

Research paperTwo newly naturalized plant species in Taiwan: *Astraea lobata* and *Merremia umbellata*Chien-Ti Chao<sup>1</sup> Po-Hao Chen<sup>2</sup> Chiu-Mei Wang<sup>3\*</sup>

【Abstract】 We report two newly naturalized species—*Astraea lobata* (L.) Klotzsch and *Merremia umbellata* (L.) Hallier f. subsp. *umbellata* in Taiwan. *Astraea* was a newly recorded genus to the flora of Taiwan and *A. lobata* was its type species. This species was characterized by its tri-lobed leaves and highly divided styles. In addition, on the reviewing of literature and specimen of Taiwanese *Merremia*, *M. umbellata* was recorded by some authors. The only specimen cited by some of them, was contained only one leaf that hardly to recognized as any *Merremia* species. Besides, the description of this species was more or less scanty in those studies. Thus, this study confirms the newly naturalization of *M. umbellata* in Taiwan. Descriptions and photos of two species are provided.

【Key words】 *Astraea lobata*, *Merremia umbellata* subsp. *umbellata*, newly naturalized species, plant taxonomy.

研究報告

## 台灣的二種新馴化植物：裂葉巴豆及繖花菜欒藤

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【摘要】 本文報導台灣二種新馴化植物—裂葉巴豆 (*Astraea lobata* (L.) Klotzsch) 和繖花菜欒藤 (*Merremia umbellata* (L.) Hallier f. subsp. *umbellata*)。其中裂葉巴豆屬為台灣新紀錄屬，裂葉巴豆為模式種。本種之區別特徵在於三裂的葉片及多岐的花柱。另外，我們查閱臺灣菜欒藤屬文獻及標本後發現繖花菜欒藤曾紀錄於某些文獻中，但這些研究所引證的唯一一份標本，卻僅有單一葉片而難以鑑定。如此，本研究確認其為臺灣之新馴化種。本文並提供兩者之描述與照片。

【關鍵詞】 新馴化植物、裂葉巴豆、繖花菜欒藤、植物分類。

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## Introduction

The human activities often accompanied with species distribute to new environment. Some species of them were became biological invasions, which often cause serious problems on ecology, economy and agriculture (Vilà et al. 2011; Gallardo et al. 2015). Therefore, the early discovery and identifying of alien species are important for monitoring and controlling these species. These tasks are usually relied on the work of taxonomic researchers. In Taiwan, many naturalized species were reported after the publication of supplement of Flora of Taiwan second edition (Wang & Lu 2012), e.g. *Gibasis pellucida* (Martens & Galeotti) D.R. Hunt (Chao et al. 2014), *Ipomoea leucantha* Jacq. (Chen & Yang 2017), *Linum usitatissimum* L. (Chao et al. 2017), *Fumaria parviflora* Lam., *Merremia quinquefolia* (L.) Hallier f. (Chung et al. 2017), *M. cissoides* (Lam.) Hallier f. (Ko & Liu 2011) (neglected by Wang & Lu 2012), *Nelsonia canescens* (Lam.) Spreng. (Wang et al. 2016) and *Polycarpon tetraphyllum* (L.) L. (Jung 2016). The natural distributions of these species were often in the different continents, e.g. North America or South America, that hard dispersed to Taiwan by natural power. They also often found near or right on the place of human activities. Thus, they were identified as naturalized species based on these features.

Recently, we found two unknown species in Kaohsiung city of southern Taiwan. These species showed well regeneration among several investigations. Therefore, these species should be described in a formal style. After literatures and herbaria reviewing, the status of these species were confirmed. However, on the processing of these works, some taxonomic problems were found on the *Merremia umbellata* (L.) Hallier f.

of Taiwan. Thus, the aims of this study are to (1) provide morphological descriptions of these two species, (2) discuss the taxonomic problems of *M. umbellata* of Taiwan.

## Materials and Methods

The study materials were collected from living plants in the field, at least three specimens of each species were collected. Voucher specimens were deposited in the herbarium of National Museum of Natural Science (TNM) in Taichung. For the identification of unknown taxa, following herbaria were examined: TNM, TAIF, HAST, K, BM, P. Local Flora and related taxonomic literatures were reviewed. Measurement of quantitative characters were based on at least three individuals. Description of shape of planar organs were followed Systematics Association Committee for Descriptive Terminology (1962).

## Results

### 1. Description of newly naturalized species

*Astraea* Klotzsch in Archiv für Naturgeschichte 7(1): 194. 1841. 裂葉巴豆屬 (新擬)

Annual herbs to shrubs. Leaves alternate, often palmately lobed, margin entire to serrate, venation palmately, stipule present. Inflorescences racemes to thyrses, monoecious, pistillate flowers proximal and staminate flowers distal, pedicels present. Staminate flowers: sepals 5, petals 5, stamens 8-15, pistillode absent. Pistillate flowers: sepals 5, petal absent, ovary superior, carpels 3, style 3-fid, each lobe irregular lobed. Capsules globose. Seeds oblong-rectangular, caruncle present.

Ca. 12 species distributed in Mexico, West Indies, Central to South America, introduced in North America (Florida), Asia and Africa.

1. *Astraea lobata* (L.) Klotzsch in Archiv für Naturgeschichte 7(1): 194. 1841. 裂葉巴豆 (新擬) (Figure 1)

Annual herbs. Stem erect, 20-70 cm tall, villous. Roots fibrous. Leaves simple, alternate, triangular widely ovate, 4-6 cm long, 5-8 cm wide, green, base cordate, margin 3 lobed, crenate, lateral lobes oblique, elliptic, 3-4 cm long, 1.5-2.5 cm wide, terminal lobe ovate to widely-ovate, apices cuspidate, ternate-netted veined, sericeous on both surfaces; petioles 4-6 cm long, ca. 1 mm in diam., terete, villose. Stipules lanceolate, ca. 3 mm long, ca. 1 mm wide, sometimes lobed at base. Inflorescences raceme, terminal, 5-8 cm long, pistillate flowers at base part, staminate flowers at apex part, bract absent, villous at pistillate part, staminate part glabrous. Staminate flowers: sepals 5, oblong, ca. 1 mm long, ca. 0.5 mm wide, green, glabrous; petals 5, oblong, ca. 1 mm long, ca. 0.6 mm wide, pellucid-yellow, apex purplish-red, glabrous; stamens 7-8, filaments ca. 1 mm long, pale-yellow, anthers ca. 0.3 mm long, pale-yellow, both glabrous. Pistillate flowers: sepals 5, spatulate, ca. 4 mm long, ca. 1 mm wide, green, villous; petal absent; ovary superior, globose, 2-3 mm wide, green, villous; style 3, ca. 3 mm long, each branched, pale yellow. Fruits capsule, globose, ca. 5 mm in diam., villous.

Chromosome number  $n=9$  (Miller & Webster 1966).

This species was only known from Tashe district of Kaohsiung city at present (Figure 2).

Specimens examined: Kaohsiung city, Tashe district, Paoshe village, abandoned pineapple garden, 16 Nov. 2017, C. M. Wang 17199 (TNM); same loc., 25 Nov. 2017, C. T. Chao 4528 (TNM); same loc., 9 Dec. 2017, P. H. Chen 1360, 1362 (TAIF).

2. *Merremia umbellata* (L.) Hallier f. subsp.

*umbellata* in Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie 16(4-5): 552. 1893. 繖花菜欒藤 (Figure 3)

Perennial liana. Stem dextrorsely twining, ca. 3 mm in diam., glabrous, with milky sap. Leaves evergreen, simple, alternate, heart-shaped to oblong, 6-16 cm long, 3-12 cm wide, chartaceous, base cordate to auriculate, margin entire, apex acute, pinnate-netted venation, lateral veins 5-7 pairs, glabrous, green, stipule absent, petiole 3-5 cm long, pubescent to subglabrous, with a pair of corn-like appendages at the junction between petiole and node. Inflorescences umbel-like cymes, axillary, bract absent, flowers 1-50, glabrous. Flowers: sepals concave, green, 4-5 mm long, 3-4 mm wide, subcoriaceous, glabrous, corolla funnelform, margin shallowly lobed, yellow, 2-3 cm long, 2-3 cm wide, glabrous. Stamen 5, filaments filiform, ca. 1 cm long, pale-yellow, pubescent at lower part; anthers basifixed, not twisted, ca. 2 mm long, longitudinal dehiscent, milky white; ovary superior, globose, glabrous; style straight, stigma bifid, green; carpels 2-3, each with one ovule. Fruits capsule, globose, dark brown, diam. ca. 1 cm. Seeds 4, dark brown, pubescent.

This species was almost cosmopolitan distributed, subsp. *umbellata* was found in neotropics (Staples 2010). This species was naturalized in Kaohsiung city and Pingtung county at present (Figure. 2).

Specimens examined: Kaohsiung city, Tashe district, Paoshe village, roadside, 16 Nov. 2017, C. M. Wang 17201 (TNM); same loc., 25 Nov. 2017, C. T. Chao 4529 (TNM); Pingtung county, Linbian township, Forguangtsai Wetland, 8 Dec. 2017, C. M. Wang 17236 (TNM); same loc., 9 Dec. 2017, P. H. Chen 1361 (TAIF).

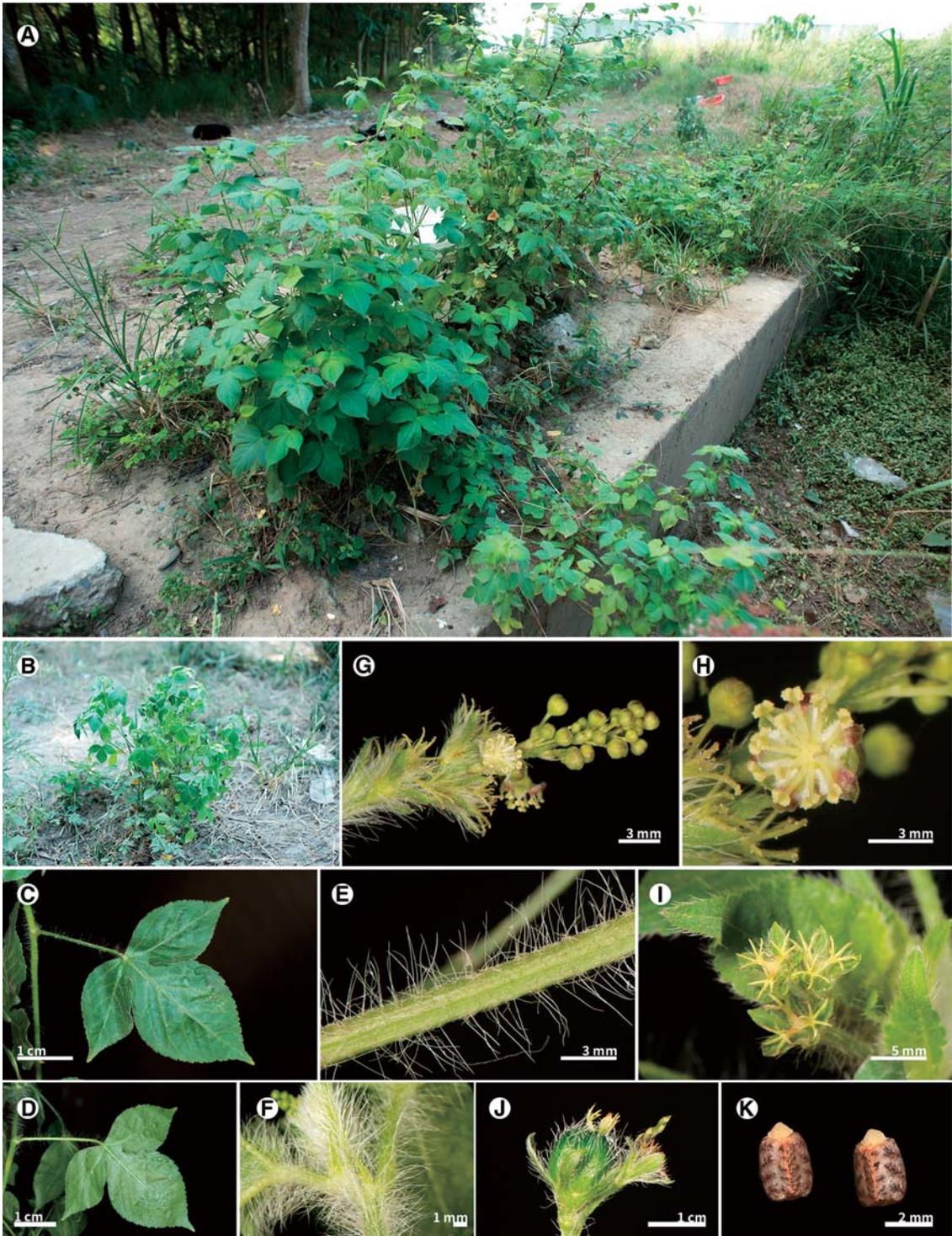


Figure 1. *Astraea lobata*. A. habitat, B. habit, C. leaf adaxial surface, D. leaf abaxial surface, E. stem, F. stipule, G. inflorescence, H. staminate flower, I. pistillate flowers, J. immature fruit, K. seeds.

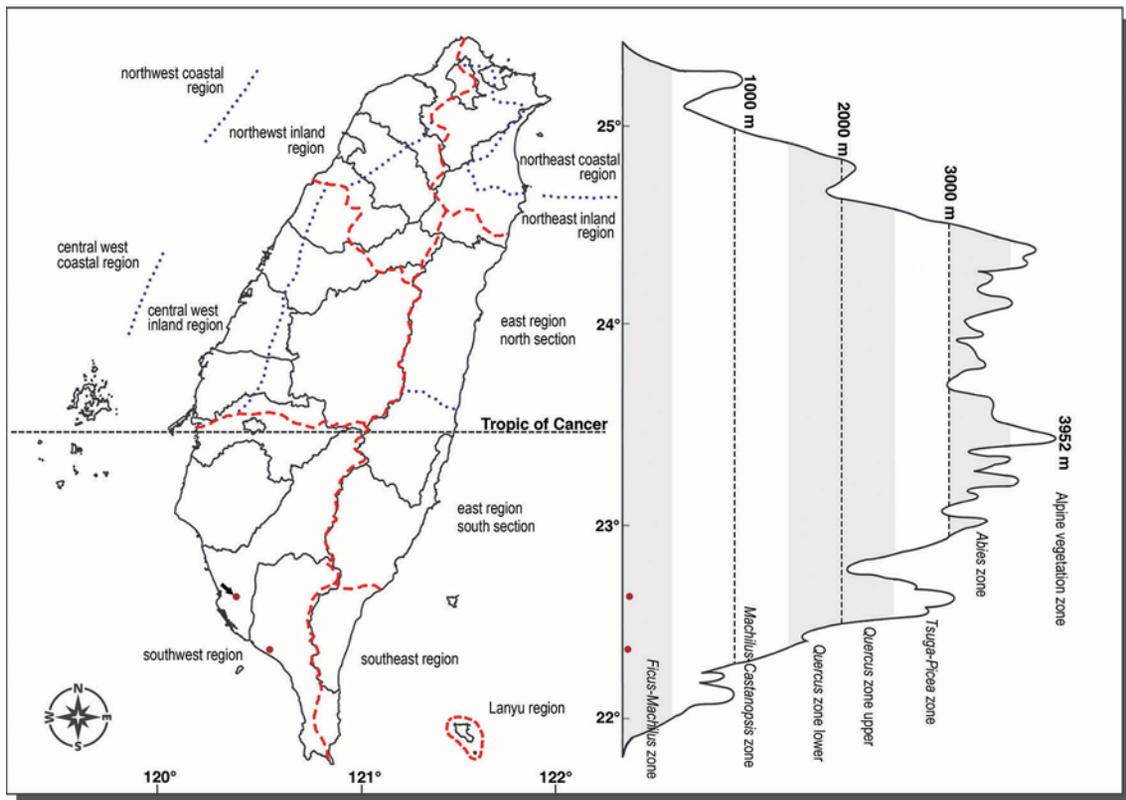


Figure 2. Distribution of *Astraea lobata* and *Merremia umbellata* subsp. *umbellata* in Taiwan. The arrow indicates two species co-occurred in Tashe district, Kaohsiung city. The circle indicates *M. umbellata* subsp. *umbellata* occurred in Linbian township, Pingtung county.

## Discussion

Brief taxonomic history of *Astraea*

*Astraea* was described by Klotzch in 1841. The genus was treated as a section or a subgenus under *Croton* L. (Baillon 1858; Pax 1890; Webster 1993). Phylogenetic study of *Croton* supported the independent status of *Astraea* (Berry et al. 2005). This genus distinguished from *Croton* by highly divided styles, lobed leaves, staminate flowers with imbricate perianth, and quadrangular seeds with caruncle (Berry et al. 2005). *Astraea lobata* was the type species of *Astraea*, lectotype was designated by van Ee (2011). This species was native to central and south America, and introduced in India and some other Asian areas

(Gaikwad et al. 2012; Levin & Gillespie 2016).

This species was similar to the herbal *Croton* taxa in Taiwan, e.g. *C. bonplandianus* Baill. and *C. crassifolius* Geiseler, but distinguished by having tri-lobed leaves and highly divided styles.

Study history of *M. umbellata* in Taiwan

*Merremia umbellata* was described by Linnaeus (1753) as *Convolvulus umbellatus*, and transferred to *Merremia* by Hallier (1893). The first record in Taiwan was made by Sasaki (1928) from eastern Taiwan, which was followed by Mori (1936), Masamune (1954), Lu (1972) and Chang (1978). The only specimen cited by Lu (1972) and Chang (1978) was collected by Mori (cited as unknown collector) in 21 Apr.

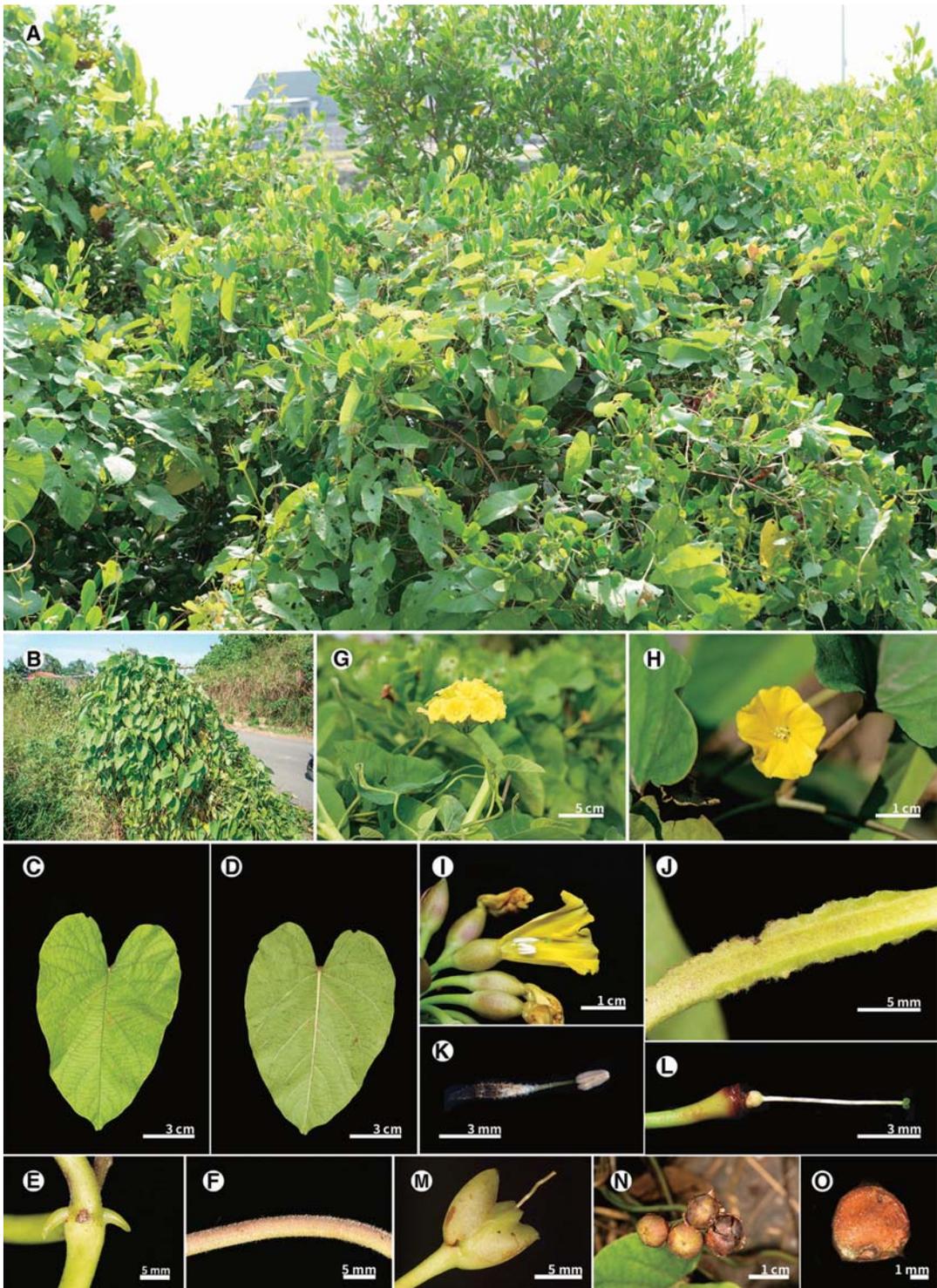


Figure 3. *Merremia umbellata* subsp. *umbellata*. A. habitat, B. habit, C. leaf adaxial surface, D. leaf abaxial surface, E. appendages of petiole, F. petiole, G. inflorescence, H. flower, I. floral section, with part of corolla removed, J. peduncle, K. stamen, L., pistil, M. sepals, loosened to show the concave habit, N. fruits, O. seed.

1907, Taimali, Taitung (TAIF 20689). No other duplicate specimen was found in TAIF or other herbaria, thus, this could be the only specimen of *M. umbellata* of Taiwan. However, this specimen had only one leaf left that hardly recognized as any *Merremia* species in Taiwan. Considering the uncertainty of the specimen, the Sasaki's report could not be referred as formal record of *M. umbellata*. On the other hand, Sasaki (1928) didn't provide any description of this species. Although Lu (1972) and Chang (1978) had described this species, the description had more or less incongruent with the plant we found, that would not from local material. Thus, our study completed the detailed part of description and specimens of *M. umbellata* in Taiwan.

Van Ooststroom (1953) recognized two subspecies of *M. umbellata*-subsp. *umbellata* and subsp. *orientalis* (Hallier. f.) Ooststr in Malesia region. *M. umbellata* subsp. *umbellata* was distinguished by more robust habit, larger leaves, longer peduncle, more and larger flowers

which were always yellow, sepals 7-10 mm long, subglobose capsules, and seeds with short-hairs (van Ooststroom 1953). However, Staples (2010) abandoned such treatment hence caused some specimens that had intermediate characters that could not well fit in any subspecies. Considering the distribution of subspecies, we adopt the treatment of van Ooststroom (1953), and this taxon of Taiwan should belong to subsp. *umbellata*.

The yellow corolla of *M. umbellata* subsp. *umbellata* was similar to some congeners of Taiwan, such as *M. gamella* (Burm. f.) Hallier f. and *M. hederacea* (Burm. f.) Hallier f. But *M. umbellata* subsp. *umbellata* could be easily distinguished by its robust habit, unlobed leaves, appendages on the junction of petiole and stem node and umbelliform inflorescences. The leaves were often larger than those of the other species, but this character was various among different individuals and position on the stem (Figure 4). Accordingly, this could not be a primary



Figure 4. Leaf variation of *Merremia umbellata* subsp. *umbellata*.

diagnostic character.

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