Taiwania, **51**(3): 240-248, 2006

Notes on Grasses (*Poaceae*) for the Flora of Taiwan (II)

Ming-Jer Jung[1], Robert J. Soreng[2], and Chang-Sheng Kuoh[1,3]

(Manuscript received 27 January, 2006; accepted 26 April, 2006)

ABSTRACT: *Poa compressa* L., *P. pratensis* L., and *P. trivialis* L. were recently naturalized in the central part of Taiwan. The existence of *P. acroleuca* Steud. in Taiwan was confirmed by examining the specimens deposited in HAST, NCKU, TNM, TNU, and TAI. We treated these four bluegrasses with corresponding descriptions, illustrations, and distribution maps.

KEY WORDS: Naturalized plants, *Poa acroleuca, Poa compressa, Poa pratensis, Poa trivialis,* Gramineae, Poaceae, Taiwan, Taxonomy.

INTRODUCTION

The genus *Poa* L. has ca. 500 species distributed in temperate regions and tropical mountains (Clayton and Renvoize, 1986). In Taiwan, seven or eight taxa were recognized in this genus, including five endemic species (Boufford et al., 2003; Kuoh and Chen, 2000). The existence of *Poa acroleuca* Steud. in Taiwan was reported by Ohwi (1941), Hsu (1975, 1978), and Koyama (1987); however, Ohwi (1941) and Koyama (1987) did not cite any specimens of this species in their publications. In addition, Osada (1993) did not consider the existence of *P. acroleuca* in Taiwan. Chen et al. (2000) even doubted the identification of *P. acroleuca* by Hsu (1975, 1978) when checking with Veldkamp's revision of *Poa* in Malesia (1994). We found numerous misidentifications on both *P. annua* L. and *P. acroleuca* upon examination of the specimens deposited in HAST, NCKU, TNM, TNU, and TAI. Furthermore, three bluegrasses: *P. compressa* L., *P. pratensis* L., and *P. trivialis* L. were recently found in the central part of Taiwan, so we treated them along with *P. acroleuca* and herein present their descriptions, distribution maps (Fig. 1), and illustrations (Figs. 2-5).

TAXONOMIC TREATMENT

Poa acroleuca Steud., Syn. Pl. Glumac. 1: 256, 1854; Koyama, T. 1987. Grasses of Japan and its neighboring regions 91-93; Osada, T. Illustrated Grasses of Japan 166. 白頂早熟禾 Fig. 2

Herbs annual to biannual, tufted. Culms erect, to 50 cm tall. Sheath keeled near leaf base; ligule ca. 2 mm long, membranous, margin serrate, apex acuminate. Leaf blade linear, 8-15 cm long, longer than sheath, apex acute. Inflorescence a spreading panicle, with 5-7 nodes, 5-12 cm long; lowest branch ca. 1/3-1/2 as long as panicle axis. Lower glume ovate, ca. 1.5 mm long, margin membranous, 1-veined, apex acute. Upper glume ovate, ca. 2 mm long, 3-veined, margin membranous, apex acute. Lemma ovate, boated, ca. 2.5 mm long, margin membranous, 5-veined, central and marginal veins long pilose from base to middle part; intercostal region between central and marginal veins pilose from base to middle, apex acute. Palea oblong, ca. 2 mm long, apex truncate, with 2 long pilose keels. Anthers 3, ca. 0.75 mm long.

Distribution and Notes: The culms of *P. acroleuca* are 25-50(-80) cm tall, taller than *P. annua* (usually 8-30 cm tall) (Koyama, 1987; Osada, 1993). The leaf blades of *P. acroleuca* are acute, differing from the obtuse blade apices of *P. annua*. Also, *P. acroleuca* has contorted callus hairs and a hairy intercostal region on the lower part of the lemma, but these are absent in *P. annua*. Although a hairy intercostal region on the lower part of the lemma could be found in *P. nankoensis* Ohwi, its perennial habit, longer lemmas, and scabrous palea keels were significantly different from these characters in *P. acroleuca*. According to the specimens examined, *Poa acroleuca* occurs in the northern and central parts of Taiwan.

Specimens examined: Hsinchu Hsien: Chenshi Hsiang, Showluan, Aprl. 11 1999, *Wang J.-C.* et al. *10839* (TNM, TNU), Jan. 8 2005, *Jung M.-J. x010801* (NCKU), Chenshipao, Apr. 11 1999, *Yang K.-C. 5503* (TNM); Wufeng Hsiang, Shihlu Historic Road, near Kaochiao Relic, Feb. 20 2002, *Huang Y.-Y. 923* (HAST, TNM, TNU). Taichung Hsien: Hoping Hsiang, Lishan, May 1998, *Chen M.-Y. 20049* (NCKU), Mar. 12 2006, *Jung M.-J. y031201* (NCKU), Apr. 12 1985, *Yang T. Y. A. 1667* (TNM); Wuling Farm, Apr. 25 2006, *Jumg M.-J. y042501* (NCKU).

1. Department of Life Sciences, National Cheng-Kung University, 1, Ta-Hsueh Road, Tainan 701, Taiwan.
2. Department of Botany, National Museum of Natural History, Smithsonian Institution, NHB MRC-166, Washington DC 20013-7012, USA.
3. Corresponding author. Email: kuohpopo@gmail.com

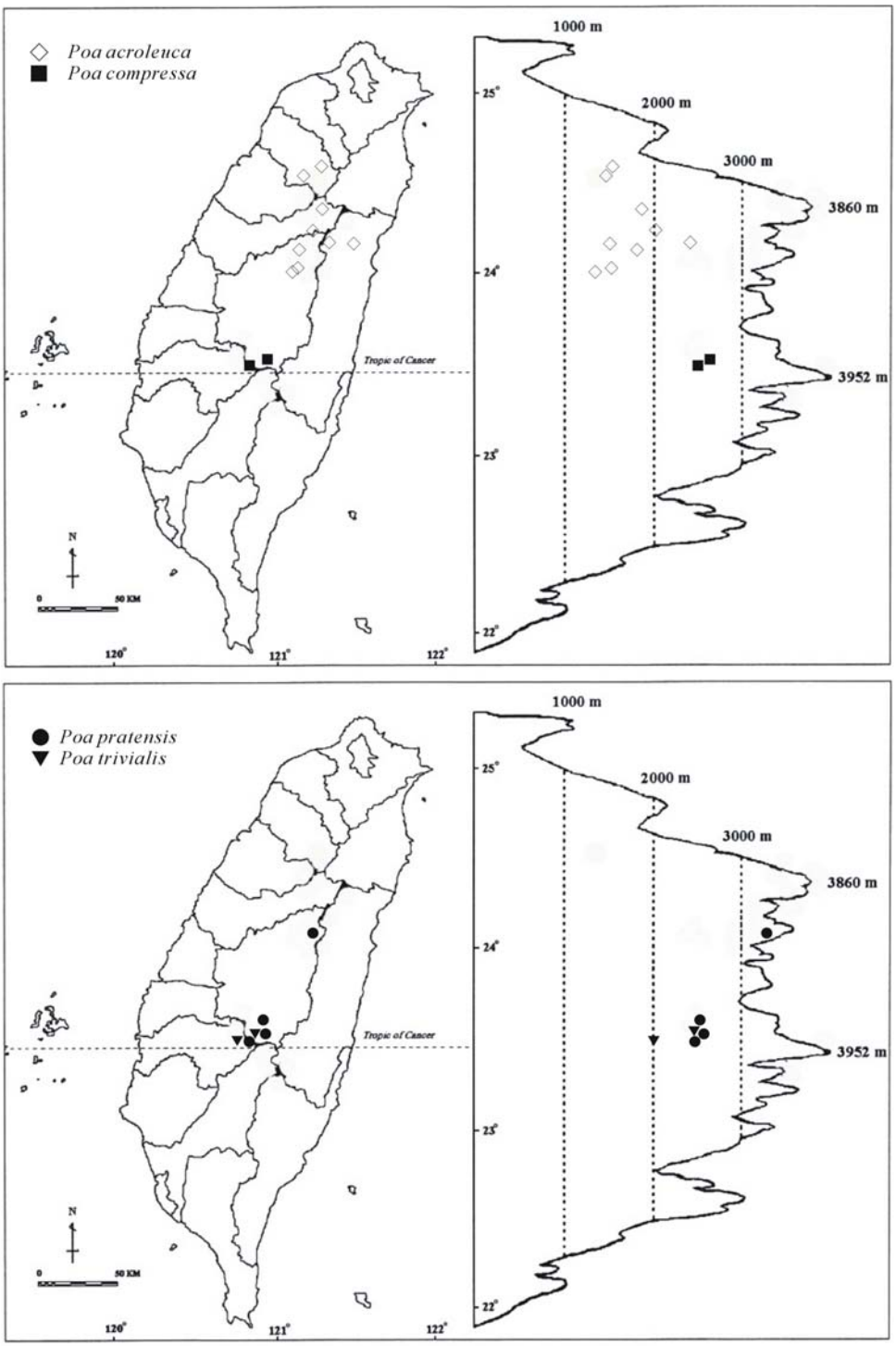

Fig. 1. Distribution of *Poa acroleuca* Steud. (◇), *Poa compressa* L. (■), *Poa pratensis* L. (●), and *Poa trivialis* L. (▼) in Taiwan.

Nantou Hsien: Jenai Hsiang, Chingching Villa, Provincial Highway No. 14A, between Meifeng and Wushe, Apr. 22 1994, *Conn B.-J. & Peng C.-I* 4053 (HAST), Mar. 13 2006, *Jung M.-J. y031301* (NCKU); Entrance of Li-shin Industrial Road, Mar. 20 2006, *Jung M.-J. y032004* (NCKU); Ma-lie-Ba, along Li-shin Industrial Road, Mar. 12 2006, *Jung M.-J. y031207* (NCKU). Hualian Hsien: Showlin Hsiang, Taroko National Park, Yueh-wang-ting to Yenhai Forest Road, May 4 1993, *Peng C.-I 15452* (HAST); Kuanyuan, May 20 2006, *Jung M.-J. y032001* (NCKU).

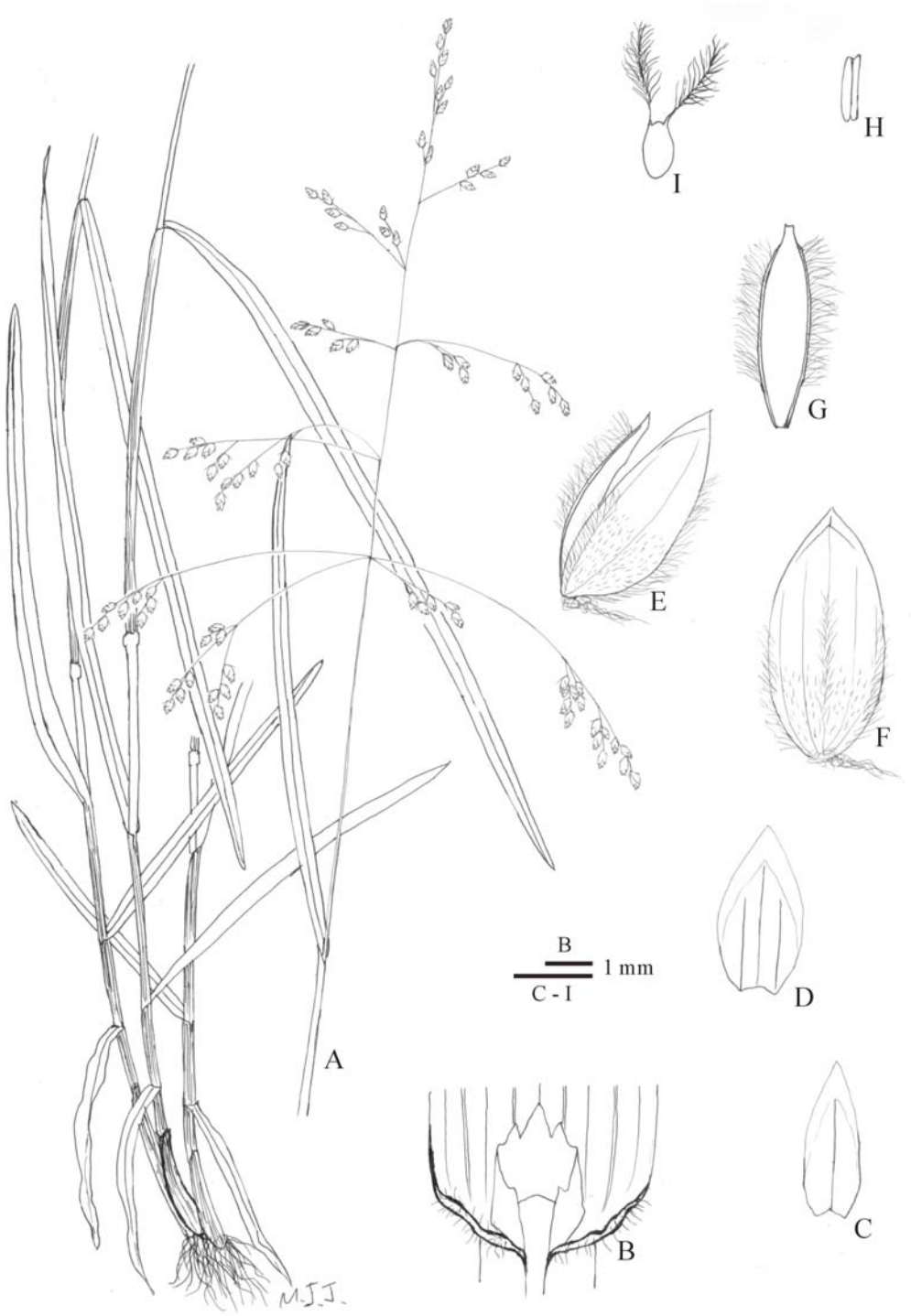

Fig. 2. *Poa acroleuca* Steud.. A: Habit. B: Ligule. C: Lower glume. D: Upper glume. E: Lateral view of floret. F: Lemma. G: Palea. H: Anther. I: Pistil.

Poa compressa L., Sp. Pl. 1: 69. 1753; Hitchcock, A. S. 1951. Manual of Grasses of the United States 106; Osada, T. 1993. Illustrated Grasses of Japan 178. 扁桿早熟禾 Fig. 3

Herbs perennial, rhizomatous. Culms ascending, to 40 cm tall. Nodes articulate, internodes keeled, glabrous. Leaf sheaths longer or shorter than internodes, glabrous, strongly compressed with a

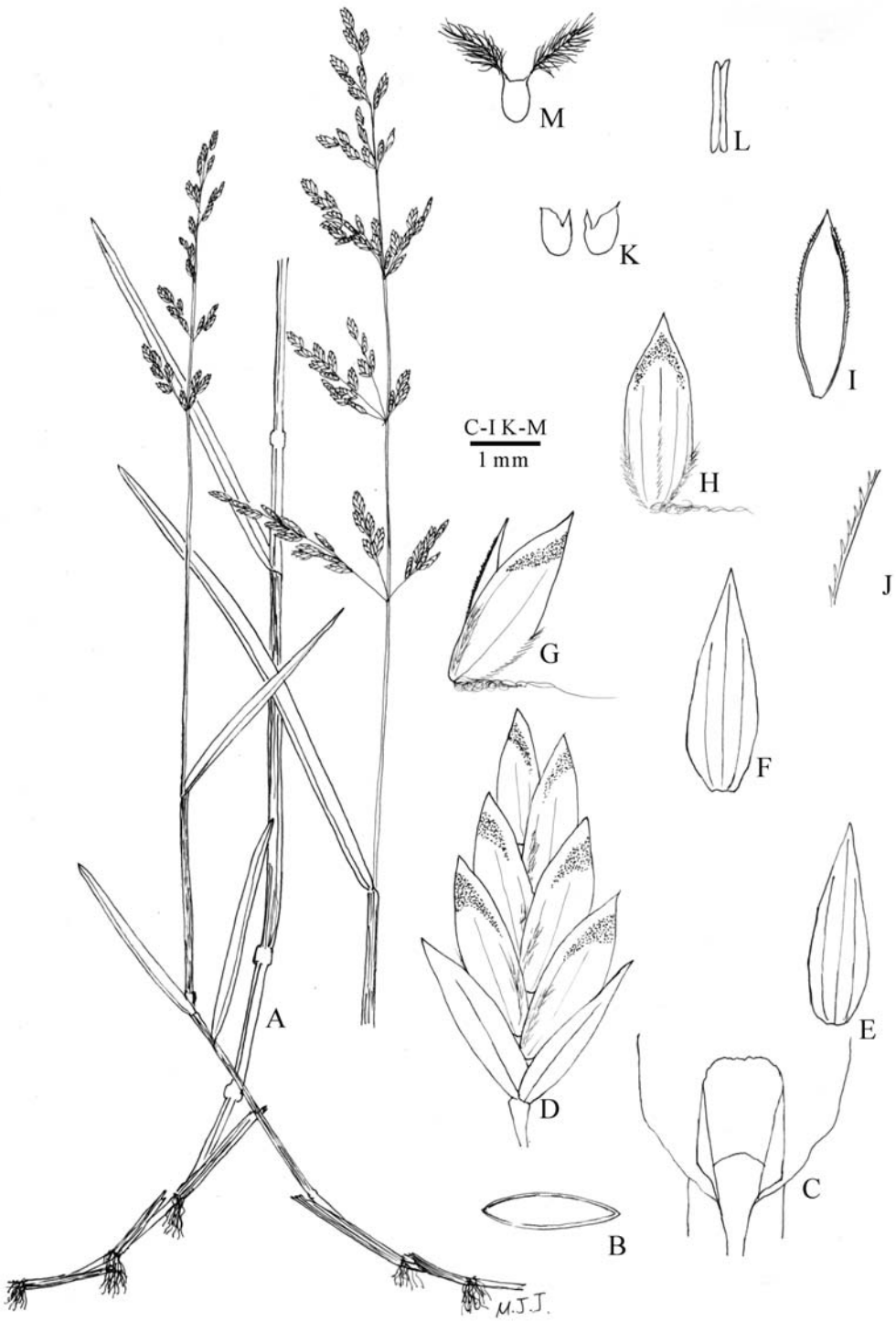

Fig. 3. *Poa compressa* L. A: Habit. B: Transection of internode. C: Ligule. D: Spikelet. E: Lower glume. F: Upper glume. G: Lateral view of floret. H. Lemma. I: Palea. J: Hispids on palea keel. K: Lodicules. L: Anther. M: Pistil.

keel, connected with keel of abaxial blade surface; ligule 1.5-2 cm long, membranous, apex truncate to retuse; blade linear, ca. 5 cm long. Inflorescence a panicle, spreading, with ca. 6 nodes, 5-10 cm long; lowest branches 3-5 cm long. Lower glume lanceolate, ca. 2.5 mm long, 3-veined. Upper glume lanceolate to ovate, ca. 3 mm long, 3-veined. Callus with webbed hairs. Lemma ovate, boated, ca. 3 mm

long, 5-veined, central and marginal veins from base to middle part pubescent, lateral veins glabrous, apical margin usually purplish. Palea ovate, ca. 2.5 mm long, apex acute, with 2 hispid keels. Lodicules 2, ca. 0.75 mm long, membranous, apex bifid. Anthers 3, ca. 1.5 mm long.

Distribution and Notes: *Poa compressa* (Canada bluegrass) is native in Europe and Russia, and naturalized in North America (Villasefior and Espinosa-Garcia, 2004) and eastern Asia (Koyama, 1987). Although the specific epithet "*compressa*" describes the compressed internodes of *P. compressa*, this character is shared with *P. trivialis* L. (see below). Several *Poa* grasses have keeled leaf sheaths but their internodes are not keeled. Also, the purplish upper part of the lemma margins is not unique in *P. compressa* since it also occurs in *P. annua*. In Taiwan, *P. compressa* can be distinguished from other *Poa* grasses by its well developed rhizomes, keeled internodes and sheaths, webbed callus, glabrous lateral veins on lemmas, shortly hispid palea keels, and longer anthers. *P. compressa* is found at Tatachia, Hsin-yi Hsiang, Nantou-Hsien. It is generally associated with *Agrostis stolonifera* L., *Dactylis glomerata* L., *Deschampsia flexuosa* (L.) Trin., *Festuca arundinacea* Schreb., *Festuca ovina* L., *Poa annua* L., and *Yushania niitakayamensis* (Hayata) Keng f.

Specimens examined: Nantou Hsien: Shin-yi Hsiang, Lu-lin Shan, Jul. 22 2000, *Kuoh C.-S* (NCKU), Ta-ta-chia, Aug. 2 2005, *Jung M.-J. x080201* (NCKU), *x080202* (NCKU), Oct. 10 2005, *Jung M.-J. x101001* (NCKU), Oct. 11 2005, *Jung M.-J. x101103* (NCKU).

Poa pratensis L., Sp. Pl. 1: 67-68. 1753; Hitchcock, A. S. 1993. Manual of Grasses of the United States 115; Osada, T. 1993. Illustrated Grasses of Japan 180. 草地早熟禾 Fig. 4

Herbs perennial, tufted or with long rhizomes. Culms to 40 cm tall, ascending to erect, with 3 or 4 nodes. Nodes covered by leaf sheaths, and cauline leaves usually withered at anthesis. Leaf sheaths glabrous; ligules 1-2 mm long, membranous, truncate, margin ciliate; blades 10-25 cm long, apex acute. Panicle contracted to spreading, 4-10 cm long; spikelets with 1-8 florets, reduced florets occasionally present. Lower glume lanceolate, 2-2.5 mm long, 1-veined, apex purplish or not; upper glume ovate, longer than lower glume, 2-3 mm long, 3-veined, apex purplish or not. Callus webbed. Lemma ovate, 2.5-3.5 mm long, margin membranous, upper margin usually purplish, 5-veined, lower part of central and marginal veins glabrous, obscure to pubescent, middle veins glabrous. Palea 2-3 mm long, membranous, apex acuminate, with 2 shortly hispid keels. Lodicules 2, ca. 1 mm long, membranous. Stamens 3; anther 1-2 mm long; filament ca. 4 mm long.

Distribution and Notes: *Poa pratensis* (Kentucky bluegrass) is native in Europe, and naturalized in temperate region of Asia (Osada, 1993; Veldkamp, 1994) and North America (Koyama, 1987; Villasefior and Espinosa-Garcia, 2004). *P. pratensis* has few sparse hairs over the veins on the adaxial surface or is glabrous, the ligule is truncate, and the upper blade is relatively short. The panicles of specimens we collected, are more congested, with thin round branches with few hooks, and the branches are shorter and more numerous, but with the same number of spikelets. *Poa pratensis* shares several characters with *P. compressa*, such as the rhizomes, webbed callus, glabrous middle veins of the lemmas, and long anthers, but can be distinguished from *P. compressa* by its cylindrical internodes, obtuse leaf blade apices, and leaf sheaths without keels. Populations in Lu-lin Shan and Sher-shan (Shin-yi Hsiang, Nantou Hsien) were growing in open area, in thin drying soil, that being a harder leaf form of *P. pratensis* that is intermediate between subsp. *pratensis* and subsp. *angustifolia*, and does have the sparse "*P. pratensis*" type soft hairs on the upper surface of some leaves, especially lower and lateral ones.

In the past, one wild population occurring in Wushe, Jenai Hsiang, Nantou Hsien was considered as introduced but no specimen was cited (Hsu, 1975). Recently, one population was found at Shimen Shan, Jenai Hsiang, Nantou Hsien; *Agrostis infirma* Büse, *Deschampsia cespitosa* (L.) P. Beauv. var. *festucifolia* Honda, *Lolium perenne* L., and *Poa nankoensis* Ohwi were associated with this species. Another population was found along the Taiwan Highway No. 18, in central Taiwan at middle elevations (Fig. 1), and many grasses such as: *Dactylis glomerata* L., *Festuca arundinacea* Schreb., *P. annua* L., *Polypogon fugax* Nees ex Steud., *Vulpia myuros* (L.) C. C. Gmelin, and *Yushania niitakayamensis* (Hayata) Keng f. were found at the same sites.

Specimens examined: Nantou Hsien: Jenai Hsiang, Shimen Shan, Jul. 27 2005, *Jung M.-J. & Lin J.-U x072710* (NCKU), *x072711* (NCKU), *x072712* (NCKU); Shin-yi Hsiang, Lu-lin Shan, May 24 2005, *Jung M.-J. x052402* (NCKU), *x052403* (NCKU), *x052413* (NCKU), Sher-Shan, May 24 2005, *Jung M.-J. x052404* (NCKU), *x052405* (NCKU).

Poa trivialis L., Sp Pl. 1: 67. 1753; Hitchcock, A. S. 1951. Manual of Grasses of the United States 116. 1951; Osada, T. 1993. Illustrated Grasses of Japan 172. 粗莖早熟禾 Fig. 5

Fig. 4. *Poa pratensis* L. A: Habit. B: Ligule. C: Lower glume. D: Upper glume. E: Lateral view of floret. F: Lemma. G: Palae. H: Lodicules. I: Anther. J: Pistil.

Culms to 30 cm tall; stolons to 30 cm long, creeping then ascending; nodes 3 or 4 at anthesis, articulate, glabrous, covered by leaf sheath; internodes cylindrical to strongly compressed with keels. Leaf sheath scaberulous, compressed with a keel; ligule 4-5 mm long, membranous, abaxially pubescent, margin entire; blade 10-15 × ca. 1 cm, abaxial surface of central vein keeled, apex

Fig. 5. *Poa trivialis* L. A: Flowering plant. B: Cross section of internode. C: Ligule. D: Spikelet. E: Lower glume. F: Upper glume. G: Lemma. H: Palae. I: Lodicules. J: Anther. K: Pistil.

acuminate. Inflorescence a spreading panicle, 10-15 cm long; longest branch at middle or basal part of panicle, ca. 1/4-1/2 as long as panicle axis. Bract fan-shaped, ca. 0.3 mm long, membranous, margin irregular, falling easily. Spikelet with 1-5 florets; lower glume lanceolate to ovate, 2-2.5 mm long, 1-veined, scaberulous on vein, margin membranous, apex acuminate; upper glume lanceolate to ovate,

2.5-3 mm, 3-veined, tuberculate on veins margin membranous, apex acuminate; rachis webbed. Lemma ovate, 2.5-3 mm long, 5-veined, base of central vein puberulous, margin membranous, apex acuminate. Palea oblong, ca. 2 mm long, membranous, apex acute, 2-keeled, tuberculate on keels to 1/2 from apex. Lodicules 2, ca. 0.5 mm long, membranous. Anthers 3, ca. 1.5 mm long.

Distribution and Notes: The common names of *Poa trivialis* include meadow grass, rough bluegrass, rough meadow grass, and rough stalk bluegrass. This bluegrass is native in Europe; and naturalized in North America and Asia (Koyama, 1987). Internodes and leaf sheaths of *P. trivialis* could be terete to flatten with keels, and the middle veins of the lemmas are glabrous, and similar to *P. compressa*. The roughness of sheaths of *P. trivialis* is the key character for primary identification. Viviparous seedlings can be found in the wild. One population was found at Er-Wan-Ping, Ali-shan Hsiang, Chia-yi Hsien. Its habitat was near an artificial pond, and the grasses: *Agrostis clavata* Trin., *Alopecurus aequalis* Sobol. var. *amurensis* (Kom.) Ohwi, *Festuca arundinacea* Schreb., *Phalaris arundinacea* L., *Poa annua* L., and *Trisetum bifidum* (Thunb.) Ohwi were found at the same location. Another site where it occurs was near Dongpu Hostel, Nantou Hsien, along the roadside of Taiwan Highway No. 18. This habitat was drier than the earlier-mentioned habitat, and the internodes of this population were compressed when juvenile, but columnated at anthesis. *Alopecurus pratensis* L., *Miscanthus sinensis* Anderss., and *Poa annua* L. were found at the same location.

Specimens examined: Nantou Hsien: Hsin-yi Hsiang, Dongpu Hostel, Jun. 6 2005, *Jung M.-J. x060608* (NCKU), *x060609* (NCKU), *x060610* (NCKU). Chia-yi Hsien: Ali-shan Hsiang, Alishan, *Chen Y.-F. 22230* (NCKU), *Ream 585* (US, United States National Herbarium), Er-Wan-Ping, May 30 2005, *Jung M.-J. x053003*, Jun. 1 2005, *Jung M.-J. x060101* (NCKU), *x060103* (NCKU), *x060104* (NCKU), *x060105* (NCKU), *Jung M.-J.* Aug. 2 2005, *x080206* (NCKU).

ACKNOWLEDGEMENTS

The authors thank Dr. Anthony R. Brach (MO c/o A, GH) for critical reading of the manuscript. The authors also thank Chen-Meng Kuo and Jer-How Li at Herbarium, National Taiwan University (TAI), Ching-I Peng at Herbarium, Research Center for Biodiversity, Academia Sinica, Taipei (HAST), Jeng-Che Wang at Herbarium, National Taiwan Normal University (TNU), and Shau-Ting Chiu at Herbarium, National Museum of Natural Science (TNM) for helping examine our specimens.

LITERATURE CITED

Boufford, D. E. et al. 2003. A Checklist of the Vascular Plants of Taiwan: 26. Gramineae (Poaceae). In: Huang, T.-C. et al. (eds.), Flora of Taiwan, 2nd ed., **6**: 120-127. Editorial Committee, Dept. Bot., NTU, Taipei, Taiwan.

Chen, C.-H. and C.-S. Kuoh. 2000. The genus *Poa* L. (Poaceae) in Taiwan: A DELTA database for generating key and descriptions. Taiwania **45**: 147-157.

Clayton, W. D. and S. A. Renvoize. 1986. Genera Graminum:, Grasses of the World, H. M. S. O., London, UK. pp. 389

Hitchcock, A. S. 1951. Manual of Grasses of the United States. Ed. 2, rev. by A. Chase, U.S. Dep. Agr. Misc. Publ. 200. Washington, USA. p.106 and p.116

Hsu, C.-C. 1975. Taiwan Grasses. Taiwan Provincial Education Association, Taipei, Taiwan. p. 283.

Hsu, C.-C. 1978. Gramineae. In: Huang, T.-C. et al. (eds.), Flora of Taiwan, 1st ed., **5**: 400. Editorial Committee, Dept. Bot., NTU, Taipei, Taiwan.

Koyama, T. 1987. Grasses of Japan and Its Neighboring Regions: An Identification Manual. Kodasha Ltd., Tokyo, Japan. p. 570.

Kuoh, C.-S. and C.-H. Chen. 2000. Pooideae of Gramineae (Poaceae). In: Huang, T.-C. (eds.), Flora of Taiwan. 2nd ed., vol. **5**: 384-389. Editorial Committee, Dept. Bot., NTU, Taipei, Taiwan.

Ohwi, J. 1941. Graminea Japonica I. Acta Phytotax. Geobot. **10**: 94-135 (in Japanese).

Osada, T. 1993. Illustrated Grasses of Japan, Heibonsia Ltd., Tokyo, Japan. pp. 158-205.

Veldkamp, J. F. 1994. *Poa* L. (Gramineae) in Malesia. Blumea **38**: 409-457.

Villasefior, J. L. and F. J. Espinosa-Garcia. 2004. The alien flowering plants of Mexico. Diversity Distrib. **10**: 113-123.

臺灣產禾草補遺（二）

鍾明哲[1]、Robert J. Soreng[2]、郭長生[1,3]

(收稿日期：2006 年 1 月 27 日；接受日期：2006 年 4 月 26 日)

摘　　要

扁桿早熟禾 (*Poa compressa* L.)、草地早熟禾 (*P. pratensis* L.)、及粗莖早熟禾 (*P. trivialis* L.) 近期歸化於臺灣中部。檢視各標本館 (HAST，NCKU，TNM，TNU 及 TAI) 近期所採得的標本後，確認白頂早熟禾 (*P. acroleuca* Steud.) 存在於臺灣。本文提供此四種禾草的描述、手繪圖及分布圖。

關鍵詞：歸化植物、白頂早熟禾、扁桿早熟禾、草地早熟禾、粗莖早熟禾、禾本科、臺灣、分類。

1. 國立成功大學生命科學系，701 台南市東區大學路 1 號，臺灣。
2. 史密森尼機構，國家自然史博物館植物學系，NHB MRC-166，華盛頓特區 20013-7012，美國。
3. 通信作者。Email: kuohpopo@gmail.com