



## NOTE

## Four Newly Naturalized Grasses and Rushes in Taiwan

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**ABSTRACT:** Four Monocots newly naturalized in Taiwan: *Juncus imbricatus* (Juncaceae), *J. marginatus* (Juncaceae), *Setaria barbata* (Poaceae) and *Sorghum bicolor* subsp. *arundinaceum* (Poaceae) were represented in this article. We described and illustrated by line-drawings of these four alien rushes and grasses, and offered relative information of them.

**KEY WORDS:** Alien plant, *Juncus*, *Setaria*, *Sorghum*.

## INTRODUCTION

Naturalization of alien plants in Taiwan was concerned in academics and publics (Chen, 2007; Jung, 2011; Wang et al., 2011). After publish of latest checklist of alien plant in Taiwan (Wang et al., 2011), four alien monocots belong to Juncaceae and Poaceae were found in low elevations, western Taiwan. The first two monocots are *Juncus imbricatus* Laharpe and *J. marginatus* Rostkovius. Both are native to western Hemisphere (Balslev, 1996) then naturalized in eastern Hemisphere in recent years (Lazarides et al., 1997). Six species including four aquatic *Juncus* species had been recorded in the flora of Taiwan (Kao et al., 2000; Boufford et al. 2003; Li, 2007, Li et al., 2008). We added another two territorial *Juncus* species in this article, described and illustrated their morphological characters. Microstructure of their seed surfaces were also illustrated herein to aid for identification.

Members of Poaceae are not only main components of Taiwanese native vascular plants, but also dominant in alien weeds of Taiwan (Boufford et al., 2003; Jung, 2011; Wang et al., 2011). In our steadily field surveys, wild populations of two alien grasses: *Setaria barbata* (Lam.) Kunth and *Sorghum bicolor* (L.) Moench subsp. *arundinaceum* (Desv.) de Wet & J. R. Harlan were found in low elevations, western Taiwan. Both of them steadily occurred around farms and bamboo fields with serious human disturbances, implying their naturalization events. Descriptions and line-drawings of these two grasses were presented here.

## TAXONOMIC TREATMENTS

*Juncus imbricatus* Laharpe, Essai Mongr. Junc. 61. 1825. Balslev, Juncaceae. In: Fl. Neotropica: 83. 1996.

絲葉燈心草 Figs. 1 & 5

Perennial cespitose herbs, erect, 15–45 cm tall. Leaves 3–4 per culm; sheaths 1.5–6 cm long with scariose margins terminating in two 0.3–0.5 mm long auricles; blade filiform with an adaxial groove, 0.6–1 mm wide. Cyme terminal, branches unilateral; lower inflorescence bract resembling a basal leaf, herbaceous, 3–4 cm long; each flower clasped by two 1.5–2 mm long bracteoles, bracteoles ovate, apex obtuse, margin hyaline; perianths 6, lanceolate, midrib green, margins hyaline, ca. 3 mm long, inner perianths slightly shorter than outer ones; stamens 6, 1.7–2 mm long, anthers ca. 0.5 mm long; pistil 1, ovary ellipsoid, glabrous, stigma 3-lobed. Capsule ellipsoid, apically obtuse to truncate, trigonous, ca. 3 mm long, to 2.5 mm wide; seeds 0.4–0.6 mm long, 0.2–0.3 mm wide, rugose, brown.

Specimens examined: TAIWAN. Taipei City, Campus of Chinese Culture University, *J.-C. Kao 1294* (TAIF); New Taipei City, Jingshan Township, Jingshan, 30 May 2011, *M.-J. Jung 5478* (TNU, TAIF); Keelung City, Keelung Island, 21 Apr 2007, *P.-F. Lu 13628* (TAIF); Kaohsiung City, Taoyuan District, Meilan Forest Road, 7 Oct 2000, *C.-I Peng 18138* (HAST); Ilan Co., Nan-au Township, Shen-Mi Lake, 15 May 2004, *M.-L. Wu s. n.* (TAIF), Tsuifeng Lake, 28 Aug 2002, *P.-J. Lin 31* (HAST), Tatung Township, Chetui Lake, 10 May 2002, *C.-I Huang 819* (HAST).

Distribution and notes: *Juncus imbricatus* is native to South America and Mexico, then naturalized in South Africa, Australia and Portugal (Balslev, 1996; Lazarides et al., 1997). Nowadays, three wild populations of *J. imbricatus* had been found at coastal grasslands and low elevations, northern Taiwan. In Taiwan, this newly

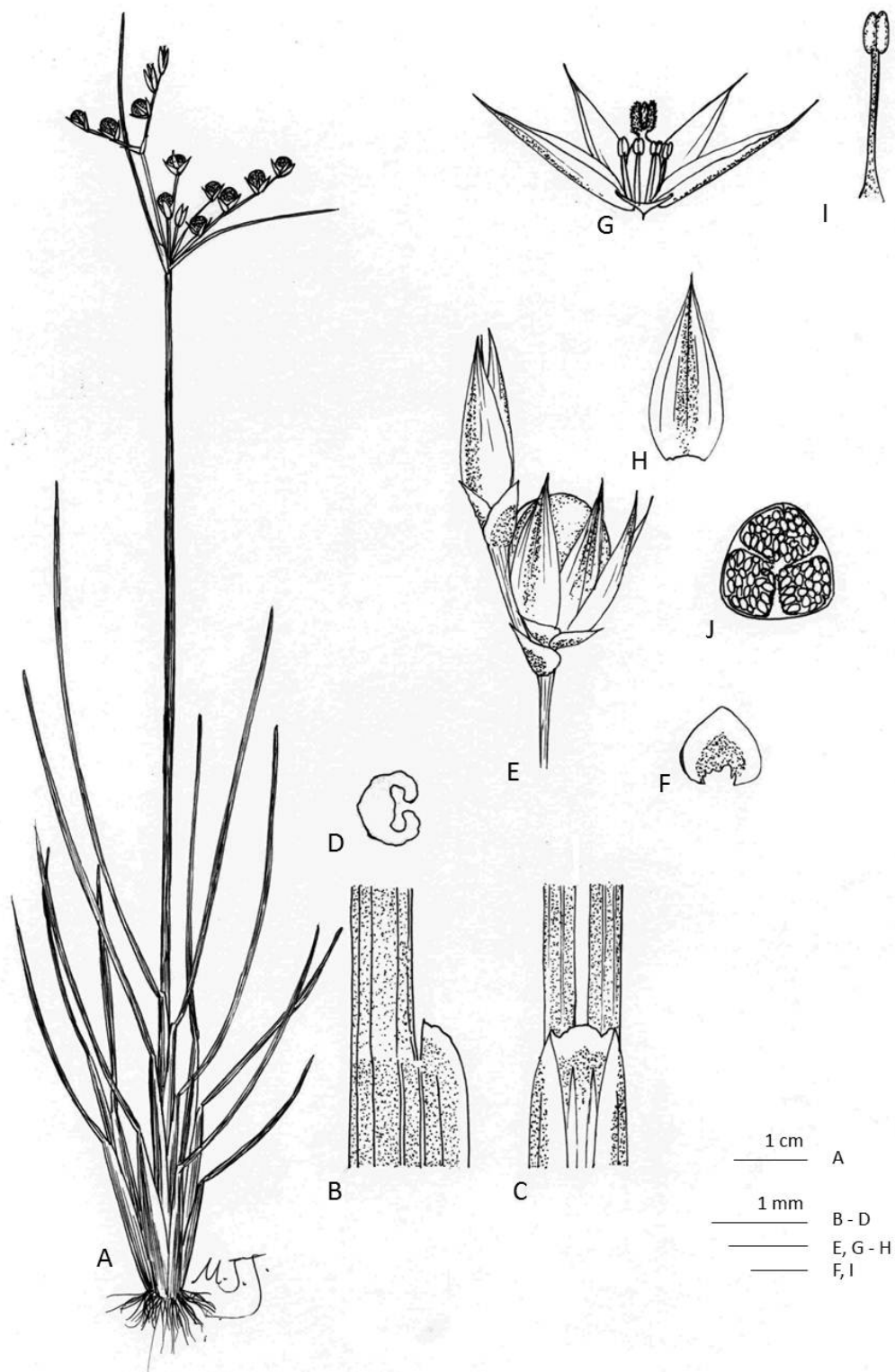


Fig. 1. *Juncus imbricatus* Laharpe. A: Habit. B & C: Ligules, B: Lateral view. D: Cross-section of leaf blade. E: Cluster of flowers, basal one fruiting. F: Bract. G: Dissected flower. H: Perianth. I: Anther. J: Cross-section of Capsule.



naturalized rush is most similar to *J. tenuis* Willd., *J. triflorus* Ohwi and *J. wallichianus* Laharpe in outline which with terete leaf blades. However, *J. triflorus* is a tiny alpine rush with apical capituliform inflorescence, which is differed to the other three rush species with apical and spreading cyme. Margins of leaf sheaths are dominant hyaline in *J. imbricatus*, but herbaceous in both *J. tenuis* and *J. wallichianus*. These morphological differences would be benefit for identifying *Juncus* spp. in Taiwan.

*Juncus marginatus* Rostkovius. De Junco: 38, pl. 2, fig. 3. 1801. Balslev, Juncaceae. In: Fl. Neotropica: 100. 1996; Brooks and Clemants. Juncaceae. In: Fl. N Amer. Edit. Commi. (Eds.), 22: 229. 2000.  
禾葉燈心草 Figs. 2 & 5

Perennial herbs, tufted, rhizomatous or not, rhizomes short, base culms bulblike. Leaves basal and cauline; auricles 0.5–1.5 mm, apex rounded, membranous; basal blade flat, 15–25 cm long, 5–6 mm wide, cauline leaves with glabrous sheaths, margin hyaline, blades narrower than basal ones. Cyme terminal and spreading, 3–10 cm, with 5–10 glomerules, with 2–3 flowers on each glomerule; bracts 2, broadly ovate, amplexical, hyaline, 1-nerved, apex acuminate to a short awn; flowers bisexual, perianths 6, usually with green midstripe, ovate-lanceolate, 2–3 mm long, apex acute, awned or not; stamens 3, filaments 0.7–1 mm long, anthers ca. 0.2 mm long; pistil 1, ovary ellipsoid, glabrous, style 0.2–0.3 mm long, stigma 3-lobed. Capsules brownish, 3-locular, obovoid to nearly globose, 2–3 mm long; seeds yellow to light brown, ovoid to fusiform, 0.4–0.7 mm long.

Specimens examined: TAIWAN. Taipei Co., Hsintien City, Sher-tzai-tou-shan, 20 Jun 2009, M.-J. Jung 5067 (TNU, TAIIF).

Distribution and notes: Vernacular name of *Juncus marginatus* is Grass-leaf Rush. This rush is native to E North America, Mexico to Costa Rica, the West Indies and South America (Balslev, 1996; Brooks and Clemants, 2000), and locally naturalized at low elevations, northern Taiwan. Since two newly naturalized *Juncus* species had been recorded in this article, an advanced key to members of this genus in Taiwan were offered in follow.

### Key to the *Juncus* species in Taiwan

1. Leaves wanted or extremely reduced ..... 2
1. Leaves basal and/or cauline, dominant ..... 3
2. Culms thicker than 2 mm, cymes with 100–150 florets .....  
..... *J. effuses*
2. Culms narrower than 1 mm, cymes with 10–30 florets .....  
..... *J. tobdenii*
3. Basal and cauline leaves falcate, not flat, terete, cylindrical or filiform ..... *J. leschenaultia*
3. Basal and cauline leaves flat, terete, cylindrical or filiform ..... 4

4. Basal and/or cauline leaves conspicuously flat ..... *J. marginatus*
4. Basal and/or cauline leaves terete, cylindrical or filiform ..... 5
5. Leaves cylindrical, not grooved on adaxial surface .....  
..... *J. wallichianus*
5. Leaves terete or filiform, with a single groove on adaxial surface ..... 6
6. Culms shorter than 10 cm, perianths longer than 5 mm .. *J. triflorus*
6. Culms taller than 15 cm, perianths shorter than 4 mm ..... 7
7. Margins of sheaths hyaline ..... *J. imbricatus*
7. Margins of sheaths herbaceous ..... *J. tenuis*

*Setaria barbata* (Lam.) Kunth. Rev. Gram. 1: 47, 1829.

Bor and Taylor. The Grasses of Burma, Ceylon, India and Pakistan: 360. 1960; Ravi and Mohanan. Comm. Trop. Subtrop. Sedges & Grasses: 198, 2002. Rominger, Fl. N Amer. 25: 543, 2003.

柔毛狗尾草 Figs. 3 & 5

Plants annual, cespitose then erect or ascending when flowering; culms 50–200 cm; nodes glabrous or sericeous; sheaths slightly keeled, keels glabrous, sheaths margins and submargins sericeous abaxially, sparsely with papillose-based hairs on abaxial surface; ligule sericeous, hairs about 1 mm; blades 10–25 cm wide, plicate, abaxial surface ciliate, margins with parallel rows of papillose-based hairs. Panicles to 20 cm, open; branches 2–4 cm, axes villous; bristles present or not, solitary when present, 5–8 mm, flexible; spikelets 2.5–3 mm. Lower glumes ca. 1 mm long, orbicular to ovate, 3–5 veined; upper glumes ca. 2 mm long, ovate, apex acute, 7-veined; lower lemmas ca. 2.5 mm long, apex acute; lower paleas 2-keeled, scabrous on keels, slightly shorter than lower lemma; upper lemmas ovate, margins reflexed, apex acute, ca. 2.3 mm long, densely transversely rugose on abaxial surface, coriaceous; upper paleas coriaceous, rugose on central part of abaxial surface; caryopsis obovoid, apex round.

Specimens examined: Taiwan. Taipei City, Dachi, 29 Nov 2011, T.-C. Hsu 5135 (TAIF), same loc., 16 Feb 2012, M.-J. Jung 5750 (TNU, TAIIF). Pingtung Co., Yenpu Township, Yenpu, 10 Oct 2008, S.-H. Dai s. n. (TAIF); Hualien Co., Hualien City, Hua-Shih Campus of National Dong-Hua University, 28 Nov 2006, S.-H. Chen s. n. (TAIF).

Distribution and notes: Vernacular name of *Setaria barbata* are: Mary grass, corn grass and east Indian bristlegrass. This grass is native to Africa and India, then introduced to the West Hemisphere include West Indies and Florida (Bor and Taylor, 1960; Ravi and Mohanan, 2000). Ten *Setaria* species including six or seven alien ones were recorded in the flora of Taiwan (Boufford et al., 2003; Wang et al., 2011). In recent, this grass had been locally naturalized near farms and bamboo gardens in low elevations, northern and southern Taiwan. This alien grass is similar to *S. palmifolia* (J. König) Stapf and *S. plicata* (Lam.) T. Cooke based on dominant elliptic and plicate leaf blades in outline. However, sheaths of *S. barbata* are coated with both sericeous and papillose-based hairs



Fig. 2. *Juncus marginatus* Rostkovius. A: Habit. B & C: Ligule. C: Lateral view. D: Cluster of two flowers. E: Bract. F: Perianth. G: Stamens and Pistil. H: Fruiting flower. I: Seed.

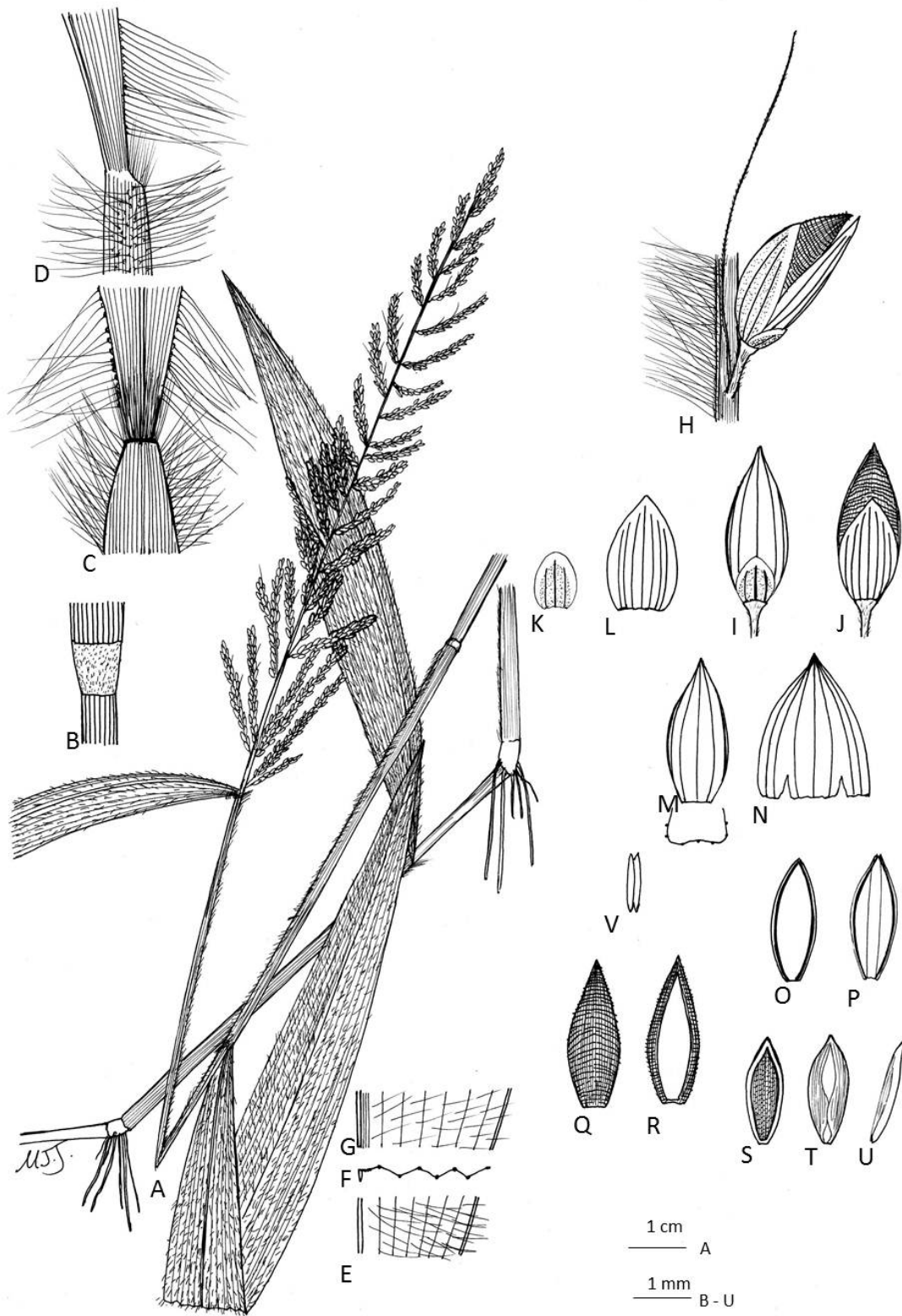


Fig. 3. *Setaria barbata* (Lam.) Kunth. A: Habit. B: Node. C and D: Ligule, hairy sheaths and blade margins. E-G: Part of leaf blade. H: Spikelet with bristle. I and J: Spikelets. K: Lower glume. L: Upper glume. M and N: Lower lemmas, N: Flattened one. O and P: Lower paleas. Q and R: Upper lemmas. S-U: Upper paleas. V: Anther. E, P, R and T: Adaxial view. F: Cross-section view. G: Abaxial view. H and U: Lateral view.



conspicuously, but are hispidulate in *S. palmifolia* and glabrous in *S. plicata*.

***Sorghum bicolor* (L.) Moench subsp. *Arundinaceum*** (Desv.) de Wet & J. R. Harlan. *Origins African Pl. Domest.* 455. 1976. Barkworth, *Fl. N Amer.* 25: 628, 2003.

葦狀高粱 Figs. 4 & 5

Plants annual or short-lived perennials; culms 0.5–2 m tall, 0.7–1 cm thick, sometimes branching; nodes and internodes glabrous; ligule 1–4 mm, apex obtuse, hyaline, margin ciliate; collar sparsely hirsute on adaxial surface; blades linear, 5–30 cm long, to 1.5 cm wide, midrib 1. Panicles to 50 cm long, spreading; sessile spikelets bisexual, 7–10 mm; callus hirsute, hairs 0.7–1.5 mm long; lower glumes lanceolate to elliptic, coriaceous, glabrous or densely hirsute outside, apex acuminate, 12-nerved with transverse veinlets, 2-keeled, keels scabrous on upper part; upper glume lanceo-ovate, apex acuminate, 7-nerved with transverse veinlets, scabrous on upper part of midnerve; lower lemma present or not, lanceolate, hyaline, ciliate at upper margin; upper lemmas ovate, *ca.* 4 mm long, upper margin ciliate, apex notched, unawned; upper palea lanceolate, hyaline, upper margin ciliate; lodicules 2, apex truncate and with 2 clusters of hairs; pedicels 1–2.6 mm, pedicellate spikelets to 6 mm long, usually sterile; lower glume elliptic, coriaceous, upper margins ciliate, 12-nerved and 2-keeled, upper part of keels scabrous; caryopsis fusiform to ellipsoid, apex obtuse.

Specimens examined: Taiwan. Miaoli Co., Tongshau Township, Tongshau, 4 Nov 2011, *M.-J. Jung* 5259 (TNU, TAIF); Kaohsiung Co., Alien Township, Daganshan, 14 Mar 2011, *M.-J. Jung* 4877 (TNU, TAIF); Luchu Township, Luchu Scientific Park, 14 Mar 2011, *M.-J. Jung* 4884 (TNU, TAIF).

Distribution and notes: Vernacular name of *Sorghum bicolor* subsp. *arundinaceum* include: Mary grass, corn grass and east Indian bristlegrass. This subspecies of *S. bicolor* (L.) Moench is native to Africa, then introduced to the West Hemisphere i. e. the West Indies and Florida from Asia (Barkworth, 2003). In Taiwan, this alien grass had been naturalized at orchards and fields in central and southern Taiwan. Compared to the long-term naturalized grass: *S. halepense* (L.) Pers. (which has ovate spikelets) and the broadly cultivated then escaped crop: *S. bicolor* (L.) Moench subsp. *bicolor* (which has obovate spikelets), *S. bicolor* (L.) Moench subsp. *arundinaceum* has lanceolate spikelets, which could be used as an identification characters for this newly naturalized weed in Taiwan. Based on its populations are usually nearby plains with agricultural activities, this grass might be introduced as pastures or just immigrated with substrates.

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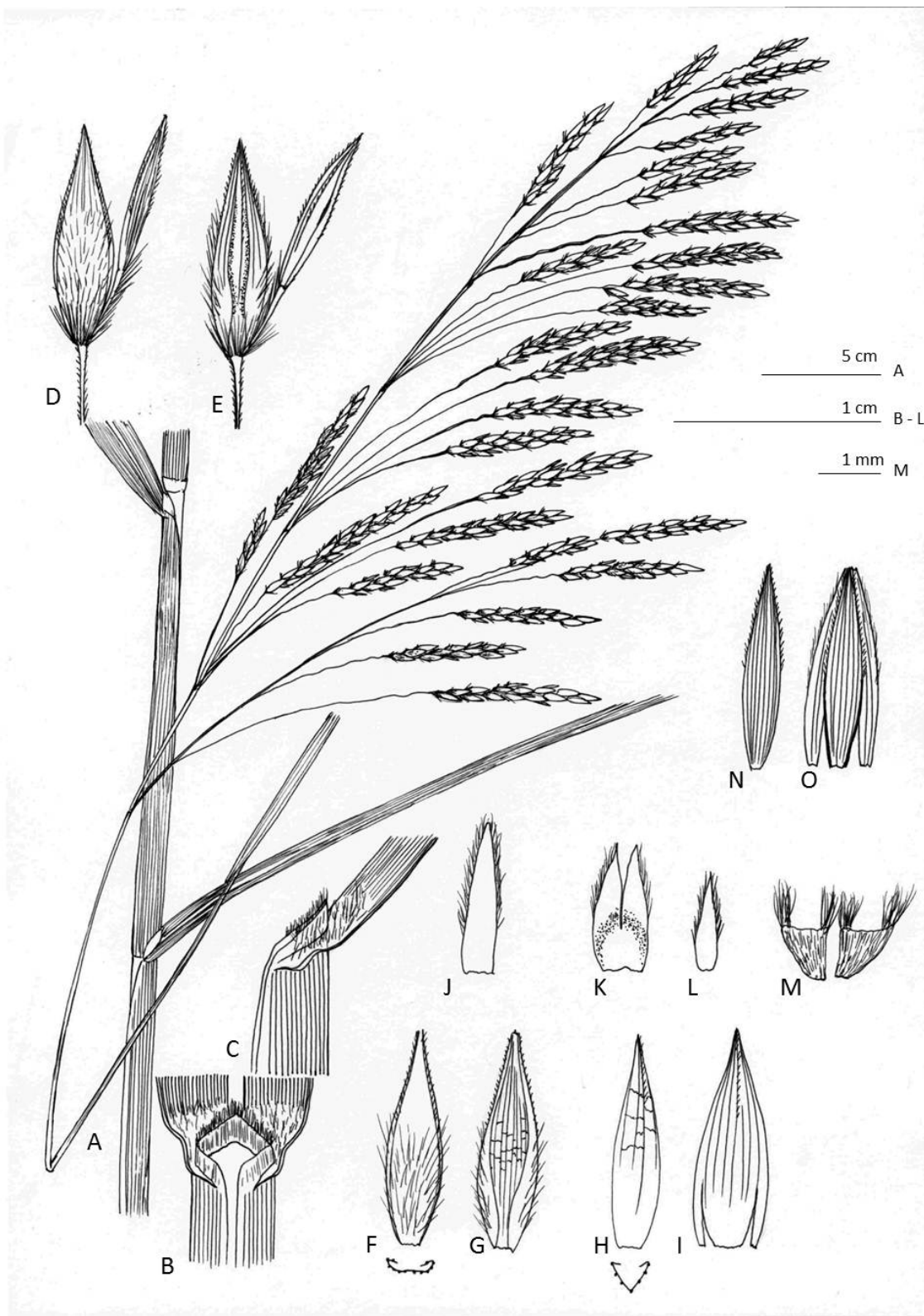


Fig. 4. *Sorghum bicolor* (L.) Moench subsp. *arundinaceum* (Desv.) de Wet & J. R. Harlan. A: Habit. B and C: Ligules and hairy collars, C: Lateral view. D and E: Pairs of spikelets, E: Upper glume side view. F and G: Lower glume. H and I: Upper glume. J: Lower lemma. K: Upper lemma. L: Upper palea. M: Lodecules. N and O: Lower glume of pedicel spikelet, O: Flatten one. G and I: Adaxial view.

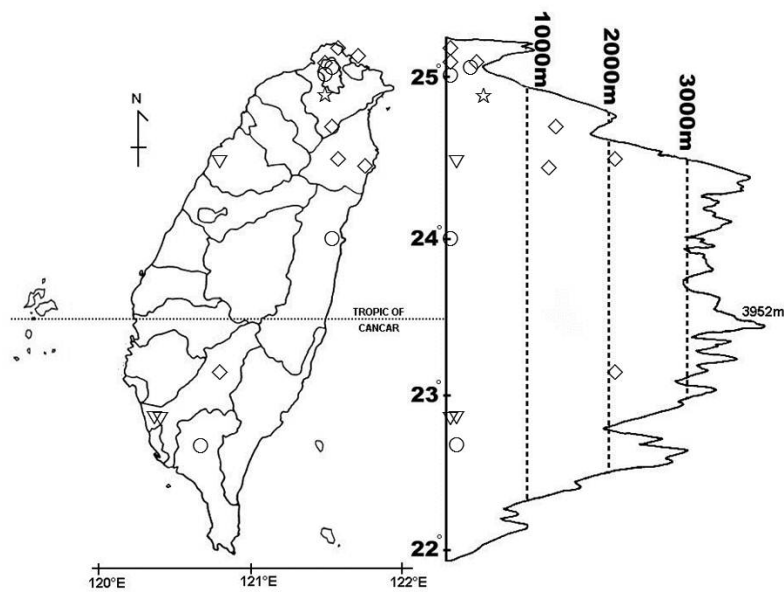


Fig. 5. Distribution map of *Juncus imbricatus* (◇), *J. marginatus* (☆), *Setaria barbata* (○) and *Sorghum bicolor* subsp. *arundinaceum* (▽).

#### 四種臺灣新歸化禾草與燈心草

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摘要：本文報導四種臺灣新歸化單子葉植物：絲葉燈心草（燈心草科）、禾葉燈心草（燈心草科）、柔毛狗尾草（禾本科）與葦狀高粱（禾本科），並提供特徵描述、手繪圖與相關資訊。

關鍵詞：外來植物、燈心草屬、狗尾草屬、蜀黍屬。