

## NOTES ON THE FLORA OF TAIWAN(18)--*Tribulus* L. (Zygophyllaceae)<sup>(1)</sup>

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**ABSTRACT:** After close studies of literature and type photos of *Tribulus cistoides*, external-, floral- and pollen- morphology and chromosome counts of Taiwan materials available in TAI-herbarium, We propose a new species, *T. taiwanense* Huang & Hsieh *sp. nov.* in this paper.

**KEYWORDS:** *Tribulus cistoides*, *T. taiwanense*, *T. terrestris*, Taxonomy.

### INTRODUCTION

During our botanical expedition to South China Sea, we collected some interesting plant specimens at Taipingtao and Tungshatao. One of them, *Tribulus cistoides* L. gave us special attention in the field. According to Chaw et al (1993), in Taiwan and Penghu island, the genus *Tribulus* has two species, namely *T. cistoides* L. and *T. terrestris* L. They distinguished the two species by the floral features. The larger flower with longer style is *T. cistoides* and the smaller flower with shorter style is *T. terrestris*. But in our field observations in Tungshatao we felt that the size of flowers and pedicels are different from those plants in Taiwan. So we re-examined all collections of *Tribulus* specimens in TAI herbarium, then we reconfirm that our feelings in the field are correct. Therefore one new species, *T. taiwanense* is here reported.

### MATERIALS AND METHODS

First, we reviewed the past publications about *Tribulus cistoides* and specimens of *Tribulus* available in TAI-herbarium. Plants of *T. cistoides* in Tungshatao have larger flowers of 2.0-2.5 cm in diameter and longer pedicels as long as or longer than the short pinnae. According to the description of Edgeworth and Hook. f. (1874) in Flora of British India, and Hou and Huang (1964) in the Flora of Hainan, *T. cistoides* has long pedicel

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which is the most important character to identify this taxon from other related species. These features are further supported by our studies of *T. cistoides* from microfiches of de Lamark 330 (P-LM) and Linn. 547.5 (L). All specimens from Taiwan possess the pedicels shorter than short pinnae which can be distinguished from those of *T. cistoides* from Tungshatao. For additional evidences, We studied pollen morphology and chromosome counts.

The pollen materials were obtained from the collections, chromosome count was done in the laboratory from planting materials, and herbarium specimens were examined from TAI- and HAST- herbaria. Pollen grains were prepared following Erdtman's methods (1952), and studied using SEM. Somatic chromosomes were studied using root tips which had been kept in a solution of 0.002 M 8-hydroxyquinoline for 3-4 hours at a temperature of 18-20 °C, then fixed in 1:3 acetic ethanol overnight, and hydrolysed in pectinase and squashed in acetic orcein.

## RESULTS

After further examinations of the external, floral (Table 1) and pollen morphology (Fig. 1), and chromosome numbers (Fig. 2), we came to the conclusion that the Taiwan plants described as *T. cistoides* by Chaw's *et al.* (1993), should be a new taxon to Taiwan. Our taxonomic treatment is as below.

### TAXONOMIC TREATMENT

#### Key to the species of *Tribulus* in Taiwan and Tungshatao

1. Flowers 0.8-1.0 cm in diam.; styles shorter than 0.5 mm long, completely enclosed by pustulate hairs; leaflets 0.8-1.0 x 0.3-0.4 cm ..... 3. *T. terrestris*
1. Flowers 2.0-2.5 cm in diam.; styles longer, about 1.0 mm long, incompletely enclosed by pustulate hairs; leaflets 1.0-2.0 x 0.6-0.8 cm
  2. Pedicels as long as or longer than the short pinnae; schizocarp with long multicellate pustulate hairs only, the spines glabrous ..... 1. *T. cistoides*
  2. Pedicels shorter than the short pinnae; schizocarp with long pustulate hairs and short sericeous hairs, the spines densely covered with hairs ..... 2. *T. taiwanense*

1. ***Tribulus cistoides*** L. Sp. Pl. 1: 387. 1753; Edgeworth & Hooker. f. in Hooker. f. Fl. Brit. Ind. 1: 423. 1874; Mill, Manual of Flowering Plants of Hawaii 2: 134. 1990; Hou & Huang in Fl. Hainan 1: 413. 1964. (Linnaeus herbarium 547.5, type photo?; de Lamark 330). 大花蒺藜 Fig. 3

A hispid hairy herb, with long prostrate to ascending stem. Leaves opposite pinnately compound, dimorphic, the long pinnae with 6-8 pairs of leaflets, 5.5-7 cm long, the short

Table 1. The comparative study of *Tribulus* species in Taiwan and Tungshatao

Characters	TAXA	<i>T. cistoides</i>		<i>T. taiwanense</i>		<i>T. terrestris</i>	
		Long	Short	Long	Short	Long	Short
Leaves	Pinnae	Long	Short	Long	Short	Long	Short
	Pairs	6-8	4-5	6-7	4-5	6-7	4-5
	Length(cm)	5.5-7.5	3.5-4.5	6.5-7	3.5-4.5	3.5-3.7	2.0-2.5
Leaflets	Length(cm)	1.2-1.5	1.2-1.5	1.0-2.0	1.0-2.0	0.8-1.0	0.8-1.0
	Width(cm)	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.3-0.4	0.3-0.4
	Hair	upper surface hairy	lower surface medium hairy	upper surface hairy	lower surface densely hairy	upper surface glabrous	lower surface densely hairy
	Apex	acute to obtuse	acute to obtuse	obtuse	obtuse	acute	acute
	Color	green	green	green	green	dark green	dark green
	Flower	Pedicel	as long as or shorter than short pinnae,	longer than 3-4 cm long	shorter than short pinnae 1.5-2.3 cm long		shorter than 1.0-1.5 cm long
	Diameter (cm)	2.0-2.5		2.0-2.5		0.8-1.0	
	Petal	Length (cm)	Width (cm)	Length (cm)	Width (cm)	Length (cm)	Width (cm)
		1.1	1.1	1.1	1.1	0.4	0.2
	Style	incompletely covered by sericeous hairs		incompletely covered by sericeous hairs		wholly covered by sericeous hairs	
Pollen	Columellae	uniformly thick		constricted on both ends		uniformly thick	
	Diameter ( $\mu$ )	50-62		40-45		40-45	
Chromosome	Number (2n)	12, 36 (Carr, 1978)		24+2B(?)		36	
Fruit	Vesture	one kind: multicellate pustulate hairs		2 kinds: long multicellular pustulate hairs and short unicellular sericeous hairs		one kind: long multicellular pustulate hairs	
	Spines	glabrous		densely hairy		glabrous or scanty hairs	
	Width (cm)	1.5-2		1.5		1.5	

pinnae with 4-5 pairs of leaflets, 3.5-4.5 cm long; leaflets obliquely oblong, 1.2- 1.5 cm long, 0.6-0.8 cm wide, acute to obtuse at apex, oblique at base, ciliate at margin, upper surface with sericeous hairs on midrib and puberulous hairs on the other portion, lower surface with loose sericeous hairs; stipules paired. Flowers yellow, 2.0-2.5 cm in diam., pedicels equalling or exceeding the short pinnae, 3-4 cm long; sepals lanceolate, strigose abaxially; petals 5, fan-shaped, 1.1 cm long, 1.1 cm wide, stamens 10 in 2 whorls; pollen grains spheroidal, inaperturate, 50-62  $\mu$  m in diam.; tectum reticulate, infrategilla columellate, the columellae evenly thick on both ends (Fig.1: A-B); ovary strigose, 5-carpels; style 1, glabrous, about 1 mm long. Fruit 1.5-2.0 cm in diam. including the spines; mericarps 5, dorsally crested, with long multicellular pustulate hairs, each mericarp bearing with 2 long and 2 short spines, the spine glabrous.

Specimens examined: Tungsha island, *T. C. Huang et al.* 16522, 16628.

## 2. *Tribulus taiwanense* T. C. Huang et T. H. Hsieh, *sp. nov.*

臺灣蒺藜 Fig. 4

*Tribulus cistoides* auct non L.: Chaw *et al.* in Bot. Bull. Acad. Sin. 34(1): 31. 1993; T. C. Huang in Fl. Taiwan 2nd. 3: 410. Pl. 214. 1993.

Haec species nova *Tribulo cistoideo* L. similis sed pedicellis pinnis brevibus brevioribus et mericarpo pilis biformis obtectis differt.

Herbae perennes prostratae ascendens hispidae, 1 m longae. Folia opposita pinnata dimorpha; pinnae longae 6-7-foliolis 6.5-7 cm longae, pinnae breves 4-5-foliolis, 3.5-4.5 cm longae; foliolia oblique oblonga, 1.5-2.0 cm longa, 0.6-0.8 cm lata, apices acutis vel obtusis, basibus obliquis, margine ciliata, supra costa sericea cetera puberula, infera sericea; stipula binata. Flores flava, 2-2.5 cm lata; pedicelli pinnis breves breviores, 1.5-2.3 cm longi; sepala lanceolata strigosa abaxiale; petala 5, obovata 1.1 cm longa 1.1 cm lata; stamina 10 verticillata duobus ordinibus; pollen inaperturatum spherioideum 40-45  $\mu$  m latum tecto reticulato columellato, columellae constrictae duo ad extrema (Fig. 1:C-E); ovaria 5-carpella, placentibus axilis; stylo glabrus 0.8-1.2 mm longus. Schizocarpia 5-mericarpia, 1-1.5 cm lata, crestata dorsalia pilis pustuliformis multicellularis longo et sericis unicellularis brevis, spinis biformis bicornutis dense pubescente;  $2n=24$  (Fig. 2a).

A hispid hairy herb, with long prostrate to ascending stem, up to 1 m long. Leaves opposite pinnately compound, dimorphic, the long pinnae with 6-7 pairs of leaflets, 6.5-7 cm long, the short pinnae with 4-5 pairs of leaflets, 3.5-4.5 cm long; leaflets obliquely oblong, 1.0-1.5 cm long, 0.6-0.8 cm wide, acute to obtuse at apex, oblique at base, ciliate at margin, the upper surface with sericeous hairs on midrib and puberulous hairs on the other portion, the lower surface with sericeous hairs; stipules paired. Flowers yellow, 2-2.5 cm in diam., pedicels shorter than the short pinnae, 1.0-2.5 cm long; sepals lanceolate, strigose abaxially; petals 5, obovate, 1.1 cm long, 1.1 cm wide; stamens 10 in 2 whorls, pollen grains spheroidal, inaperturate, 40-45  $\mu$  m in diam., tectum reticulate, columellate, the columellae constricted on both ends (Fig. 1:C-E); ovary strigose, 5-carpels with axile placentation; style 1, glabrous, 0.8-1.2 mm long. Fruits 1.0-1.8 cm in diam. (including the spines); mericarps 5, dorsally crested, with long multicellular pustulate hairs and short unicellular sericeous hairs, 2 long and 2 short spines, the spines covered with densely hairs,  $2n=24$  (Fig. 2a).

This species is closely related to *Tribulus cistoides*, but can be distinguished from the latter by shorter pedicels and 2 kinds of hairs on the mericarp. *T. eichlerianus* K. L. Wilson differs from this new species in having numerous, scattered spines all over the abaxial surface of the coccus (Wilson, 1992).

Specimens examined:

**Taichung Co.:** Wuchi, *Chaw 1351* (HAST). **Yunlin Co.:** Wutaokan, *T. C. Huang et al. 16696*. **Tainan Co.:** Hsikan, *Kao 10402*. **Tainan city:** *T. C. Huang & S. F. Huang 13736* (Holotype, isotypes, TAI); Anping, *T. C. Huang et al. 16684*; *Hsu 13633*. **Kaohsiung City:** Kichun, *T. C. Huang 8425*; Linyuan, *T. C. Huang & S. F. Huang 12984*. **Pingtung Co.:** Hsisaoliuchiu, *Lin 460* (HAST). **Penghu Co.:** Tungliang, *Cheng s. n. Aug. 1933*; *Hsiyu, Chaw 1331* (HAST).

3. ***Tribulus terrestris*** L., Sp. Pl. 1: 387. 1753. Chaw *et al.* in Bot. Bull. Acad. Sin. 34: 33. 1993; Huang in Fl. Taiwan 2rd. 3: 412. pl. 215. 1993. 蒺藜 Fig. 5

A hispid hairy herb, with long creeping stems, up to 1 m long. Leaves opposite pinnately compound, dimorphic, long pinnae with 6-7 pairs of leaflets, 3.5-3.7 cm long, the short pinnae with 4-5 pairs of leaflets, 2.0-2.5 cm long; leaflets obliquely oblong, 0.8-1.0 cm long, 0.3-0.4 cm wide, acute at apex, oblique at base, ciliate at margin, the upper surface with sericeous hairs on the midrib and glabrous on the other portion, the lower surface with serious hairs; stipules paired. Flowers yellow, 0.8- 1.0 cm in diam., pedicels shorter than the short pinnae, 1.0-1.5 cm long; petals 5, fan-shaped, 0.4 cm long, 0.2 cm wide; stamens 10 in 2 whorls; pollen grains spheroidal, inaperturate, 40-45  $\mu$  m in diam., tectum reticulate, columellate, the collumellae evenly thick on both ends(Fig. 1:F-H); ovary strigose, 5 carpels with axile placentation; style 1, glabrous, 0.4-0.8 mm long. Fruits 1.5 cm in diam.(including spines); mericarp 5, dorsally crested and covered with long pustulate hairs, each mericarp bearing 2 long and 2 short spines, the spines scanty hairy.  $2n=36$  (Fig. 2b).

Specimens examined:

**Miaoli Co.:**Ronkan, *Kao* 7393. **Hsinchu Co.:** Longkan, C. C. *Chuang* 3066. **Changwa Co.:** Fangyan and Hsikang, *Chow* 100. **Yinlin Co.:** Wutaokan, T. C. *Huang et al.* 16695. **Penghu Co.:** *Pandanus* Park, T.C. *Huang and M.T. Kao* 6815.

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## LITERATURES CITED

- Chaw, S. M. S., H. Lin and B. S. Wang. 1993. *Tribulus cistoides* L. (Zygophyllaceae): a new record for the flora of Taiwan. Bot. Bull. Acad. Sin. 34(1): 31-36.
- Carr, G.D. 1978. Chromosome numbers of Hawaiian flowering plants and the significance of cytology in selected taxa. Amer. J. Bot. 65:236-242.
- Edgeworth, M. P. and J. D. Hooker. 1874. Zygophyllaceae. In: J. D. Hooker. Flora of British India. p. 442-445.
- Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy. Waltham. Chronica Botanica Co., 239 pp.
- Hou, K. C. and M. H. Huang. 1964. In: W. T. Chun et al. (eds). Flora of Hainan. Science Press. 1:413.

- Huang, T. C. 1993. Zygophyllaceae. In: T.C.Huang et al. (eds). Flora of Taiwan. Bot. Dept. Press, Nat. Taiwan Univ., Taipei. 2rd.ed.vol. 3. p. 410-413.
- Mill, S. M. 1990. Zygophyllaceae. In: W. L. Wagner and D. R. Herbst (eds.). Manual of the Flowering Plants of Hawaii. University of Hawaii Press and Bishop Museum Press. Vol. 2. p. 1342-1344.
- Wilson, K. L. 1992. A new species and a neotypification in Australian *Tribulus* (Zygophyllaceae). *Telopea* 5(1): 21-29.

### 臺灣植物誌之觀察(18)--疾藜屬(疾藜科)

黃增泉 謝宗欣

#### 摘 要

根據文獻和模式標本微縮影片認為臺灣本島並沒有大花疾藜(*Tribulus cistoides* L.)，而東沙島則有該種的分布。本文從外部形態、花部形態和花粉來比較大花疾藜和省產2種疾藜，確認爲3個不同的分類群，分別爲大花疾藜、疾藜(*T. terrestris* L.)和臺灣疾藜(*T. taiwanense* Huang & Hsieh)。本文並報導染色體數目，疾藜 $2n=36$ ，大花疾藜 $2n=12, 36$ ，而臺灣疾藜 $2n=24$ 。

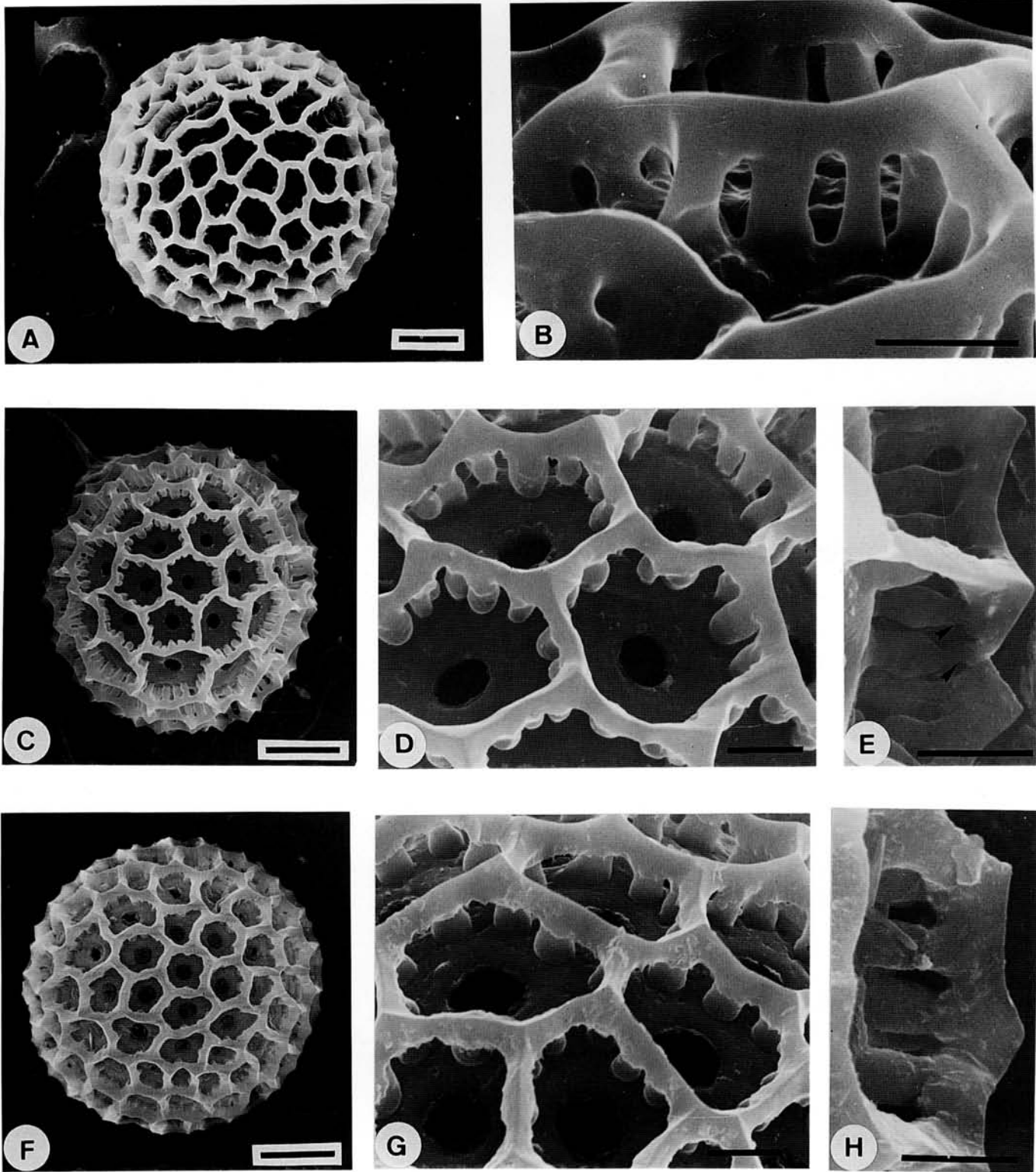


Fig. 1. SEM micrographs of pollen grains of *Tribulus cistoides* (A,B) from T. C. Huang et al. 16522, *T. taiwanense* (C,D,E) from T. C. Huang et al. 16695, and *T. terrestris* (F,G,H) from T. C. Huang et al. 16696. Scales = 10  $\mu$  m (A,C,F); 2.5  $\mu$  m (B,D,E, G,H). Arrow on constricted part of columella.

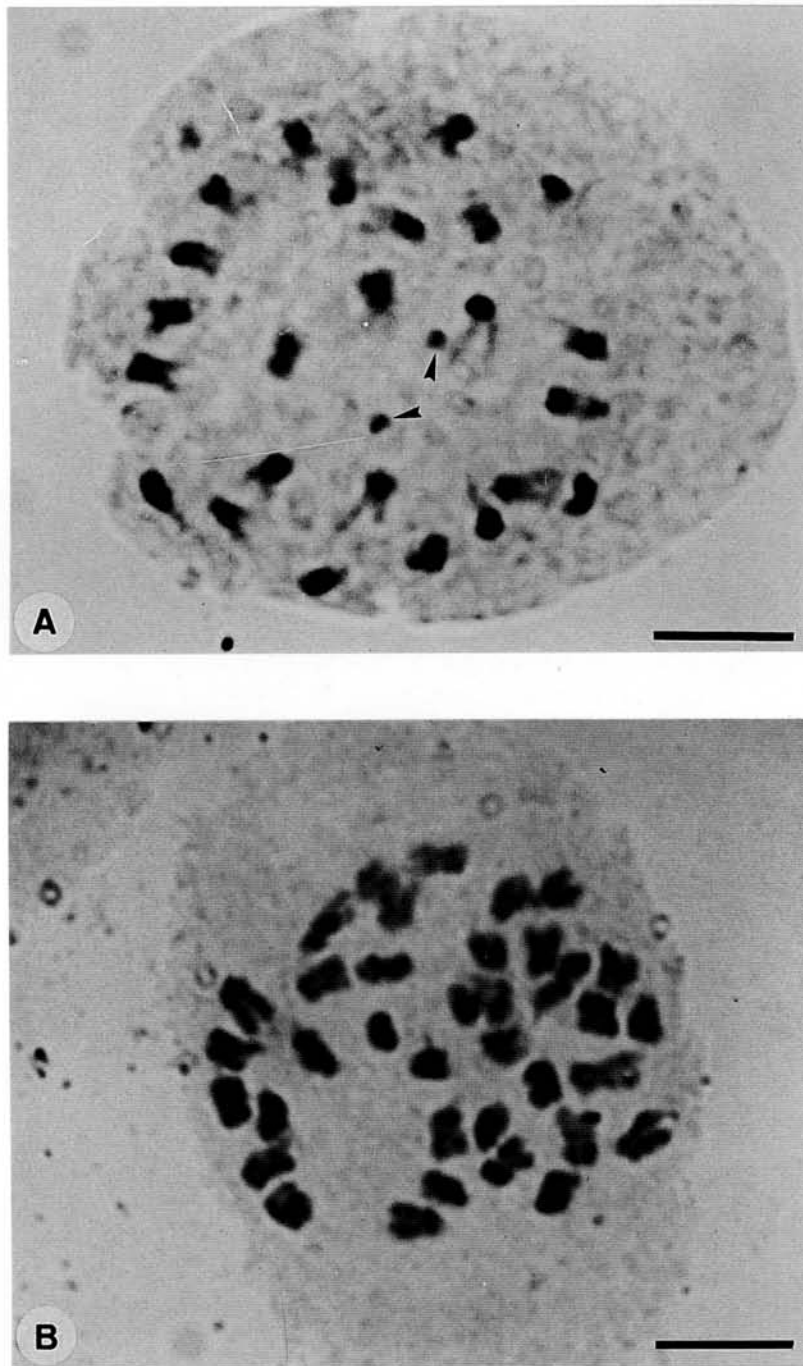


Fig. 2. Mitotic metaphase chromosome of *Tribulus taiwanense* (A,  $2n = 24$ ) from T. C. Huang et al. 16695 and *T. terrestris* (B,  $2n = 36$ ) from T. C. Huang et al. 16696. Scales =  $5 \mu\text{m}$ . Arrow in Fig. 2A may be B-chromosomes.



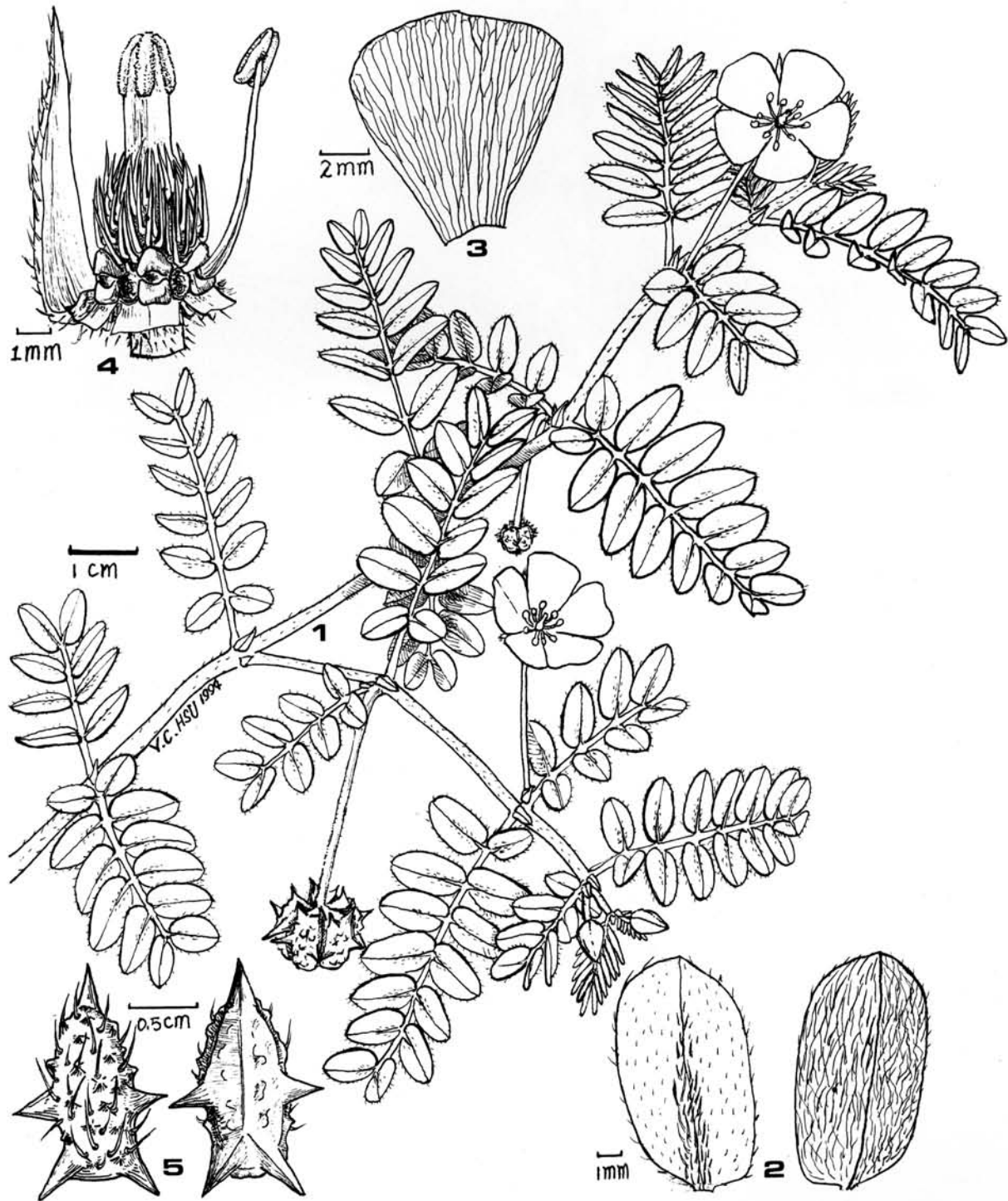


Fig. 3. Illustration of *Tribulus cistoides* L. from T. C. Huang et al. 16522. 1. habit; 2. leaflets; 3. petal; 4. flower removed petals, stamens and part of sepals; 5. mericarps.

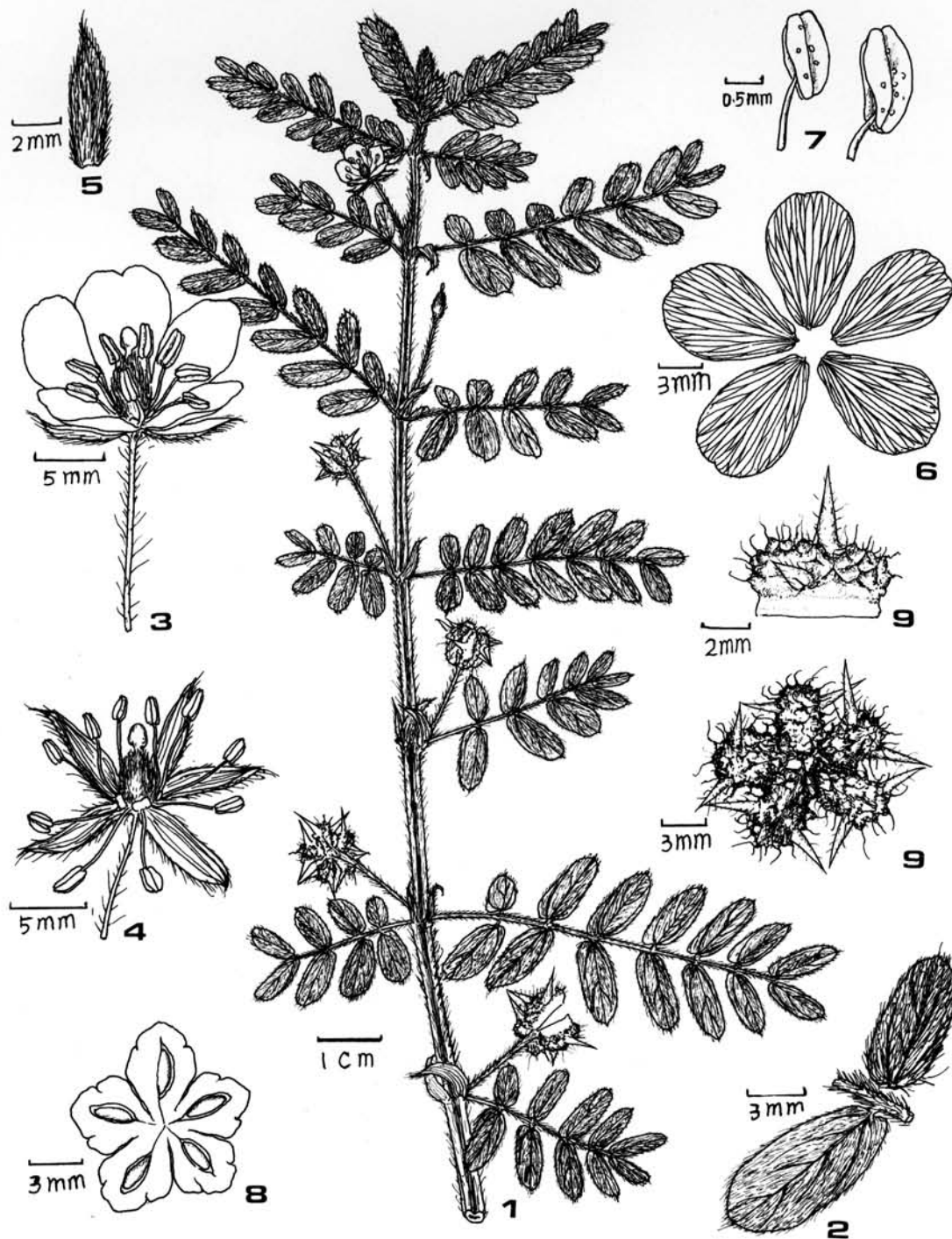


Fig. 4. Illustration of *Tribulus taiwanense* Huang & Hsieh. from *T. C. Huang & S. F. Huang 13736*. 1. habit; 2. leaflets; 3. flower; 4. flower removed petals; 5. sepal; 6. petals; 7. stamens; 8. cross-section view of ovary; 9. lateral and abaxial surface of fruits. (Huang, 1993)

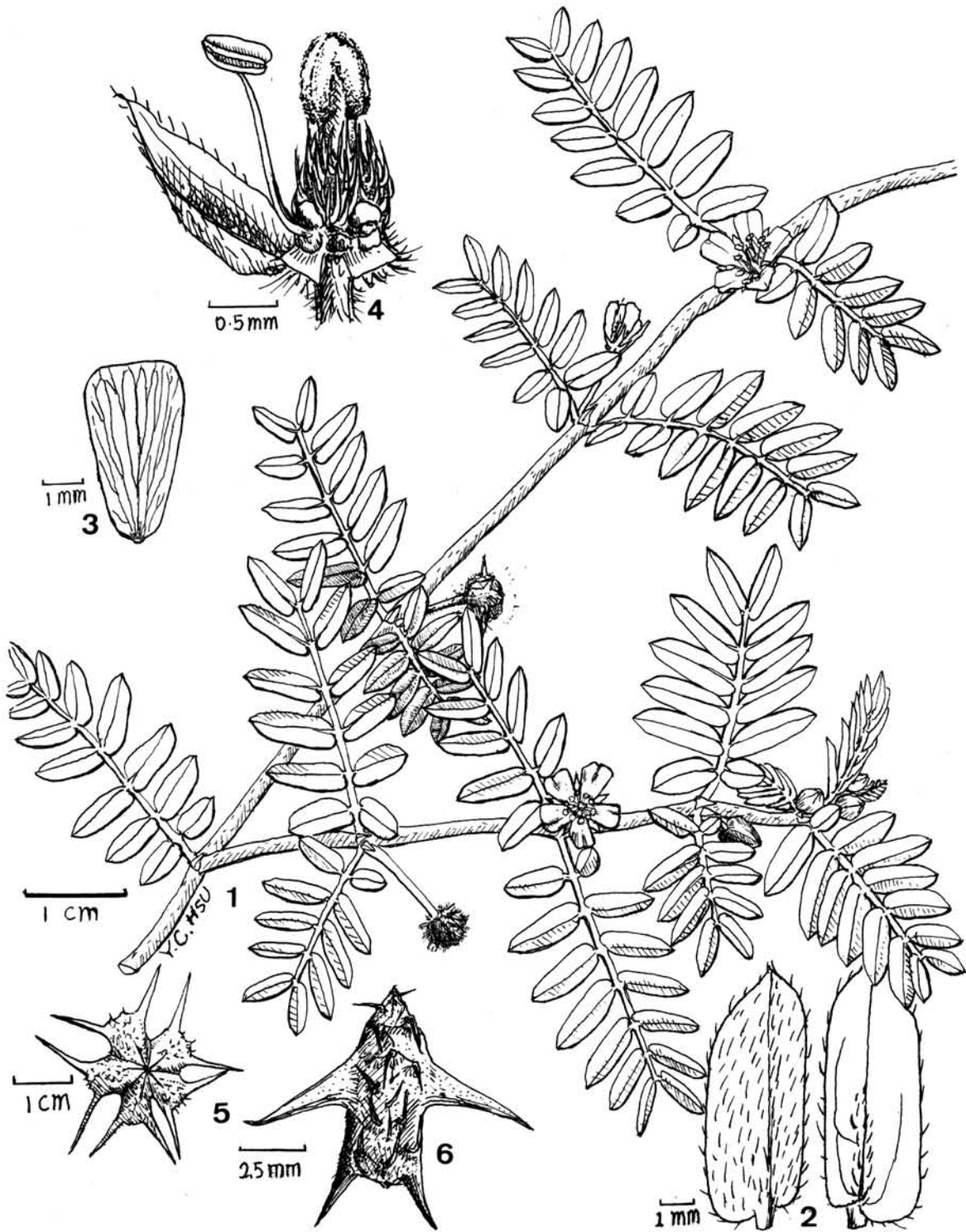


Fig. 5. Illustration of *Tribulus terrestris* L. from *Chow 100*; 1. habit; 2. leaflets; 3. petal; 4. flower removed petals and parts of sepals and stamens; 5. fruit; 6. mericarp.