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Identity of a problematic Menispermaceae in Taiwan, *Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman

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ABSTRACT: For the past 30 years, two staminiferous specimens of the family Menispermaceae deposited in the Herbarium of National Taiwan University were identified as *Cyclea insularis* (Makino) Hatusima. These two specimens actually belong to the genus *Cissampelos* L. which represents the first newly recorded genus in Taiwan. The genus *Cissampelos* can be differentiated from the genus *Cyclea* by its patelliform or cupulate corolla of staminate flowers, corymbose cyme of staminate inflorescence, and foliaceous bracts in the pistillate infructescence. A newly recorded species, *Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman. is also found in Liuqui Township, southern Taiwan. A morphological description, photographs, line-drawings, and a key to the genera of Menispermaceae in Taiwan are provided to facilitate identification.

KEY WORDS: *Cissampelos pareira* var. *hirsuta*, Menispermaceae, newly recorded genus, newly recorded species, taxonomy.

INTRODUCTION

The family Menispermaceae comprises about 70 genera and 450 species that are distributed in the tropical or subtropical lowland regions (Lo *et al.*, 2008; Ortiz *et al.*, 2007; Sharma *et al.*, 2010). Yamamoto (1948) recorded five genera and eight species of this family in Taiwan. Six genera and 13 taxa of this family were identified in the Flora of Taiwan (Huang and Huang, 1996), most of which are lianas and vines.

The flowers of Menispermaceae are unisexual, dioecious, usually small in size with inconspicuously pedicellate. Two staminiferous specimens (TAI 258924, TAIF 200534) collected in Hongton to Tienchih and Chungaichiao, Lanyu Island in 1982 and 1997, respectively, are deposited in the Herbarium of National Taiwan University (TAI Herbarium) and were identified as *Cyclea insularis* (Makino) Hatusima; the line-drawing materials in the Flora of Taiwan, second edition (Huang & Huang 1996) referred to these specimens.

In 2013, an image of a menispermaceous plant with a few conspicuous bracts and red fruits on the short infructescence was posted on a plant forum website (Nature Campus, 2013), and the reporter identified it as *C. insularis*. However, the conspicuous bracts of this plant showed it greatly different from the known species of the the genus *Cyclea* in Taiwan. Unfortunately, the original habitat of this plant in Langdaodonshi, Lanyu Island, Taitung County, was destroyed by a typhoon and no voucher specimens were available for reexamination. In 2014, another image of a menispermaceous species with a number of foliaceous bracts arranged on the racemiform infructescence was also posted on a plant forum website (Taiwan Plants Inventory and Phenology Observations Association 2014). The habitat of this plant is located in Liuqiu Township, Pingtung County, and the reporter did not identify its name. We then visited this location, collected fresh samples of this unknown species, and noted obvious foliaceous bracts in pistillate inforescence and patelliform corollas in staminate flowers. The characteristics of the reproductive organs of this species markedly differed from those of the genus *Cyclea*. After a review of the genus *Cissampelos* (Rhodes, 1975) and examination of some other specimens from the Herbaria (TAI, TAIF, PPI) we identified the plant in the second posted image and collected from Liuqiu Township as *Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman, which is then a newly recorded genus (Cissampelos L.) in Taiwan.

In the present study, we provided the descriptions of the genus and species, photographs (Fig. 1, 4), line drawings (Fig. 2), a key to the genera of Menispermaceae in Taiwan, and a distribution map (Fig. 3) to add more information in the flora of Taiwan.

TAXONOMIC TREATMENT

Cissampelos L. Sp. Pl. 1031. 1753.

Vine, rarely erect shrub. Leaves alternate, petiolate, peltate or basifixed, palmately veined; leaf blade ovate, cordate or rotund. Staminate inflorescences axillary, fasciculate, originating in leaf axils as multi-flowered dichasia or the dichasia originating on axillary secondary branches in axils of reduced leaves or bracts. Staminate flowers actinomorphic; sepals 4, free, usually exteriorly pubescent; petals connately cupulate to patelliform; stamens 4–9, synandrium, dehiscing

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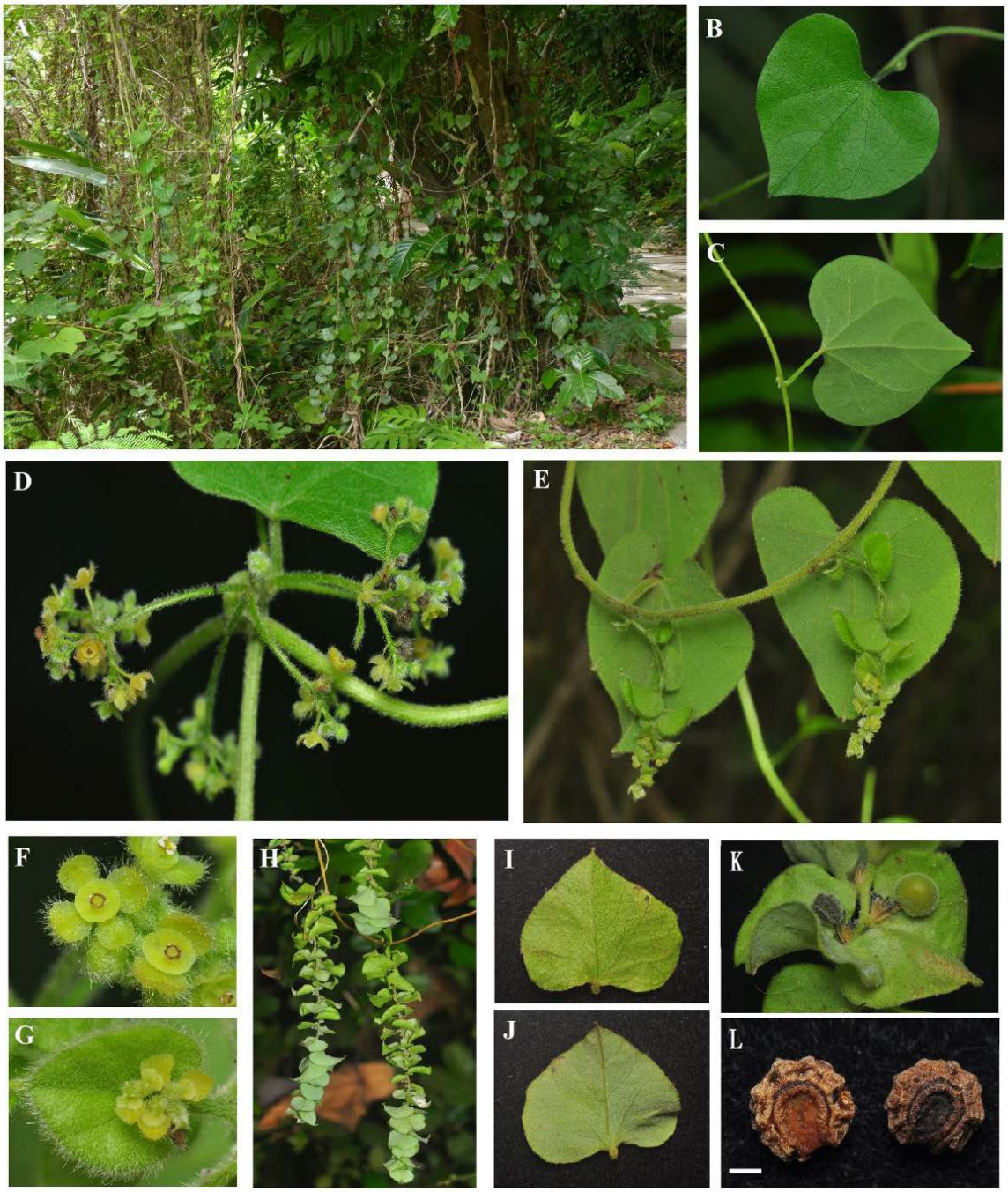


Fig. 1. ***Cissampelos pareira*** L. var. ***hirsuta*** (Buch.-Ham. ex DC.) Forman. **A.** Habit. **B.** Adaxial leaf surface. **C.** Abaxial leaf surface. **D.** Staminate inflorescence: corymbose cymes. **E.** Pistillate inflorescences. **F.** Staminate flower showing patelliform corolla. **G.** Pistillate flowers fasciculate and bracteate. **H.** Infructescence with conspicuous foliaceous bracts. **I.** Adaxial bract surface. **J.** Abaxial bract surface. **K.** Drupe depressed globose with pubescent hairs. **L**. Endocarp horseshoe-shaped, lateral view (Scale bar = 0.5 mm).

transversely. Pistillate flowers zygomorphic, fasciculate in the axils of reduced leaves or bracts; sepal 1, obovate, exteriorly pubescent; petal 1, antesepalous; carpel 1, free, gibbous, the style short, the stigma 3–5 lobed. Drupes subglobose, laterally compressed.

Approximately 20–25 species, pantropical distribution, and mostly found in Africa and America (Forman, 1968; Rhodes, 1975); only one species in Taiwan.

Key to the genera of Menispermaceae in Taiwan

1a. Filaments connected into a column; carpel 1……....2
1b. Filaments free; carpels 2–6……...……4
2a. Sepals alternate with petals in female flowers; sepals free in 1–2 whorls……..……***Stephania***
2b. Sepals opposite with petals in female flowers; sepals free in 1 whorl or connate ……3

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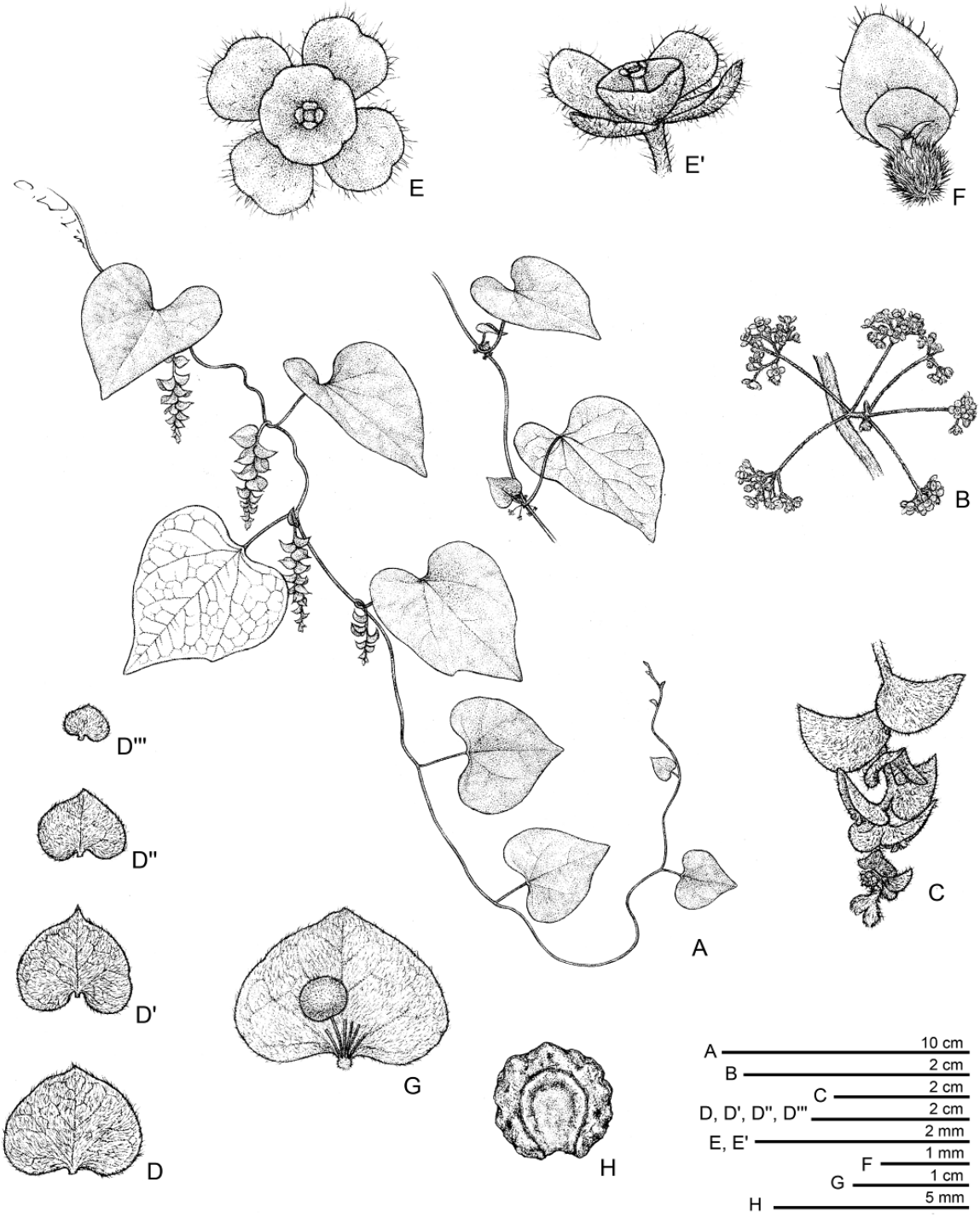


Fig. 2. ***Cissampelos pareira*** L. var. ***hirsuta*** (Buch.-Ham. ex DC.) Forman. **A.** Habit. **B.** Staminate inflorescences. **C.** Pistillate inflorescences. **D-D'''.** Bracts from the minimum to maximum sizes. **E-E'.** Staminate flowers showing patelliform corolla. **F.** Pistillate flower with 1 sepal and 1 petal, opposite each other. **G.** Bract and drupe. **H.** Endocarp horseshoe-shaped. Drawn by Mr. Che-Wei Lin from *P. H. Chen & C. F. Chen 569*, *570*.

3a. Pistillate inflorescence with accrescent bract; bract cordate to reniform ……..…….. ***Cissampelos***
3b. Pistillate inflorescence without accrescent bract; bract lanceolate ……..……..…….. ***Cyclea***
4a. Petal 2-lobed at apex ……..……..… ***Cocculus***
4b. Petal unlobed at apex ……..……. 5
5a. Stamens 8 or more ……..…… ***Sinomenium***
5b. Stamens 6 ……..……..…… 6
6a. Sepals 8–12 in staminate flowers, and sepals 9 in pistillate flowers ……..……..…… ***Pericampylus***
6b. Sepals 6 in staminate flowers, and sepals 4–8 in pistillate flowers ……..……..…… ***Tinospora***

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Table 1. Morphological comparison of ***Cissampelos pareira*** var. ***hirsuta*** (Buch.-Ham. ex DC.) Forman in Taiwan, China and Malesiana.

Characters	Taiwan	China	Malesiana
Leaf apex	acuminate	obtuse	acuminate or obtuse
Sepal shape of staminate flower	obovate	ovate	obovate
Sepal length of staminate flower (mm)	1–1.1	1.2–1.5	1.3–1.5
Corolla shape of staminate flower	patelliform	patelliform	cupulate
Synandrium length (mm)	0.2–0.3	0.7	0.8
Sepal length of pistillate flower (mm)	1	1.5	1.5
Bract shape of pistillate inflorescence	cordate	suborbicular	suborbicular

Cissampelos pareira L. var. ***hirsuta*** (Buch.-Ham. ex DC.) Forman, Kew Bull. 22: 356. 1968. 毛錫生藤 Figs. 1 & 2

Woody or subherbaceous vines. Young stems pilose to tomentose and becoming puberulous, clockwise climbing. Leaves petiolate, peltate to 2 mm from the basal margin, chartaceous, alternate, cordate, entire to undulate, rarely 1–2 dentate on each side, the apex acuminate, rarely emarginate, mucronate, base cordate or subtruncate, 3–9 cm long and 4–8 cm wide, palmately 5–7 veined, usually prominent below, puberulent to pilose above, paler below and tomentose to puberulent; petioles 2–5 cm long, pilose to tomentose. Staminate inflorescence multi-flowered fasciculate dichasia arranged as cymose clusters arising from axils of normal leaves, each inflorescence with 3–6 dichasia; peduncle of dichasium up to 2 cm long, pilose to tomentose. Staminate flowers green or yellowish-green; sepals 4, obovate, 1–1.1 mm long and 0.7–0.8 mm wide, pilose to villous outside and puberulent inside; corolla patelliform, 0.3–0.4 mm long, ca. 0.9 mm in diameter, pilose outside; synandrium 0.2–0.3 mm long, anthers 4, rarely 5–6, dehiscing transversely, glabrous. Pistillate inflorescences racemiform, 6–7 cm long, infructescence elongated up to 14 cm long, bracts foliaceous, about 40 individual bracts, each bract composed of 3–7 individual flowers, fasciculate, thyrsoid; bract basifixed, 5–7 veined, sessile or petiolate to 0.5 mm, cordate to reniform, 0.4–16 mm long and 0.5–16 mm wide, cordate at base and mucronate at apex, frequently grading into minute, entire and sometime undulate, chartaceous to membranous, pilose to tomentose. Pistillate flowers yellowish-green; sepal 1, ovate, suborbicular or subrhombate, ca. 1 mm long and 0.9 mm wide, pilose outside and glabrous inside; petal 1, obovate, reniform or suborbicular, ca. 0.5 mm long and 0.4 mm wide, entire or rarely bilobed, pilose outside. Carpel 1, ca. 0.7 mm long, gibbous, pilose to villous, stigma 3-lobed. Fruit red, pubescent, depressed globose; fruiting stalk ca. 2 mm long, pilose; endocarp horseshoe-shaped, 3.5–4 mm long, 3.4–3.9 mm wide, 1.9–2.2 mm thick, ornamented with two lateral ridges, tubercles ＜10.

Phenology: Male and female flowering periods are from June to November. Fruiting stage is in October and all the fruits are enclosed by the mature foliaceous bracts.

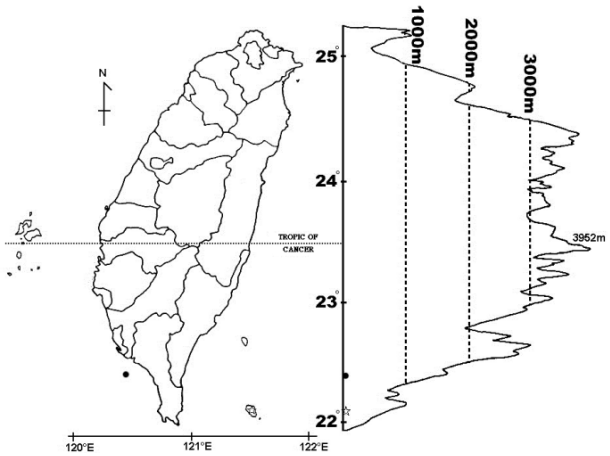


Fig. 3 Distribution of ***Cissampelos pareira*** L. var. ***hirsuta*** (Buch.-Ham. ex DC.) Forman (●) in Liuqui Island and ***Cissampelos*** sp. (☆) in Lanyu Island of Taiwan.

Ecology: In Liuqiu Township on Hsiao Liuqiu Island (Fig. 3); the population is concentrated in a township along the sides of trails on an uplifted coral reef, where it is slightly shaded and exposed to relative low humidity. Vines twined around Epipremnum pinnatum (L.) Engl., Ipomoea cairica (L.) Sweet, Malaisia scandens (Lour.) Planch., Paederia foetida L., Passiflora suberosa L., and its associated species, including Atalantia buxifolia (Poir.) Oliver, Bischofia javanica Bl., Euphoria longana Lam., Ficus microcarpa L. f., Ficus septica Burm. f., Ficus superba (Miq.) Miq. var. japonica Miq., Ixora philippinensis Merr., Macaranga tanarius (L.) Muell.-Arg., and Melanolepis multiglandulosa (Reinw.) Reich. f. & Zoll.

Distribution: Pantropical, through continental Southeast Asia, Australia (Queensland); in Malesia: N. Borneo, Philippines, Celebes Lesser Sunda Is., Moluccas, New Guinea. To date, in Taiwan, only found in two locations on Hsiao Liuqiu Island, Liuqiu Township, Pingtung County.

Elevation: 50–100 m.

Conservation assessment: Only two or three populations have been found in Taiwan. Insufficient information about the distribution, abundance, and threats to this species; we regard the species as Data Deficient (DD).

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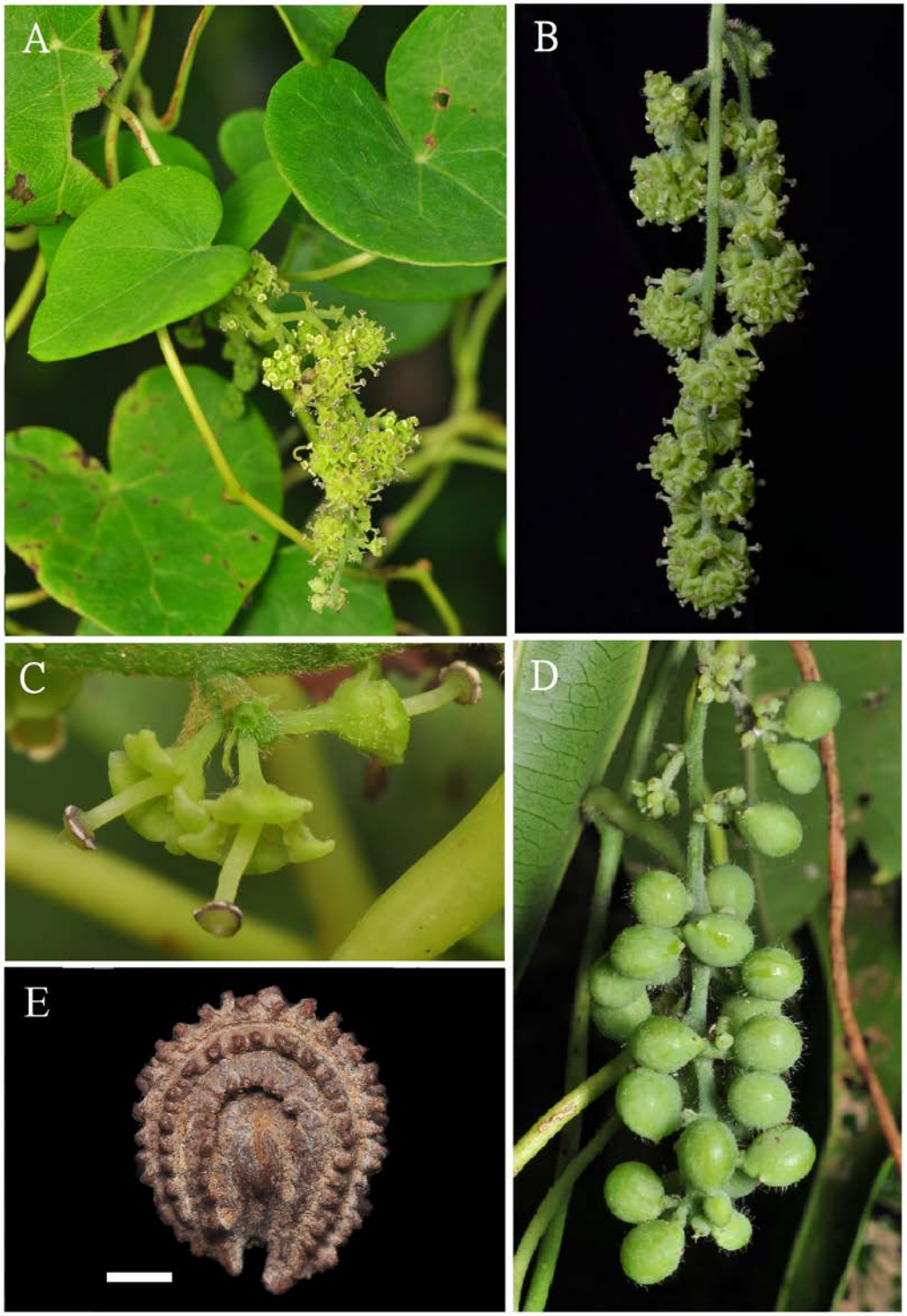


Fig. 4. ***Cyclea insularis*** (Makino) Hatusima. **A.** Habit. **B.** Staminate inflorescence: pseudoracemose or thyrsoid. **C.** Staminate synandrium with lanceolate bracts. **D.** Infructescence. **E.** Endocarp horseshoe-shaped with numerous lateral ridges (Scale bar = 1 mm).

Specimens examined: **TAIWAN**: PINGTUNG Co.: Liuqiu Township, Hsiao Liuqiu, *P.H. Chen & M.Y. Kuo 502, 503* (PPI 76635, 76640, fruit); same location, *P.H. Chen & S.Z. Yang 559* (PPI 76847); same location, *P.H. Chen & C.F. Chen 569* (male), *570* (female). TAITUNG Co.: Lanyu Township, Hungtou to Tienchi, along the river near seaside, *S.F. Huang & Y.C. Hsu 4694* (TAI 223034, 223035, 226312; male); Lanyu, *Y. Tateishi et al. 15120* (TAI 258924, male); Lanyu Township, Chungaichiao, T.Y.Aleck 8457 (TNM S046683, TAIF 200534, male). **PHILIPPINES**: Luzon, Umiray Province of Tayabas, *M. Ramos & G. Edano s.n.*, May-June 1925 (TAIF 9963), Province of Laguna, *C. Madesa s.n.* June-Dec. 1915 (TAIF 24883); Mindanao, District of Cotabato, *B. Rodinson 11718* (TAIF 9964).

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Table 2. Morphological comparison of ***Cissampelos pareira*** L. var. ***hirsuta*** (Buch.-Ham. ex DC.) Forman and ***Cyclea insularis*** (Makino) Hatusima

Characters	***Cissampelos pareira*** var. ***hirsuta***	***Cyclea insularis***
Leaf size (cm)	3–9 by 4–8	4–10.5 by 4.5–9
Peltate length (mm)	0.5–2	2–4
Petiole length (cm)	2–5	4–7.5
Leaf base	cordate to truncate	cordate to subcordate
Numbers of palmate veins	5–7	7–11
Petals of staminate flower	connate	free
Bract shape	cordate to reniform	lanceolate
Bract length (mm)	0.6–14	1
Numbers of lateral ridges in endocarp	2	numerous

DISCUSSION

The species *C. pareira* var. *hirsuta* was distributed in China and Malesia regions (Forman, 1986; Lo *et al.*, 2008) (Table 1); the diagnostic characteristics of the leaf apex, shape of calyx and corolla of staminate flower, calyx length of staminate and pistillate flower, shape of foliaceous bract, and synandrium length found in these two regions are similar to those of the species in Taiwan. Thus, we concluded that the species found in Liuqiu Township, Taiwan is the same species as that distributed in China and Malesiana regions.

Comparing the reproductive organs between the genus *Cyclea* and *Cissampelos*, the staminate inflorescences of the former is pseudoracemose or thyrsoid (Forman, 1986) (Fig. 4A, B) and that of latter is corymbose cymes (Fig. 1D, Fig. 2B). The genus *Cissampelos* can be differentiated from *Cyclea* by the fact that the staminate flowers have cupulate to patelliform corolla and the pistillate inflorescences are composed of individual flowers, fasciculated, bracteate or ebracteate, and racemiform or paniculiform secondary branches (Rhodes 1975) in the former genus. The diagnosticfeatures of these two genera are the size and shape of the bract (Lo *et al.*, 2008): the bract length of *Cissampelos* are within the range 0.4–16 mm (Table 2) and cordate to reniform (Fig. 1I, J) in shape, whereas those of *Cyclea* are 1 mm long and lanceolate (Fig. 4C) in shape.

According to the pictures taken in Langdaodonshi, Lanyu Island posted on the website, its leaves are smooth-like, non-peltate, and the fruits also with enlarged bracts, we concluded that it belongs to the genus *Cissampelos*. The characteristics of two specimens deposited in TAI are included that the leaves are hairs on both surface, staminate inflorescence is cymes, as well as corolla of staminate flowers is cupulate to patelliform. By the characteristics described as above, we also suggested it belongs to the genus *Cissampelos*. However, the original habitat, Langdaodonshi, has been destroyed, and the habitat of the specimens, Chungaichiao, had been changed and did not find this population, so the specific name of this newly recorded genus *Cissampelos* found in Lanyu Island is worthy to study in detail in the near future.

The habitat of *C. pareira* var. *hirsuta* is narrow and limited on an uplifted coral reef, in Liuqiu Township, we estimated this species has been survived on Hsiao Liuqiu Island for a long time, it should be a native species. Natural disturbance or human activity may result in this populations scarcity and rare, the local government should enhance the policy to protect this narrow niche in order to maintain this population persistence.

The phylogenic relationship among the genera of *Cissampelos*, *Cyclea*, and *Stephania* is a clade which strongly supported as a monophyletic (Ortiz, *et al.* 2007). The evolution of a single carpel that is occurred in these three genera support the assumption of its derived condition, a synapomorphy. The information about the morphological characteristics of endocarps in the family Menispermaceae, including the shapes, the lateral view, dorsal view, and ventral view (Jacques, 2009), are still insufficient in Taiwan, it is needed to study further more for adding the diagnostic characters of this family.

ACKNOWLEDGEMENTS

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臺灣防己科疑問種之澄清-毛錫生藤

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摘要:過去30年來存放於TAI標本館的兩份防己科的標本僅具雄花序，被鑑定為蘭嶼土防己(*Cyclea insularis* (Makino) Hatusima)。此兩份標本應屬於錫生藤屬(*Cissampelos* L.)，是臺灣的新記錄屬。錫生藤屬與土防己屬的主要區別特徵在於錫生藤屬的雄花花瓣連合成盤狀或杯狀、雄花序為繖房狀聚繖花序以及雌花序具明顯葉狀苞。出現於南臺灣琉球鄉的毛錫生藤(*Cissampelos pareira* L. var. *hirsuta* (Buch.-Ham. ex DC.) Forman)也是臺灣的新記錄種。本文提供本種與本屬的形態描述、彩色照片、手繪圖以及臺灣產防己科之屬檢索表將有助於鑑別之用。

關鍵字：毛錫生藤、防己科、新紀錄屬、新紀錄種、分類。

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