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A Taxonomical Study of the Genus *Boerhavia* (Nyctaginaceae) in Taiwan

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ABSTRACT: The genus *Boerhavia* is distributed in the tropical and subtropical regions of the Old and New World in both hemispheres. Many are characteristic of coastal habitats. It is represented in Taiwan by five species: *B. coccinea* Mill., *B. erecta* L., *B. repens* L., *B. glabrata* Bl., and *B. hualienense* Chen & Wu *sp. nov*. *Boerhavia coccinea* and *B. erecta* are recently known as alien species. *Boerhavia repens* and *B. glabrata*, both incorrectly reported previously in Taiwan as *B. diffusa* L., are recognized. *Boerhavia hualienense* is a new species from eastern Taiwan. In this paper we present a brief revision of the Taiwanese species of *Boerhavia*. A key to its taxa along with descriptions, line drawings, ecology, taxonomical notes, and a map showing the distribution of all five species on this island are provided.

KEY WORDS: ***Boerhavia, B. coccinea, B. erecta, B. glabrata, B. hualienense, B. repens,* Nyctagniaceae, Taxonomy, Taiwan.**

INTRODUCTION

Boerhavia is a genus of 10 to 40 species, almost all of which are widely distributed in tropical and subtropical areas of the world (Fosberg, 1999; Spellenberg, 2003). Some of the species are extraordinarily plastic or polymorphic and are treated as complex groups. They are usually coastal plants spreading in sandy areas, gravelly plains, or on rocky slopes. Owing to the polymorphism and the possible existence of hybrids between members of the complexes, many authors of regional floras have indicated that the distinctiveness at the species level, especially in the pantropical *Boerhavia diffusa* complex and *B. repens* complex, was rather difficult (Walker, 1976; Meikle and Hewson, 1984; Whitehouse, 1996; Fosberg, 1999; Spellenberg, 2003).

The genus *Boerhavia* is characterized by elongate stems with prominent nodes, slender forking cymose or rarely racemose or spicate inflorescences with small, scale-like free bracts, small flowers with campanulate, cylindric, funnel-shaped perianth limb separated by a constriction from the sulcate, enlarged lower portion of the perigone, and anthocarps that are clavate or oblong, often glandular (Fosberg, 1978). In Taiwan, three binominals, *Boerhavia repens* L., *B. crispa* Heyne and *B. diffusa* L. had, in the past, been enumerated for the genus. However, only *Boerhavia diffusa* was represented in the flora of Taiwan (Liu, 1976; Yang and Lu, 1996). More recently, *B. erecta* L. and *B. coccinea* Mill. were reported as being newly introduced (Chou et al., 2004; Chen and Wu, 2005). *Boerhavi diffusa* is a very broad collective species and renowned as a difficult species in regions of the Old World and New World in both hemispheres (Whitehouse, 1996; Spellenberg, 2003). In a study of a wide range of specimens, Fosberg (1978) divided the species into two groups, *B. diffusa* group and *B. repens* group, on the basis of the mode of inflorescence, viz. in *B. diffusa* group the inflorescences are strictly terminal and paniculate, while in *B. repens* group the inflorescences are axillary and pedunculate cymes or umbels. Both of these groups are complex and several distinct species are included. Following his concept we confirmed the occurrence of *B. repens* in Taiwan and recognized two additional members of *B. repens* group, *B. glabrata* and *B. hualienense*, undescribed on the island. Among them *B. hualienense* is a new species from eastern Taiwan.

In this paper we report our findings of preliminary investigations and provide an artificial key and taxonomic treatment of all species of *Boerhaiva* found in Taiwan, based on specimens available from Taiwan, China (Kwangtung), Micronesia, the Philippines and Ryukyu at the Institute of Ecology and Evolutionary Biology, National Taiwan University (TAI), Research Center for Biodiversity, Academia Sinica (HAST), and National Hualien University of Education (NHU).

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Key to the Species of *Boerhavia* in Taiwan

1a. Plants robust, decumbent to erect, 30-80 cm tall; leaves orbicular, ovate, ovate-lanceolate to lanceolate, 3-8 cm long and 2-7 cm wide.
  2a. Inflorescences of widely branched panicles, terminal; plants decumbent.
    3a. Anthocarps clavate or obconical-clavate, glandular; leaves broadly ovate to suborbicular ..... 1. *B. coccinea*
    3b. Anthocarps narrowly obconical, glabrous, with undulate ribs; leaves ovate to lanceolate ……..……. 2. *B. erecta*
  2b. Inflorescences of pedunculate cymes, axillary; plants prostrate; anthocarps ellipsoid to obovoid, glandular ...…… ..... 3. *B. repens*
1b. Plants slender, prostrate, less than 20 cm tall; leaves ovate, ovate-lanceolate, oblong, oblong-lanceolate to linear lanceolate, 1.5-3 cm long and 0.5-2.5 cm wide.
  2a. Plants dark green to purplish green; leaves ovate to lanceolate, with entire to undulate margins; flowers purple, pale purple to white, usually 4-6, in cymes, umbels or pseudoumbels; anthocarps ellipsoid to obovoid, with ribs glabrous …..... 4. *B. glabrata*
  2b. Plants whitish green; leaves oblong, lanceolate to linear lanceolate, with distinctly crispate margins; flowers white, usually solitary, rarely 2; anthocarps clavate, with ribs densely glandular ..……..…… 5. *B. hualienense*

1. *Boerhavia coccinea* Mill., Gard. Dict., ed. 8, *Boerhaavia* no. 4. 1768; Fosberg in Wagner et al., Man. Flowering Pl. Hawaii (Rev. ed.) 1: 978. *pl.139*. 1999; Steyermark & Aymard C. in Berry et al., Fl. Venez. Guayana 7: 102. *fig. 106*. 2003; Spellenberg in Fl. N. Amer. Ed. Comm., Fl. N. Amer. 4: 20. 2003; Chen & Wu, Taiwania 50 (1): 31. *fig. 4-5*. 2005. 紅花黃細心 Figs. 1 & 2

Perennial herbs, prostrate to ascending, up to 80 cm tall. Stems terete, 2-5 mm across, green flushed with purplish red, glandular puberulent and sparsely pilose. Leaves somewhat fleshy, opposite, in unequal pairs; blades ovate, broadly ovate to suborbicular, upper surface yellowish green, green to bluish green, obscurely glandular to glabrous, lower surface pale, pubescence on veins, margins entire, cartilaginous, undulate to slightly lobed, distinctly long-ciliate ca. 1 mm long, obtuse to rounded at the apex, truncate to subcordate at the base, the larger one 3-8 cm long and 2-7 cm wide, with a long petiole up to 4 cm long, the smaller 1.5-3 cm long and 1-2.5 cm wide, with a petiole less than 1 cm long; petioles pale flushed with purplish red, with long hairs. Inflorescences of cymes, in an terminal open panicle, up to 60 cm long, the panicle 4-8 branched, more or less zigzag, ascending, with sticky internodal bands, the peduncles stout at base, capillary at apex, green flushed with purplish red, obscurely glandular, each branch of inflorescence subtended by a bract, bracts ovate and ciliate, 1.5 mm long and 1 mm wide, caducous. Flowers 3-6, clustered at the apex of peduncle, subsessile; bracteoles usually 2, subtending a flower, in an unequal pair, the smaller slightly above, linear-lanceolate, 0.8 mm long and 0.2 mm wide, the larger below, lanceolate, 1.2 mm long and 0.5 mm wide, all those pale yellow flushed with purple, pilose and glandular on margins and abaxial surface; perianth constricted near the middle, the limb campanulate-tubular 1.2-2 mm long, 2 mm across when opening, magenta to dark red, shallowly 5-lobed, the lobes 0.8 mm wide, emarginated, with protuberance bearing hairs on the sinus, the abaxial side with a calyx-like surface, pilose above and glandular below; stamens 1 or 2, filaments 0.6 mm long, purple, anthers dithecal, orbicular, 0.4 mm across, purple to orange red; style 1 mm long, purple; stigma capitate, purplish red, 0.3 mm across; ovary 1.2 mm long. Anthocarps obconical-clavate, 4-4.5 mm long and 1.8 mm wide, rounded-subtruncate at apex, 5-ribbed, the ribs green, 0.3-0.4 mm wide, prominently stipitate glandular, the furrows pale, wider than ribs, 0.5-0.6 mm wide, densely puberulent, with longitudinally arranged raphide bundles and a few glandular hairs occasionally, straw-colored when mature.

Specimens examined: TAIWAN: Taitung Co.: Lutao (Green Island), 22 October 2002, *Hua s. n.*; same loc. and date, *Li s. n.*; Lutao, Chonliau Hsiang, along trail to mountain, 29 March 2003, *Su & Hsu s. n.*; Lutao, Turkey Rock, 30 March 2003, *Su & Hsu s. n.*; Lutao, Tzu-Ping, 30 March 2003, *Su & Hsu s. n.* (All at NHU). Pingtung Co.: Chaochou, roadside, along the Provincial Way 1, *Lin 66* (NHU); Chiuju, elev. 30 m, flat ground, grassland, open place, middle humidity, full sun, *Chiang 203* (HAST). Kaohsiung Co.: Nanshachuntao, Taipingtao, elev. ca. 0-4 m, open place, *Huang et al. 16408* (TAI). Kaohsiung City: Chungchou, beach, elev. ca. 0-20 m, *Huang 4640* (TAI); Yochang, near graveyard, 6 May 2006, *Chen s. n.* (NHU). Tainan City: on lawns of Yen-Pin-Chung-Wang-Chi (Kuo-Sin-Ya Temple), 6 January 1988, *Chen s. n.* (NHU). Yunlin Co.: Hou-an, roadside, *Yang 485*; Chin-hu, elev. ca. 10 m, *Huang et al. 15312*; Tai-shi, waste land, *Wang 2536*, same loc., beside stream, *Yang 519* (All at TAI). Changhua Co.: Tatushi, bank, *Tang 1010* (TAI). Miaoli Co.: Tongshiao, weeds along Haibin (Seashore) Rd. elev. ca. 5-10 m, flowers red, *Peng 5447* (HAST). Hualien Co.: Hualien City, Meilung, 13 August 1990, *Yung s. n.*; Meilung Shan (mountain), near a community park, on mountain slope, 11 June 1996, *Wang s. n.*; Hualien City, 30 October 2002; same loc., 1 June 2003, *Chen s. n.*; Hualien City, by Hualien jail, on lawns under planted trees, 10 December 2004 *Chen s. n.* (All at NHU)

Distribution and notes: *Boerhavia coccinea* is native to tropical America, perhaps to the Caribbean Islands, and was introduced and naturalized in Africa (Whitehouse, 1996), Australia (Meikle and Hewson, 1984) and Hawaii (Fosberg, 1999). In North America it is also known along the Pacific coast from southern California to the southeastern states (Shreve and Wiggins, 1964).

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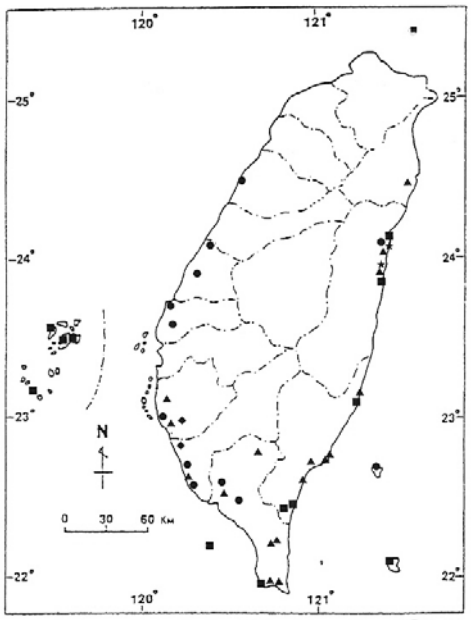


Fig. 1. Distribution map of *Boerhavia* in Taiwan area. (●) *B. coccinea* Mill.; (◆) *B. erecta* L.; (■) *B. glabrata* Bl.; (★) *B. hualienense* Chen & Wu; (▲) *B. repens* L.

Boerhavia coccinea is a highly variable species, and is a member of *B. diffusa-B. coccinea* complex. Some considered as the same species with *B. diffusa* (Woodson et al., 1961; Wunderlin, 1998), some treated as different (Meikle and Hewson, 1984; Whitehouse, 1996). Since our populations with dark red flowers and long-ciliate leaf margins are an excellent match to the populations of *B. coccinea* from the Hawaiian Islands (Fosberg, 1999), they are identifiable as *B. coccinea*. It may be introduced from somewhere in the Pacific areas.

In Taiwan, it is a weed of coastal or slightly inland, disturbed places such as roadsides, river banks and lawns, and associates with other weedy plants commonly found in open sandy places. Flowering and fruiting are throughout the year.

2. *Boerhavia erecta* L., Sp. Pl. 3. 1753; Backer & Bakh. f., Fl. Java 1: 271, 1963; Stemm. in Steenis, Fl., Males. ser. 1, 6 (3): 454. *fig. 1: h.* 1964; Codd, Bothalia 9 (1): 115. *fig. 1-1; 1a, 1b, 1c, 1d.* 1966; Whitehouse in Polhill, Fl. Trop. E. Africa, Nyctaginaceae 2. 1996; Lu in Tang et al., Fl. Reipubl. Popul. Sin. 26: 12. *fig. 2*: *8*. 1996; Spellenberg in Fl. N. Amer. Ed. Comm., Fl. N. Amer. 4: 22. 2003; Chou, Lin & Sheue, Taiwania 49 (1): 40. *figs 1-2*. 2004. 直立黃細心 Figs. 1 & 3

Perennial herbs, decument to erect, up to 60 cm tall. Stems terete, 3-5 mm across, green flushed with purple, puberulent, with pilose at nodes and sticky internodal bands, becoming glabrous and woody towards the base. Leaves somewhat fleshy, opposite, in unequal pairs; blades ovate, ovate-lanceolate to lanceolate, upper surface green, puberulent, glandular-dotted or not, lower surface greyish-white, usually flushed with purplish red, pubescent on veins, glandular-dotted, margins sinuate, flushed with purplish red, acute or obtuse at the apex, truncate to cuneate at the base, the larger one 3-4.5 cm long and 2-3.5 cm wide, with a long petiole up to 3 cm long, the smaller 1.5-2.5 cm long and 1-2 cm wide, with petiole less than 2 cm long; petioles pale green flushed with purple, pubescent. Inflorescences of cymes or subumbels, axillary and in an terminal open panicle, up to 60 cm tall, the panicle 4-6 branched, the peduncles stout at base, capillary at apex, green flushed with purplish red, subglabrous, with sticky internodal bands, each branch of inflorescence subtended by 2 leafy bracts or a bract, bracts linear lanceolate, puberulent, 0.3-0.5 mm long, caducous. Flowers 2-6, clustered at the apex of peduncle, sessile; bracteoles 2, subtending a flower, narrowly lanceolate, 0.4-0.8 mm long, acuminate at apex, pale yellow flushed with purple, perberulent; perianth constricted near the middle, the limb campanulate, 1.5 mm long, 2 mm across when opening, pink, shallowly 5-lobed, the lobes 0.8 mm wide, emarginate, with protuberance bearing hairs on the sinus, sparsely puberulent and glandular on the abaxial surface; stamens 2-3, filaments 1 mm long, white, anthers dithecal, orbicular, 0.3 mm across, white to pink; style 1 mm long, white; stigma capitate, white, 0.3 mm across. Anthocarps narrowly obconic, 3-4 mm long and 1.5-2 mm wide, truncate at apex, 5-ribbed, the ribs undulate, pale green flushed with purple, 0.3-0.5 mm wide, glabrous, the furrows pale, 0.3-0.6 mm wide, slightly to prominently coarsely transverse rugose, with longitudinally arranged raphide bundles.

Specimens examined: TAIWAN: Kaohsiung Co.: Nehu Hsiang, Haipu Village, along abandoned railroad of sugarcane fields, 3 Feb 2004, *Liu s. n.* (NHU). Tainan Co.: Yonkang City, Lontang, on borders of paddyfields, 1 May 2004, *Lin s. n.* (NHU). CHINA: Kwangtung: Shi-pai, suburb, along rail-road, *Hosokawa 10169* (TAI). PHILIPPINES: Laguna: Los Banos, UPLB., college campus, near green house of Botany Dep., elev. ca. 30 m , flowers purplish, *Hernaez 1461* (TAI). THAILAND: S. W. Prov. Prachuap Khiri Khan: Khao Klong Wan, Muang Distr., limestone slope with bush, by path, flowers pink with somewhat purplish color, *Shimizu et al. 28751* (HAST).

Distribution and notes: *Boerhavia erecta* is from tropical America and widely introduced throughout the tropics and warm-temperate regions (Spellenberg, 2003). In Asia it extends from India (Matthew, 1995), Java (Backer and Bakhuizen,

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Fig. 2. *Boerhavia coccinea* Mill. A: Habit. B: Portion of inflorescence.

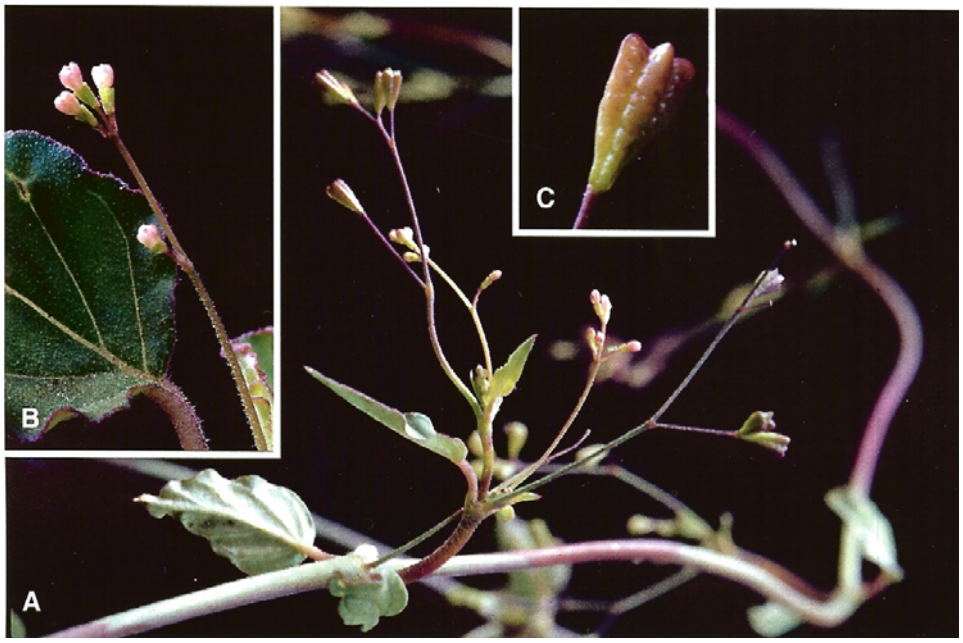


Fig. 3. *Boerhavia erecta* L. A: Habit. B: Portion of inflorescence. C: Anthocarp.

1963), Malaysia (Stemmerik, 1964), Thailand, and the Philippines to Mainland China (Lu, 1996) and the Ryukyu Islands (Shimabuku, 1997).

In Taiwan it occurs in central and southern coastal counties, found along railroads, roadsides, wastelands and borders of fields. Flowering is throughout the year. The present species is readily recognizable by its obconical anthocarps, which are completely glabrous, truncate at the apex, and with undulate ribs.

3. *Boerhavia repens* L., Sp. Pl. 3. 1753; Backer & Bakh. f., Fl. Java 1:271.1963. *pro parte*; Fosberg, Smithsonian Contr. Bot. 39: 8. 1978; Fosberg in Wagner et al., Man. Flowering Pl. Hawaii (Rev. ed.) 1: 981. *pl. 139*. 1999. 黃細心 Figs. 1 & 4

Boerhavia diffusa auct. non L. 1753: *senus* Liu in Li et al., Fl. Taiwan (1st ed.) 2: 297. *pl. 301*. 1976; Hong et al., Seaside Pl. Taiwan 1: 11. 1978; Jeng, Seaside Pl. Taiwan 133. *phot.* 119. 1987; Ying,

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Coloured Illustr. Fl. Taiwan 3: 547. *phot. 588*. 1988; Yang & Lu in Huang et al., Fl. Taiwan (2nd ed.) 2: 320. *pl. 49, phot. 135. 1996.*
Boerhavia mutabilis auct. non R. Br. 1810: *sensu* Walker, Fl. Okin. & S. Ryuk. Isl. 445. 1976.

Perennial herbs, prostrate, ascending to erect, up to 50 cm tall. Stems fleshy, terete, 2-5 mm across, green flushed with purplish red, pubescent, becoming glabrous and woody towards the base. Leaves somewhat fleshy, opposite, in unequal pairs; blades ovate, ovate-lanceolate to lanceolate or elliptic, upper surface green, flushed with purplish red, puberulent or subglabrous, lower surface pale, pubescent on veins, margins entire, cartilaginous undulate to slightly lobed, glabrous to distinctly short-ciliate, obtuse at the apex, usually minutely apiculate, truncate, rounded to subcordate at the base, the larger one 3-5.5 cm long and 2-4 cm wide, with a long petiole up to 2.5 cm long, the smaller 1.5-2.5 cm long and 1-3 cm wide, with petiole less than 1.5 cm long; petioles pale flushed with purple, pubescent, the leaves in the portion from stem to inflorescence gradually reduced. Inflorescences of pedunculate cymes or pseudoumbels, axillary, or a small terminal panicle, the peduncules 1-8 cm long, 2-4 branched, capillary at apex, green flushed with purplish red, pubescent and glanduar to glabrous, each branch of peduncle subtended by a bract, bracts linear lanceolate, puberulent, 1.5 mm long, caducous. Flowers 3-6, clustered at the apex of peduncle, subsessile; bracteoles usually 2, subtending a flower, in an unequal pair, the smaller slightly above, linear-lanceolate, 1 mm long and 0.2 mm wide, the larger below, lanceolate, 1.2 mm long and 0.3 mm wide, all those pale yellow, flushed with purple, puberulent; perianth constricted below the middle, the limb campanulate- tubular 1.5-2 mm long, 2.5 mm across when opening, pink to purple, shallowly 5-lobed, the lobes 1 mm wide, emarginated, with protuberance bearing hairs on the sinus, sparsely puberulent and glandular on the abaxial surface; stamens 2, filaments 1.5 mm long, pale pink, anthers dithecal, orbicular, 0.5 mm across, white; style 1.5 mm long, stigma capitate, 0.6 mm across, all pale pink. Anthocarps ellipsoid to obovoid, 3-3.8 mm long and 2-2.3 mm wide, rounded at apex, 5-ribbed, the ribs green or green flushed with purple, 0.2-0.3 mm wide, prominently stipitate glandular, the furrows pale, wider than ribs, densely stipitate glandular, with longitudinally arranged raphide bundles.

Spcimens examined: TAIWAN: Taitung Co.: Chengkung Town, Chiaping, on roadside, cleft of coral reefs, seashore, *Wang et al. 1521*; Taimali Hsiang, Hsinhsing, *Y.-K. Chen 487*; Hsiaoyehliu, elev. ca. 5 m, *Wang et al. 1188* (All at HAST). Peinan Hsiang, along trail to Taipin Farm. 30 Jun 2003, *Liu & Su s. n.*; Taitung City, on the west side of Chi-Hua Temple, 17 Oct 2003, *Chang & Tseng s. n.* (All at NHU). Pingtung Co.: Wutai Hsiang, on the way from Haocha to Old Haocha, disturbed broadleaf forest, on exposed roadside, flowers purple, *Liu et al. 763*; Mutan Hsiang, Wenchangshan, elev. ca. 300-500 m, *C.-H. Chen 810* (All at HAST); Ken-ting, *Chuang & Kao* 3948; Oluanpi, along coastside, *Huang 4778*; Shihmen, elev. ca. 100 m, *Liu 273*; Hsiaoliukiu, coastal area, *Huang 9038*; Mao-pi-tou, elev. ca. 0-10 m, seaside, *Huang et al. 14657* (All at TAI); Chunjih Hsiang, Chi-Chia, along a logging tract, elev. ca. 300-600 m, *Wang & Yang 8889* (HAST). Kaohsiung Co.: Nanshachuntao, Taipingtao, elev. ca. 0-4 m, open seaside, flowers white, *Huang et al. 16358*; Tungshatao, Tungshachuntao, elev. ca. 0-20 m, open places, *Huang et al. 16574*, Pratas Islands (West of Bashee Islands), Mar 1975, *Chiang s. n.* Kaohsiung City: Chiching, *Chuang & Kao 2985* (HAST), *Yang 1412*; Chingshuiyen, elev. ca. 100 m, on hilly coral, *Huang & Huang 12991B* (All at TAI). Tainan Co.: Shuichia, in fields, *Kao 10630* (TAI). Tainan City: City Park, enroute from Kungkuan to Tungkang, on border of paved way, *Peng 7038* (HAST). Hualien Co.: Lingting, Chian, elev. ca. 0-50 m, in grassland, sandy, *Huang et al. 5228* (TAI). Hualien City, on the mouth of Hualien Hsi (River), seaside, 1 Sep 2002, *Tseng s. n.*, Lindin, by Kuo-Sin-Ya Temple, seaside, flowers purple, 24 Aug 2005, *Chen s. n.* (All at NHU). Ilan Co.: Nan-ao to Wuta, 19 Oct 2002, *Hu s. n.* (NHU). CHINA: Hainan: Chim Fung Mt., near Fong Ngau Po Village, Kan-en District, *Lau 5116* (HAST). RYUKYU: Miyako-jima: 3 Aug 1934, *Masamune & Mori s. n.* (TAI). MICRONESIA: Palau: islet Peliliu, on a roadside, 9 Sep 1937, *Hosokawa s. n.* (TAI). NORTH SUMATRA: *J.C.R.R.13077* (TAI).

Distribution and notes: *Boerhavia diffusa* L., a species traditionally treated as conspecific with the present species, was segregated by Fosberg (1978). Based on our field work and the available herbarium specimens, *B. diffusa* does not seem to be present in Taiwan, though the binomial had, in the past, been enumerated (Fosbes and Hemsley, 1891; Matsumura and Hayata, 1906; Sasaki, 1928; Suzuki, 1936; Liu, 1976; Yang and Lu, 1996; Yang et al., 1999).

Boerhavia repens is a species of Indo-Pacific and Africa origin (Fosberg, 1978), probably indigenous in Taiwan. It is distributed from Africa (Whitehouse, 1996), eastward to Java (Backer and Bakhuizen, 1963), Polynesia and Hawaii (Fosberg, 1999) and the Ryukyu Islands (Walker, 1976). It usually occurs in the sandy areas by the coast. Flowering is throughout the year. Although occasionally growing slightly inland on roadsides, it does not seem to appear to be a weed.

This species closely resembles *B. coccinea* of much wider distribution, from which it differs primarily in its axillary pedunculate inflorescences and ellipsoid anthocarps, in contrast to terminal paniculate inflorescences and obconical anthocarps in the latter.

4. *Boerhavia glabrata* Bl., Bijdr. Fl. Ned. Ind. 733. 1826; Fosberg in Wagner et al., Man. Flowering Pl. Hawaii (Rev. ed.) 1: 978. 1999.

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Boerhavia repens auct. non L. 1753: *sensu* Backer & Bakh. f., Fl. Java 1: 271. 1963. *pro parte*; Walker, Fl. Okin. & S. Ryuk. Isl. 444, 1976.
Boerhavia crispa auct. non Heyne 1829: *sensu* Matsum. & Hayata, Enum. Pl. Form. 22: 322. 1906; Liu in Li et al., Fl. Taiwan (1st ed.) 2: 297. 1976.

Perennial herbs, prostrate. Stems radiating from a woody root crown, up to 80 cm long, compressed-terete, 2-3 mm across, green flushed with purplish red, glandular and puberulent to glabrous, woody towards the base. Leaves somewhat fleshy, opposite, in unequal pairs; blades narrowly ovate, oblong-ovate, broadly lanceolate or lanceolate, upper surface dark green, somewhat flushed with purple, finely puberulent, lower surface greyish white, usually flushed with purplish red, sparsely puberulent on veins, margins entire, cartilaginous, more or less undulate, glabrous or sparsely hispidulous, acute to rounded at the apex, usually minutely apiculate, obtuse to truncate at the base, the larger one 1.5-3 cm long and 0.8-2.5 cm wide, with a long petiole up to 1.8 cm long, the smaller 0.4-1.2 cm long and 0.4-0.6 cm wide, with petiole less than 2 mm long; petioles purplish red, slightly puberulent, the leaves in the portion from stem to inflorescence gradually reduced. Inflorescences of pedunculate cymes or pseudoumbels, axillary, or a small terminal panicle with a clear central axis, the peduncles 1-8 cm long, simple or 2-3 branched, capillary at apex, purplish red, subglabrous, each branch of peduncle subtended by a bract, bracts linear lanceolate, puberulent, 1 mm long, caducous. Flowers simple or usually 3-6, clustered at the apex of peduncle, sessile; bracteoles usually 2, subtending a flower, in an unequal pair, the smaller slightly above, linear, 0.8 mm long and 0.2 mm wide, the larger below, linear-lanceolate, 1.2 mm long and 0.3 mm wide, all those pale yellow flushed with purple, puberulent; perianth constricted below the middle, the limb campanulate 1.2-1.5 mm long, 3 mm across when opening, white flushed with purple, shallowly 5-lobed, the lobes 1.5 mm wide, emarginated, with protuberance bearing hairs on the sinus, sparsely puberulent and glandular on the abaxial surface; stamens 1-2, filaments 1.2 mm long, anthers dithecal, orbicular, 0.5 mm across, all white flushed with purple; style 1.2 mm long, stigma capitate, 0.3 mm across, all white flushed with purple. Anthocarps obovoid or ellipsoid, 2.2-3.5 mm long and 1.3-1.8 mm wide, rounded at apex, 5-ribbed, the ribs purple or green flushed with purple, 0.2-0.3 mm wide, glabrous, the furrows pale, wider than ribs, densely. stipitate glandular, with longitudinally arranged raphide bundles

Specimens examined: TAIWAN: Taitung Co.: Lanyu (Botel Tobago), Jul 1926, *Sasaki s.n.*, Tungchin to Hongtou, elev. ca. 0-50 m, on rock near seaside, *Huang & Hsu 4746*, in the vicinity of Lang-tao village, cultivated field, partly along stream close to forest margin, flowers pink, *Hsu 4962* (All at TAI); Da Wu Hsiang, roadside, along trail by Fushan Bridge, 29 June 2003, *Liu & Su s.n.* (TAI); Daren Hsiang, Tawa Hsi(River), along the Provincial Way 26, near the sea, 8 Jun 2003, *Lin & Su s.n.* (All at NHU); Sanhsientai, coastal, *Lin et al. 658* (HAST). Pingtung Co.: Kuanshan, elev. ca. 100-120 m, *Peng 12530*; Liuchiu Yu, on offshore islet, Meijen Tung (Beauty's Cave), on sea cliff, elev. ca. 0 m, *Lin et al. 472* (All at HAST); Maopitou, elev. ca. 70 m, on open coral reef, *Huang & Chen 4352*; Hsiaoliukiu, on road, *Huang 9039* (All at TAI). Penghu Co.: Peng-hu Isle, Costal places, *Huang & Kao 6830*; Chimetao, elev. ca. 50 m, open field, *Huang 014* (All at TAI); Huhsi District, Lintou, elev. ca. 0-10 m, *Peng & Peng 12727*; Hsiyu District, Lichengchiao, ca. 1.5 km east of Lungmen, elev. ca. 0-20 m, sandy coast, *Peng et al. 12760* (All at HAST). Keelung Co.: Pengchiayu, elev. ca. 0-150 m, *Huang et al. 15787* (TAI). Hualien Co.: Chih-hsin-tan, seaside, on sandy soils, 30 Oct 2002, *Chen s. n.* (NHU); Lingting, Chian, elev. ca. 0-50 m, in grassland, sandy, *Huang et al. 5225* (TAI). RYUKYU: Yona: elev. ca. 5-10 m, on raised coral rock by seashore, *Leu & Wang 1949* (HAST). MICRONESIA: Mariana Islands: Saipan, *Kaneira 1034* (TAI).

Distribution and notes: *Boerhavia glabrata* Bl. is distributed from Java (Backer & Bakhuizen, 1963) north to Micronesia, Ryukyu (Walker, 1976), also to the Hawaiian Islands (Fosberg, 1999). In Taiwan it grows on sandy beaches and coastal slopes, or slightly inland on the roadsides of coastal villages and sometimes in sandy plantations, but never far from the shore.

This species is variable in the size of plants and leaves. It can be distinguished by its slender, prostrate habit, mostly lanceolate leaves, axillary cymes or umbels of flowers borne atop a long stalk, and ellipsoid to obovoid anthocarps with glabrous ribs.

5. *Boerhavia hualienense* Chen & Wu, *sp. nov.* – Type: Taiwan, Hualien Co., Chi-hsin-tan, in grassland, on sandy beaches, elev. 0 m, 13 October 2004, *S.-H. Chen 2004a* (Holotype: NHU; isotypes: TAI, HAST)

花蓮黃細心 Figs. 1, 6 & 8

Herba perennis, prostrata, cum pilis glanduliferis sparsis; folia lanceolata, longe petiolata; laminae crispata, 1-2.5 m longa; inflorescentia axillaris et terminalis; pedunculus filiformis, 0.5-2 cm longis; flos solitarius; stamina 2 vel 3; fructus obovatus, 4-5 mm longus, glandulus.

Perennial herbs, prostrate. Stems raditing from a woody root crown, up to 60 cm long, compressed-terete 1-2 mm across, whitish yellow, glabrous to puberulent, woody toward the base.

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Fig. 4. *Boerhavia repens* L. A: Habit. B: Anthocarps.



Fig. 5. *Boerhavia glabrata* Bl. A: Habit. B: Portion of inflorescence. C: Anthocarp.

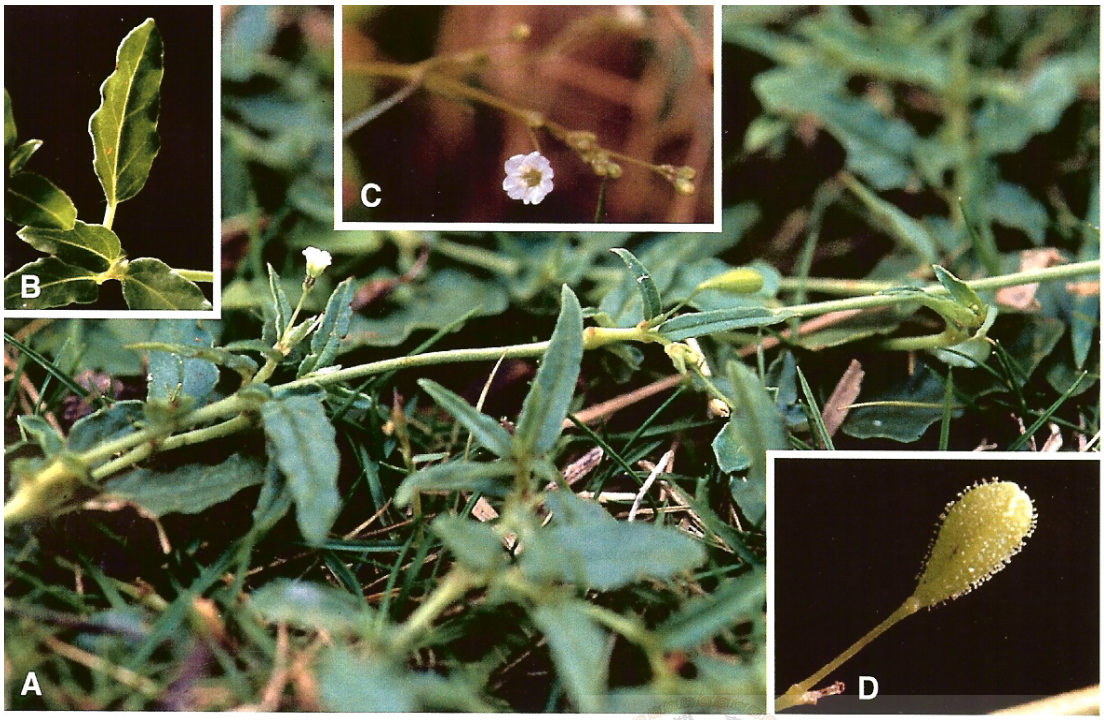


Fig. 6. *Boerhavia hualienense* Chen & Wu. A: Habit. B: Leaves. C: Portion of inflorescence. D: Anthocarp.

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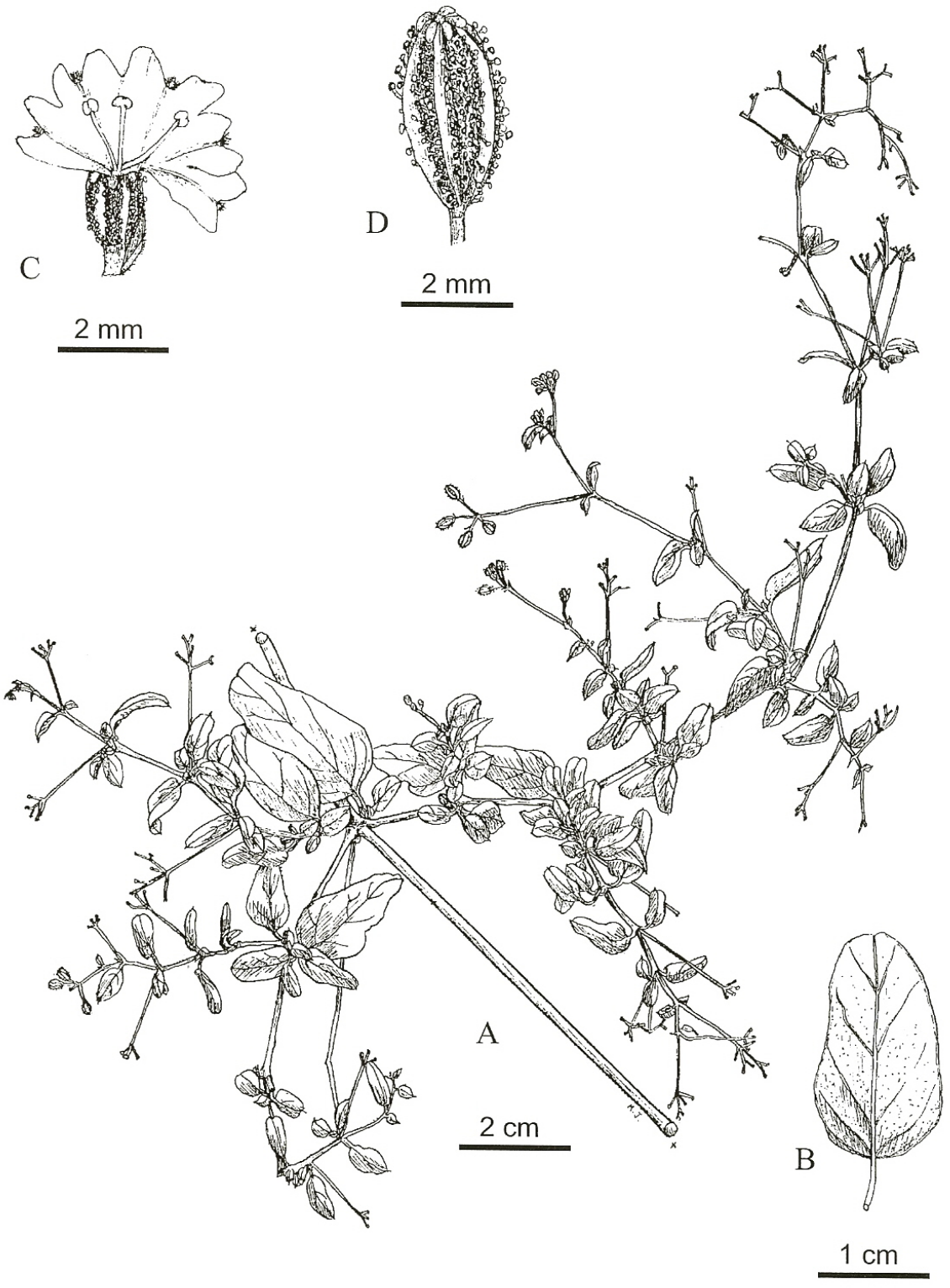


Fig. 7. *Boerhavia glabrata* Bl. A: Habit. B: Leaf. C: Dissected flower. D: Anthocarp.

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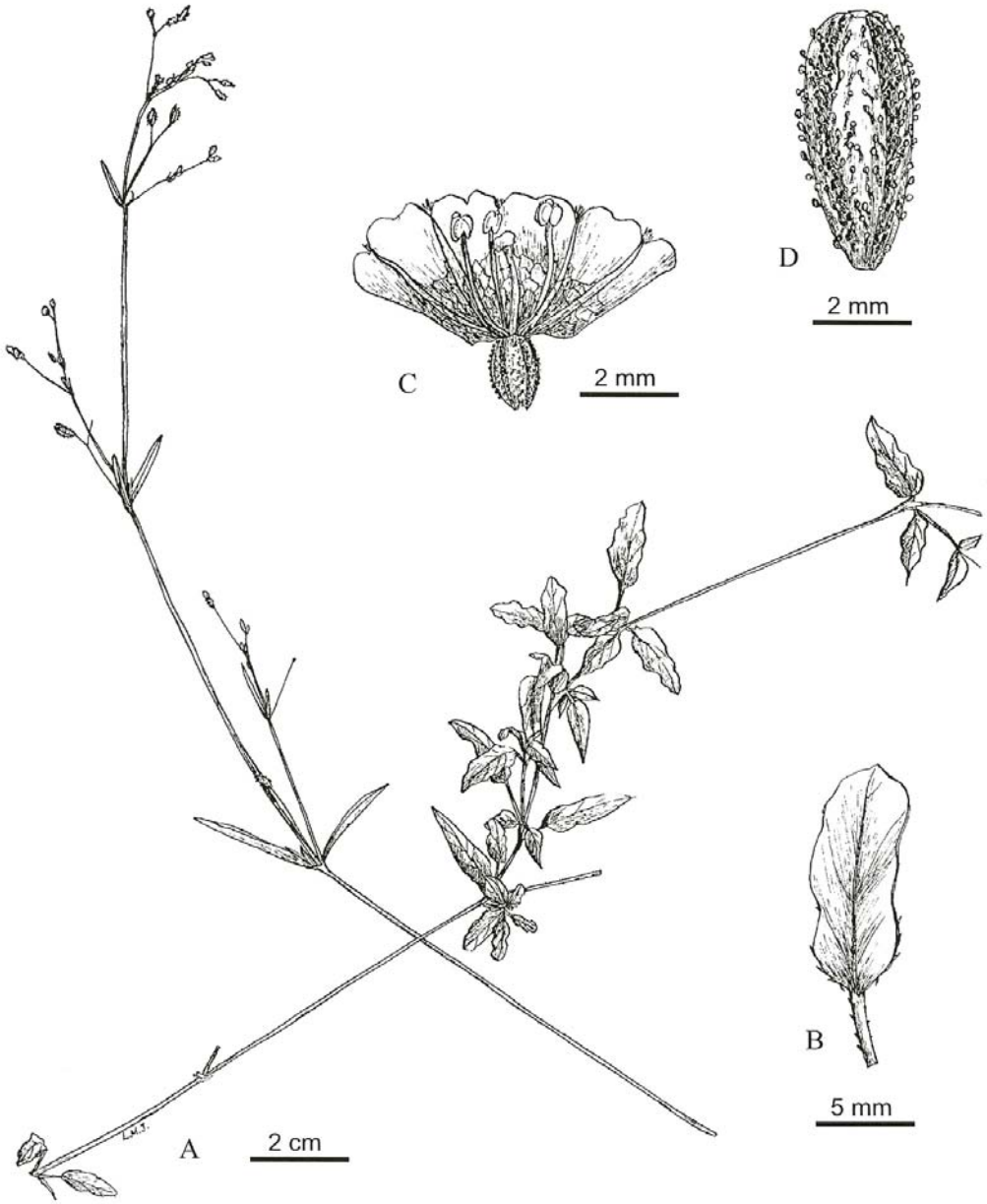


Fig. 8. *Boerhavia hualienense* Chen & Wu. A: Axillary peduncles on lateral branches and distal stem. B: Leaf. C: Dissected flower. D: Anthocarp.

Leaves somewhat fleshy, opposite, in unequal pairs; blades oblong, oblong-lanceolate or narrowly lanceolate, upper surface green or pale green, glabrous to finely puberulent, lower surface greyish white, glandular-dotted, pubescence on veins, margins strongly crispate, sparsely hispidulous, white and cartilaginous, acuminate acute to obtuse at the apex, obtuse to truncate at the base, the larger one1.5-2.5 cm long and 0.4-0.8 cm wide, with a long petiole up to 0.8 cm long, the smaller 0.8-1.2 cm long and 0.3-0.5 cm wide, with petiole less than 0.5 mm long; petioles pale, puberulent, the leaves in the portion from stem to inflorescence gradually reduced. Inflorescences of pedunculate umbel, axillary, or a small terminal panicle, the peduncles 0.5-2 cm long, simple or 2 branched, capillary at apex, pale yellow, glabrousor subglabrous, each branch of peduncle subtended by a bract, bracts linear lanceolate, 1 mm long, puberulent, caduceus. Flowers 1 or rarely 2 at the apex of peduncle, sessile; bracteoles usually 2, subtending a flower, in an unequal pair, the smaller slightly above, linear, 0.8

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Table 1. A comparison of morphological characters between *Boerhavia glabrata* and *B. hualienense.*

Character \ Taxon	*B. hualienense*	*B. glabrata*
Leaf shape	lanceolate to linear lanceolate	ovate to lanceolate
Leaf margin	distinctly crispate	entire to undulate
Peduncle	filiform and weak	stout and rigid
Flower number	solitary or rarely 2	usually 3-6 in cymes, umbels or pseudoumbels
Anthocarp	clavate, 4-5 mm long	ellipsoid to obovoid, 2.2-3.5 mm long
Rib of anthocarp	glandular-hairy, with type 3 hairs [a]	glabrous
Furrow of anthocarp	glandular-hairy, with type 1 hairs [a]	glandular-hairy, with type 3 hairs [a]

[a] Three types of glandular hairs in *Boerhavia* are recognized by Meikle and Hewson (1984): 1. less than 0.5mm long, terminal gland-cell large, elongate, usually oriented parallel to support structure, not persisting with exudates; 2. more than 0.5mm long, needle-like, rigid or weak, often with cells collapsed at right-angles when dry, terminal gland cell small, not persisting with exudates; 3. ±0.5mm long, usually rigid, terminal gland cell large, globular, usually persisting with exudate.

mm long and 0.2 mm wide, the larger below, liner-lanceolate, 1 mm long and 0.3 mm wide, all those pale yellow, puberulent; perianth constricted below the middle, the limb widely campanulate 2-3 mm long, 4 mm across when opening, white, shallowly 5-lobed, the lobes 1-1.2 mm wide, emarginated, with protuberance bearing hairs on the sinus, sparsely puberulent and glandular on the abaxial surface; stamens 2-3, filaments 2 mm long, with anthers, egualling or 0.6-0.8 mm exceeding the stigma, erect or curved in the upper portion, white, anthers dithecal, orbicular, 0.5 mm across, white; style 1.5 mm long, white; stigma capitate, white, 0.6 mm across. Anthocarps obovoid or narrowly clavate, 4-5 mm long and 2 mm wide, rounded at apex, 5-ribbed, the ribs yellowish green, 0.2 mm wide, densely stipitate glandular, the furrows whitish, wider than ribs, densely pubescent, with longitudinally arranged raphide bundles and a few glandular hairs occasionally.

Additional specimens examined: TAIWAN: Hualien Co.: Chih-hsin-tan, in grassland, on sandy soils, 27 September 2005, *Chen s. n.*, *Wu, Chen & Lin 70*, 22 May 2007, *Chen s. n.* (All at NHU); Lingting, Chian, in grassland, sandy, elev. 0-50 m, *Huang, Yang & Hu 5237* (TAI).

Distribution and notes: This species is endemic, occurring only in the east coast of Taiwan, and grows together with *B. glabrata*, showing no evidence of hybrids with the latter species. Locally it grows in sandy soil of grassy openings. Flowering and fruiting are throughout the year. *Boerhavia hualienense* is superficially very like *B. glabrata* but differs in several respects upon close examination. A comparison of morphological characters between the two species is listed in Table 1.

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臺灣黃細心屬植物之分類訂正

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摘　　要

根據以往報告臺灣有三種原產於熱帶、亞熱帶近海岸地區之黃細心屬（*Boerhavia*）植物，：黃細心（*B. diffus*a L.）、紅花黃細心（*B. coccinea* Mill.) 及直立黃細心（*B. erecta* L.)。其中紅花黃細心及直立黃細心為近年歸化臺灣之植物，本研究由野外觀察及標本鑑定指出，過去所訂黃細心學名 *B. diffus*a L. 應為 *B. repens* L.，並報導一新紀錄種—光果黃細心（*B. glabrata* Bl.）及一新種—花蓮黃細心（*B. hualienense* Chen & Wu *sp. nov*）。本文進行以上五種黃細心屬植物之分類訂正，提供檢索表，描述分類特徵、生態環境及相近種之比較區分，並提出這些植物在臺灣之分佈圖、彩色照片及新種、新紀錄種之解剖圖幅，以供辨識。

關鍵詞：黃細心屬、紅花黃細心、直立黃細心、黃細心、光果黃細心、花蓮黃細心、紫茉莉科、分類學、臺灣。

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