

Research paper

Cirsium japonicum DC. var. *fukienense* Kitam.
(Compositae), a newly recorded taxon of Taiwan and its
western outlying islands

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【Abstract】 A newly recorded variety *Cirsium japonicum* DC. var. *fukienense* Kitam. of Taiwan and its western outlying islands is reported in this article. This taxon resembles var. *australe* Kitam., differs from its clearly longer apical prominent parts of phyllaries. Photos, line drawings, description and a key to *C. japonicum* complex in Taiwan are also provided for identification.

【Key words】 *Cirsium japonicum* DC. var. *fukienense* Kitam.; Compositae; newly recorded; Taiwan.

研究報告

長苞小薊：臺灣及其西部離島新紀錄菊科植物

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【摘要】 本文報導臺灣及其西部離島之新紀錄植物—長苞小薊 (*Cirsium japonicum* DC. var. *fukienense* Kitam.)。本分類群與南國小薊 (*C. japonicum* DC. var. *australe* Kitam.) 相似，但其總苞片之突出明顯延長可與之區別。本文提供長苞小薊的彩色照片、手繪圖、描述及與臺灣產小薊複合群 (*C. japonicum* complex) 之檢索表等供參考用。

【關鍵詞】 長苞小薊、菊科、新紀錄、臺灣。

Introduction

The genus *Cirsium* Mill. (Compositae) is characterized as spiny herb and comprises of roughly 250 species, widely distributed in temperate and subtropical zones globally (Kadota 2007). Fourty-six, 64 and 9 species were native to

China, Japan and Taiwan respectively (Iwatsuki et al. 1995; Peng 2003; Shih & Greuter 2011). Chang et al. (2019) described a new species *C. tatakaense* Y. H. Tseng & C. Y. Chang in central-southern Taiwan recently. Among them, *Cirsium japonicum* DC. complex are characterized by leaves

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pinnatifid to pinnatisect, villose to glabrescent; mature capitula erect or less nodding, solitary; corolla lobes shorter than the inflated part of corolla tube, and widely distributed in East Asia. Many intraspecific taxa of *C. japonicum* had been recorded, such as var. *japonicum*, var. *maackii* (Maxim.) Matsum., var. *diabolicum* (Kitam.) Kitam., var. *vestitum* Kitam., var. *villosum* Kadota, f. *arakii* (Kitam.) Kitam. and f. *leucanthum* Nakai were recorded in Japan (Iwatsuki et al. 1995); and var. *japonicum*, var. *maackii*, var. *spinosissimum* Kitam. and var. *spinosissimum* f. *alba* T. B. Lee were recorded in South Korea (Song & Kim 2006, 2007; Wagle et al. 2019). Two varieties, namely var. *australe* Kitam. and var. *takaoense* Kitam. were native to Taiwan (Peng 2003).

However, Shih (1984) advocated those were variation of vegetative organs in different habitats, could not be applied on recognition of different taxa; therefore, he treated those taxa as a single species, and followed by FRPS and Flora of China (Shih 1987; Shih & Greuter 2011). But the discrimination of *C. japonicum* complex often based on characteristics of reproductive organs which were stable among taxa. For example, var. *australe* was characterized by the narrower part of the corolla was longer than var. *japonicum* (Kitamura 1931, 1990); and var. *takaoense* was characterized by white corolla (Kitamura 1932). After that, many researchers still supported the subdivision of *C. japonicum* in East Asia (Kitamura 1990; Iwatsuki et al. 1995; Peng 2003; Kadota 2007; Song & Kim 2007; Wagle et al. 2019). Therefore, to recognize these different intraspecific taxa is still necessary.

Recently, we found an unknown taxon in Penghu, Matsu, Kinmen and northern Taiwan. This taxon was identified as *Cirsium japonicum* complex, and was recognized to var. *australe*

by its purple corolla in herbarium specimens. However, this taxon had clearly longer apical prominent parts of phyllaries than aforementioned two varieties. After morphology study and literature review revealed this taxon was *C. japonicum* var. *fukienense* that was recorded in Fujian province. Morphological description, photos (plant and holotype specimen), distribution map and a key to three varieties of *C. japonicum* were provided in this article for identification.

Materials and methods

Materials were collected from the field and herbarium specimens; voucher specimens were deposited in herbarium of National Chung Hsing University (TCF) and herbarium of National Museum of Natural Science (TNM) (Thiers 2019). Following herbarium were also examined: CHIA, HAST, KYO, PPI, TAI, TAIF, TCF, TI, TNM and TNU. In addition, the image of holotype specimen of *C. japonicum* var. *fukienense* deposited in KYO was examined. The map was generated by QGIS ver. 3.4 with package of Lin (2018). Distribution map of geographical climatic regions and altitudinal vegetation zones of Taiwan followed Su (1984, 1985).

Taxonomy treatment

Key to varieties of *Cirsium japonicum* in Taiwan.

1. Corolla white; leaf glabrescent.....
.....*C. japonicum* var. *takaoense* (白花小薊)
1. Corolla purple; leaf villose
 2. Apical prominent parts of phyllaries longer than 3 mm; leaves pinnatipartite to pinnatisect.....
.....*C. japonicum* var. *fukienense* (長苞小薊)
 2. Apical prominent parts of phyllaries shorter than 2 mm; leaves pinnatifid to pinnatisect*C. japonicum* var. *australe* (南國小薊)

Cirsium japonicum DC. var. *fukienense* Kitam.,
Acta Phytotax. Geobot. 1(2): 149. 1932.

Cirsium japonicum DC. f. *fukienense* (Kitam.)
Kitam., Acta Phytotax. Geobot. 41(4-6): 179.
1990.

長苞小薊 (Figure 1~3, 5A)

Type: CHINA. Fujian Province, Mt. Wushishan
(烏石山), 28 June 1910, *Nagasawa S. s. n.*
(holotype: KYO, photo!, Figure 5A).

Diagnosis: Differs from other varieties by having
clearly longer apical prominent parts of
phyllaries and leaves pubescent in both
surface.

Description: Perennial herbs, stem 0.5~1.0 m tall.
Leaves pinnatipartite or pinnatisect, V-shaped
space between pinnae, villose, margin
spinose; *rosette leaves* oblanceolate to
narrowly elliptic, base cuneate to attenuate,
apex acute to obtuse, 13.0~16.0 cm long and
4.2~5.1 cm wide; pinnae 1.5~2.1 cm long
and 1.0~1.2 mm wide, space between pinnae
3.0~6.0 mm, 8~10 pairs; petioles 0.9~1.1
cm long; *cauline leaves* narrowly elliptic to
narrowly triangular, base truncate to cordate,
apex acute to acuminate, 10.0~15.0 cm long
and 3.0~4.5 cm wide; pinnae 0.4~1.0 cm
long and 1.0~1.2 mm wide, space between
pinnae 1.1~2.1 mm, 6~10 pairs. *Capitula*
arranged into racemes or panicles, mature
capitula nodding, involucre urceolate,
3.0~5.0 cm long and 2.1~2.5 cm wide;
involucre abaxial surface with glandular
appendages, inner phyllaries acute apically,
outer phyllaries green or purplish-red with
distinct layers, entire, 1.2~1.5 cm long and
1.7~2.1 mm wide, protrusion 4.0~6.0 mm;
florets with purple or pale purple corolla,
2.9~3.0 cm long, corolla lobes 3.5~5.1 mm
long and 6.0~7.5 mm wide; *synantherous*

stamens 5, detached filaments with irregular
protuberances, basal caudate extensions,
purple, anthers 6.3~6.5 mm long, filaments
4.3~4.9 mm long; *stigma* bifid apically, style
2.7~2.9 cm long, ovary 2.0~2.4 mm long.
Achene oblong, base acute, apex truncate,
beige, 3.5~4.5 mm long and 1.2~1.4 mm
wide, long tube-shaped beak apically; pappus
1.5~1.6 cm long forming basal ring, easily
shed.

Phenology: Flowering between March and July
and fruiting between April and August.

Distribution: Southeastern mainland China,
distributed in Fujian (Kitamura 1990). In
Taiwan, this variety was discovered in
Yangmingshan national park and Penghu
archipelago, Kinmen and Matsu archipelago
at altitudes of 0~500 m (Figure 4), often
growth in open area, such as coastal, margin
of forest and grassland.

Specimens examined:

Taipei city (台北市): Shilin district (士林區),
Cingtiangang (擎天崗) to Tsuetsueku (翠
翠谷), *J. C. Wang 5290* (TNU); Hwy.
Yangchin (陽金公路), *Huang 1186* (TNU);
Beitou district (北投區), Launch station of
National Education Radio (教育電台發射
站) to gazebo, *K. C. Chang 3383* (CHIA);
Mt. Qixing (七星山) to Jhuzihu (竹子湖),
C. C. Hsu 4463 (TAI); Mt. Qixing (七星山),
L. J. Kao 38 (TAI); same loc., *C. H. Wu s.*
n. (TNU); same loc., *M. P. Ho s. n.* (TNU);
Jhuzihu (竹子湖), *S. H. Wu 1297* (HAST);
Lengshueikeng (冷水坑) to Qixing park (七
星公園), *C. Y. Chang 2012* (TNM).

New Taipei city (新北市): Wanli district (萬
里區), Tachienchih (大尖池), *Y. Y. Huang*
288 (HAST); Gongliao district (貢寮區),
Lingchiushan (靈鷲山), *C. F. Kuo 41* (TAIF);

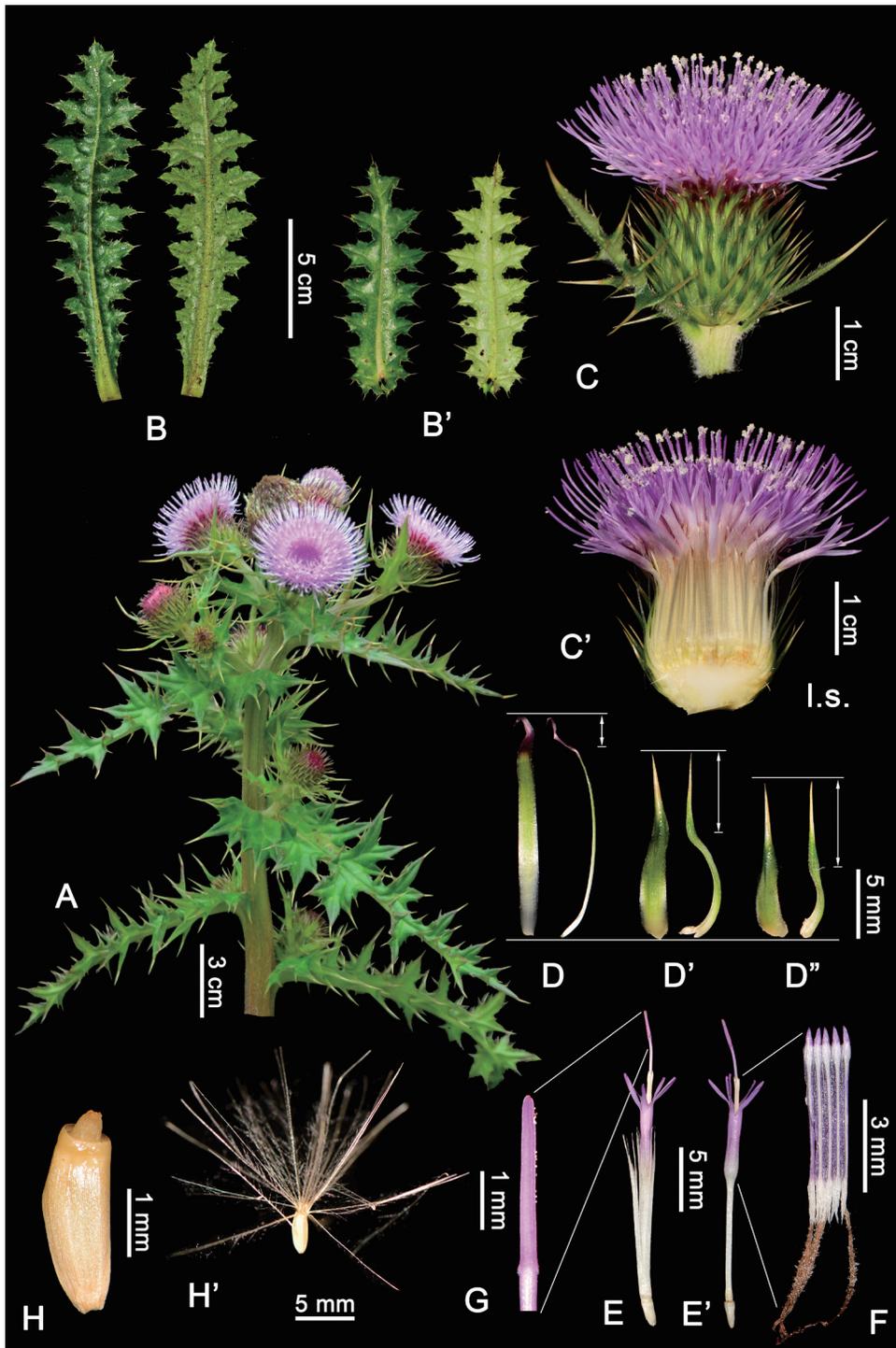


Figure 1. Morphological photos of *Cirsium japonicum* DC. var. *fukiense* Kitam. **A**: Habit; **B**: Rosette leaves; **B'**: Cauline leaves; **C**: Capitula; **C'**: Longitudinal section of capitula; **D**: Inner phyllary; **D'**: Middle phyllary; **D''**: Outer phyllary; **E**: Floret; **E'**: Floret (remove pappus); **F**: Synantherous stamen; **G**: Style branches; **H**: Achene; **H'**: Achene with pappus.

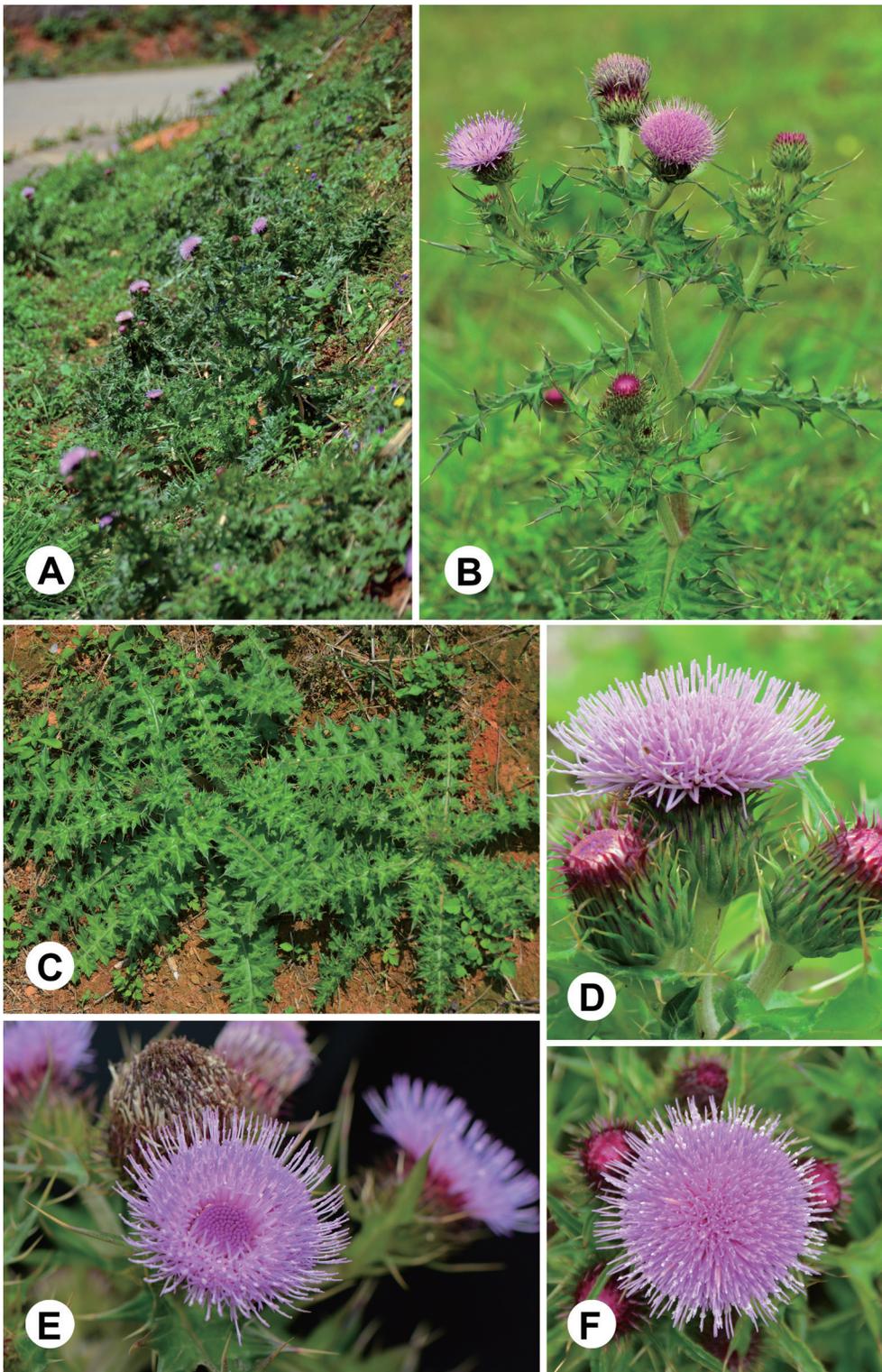


Figure 2. Photographs of *Cirsium japonicum* DC. var. *fukienense* Kitam. A: Habitat; B: Habit; C: Seeding; D: Inflorescences; E: Young capitula; F: Mature capitula.

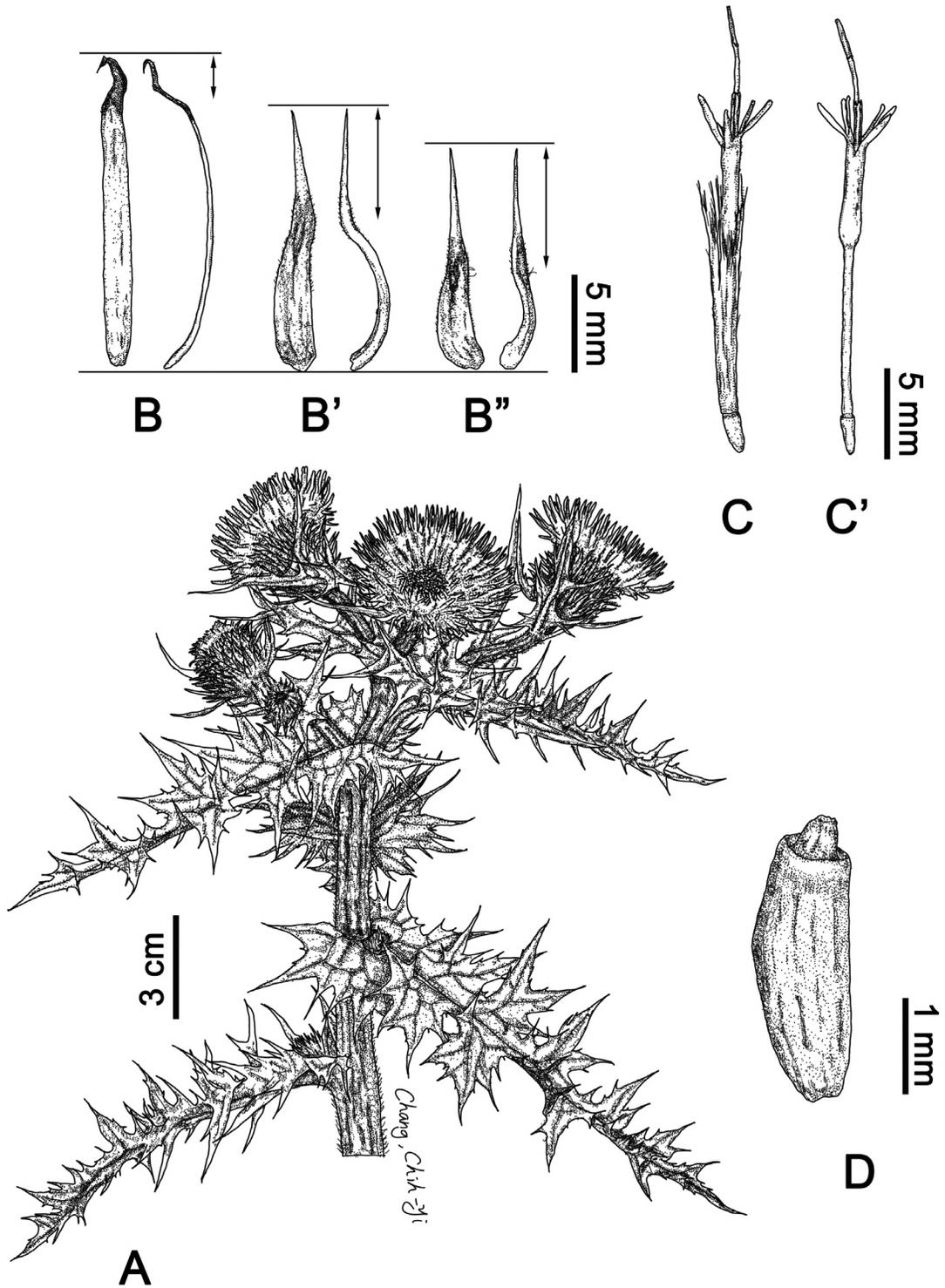


Figure 3. Line drawings of *Cirsium japonicum* DC. var. *fukienense* Kitam. A: Habit; B: Inner phyllary; B': Middle phyllary; B'': Outer phyllary; C: Floret; C': Floret (remove pappus); D: Achene.

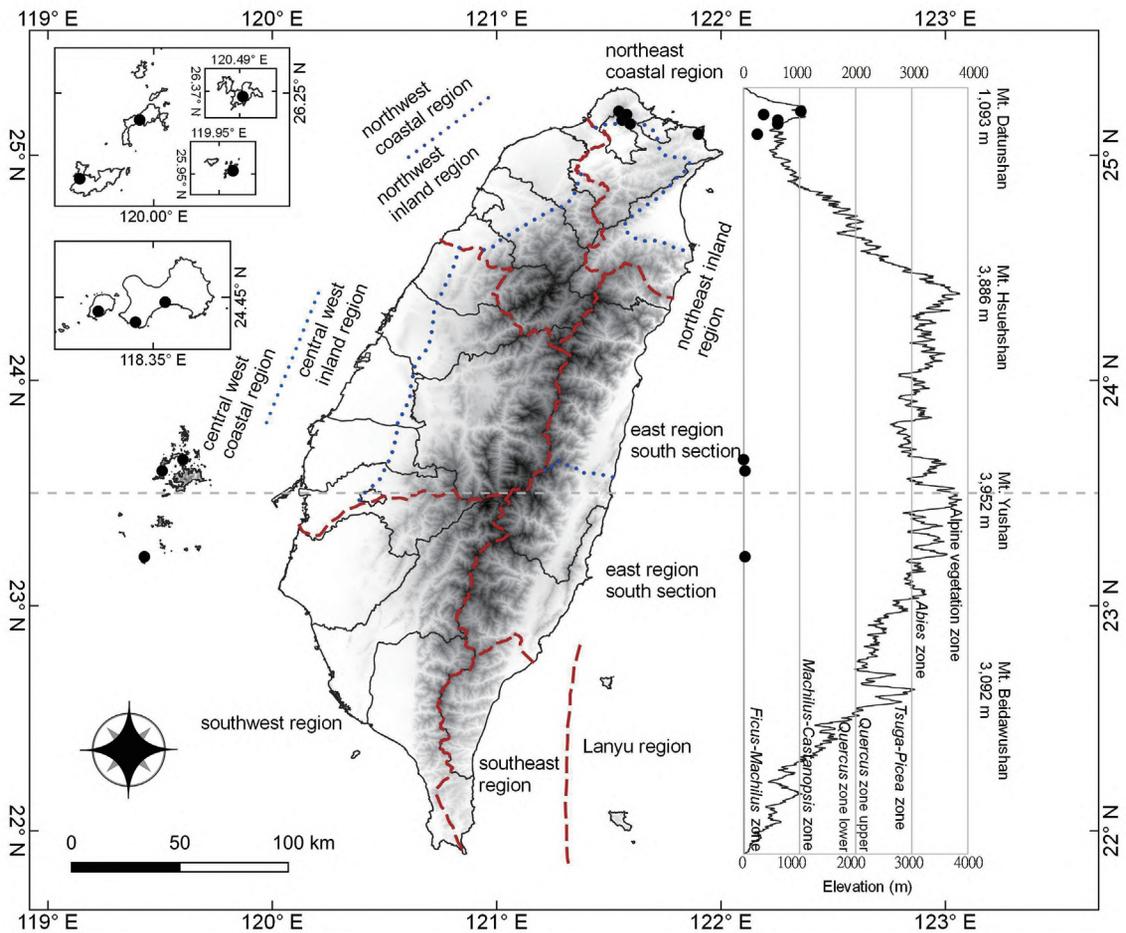


Figure 4. Distribution map of *Cirsium japonicum* DC. var. *fukiense* Kitam. of Taiwan.

Shimen district (石門區), Shimen (石門), W. F. Ho 777 (TAIF).

Penghu county (澎湖縣): Penghu (澎湖), J. C. Lin 272 (TAIF); M. F. Lou 6 (TAIF); C. T. Chen 332 (PPI); Magong city (馬公市), beach, C. Y. Chang 543 (TNM); Jingueitou fort (金龜頭砲台), C. Y. Chang 1821 (TNM); Xiyu township (西嶼鄉), Shitai bait cannon (西台餌砲), C. Y. Chang 1841 (TNM); Wangan township (望安鄉), Dongan (東安), T. Y. Aleck Yang 20454 (TNM); Qimei township (七美鄉), Qimei airport (七美機場), M. J. Jung 3262 (TAIF); Northwest gulf

(西北灣), C. Y. Chang 1832 (TNM); Baisha township (白沙鄉), Zhongtun windmill park (中屯風車園區), C. Y. Chang 1850 (TNM); Huxi township (湖西鄉), Shagang (沙港), K. C. Yang 4838 (TAIF); Kueipishan (奎壁山), C. H. Chen 727 (HAST).

Kinmen county (金門縣): Jinsha township (金沙鎮), Pishan (碧山), K. C. Lu 5688 (TCF); Pubian (浦邊), S. T. Chiu 5107 (TNM, PPI); Shanhou (山后), S. T. Chiu 6620 (TNM); Tianpu reservoir (田埔水庫), C. M. Wang 5696 (TNM); Mt. Wuhushan (五虎山), W. L. Hsieh s. n. (CHIA); Jinhu township (金湖鎮),

Hulung (后壟), *C. M. Wang* 2547 (HAST, TAIF, TNM); Mt. Nantaiwushan (南太武山), *S. C. Liu* 1058 (TNU); Jinning township (金寧鄉), Tzuhu (慈湖), *T. T. Chen* 8124 (TAIF); Agricultural Research Institute (金門農試所), *C. M. Wang* 1881 (TNM); Lieyu township (烈嶼鄉), Hongtugou (紅土溝), *C. Y. Chang* 728 (TCF, TNM); Yangtsu (楊厝), *F. Y. Lu* H2657 (CHIA).

Lienchiang county (連江縣): Nangan township (南竿鄉), Huangkuanyu island (黃官嶼), *W. H. Wu et al.* 297 (TAIF); Matzu village (馬祖村), *T. Y. Liu* 543 (HAST); same loc., *C. Y. Chang* 2249 (TNM); Shengtian park (勝天公園), *C. M. Wang* 10010 (TNM); Furen village (夫人村) Guanhai road (觀海路), *C. Y. Chang* 2240 (TNM); Beigan township (北竿鄉), *Y. P. Cheng* 3743 (TAIF); *H. L. Chiang* 2125 (TAIF); Jinyu island (進嶼), *C. H. Chen* 10028 (TNM); Daqiu island (大坵島), *C. M. Wang* 10081 (TNM); Mt. Luoshan trail (螺山步道), *C. Y. Chang* 2257 (TNM); Chukuang township (莒光鄉), Taping (大坪) to lighthouse, *T. Y. Liu* 666 (HAST); Dongyin township (東引鄉), Dongyin island (東引島), *P. F. Lu* 6187 (TAIF).

Discussion

The taxonomic status of *Cirsium japonicum* DC. var. *fukienense* Kitam.

Cirsium japonicum var. *fukienense* was described by Kitamura (1932), type specimen was collected from Mt. Wushishan in Fujian province (Figure 5A), and was characterized by leaf irregular pinnatisect; capitula 2.1 cm in diam. corolla tube 1.1 cm long, inflated part of corolla tube 5 mm long, corolla lobed 5 mm long; however, the character of phyllaries was not mentioned. Later, Kitamura (1990) pointed

out that var. *australe* (Figure 5B) had shorter corolla lobed and was widely distributed between latitude 33°~29°30' N compared to *C. japonicum* var. *fukienense*, thus, he treated this variety as a form of *C. japonicum*. However, Kitamura (1990) neglected the character of phyllaries between these taxa, and only examined holotype specimen. Obviously, the variation of var. *fukienense* is rarely studied. According to our observation, this variety was distributed in Fujian province, islands of Taiwan strait, and northern Taiwan. The phyllaries of these populations all had long protruding apex, which was different from that of var. *japonicum*, var. *australe* and constant among the populations.

As mentioned above, identification of intraspecific taxa of *C. japonicum* often based on characteristics of reproductive organs, especially capitula and involucre, such as var. *vestitum* Kitam. was characterized by involucre and leaves arachnoid (Iwatsuki et al. 1995), var. *villosum* Kadota was characterized by involucre cylindrical (Iwatsuki et al. 1995), var. *spinossimum* was characterized by its nodding capitula and longer corolla lobe, and var. *spinossimum* f. *alba* was characterized by white corolla (Song & Kim 2006, 2007). These treatments revealed that the variation of phyllaries was an important character of intraspecific taxa of *C. japonicum*. Therefore, maintaining *C. japonicum* var. *fukienense* at varietal level rather than a form proposed by Kitamura (1990) was a better choice.

Comparison of the morphological characters of *Cirsium japonicum* DC. complex in Taiwan

The major difference between three varieties are the characteristics of capitula (Figure 6, Table 1), var. *fukienense* and var. *australe* both have purple corolla, whereas var. *takaoense* has white one. Apical prominent parts of outer phyllaries of var. *australe* and var. *takaoense* are shorter

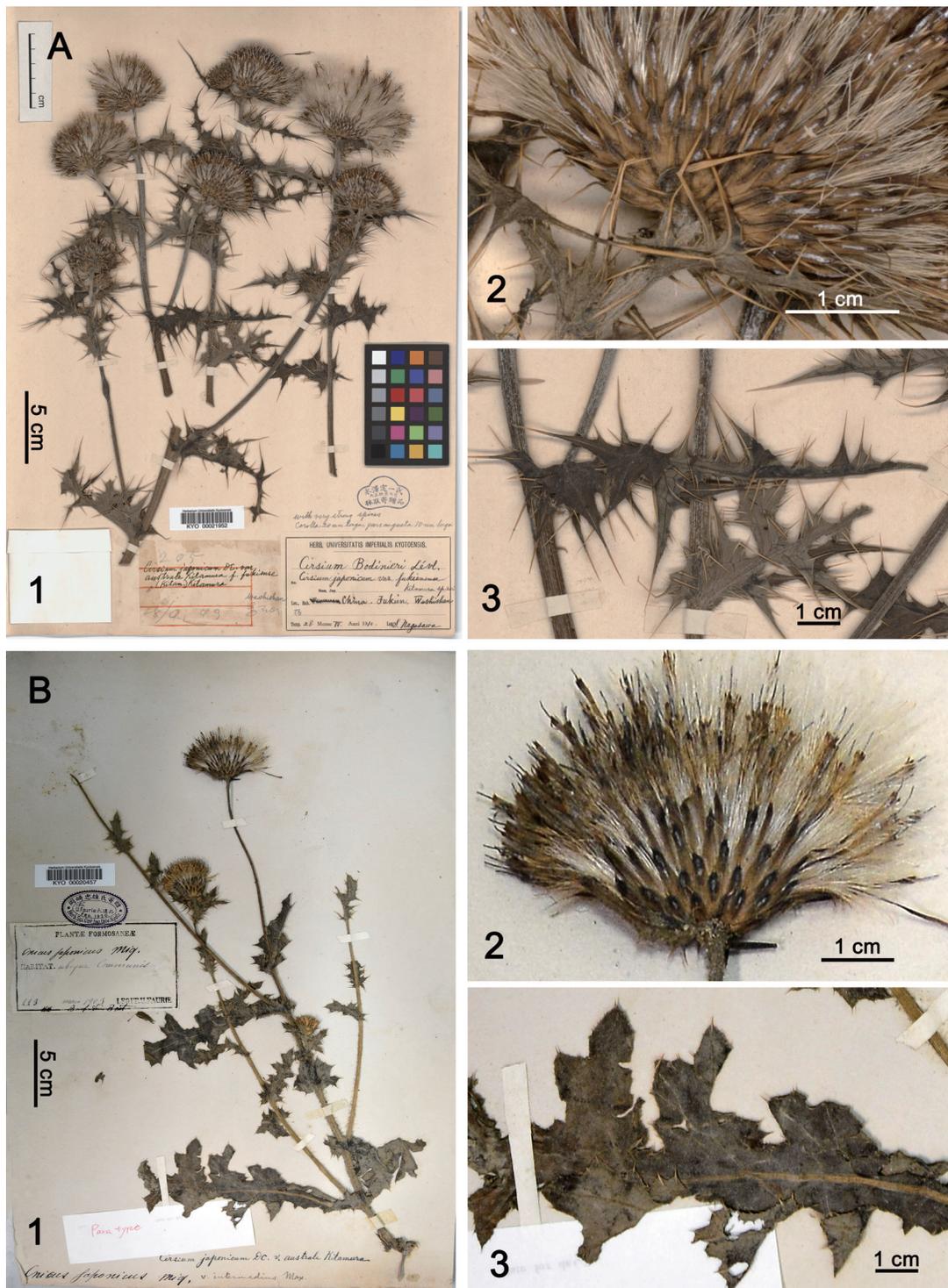
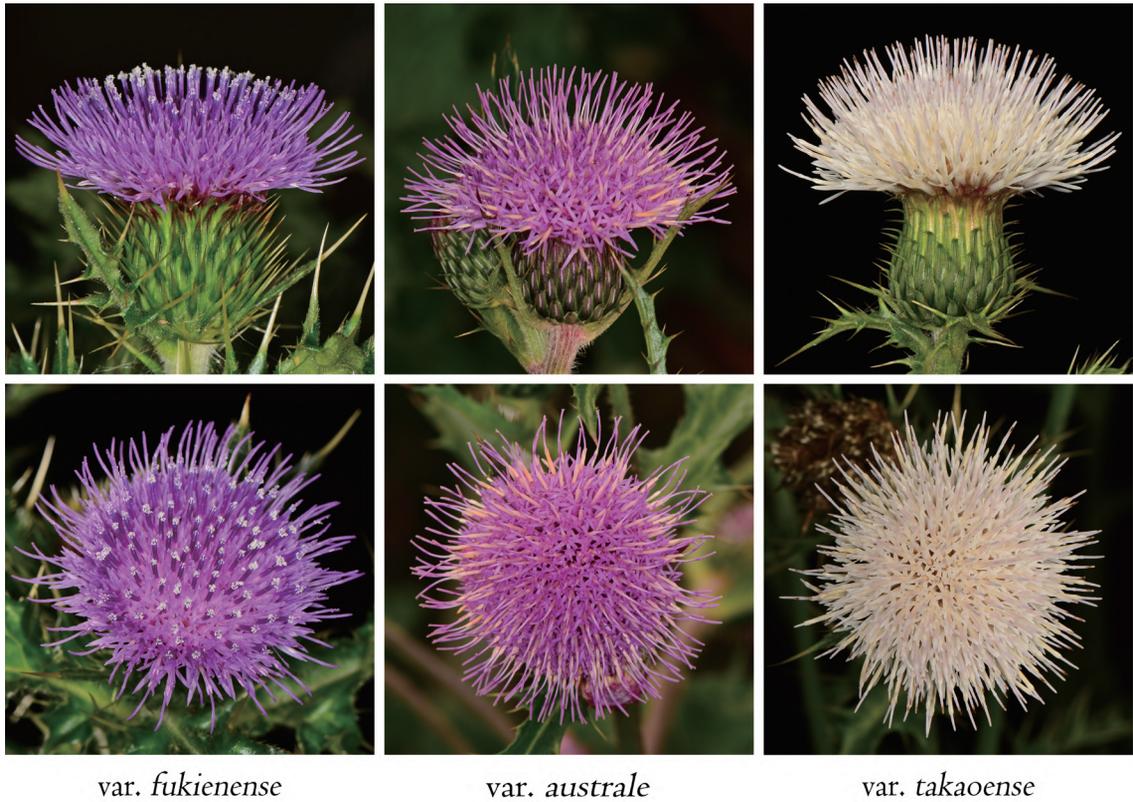


Figure 5. Type specimens of the two varieties of *Cirsium japonicum* DC. **A:** var. *fukienense* Kitam. Nagasawa S. s. n. (holotype, photo!, KYO); **B:** var. *australe* Kitam. U. Faurie 223 (paratype, KYO!). **1:** Overview; **2:** Capitula; **3:** Leaves.

Figure 6. Comparison of the capitula between *Cirsium japonicum* DC. complex in Taiwan.Table 1. Comparison of character between *Cirsium japonicum* DC. complex in Taiwan.

Characters	var. <i>fukienense</i>	var. <i>australe</i>	var. <i>takaoense</i>
Leaf surface	Villose	Villose	Glabrescent
Leaf lobes	Pinnatipartite to pinnatisect	Pinnatifid to pinnatipartite	Pinnatifid to pinnatipartite
Pair of rosette leaflobes	8-10	9-12	10-12
Corolla color	Purple to paler purple	Purple	White
Outer phyllaries color	Green or purple	Green or purple	Green
Length of apical prominent parts of outer phyllaries	> 3 mm	< 2 mm	< 2 mm
Length of corolla lobe	3.5~5.1 mm	3.4~3.8 mm	3.6~5.0 mm
Length of corolla tube	1.74~1.84 cm	1.33~1.47 cm	1.57~2.11 cm
Distribution	Northern Taiwan and its western outlying islands at altitudes of 0~500 m.	Taiwan island at altitudes of 0~2,000 m.	Southern, eastern and less in western Taiwan at altitudes of 0~2,000 m.

than 2 mm, whereas var. *fukienense* is longer than 3 mm. In addition, the trichome of leaf surface in both var. *fukienense* and var. *australe* are clearly villose, whereas var. *takaoense* usually glabrescent. The leaf lobes of var. *fukienense* usually deeper than other varieties (pinnatipartite to pinnatisect), both of var. *australe* and var. *takaoense* have pinnatifid margins. However, the leaf characters often vary from habitat, capitula characters are relatively stable between these taxa.

Habitat of *Cirsium japonicum* DC. var. *fukienense* Kitam.

In Penghu, Kinmen and Matsu, *C. japonicum* var. *fukienense* is the only *Cirsium* species distributed, almost being found in low-altitude (probably because these places lack higher altitude) open area with high drought tolerance, such as coastal, grassland and margin of forest. Common companion species are *Viola confusa* Champ. ex Benth. (Violaceae), *Vigna minima* (Roxb.) Ohwi & Ohashi (Fabaceae), *Dendranthema indicum* (L.) Des Moul. (Compositae), and *Dichondra micrantha* Urban (Convolvulaceae). *Cirsium japonicum* var. *fukienense* usually has purple corolla; however, the population in Penghu has paler corolla color. The longer apical prominent parts of phyllaries is similar to other populations, other characters are not significantly different, so we regard this population is still belonged to *C. japonicum* var. *fukienense*.

In Taiwan, this taxon is only found at Yangmingshan national park area, often discovered over altitudes of 200 m, seldom growing on the coast. In such sites, moist environments and lower temperature than other lowlands of Taiwan are characteristic. These populations also prefer open area, such as grassland and margin of forest, and common companion species are *Viola nagasawai*

Makino & Hayata (Violaceae), *Lindernia crustacea* (L.) F. Muell. (Scrophulariaceae), *Clinopodium chinense* (Benth.) Kuntze (Labiatae) and *Gnaphalium spicatum* Lam. (Compositae).

However, *Cirsium japonicum* var. *australe* and var. *fukienense* sympatric distribute in Yangmingshan national park area, and var. *australe* grows on the coast to the mountain area; in the crossing area, the morphological intermediate individuals were discovered; therefore, we assumed these plants were produced by natural hybridization; however, this assumption still needs further study.

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