arising from center of apex, 6-9 mm long. Palea lanceolate, apex acuminate, 2-keeled, keels hispid. Anthers ca. 4 mm long. Ovary ca. 1.5 mm long, pilose, hairs ca. 0.75 mm long.

Distribution and notes: *Bromus carinatus* (California brome) is distributed in western America (Hitchcock, 1951). In Taiwan, it occurs at Kuaigu, Tienchi and the entrance of the Li-guan Tunnel, along the Southern Cross-Island Highway (Taiwan Highway No. 20), and ca. 1800 m elevation (Fig. 1). It is associated with many grasses such as *Brachypodium sylvaticum* (Huds.) P. Beauv., *Bromus hordeaceus* L., *Dactylis glomerata* L., *Festuca arundinacea* Schreb., *Lolium perenne* L., *Poa annua* L., *Polypogon fugax* Nees ex Steud., and *Setaria plicata* (Lam.) T. Cooke. *Bromus carinatus* can be distinguished from *B. catharticus* by the longer awn and lesser compressed spikelet.

Specimens examined: Kaohsiung Co.: Tau-yuan Hsiang. Entrance of Li-guan Tunnel, *M.-J. Jung, x061010, x061012* (NCKU); Jhongjhihguan, *T.-H. Hsieh & C.-F. Lin s. n.*, Jun 20, 2004 (NTNTC); Tienchi, *M.-J. Jung, x071103, x071114, x071115, x071116, x071117* (NCKU); Kuaigu, *M.-J. Jung, x100501, x100502, x100503* (NCKU).

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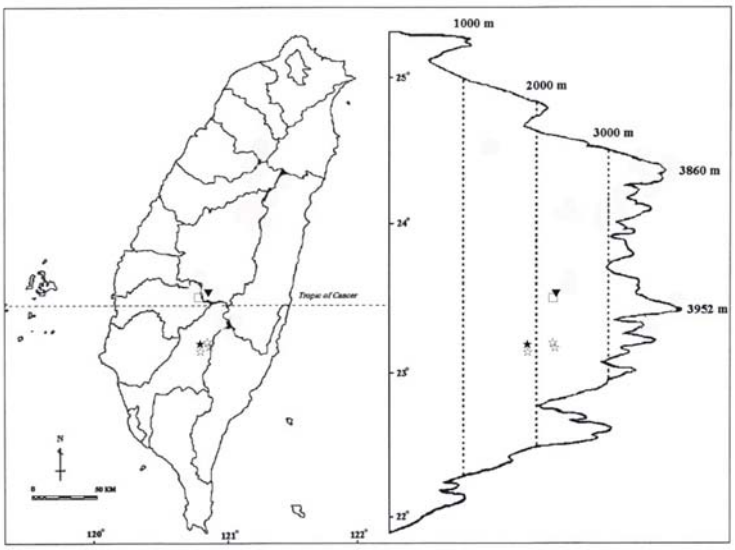


Fig. 1. Distribution of *Bromus carinatus* (☆) and *B. hordeaceus* (★), *B. pubescens* (▼) and *B. secalinus* (□) in Taiwan.

2. ***Bromus hordeaceus*** L., *Sp. Pl.* 1: 77. 1753; Pavlick L. E., Bromus L. of North America, 78-81. 1995; Smith in Cafferty et al., Taxon 49(2): 248. 2000. 毛雀麥 Fig. 3

Bromus mollis L. Sp. Pl. (ed. 2) 1: 112. 1762; Hitchcock A. S., Manual of grasses of the United States, 49-50, t. 29. 1951; Osada T., Illustrated Grasses of Japan, 390-391, 1993

Culms annual, erect, to 30 cm tall; stem long tomentose. Leaf sheath long tomentose; ligule ca. 0.8 mm long, membranous; blade linear, ca. 5 cm long. Inflorescence spike-like with few spikelets; or a panicle. Lower glume elliptical, ca. 6 mm long, tomentose, 7-veined. Upper glume ovate, ca. 7 mm long, tomentose, 9-veined. Lemma obovate, ca. 8 mm long, 7-veined, apex bifid, tomentose, with one awn; awn arising from 1/5 of apex, 7-8 mm long. Palea oblong, ca. 6.5 mm long, 2-keeled, apex obtuse and ciliate; keels strigose and hispid. Caryopsis oblong, ca. 6 mm long, base caudate, adnate with lemma and palea when mature.

Distribution and notes: The common name of *Bromus hordeaceus* is soft chess, distributed in North America and Europe. In Taiwan, it occurs at the entrance of Li-Guan Tunnel (Fig. 1), the same site as *B. carinatus* mentioned above. There are several subspecies, our specimens belong to subsp. *hordeaceus*. (J. F. Veldkamp, personal communication).

Specimens examined: Kaohsiung Co.: Tau-yuan Hsiang. Li-Guan tunnel, *M.-J. Jung, x061003, x061004* (NCKU).

3. ***Bromus pubescens*** Muhl. ex Willd., *Enum. Pl.* 120. 1809; Pavlick L. E., Bromus L. of North America, 58 - 59. 1995. 短毛雀麥 Fig. 4

Culms to 150 cm tall, rhizomatous; stems erect; lower sheaths pubescent, retrorsely pilose, upper sheaths glabrous; ligule ca. 2 mm long, membranous; blades up to 30 × 1.3 cm. Spikelet lanceolate, with 7-13 florets. Lower glume lanceolate, 8-9 mm long, with 3-5 veins. Upper glume lanceolate, ca. 1.1 mm long, 7-veined; rachilla pubescent. Lemma oblanceolate, 7-15 mm long; abaxial surface pubescent, margin long ciliate, ciliate hairs ca. 1 mm long, apex bifid, with one awn. Palea 2-keeled, keels shortly hispid. Anthers ca. 0.8 mm long. Ovary apically pubescent.

Distribution and notes: The common names of *Bromus pubescens* Muhl. ex Willd. include: Canada brome, Canadian brome, hairy brome, hairy woodland brome, and woodland brome. In Taiwan, it was found beneath Fu-ci trees, along the roadside of Taiwan Highway No. 21, at ca. 2400 m (Fig. 1). *Agrostis infirma* Buse, *Agrostis stolonifera* L., *Dactylis glomerata* L., *Dendranthema arisanense* (Hayata) Y. Ling & C. Shih, *Festuca arundinacea* Schreb., *Poa annua* L., and *Senecio inaequidens* DC. could be found at the same site.

Specimens examined: Nantou Co.: Shin-yi Hsiang. Fuci tree, *M.-J. Jung, x060601, x060603, x062704, x062705* (NCKU).

4. ***Bromus secalinus*** L., Sp. Pl. 1: 76. 1753; Hitchcock A. S., Manual of Grasses of the United States, 47-49, t. 27.1951; Osada T., Illustrated Grasses of Japan, 388-389, 1993. 歐雀麥 Fig. 5

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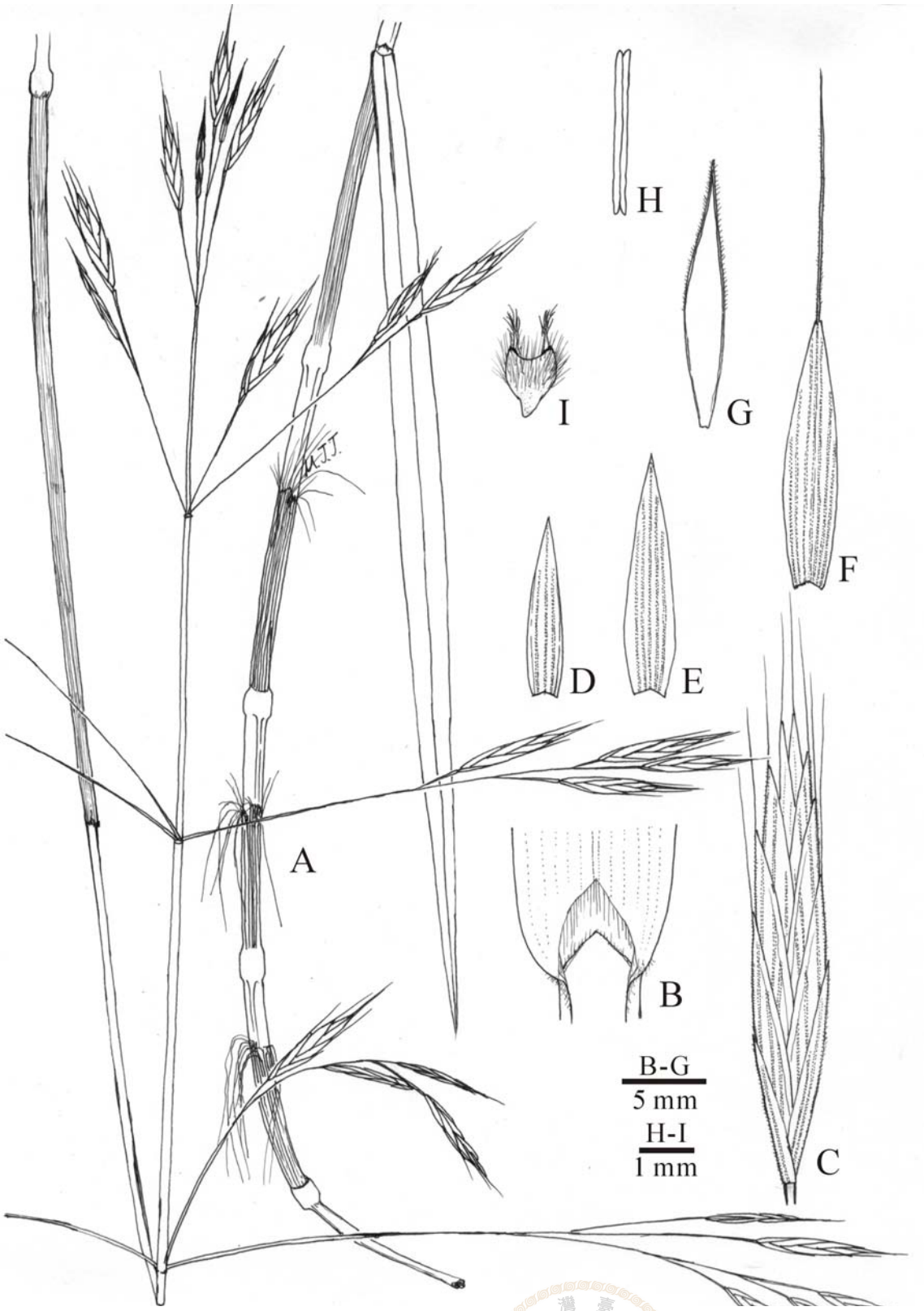


Fig. 2. *Bromus carinatus* Hook. & Arn. A: Habit. B: Ligule. C: Floret with rachilla. D: Lower glume. E: Upper glume. F: Lemma. G: Palea. H: Anther. I: Pistil.

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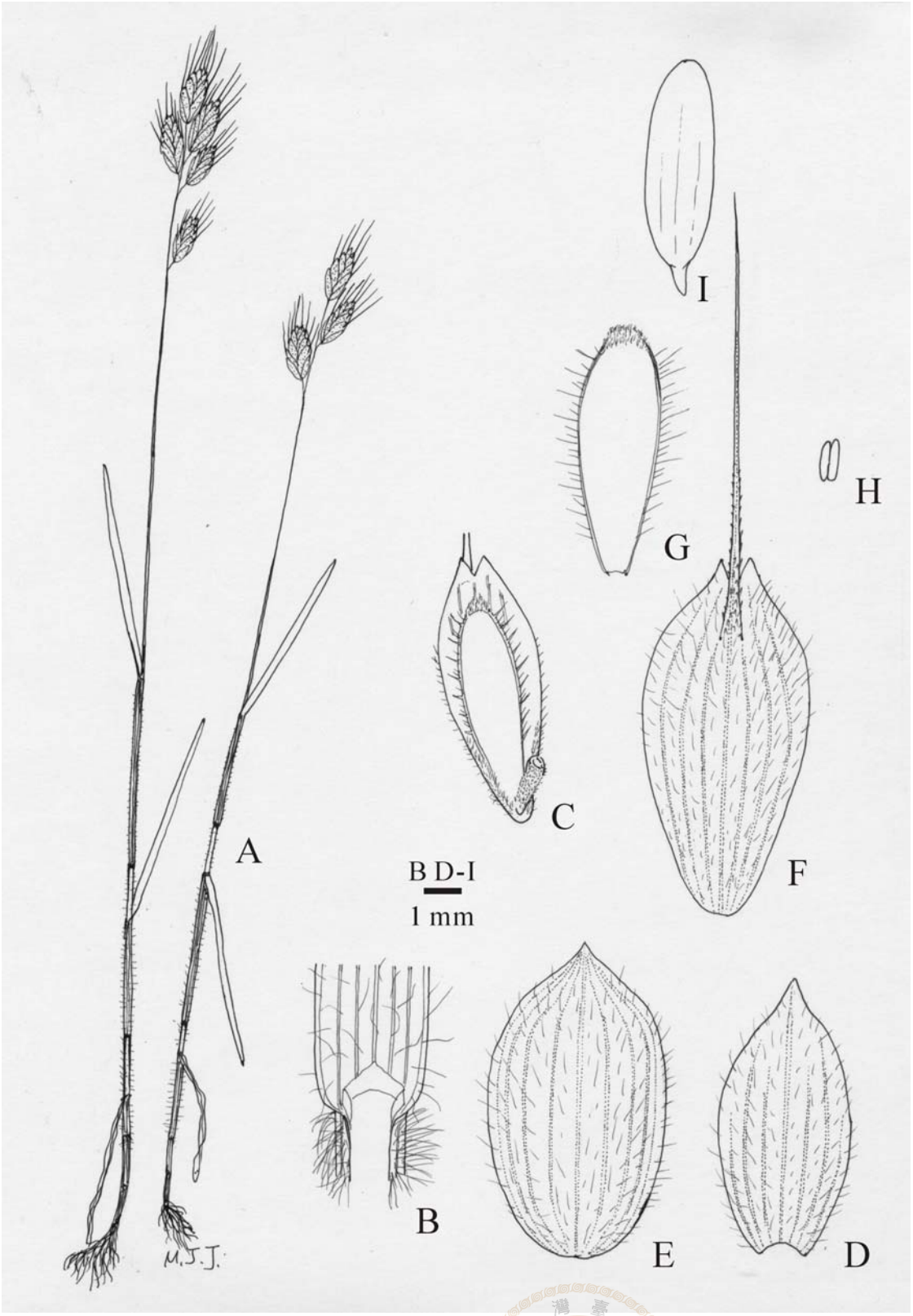


Fig. 3. *Bromus hordeaceus* L. A: Habit. B: Ligule. C: Adaxial view of floret. D: Lower glume. E: Upper glume. F: Lemma. G: Palea. H: Anther. I: Caryposis.

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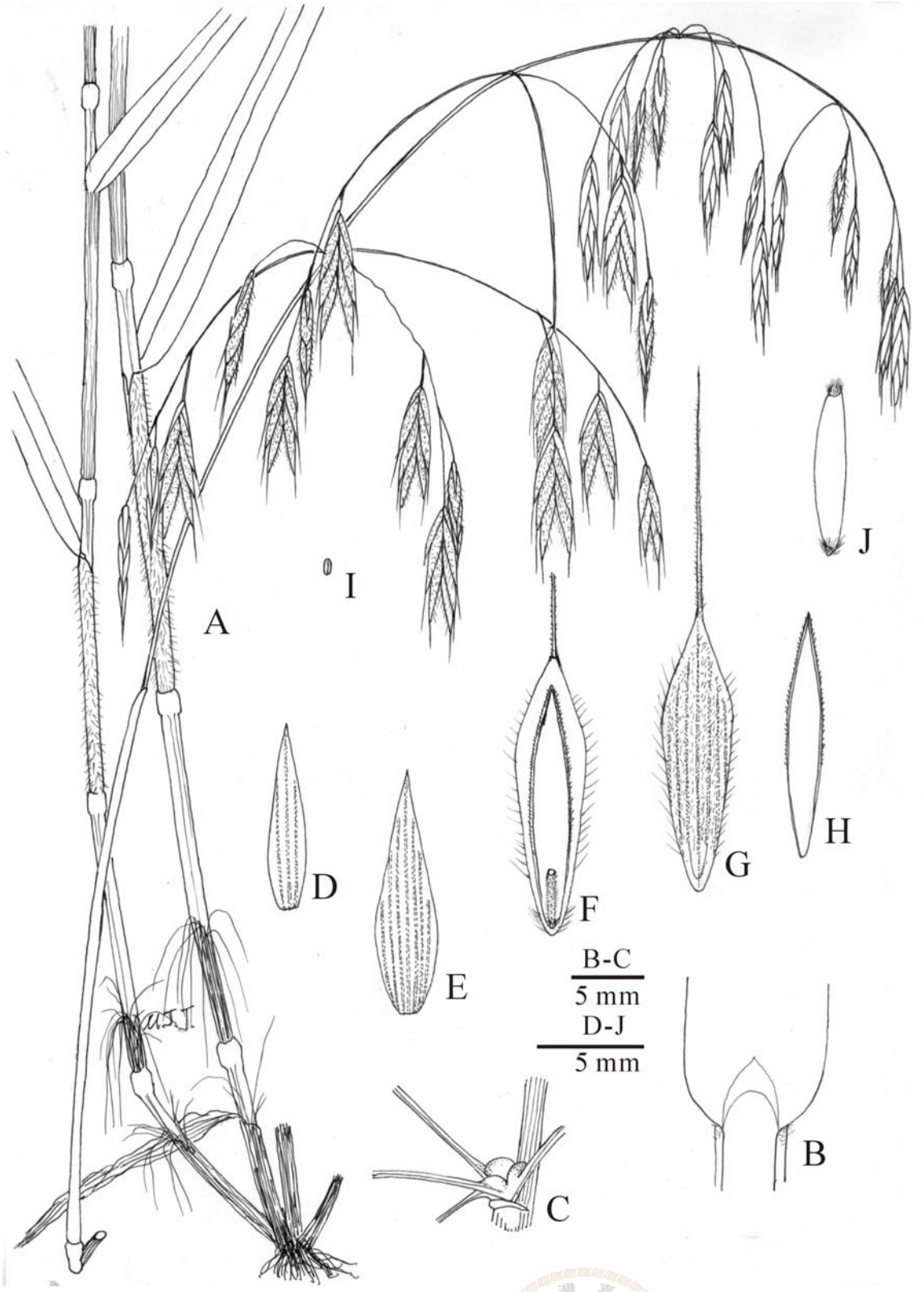


Fig. 4. *Bromus pubescens* Muhl. ex Willd. A: Habit. B: Ligule. C: Nodes of inflorescence. D: Lower glume. E: Upper glume. F: Adaxial view of floret. G: Lemma. H. Palea. I: Anther. J: Caryposis.

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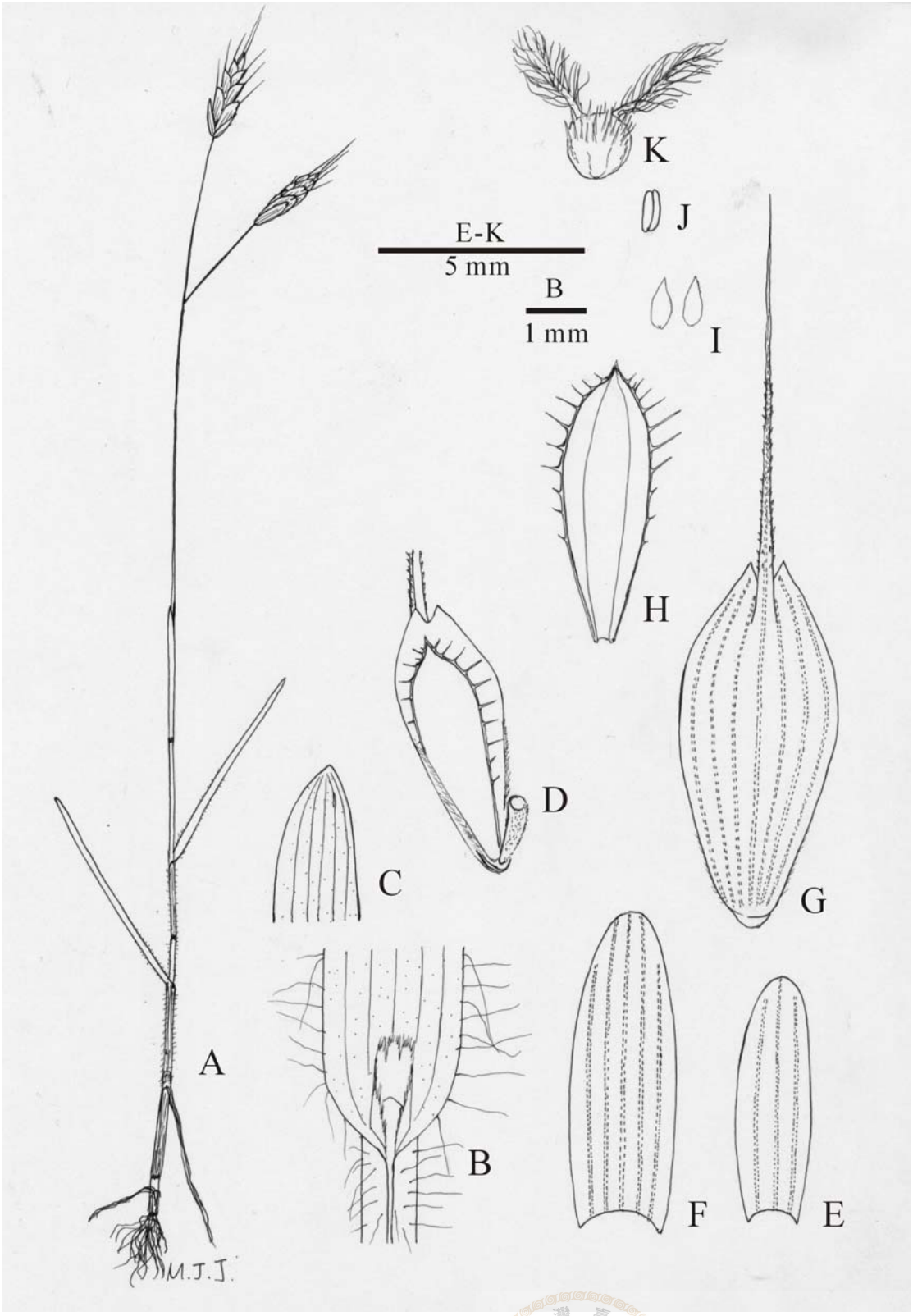


Fig. 5. *Bromus secalinus* L. A: Habit. B: Ligule. C: Blade apex. D: Adaxial view of floret. E: Lower glume. F: Upper glume. G: Lemma. H: Palea. I: Lodicules. J: Anther. K: Pistil.

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Culms erect, to 30 cm tall. Sheath pubescent. Ligule ca. 1 mm long, membranous, apex irregularly dentate. Blade up to 20 × 1 cm, pubescent. Panicle simple to spreading, ca. 15 cm long; lower branches declinate. Spikelet ca. 3 cm long, with 7-9 florets; lower glume lanceolate, ca. 5.5 mm long, glabrous, 5-veined. Upper glume lanceolate, ca. 7 mm long, glabrous, 7-veined. Lemma obovate, ca. 9 mm long, glabrous, 7-veined, apex bifid, with one awn; awn arising from submargin of lemma apex, 8-10 mm long. Palea ca. 8 mm long, membranous, with 2-keeled, long hispid on keels. Anthers 3, ca. 1 mm long. Ovary pubescent, apex hispid.

Distribution and notes: The common names of *Bromus secalinus* are cheat, chess, and rye brome. It was introduced to America from Europe (Hitchcock, 1951). In Taiwan, it occurs near the Lu-lin sacred tree, along the Taiwan Highway No. 18, at ca. 2400 m (Fig. 1). It grows together with many grasses such as *Dactylis glomerata* L., *Festuca arundinacea* Schreb., *Miscanthus sinensis* Anders., *Poa annua* L., and *Vulpia myuros* (L.) Gmel.

Specimens examined: Nantou Hsien: Shin-yi Hsiang. Lulin Lodge, *T.-H. Hsieh, 3030* (NTNTC); Lu-lin sacred tree, *M.-J. Jung, x053005, x062709, x062710, x062711* (NCKU).

5. ***Bromus diandrus*** Roth, Bot. Abh. Beobacht. 44. 1787; Veldkamp J. F., Blumea 35(2): 489. 1991.
硬雀麥

Bromus rigidus Roth in Roemer & Usteri., Mag. Bot. 10: 21. 1790; Kuo C.-M., Taiwania 24: 22. 1979; Osada T., Ill. Grasses Jap. Enl. Ed. 382. 1993; Chen C.-H., & Kuoh C.-S., Taiwania 45: 311-322. 2000

Key to the species

1. Spikelets compressed, glumes and lemmas keeled.
1. Spikelets terete, glumes and lemmas not keeled.
  2. Lemmas mostly 11-veined, awnless or with a short awn, awn shorter than 5 mm; paleaelliptical ……. *B. catharticus*
  2. Lemmas 5-7-veined, awned, awn longer than 5 mm; palea oblong. ……. *B. carinatus*
    3. Lemma awn longer than 5 cm ……..……... *B. diandrus*
    3. Lemma awn shorter than 5 cm
      4. Lemmas board, elliptical, obovate to oblanceolate
      4. Lemmas narrow, lanceolate to oblong
        5. Lemmas glabrous ..…….…..…… *B. secalinus*
        5. Lemmas pubescent
          6. Lemmas tomentose, awn arising from submargin of lemma apex. ……...…. *B. hordeaceus*
          6. Lemmas margin ciliate, awn arising from lemma apex ……..…. *B. pubescens*
            7. Lower glumes 1-nerved; upper part of lemma glabrous, lower part of lemma loose hairy; awn nearly as long as lemma ..…… ……..….. *B. morrisonensis*
            7. Lower glumes 3-nerved; lemma dense hairy, awn shorter than 1/2 length of lemma …….. ……....…….…….. *B. formosanus*

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臺灣外來雀麥屬禾草增註

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摘　　要

長芒扁雀麥 (新擬中名) (*Bromus carinatus* Hook. & Arn.)、毛雀麥 (*Bromus hordeaceus* L.)、短毛雀麥 (新擬中名) (*Bromus pubescens* Muhl. ex Willd.)、及歐雀麥 (新擬中名) (*Bromus secalinus* L.) 分別為近期在臺灣南部及中部中海拔山區所發現之外來雀麥屬植物。本文提供此四種植物的描述、形態及分布。

關鍵詞：長芒扁雀麥、毛雀麥、短毛雀麥、歐雀麥、禾本科、臺灣、分類。

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