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Notes on the Genus *Viola* in Taiwan

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There is only one genus, i. e., *Viola*, of Violaceae in Taiwan. The species are mostly localized on the mountains and in the northern parts of the island.

Since W. Becker's classical work "Die Gattung *Viola*" (1925) was published, additional species of *Viola* have been described from Taiwan by Japanese botanists such as B. Hayata, T. Nakai, etc. The species of *Viola* often hybridise with each other which renders their classification more difficult. The taxonomy of some of the species are in a state of confusion, misidentifications being frequent both in the herbarium and in literature. Cytological and ecological studies in this group are highly desired which may bring light to real distinctions between some of the species.

The present work is a revision based on specimens deposited in the Herbarium of the Department of Botany, National Taiwan University and the Herbarium of Taiwan Forest Research Institute (TF). A few species which are not represented by specimens preserved in these herbaria are not considered in the present paper. These are listed at the end of the paper. A tentative analytical key to the species as well as short descriptions for the species are given.

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Viola Linnaeus.

Perennial herbs, stemless or leafy-stemmed, with runners (or stolons). Leaves cordate, rounded, reniform or hastate; stipules free, or adnate to the petioles. Flowers of two kinds, the cleistogamous flowers apetalous, much more fruitful than the petaliferous flowers. Petaliferous flowers: sepals 5, with a backward projection at the base. Petals 5, somewhat unequal, the lower one spurred at the base. Stamens 5, closely surrounding the ovary, often slightly cohering with each other, the 2 lower bearing spurs which project into the spur of the corolla. Ovary 1-celled; ovules numerous, on 3 parietal placentas; stigma beaked, beakless, lobed or more or less dilated. Fruit a 3-valved capsule; seeds several;

embryo straight; endosperm fleshy. In this genus, hybrids are common; these commonly display characters more or less intermediate between those of the parents, and show marked vegetative vigor but greatly impaired fertility.

About 15 species in Taiwan.

Key to the species

- A. Flowers usually violet, sometimes white; stigma beaked, beakless or club-shaped.
- B. Leaves cordate.
- C. Stems stoloniferous.
- D. Plants hairy.
- E. Flowers smaller, 5-15 mm. large; petals not emarginate; spurs short, rounded, 1-3 mm long.
- F. Flowers 5-10 mm. large; leaves with the base slightly cordate or obtuse; petioles winged.....1. *V. diffusa*
- FF. Flowers 10-15 mm. large; leaves with the base broadly cordate; petioles slender.
- G. Petals unequal, the spurred petal smallest.....
-2. *V. Nagasawai*
- GG. Petals subequal, the spurred petal not smallest.....
-3. *V. rupicola*
- EE. Flowers larger, 15-22 mm. large; petals emarginate; spurs long, slender, 5-7 mm long.....4. *V. tozanensis*
- DD. Plants partly hairy especially at the sinus between the crenas.
- E. Petioles 10-15 cm. long; leaves hastately cordate, the apex acuminate or more or less obtuse.....5. *V. Kawakami*
- EE. Petioles 3-5 cm. long; leaves broadly cordate or orbicular, the apex rounded or more or less acute...6. *V. formosana*
- DDD. Plants glabrous.....1a. *V. diffusa*
var. *glabella*
- CC. Stems not stoloniferous.
- D. Stemless plants; rootstock erect.
- E. Base of leaf cordate or slightly cordate, the margins crenate-dentate; spur obtuse.....7. *V. tsugitakaensis*
- EE. Base of leaf reniform-cordate, the margins remotely serrate; spur slender.....8. *V. senzanensis*
- DD. Stems usually with leafy stems, sometimes stemless; rootstock

- decumbent or ascending.
- E. Plants hairy or nearly glabrous.
- F. Leaves thick, cordate, with cordate base....9. *V. kosanensis*
- FF. Leaves thin, rounded, with accurately cordate base.....
10b. *V. verecunda*
 form. *hensoaensis*
- EE. Plants essentially glabrous.
- F. Plants not radicant in nodes after anthesis.....
10. *V. verecunda*
- FF. Plants radicant in node after anthesis.....
10a. *V. verecunda*
 form. *radicans*
- BB. Leaves oblong or sagittate.
- C. Leaves decurrent beneath; petioles not slender.
- D. Plants glabrous.
- E. Flowers white.....11. *V. oblongo-sagittata*
- EE. Flowers violet.....11a. *V. oblongo-sagittata*
 var. *violascens*
- DD. Plants hairy.....12. *V. taiwaniana*
- CC. Leaves not decurrent beneath; petioles nearly slender, rarely winged.
- D. Base of leaf slightly cordate or truncate.
- E. Petioles hairy.....13a. *V. mandshurica*
 var. *ciliata*
- EE. Petioles glabrous.....13b. *V. mandshurica*
 var. *glabra*
- DD. Base of leaf sagittate or hastate.....14. *V. stenocentra*
- AA. Flowers usually yellow; stigmas beakless.....15. *V. biflora*
1. ***Viola diffusa*** Ging. in DC., Prodr. 1:298. 1824; Franch., Pl. David. 1:43. 1884, 2:20. 1888, Pl. Delavay. 72. 1889; Diels in Bot. Jahrb. 29:477. 1901 (Fl. Centr. China); Benth., Fl. Hongk. 20. 1861; Cudem. in Ann. Mus. Bot. Ludg.-Bat. 3:77. 1867; Boiss. in Bull. Herb. Boiss. II, 1:1077. 1901; Matsum., Enum. Pl. Jap. 2:372. 1912; Makino, in Bot. Mag. Tokyo 19:73. 1905; Hook. f., Fl. Brit. Ind. 1:183. 1875; Forbes and Hemsl. in Journ. Linn. Soc. Bot. 23:52. 1886; Maxim. Mel. Biol. 9:735. 1876; Matsum. et Hay. in Journ. Coll. Sci. Tokyo Imp. Univ. 22:28. 1906 (Enum. Pl. Formos.); Hay., Icon. Pl. Formos. 1:60. 1911; Lecomte, Fl. Gén. Indo-Chine 1:208. 1908; W. Becker in Philip. Journ. Sci. 19:713. 1921;

Suzuki in Masamune, Short Fl. Formos. 142. 1936; Masamune in Taiwaniana 1:69. 1948.

Viola tenuis Benth. in Hook., Lond. Journ. Bot. 1:402. 1842; Champ. et Benth. in Book. Journ. Bot. Kew Miscel. 3:260. 1851.

Viola kiusiana Makino in Bot. Mag. Tokyo 16:138. 1902, 19:73. 1905.

Stemless herb, pubescent or hairy, with long stolons or runners; leaves radical, ovate or ovate-oblong, about 1.5-3.5 cm. long, 1-2.5 cm. wide, obtuse to slightly pointed, the base decurrent or somewhat cordate, the margins crenate, the petiole winged, 2-5 cm. long, usually not longer; stipules free, linear-lanceolate, dentate or fimbriate; flowers not larger than 6-8 mm. in diameter, violet, without scent; peduncles longer or as long as the petioles, 5-10 cm., long; spurs short, obtuse, 2 mm. long; sepals lanceolate 3-5 mm. long, 1-3 mm. wide; stigma club-shaped; capsules about 6 mm. long.

Taiwan: Hekitanzan, *Simizu* 2117; Karenkocho, Kirizato, *Suzuki* 1627; Musya, Masamune, Mori & Nakamura 198; Hekitan, *Simizu* 2070; Hekitan, *Simizu* 1859; Taihoku, *Simada* 4003; Hunkikot Arisan, *Hayata* 17277 (TF); Isl. Kotosyo, *Kawakami* & *Sasaki* 17280 (TF); Karapin, Arisan, *Hayata* 17276 (TF).

1a. ***Viola diffusa*** Ging, var. ***glabella*** Boiss. in Bull. Herb. Boiss. II. 8:742. 1908; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Plants glabrous, otherwise as in the typical form of the species.

Taiwan: Kankei et Koro, *Suzuki* 5883; Kasainokira, Taihoku, *Suzuki* 4978; Yappitu et Ryoheh, *Suzuki* 6008; Mt. Taiheizan, *Suzuki* s. n., April 25. 1930.

A species closely related with *V. Nagasawai*, differing in its smaller flowers and winged petioles.

2. ***Viola Nagasawai*** Mak. et Hay. in Journ. Coll. Sci. Tokyo Imp. Univ. 22: 30. 1906 (Enum. Pl. Formos.); Hay., Icon. Pl. Formos. 1:58. 1911; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Stemless herb, hairy or sometimes nearly glabrous, with stolons; leaves somewhat ovate-rounded, about 10-25 mm. long, 8-20 mm. broad, with broadly cordate bases and rounded or sometimes pointed apices, the margins crenate, the petioles slender, the stipules about 9 mm. long, subulate, lacinate; flowers about 1.5 cm. large; peduncles very long, 2-3 times as long as the petioles; bracts 2, sub-opposite, acuminate, 5-7 mm. long, 1 mm. broad; sepals subequal, linear-lanceolate, 5-7 mm. long, 1-1.5 mm. broad, persistent; upper and lateral petals subequal, 8-12 mm. long, 4-8 mm. broad, obovate, cuneate at the base, the spurred petal smaller, 6-10 mm. long, 3-5 mm. broad; spur short, 1 mm. long; style nearly straight; capsules small, 6 mm. long.

Taiwan: Mt. Syokawannon, *H. Simada* 338; Urai, *H. Simada* s. n.; Mt. Sitisei, *H. Simizu* 634; Mt. Daiton, *H. Simada* s. n.; Tikusiko, *H. Simada* 1171; Kapanzan, 600 m. alt., *N. Fukuyama* s. n.; Mt. Taihei, *S. Sasaki* s. n.; Mt. Taiton, *S. Suzuki* 7477; Mt. Taihei, *S. Suzuki* 992; Sozan, *Y. Kudo et S. Suzuki* 3304; Urai, *S. Suzuki* 10131; Mt. Taihei, *S. Suzuki* s. n.; Sozan, *Kudo, Suzuki et Mori* 328; Tansui, *N. Ku* 425; Riggyahu, Haro, 1300 m. alt., *T. Suzuki* 10440; Tairyotoge, *T. Nakamura* 4299; Mt. Daiton, *R. Sho* 33; Gentozan, 1000 m. alt., [*T. Suzuki* 7767; Toyen, *Mori* 17341 (TF); Taito, *Kawakami* 17343 (TF).

2a. ***Viola Nagasawai*** Mak. et Hay. var. ***acutilabella*** (Hay.) Nakai in Bot. Mag. Tokyo 36: 87. 1922; Suzuki in Masamune, Short Fl. Formos. 142. 1936. *Viola acutilabella* Hay., Icon. Pl. Formos. 10:1. 1920.

Herb, nearly glabrous, otherwise as in the typical form of the species.

Taiwan: Mt. Sitisei, *Simada* 17347 (TF); Tikusiko, *Simada* 17347 (TF); Rahau-sya, Sindo, *Mori* 17345 (TF); Mt. Egiri, Giran, *Mori* 17346 (TF); Sosei-Kyaku, Giran, *Hayata* 17350 (TF); Mt. Soten, *Mori* 17348 (TF).

According to Nakai, this variety is characterized by its nearly glabrous habit (see Nakai, in Bot. Mag. Tokyo 36:(87). 1922), but I think that this is hardly a clear distinct character.

3. ***Viola rupicola*** Elmer, Leafl. Philip. Bot. I:324. 1908, in Philip. Journ. Sci. 19:712. 1912; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Viola acenothrix Hay., Icon. Pl. Formos. 3:23. 1913.

Viola brachycentra Hay., Icon. Pl. Formos. 3:25. 1913.

Viola effusa W. Becker in Beih. Bot. Centrabl. 34:424. 1917.

Viola Mastudai Hay., Icon. Pl. Formos. 10:1. 1921.

A perennial herb, with stolons usually long, leafy and flowering, the whole plant nearly glabrous or hirsute; leaves ovate-cordate, blunt or acute, 1.5–3 cm. long, 1–2 cm. broad; stipules lanceolate, 5–7 mm. long, toothed or fimbriate; flowers pale lavender, rarely white, 8–15 mm. large; peduncles 4–10 cm. long; sepals ovate-lanceolate, acute, slightly ciliate, 5–7 mm. long, 1–2 mm. broad, the auricle truncate or rounded, strigose; petals oblong, 8–15 mm. long, 3–5 mm. broad, the lateral petals long-bearded, the spur short, rounded; ovary glabrous, globose; capsules 4–8 mm. long.

Taiwan: Kotobuki-Joban, *Yamamoto & Mori* 312; Tyuo-sen, 3400 m. alt., *Suzuki & Fukuyama* 10174; Taiheizan, *Suzuki* 85; Ugan et Pianan anbu, *Suzuki* 5030; Suigen et Sansyo-Anbu *Suzuki* 5946; Reku-dyo, 1500 m. alt., *Simada* 2529; Daibuzan, 3200 m. alt., *Fukuyama* 3410; Mt. Tentana, Sintiku, *Simada* 17386 (TF); Mt. Rato, Sintiku, *Matuda* 17387 (TF); Nitaka, *Sasaki* 17392 (TF); Mt. Arisan, *Sasaki* 17399 (TF); Mt. Tozan, Arisan, *Sasaki* 17392 (TF); Dairoko-sya, Taito, *Mori* 17399 (TF); Tiyakau-kei, Taito, *Mori* 17400 (TF).

According to Nakai (see Nakai in Bot. Mag. Tokyo 36:(87). 1922), *V. rupicola* Elmer is synonymous with *V. Royleana* Wall. Cat. n. 1448, the latter

name being generally treated as a synonym of *V. serpens* Wall, in Roxb. Fl. Ind., ed Carey. 2:449. 1824, a fact not mentioned by Nakai. Because of lack of adequate reference material, I can not verify Nakai's judgement.

In its general characters this species is most closely related with *V. Nagasawai*, but it is easily distinguished by its broadly cordate leaves and its different altitudinal ranges. *V. rupicola* occurs at altitudes from 1500 to 3200 m., while *V. Nagasawai* is found at lower elevations, from 500 to 1300 m.

4. ***Viola tozanensis*** Hay. in Journ. Coll. Sci. Tokyo Imp. Univ. 25:53. 1906 (Fl. Mont. Formos.); Icon. Pl. Formos. 1:59. 1911; Suzuki in Masamune Short Fl. Formos. 142. 1936.

Viola arisanensis Becker in Fedde Rep. Sp. Nov. Regn. Veget. 17:314. 1921 (Viol. Nov. Asia.).

Stemless herb; leaves hairy, broadly rounded-cordate, obtuse, crenulate, the under surface greenish-violascent, about 1.5-3 cm. long, 1.5-3 cm. broad; petioles 3-4 cm. long; stipules linear-lanceolate, lacinate; peducles as long as the petioles; bracts 2, opposite; flowers 1.5-2.2 cm. large; upper and lateral petals nearly equal, ovate-cuneate, 10 mm. long, 5 mm. broad, the spurred petal largest, 18 mm. long, 8 mm. broad, very emarginate at the apex, the spurs slender, 4-6 mm. long, slightly curved; sepals nearly equal, linear-lanceolate, more or less acuminate, glabrous, persistent; styles nearly erect, the stigma sub-terminal.

Taiwan: Mt. Ari, Soma 17471 (TF); Mt. Ari, Sasaki 17410 (TF); Mt. Ari, Nimandahira, Hayata 17472 (TF) (?).

Becker in Fed. Rep. Sp. Nov. Regn. Veget. 17:314. 1921, describes *Viola arisanensis* W. Becker as "leaves distinctly rounded, obtuse, about 1.2-2 cm. long and broad, petioles 3-4 cm. hairy, petals? style?". I have not seen his specimen, but judging from the original description and locality it is most probably a synonym of *Viola tozanensis* Hay.

5. ***Viola Kawakamii*** Hay., Icon. Pl. Formos. 1:58. 1911, in Journ. Coll. Sci. Tokyo Imp. Univ. 25:52. 1908 (Fl. Mont. Formos.), in Journ. Coll. Sci. Tokyo Imp. Univ. 30:33. 1911 (Mat. Fl. Formos.); Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Viola hypoleuca Hay., Icon. Pl. Formos. 3:26. 1913.

Viola Kawakamii var. *stenopeta* Hay., Icon. Pl. Formos. 3:27. 1913.

Stemless herb, with long stolons; leaves hastately cordate, acuminate or obtuse, crenate, hairy at the sinus between the crenas, the other parts nearly glabrous, or hairy near the margins, 1.5-4 cm. long, 1-3 cm. broad, the apex

slightly pointed; petioles slender, 10-15 cm. long; stipules lacinate or fimbriate; flowers 1.5 cm. large; peduncles nearly as long as the petioles; bracts 2, remotely arranged, 5 mm. long; sepals subequal, glabrous; upper and lateral petals subequal, ovately cuneate, emarginate at the apex, 12 mm. long, 5 mm. broad, the spurred petal larger, 15 mm. long, 9 mm. broad, the apex strongly emarginate or 2-lobed; spurs 6 mm. long, slender, slightly curved; styles nearly erect; stigma terminal; capsules ellipsoid, 5-7 mm. long.

Taiwan: Musya, Masamune, Mori et Nakamura 2434; Rakuraku-Toho, Simada 917; Keinanzan, Yamamoto et Mori 733; Hatukan-Toho, Simada 919; Sinsuiei, Suzuki 8013; Mt. Egiri, Giran, Mori 17290 (TF); Taiko, Byoritu, Hayata et Mori 17291 (TF); Hunkiko-Toroen, Arisan, Hayata et Sasaki 17298 (TF); Hunkiko, Arisan, Hayata 17299 (TF); The Arisen Central Mt. Range Kawakami et Sasaki 17292 (TF); Mt. Buwi, Takao, Sasaki 17301 (TF); Sinsuiei, Taito, Kawakami et Mori 17302 (TF).

This species is near *V. formosana*, differing from it in its leaves being almost hastate-cordate and with very long petioles.

6. ***Viola formosana*** Hay. in Journ. Coll. Sci. Tokyo Imp. Univ. 22:28. 1906 (Enum. Pl. Formos.), Icon. Pl. Formos. 1:59. 1911; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Stemless plant, with stolons: leaves broadly cordate, orbicular, crenate, pilose especially at the sinus between the crenas, the other parts glabrous or with minute hairs, greenish-violet beneath, 1-3 cm. long, 1-3 cm. broad, the apex slightly pointed; petioles slender, 3-4 cm. long; stipules linear-lanceolate, lacinate; sepals nearly equal, glabrous, about 4 mm. long, 1 mm. broad; flowers 1.5-2.2 cm. large; peduncles twice as long as the petioles; bracts 2; upper and lateral petals nearly equal, ovate-cuneate, emarginate at the apex, about 12 mm. long, 5 mm. broad; spurred petal larger, about 15 mm. long, 9 mm. broad, very emarginate or slightly 2-lobed at the apex, the spurs slender, 5-7 mm. long, slightly recurved; style nearly erect, the stigma terminal; capsules 5-7 mm. long.

Taiwan: Synkyaku et Syigen, Suzuki 5963, 5939; Mt. Taiheizan, Suzuki 4118; Kamiyodani, Taihokusyū, Suzuki 6293; Mt. Taiheizan, Suzuki 421; Karasan, Taihokusyū, Suzuki 6215; Urai Taihokusyū, Suzuki s. n. March 28, 1932; Saneyo-Anbu et Yappitu, Suzuki 5986; Taran, Taihokusyū 1450 m. alt., Suzuki 17845; Mt. Egiri, Giran, Mori 17283 (TF); Mt. Taihei, Giran, Sasaki 17248 (TF); Rimogan, Sinko, Kawakami et Mori 17282 (TF); Taiwanpin, Toyen, Mori 17285 (TF); Mt. Yuku, Toyen, Simada 17286 (TF); Mt. Gakokitu, Sintiku Watanabe 17285 (TF); Mt. Tentana, Sintiku, Simada 17288 (TF); Takadai, Sintiku, Kawakami 17298 (TF).

This species is closely related with *V. tozanensis*, but is easily distinguished from the latter by its leaves being pilose especially at the sinus and the crenas, the other parts being nearly glabrous.

7. ***Viola tsugitakaensis*** Masamune in Journ. Soc. Trop. Agr. Taihoku 2:240. 1930; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Plant stemless; rootstock erect; leaves radical, broadly ovate, with a cordate base and an obtuse or more or less pointed apex, 10-20 mm. long, 10-15 mm. wide, the margins crenate-denticulate, slightly hirsute; petioles about 4 cm. long; stipules linear-lanceolate, 5 mm. long, adnate to the base of petioles, the margins ciliate-fimbriate; peduncle 2-7 cm. long; bracts opposite, linear, about 5 mm. long; upper and lower sepals triangular-ovate, 5 mm. long, 2 mm. wide, the margins ciliate; upper and lateral petals nearly equal, obovate-cuneate, the apex rounded-truncate, 9 mm. long, 4 mm. wide; spurred petals 8 mm. long, 4 mm. broad, the spur short 2 mm. long; anther sessile, the connective complanate, the apex membranaceous; style nearly erect, the stigma deltoid.

Taiwan: Mt. Tsugitaka. 3931 m. alt, Masamune 1233 (type); Mt. Tsugitaka Mori s. n. Oct. 24. 1936; Mt. Tsugitaka, Hosokawa 2342.

8. ***Viola senzanensis*** Hay., Icon Pl. Formos. 6:6. 1916; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Pubescent plant; rootstock erect; leaves radical, with long petioles, triangular-cordate, 1.5-2 cm. long, 1.5-2.5 cm. wide, the apex triangular-acute, the base reniform-cordate, the margins remotely serrate; stipules 5-8 mm. long, 1 mm. wide, slightly lacinate-serrate or entire; scapes as long as the petioles or longer than the petioles; bracts linear, 8-10 mm. long, acuminate; flowers 1-1.5 cm. large, the spur slender, but not longer; sepals linear-lanceolate; anther linear-oblong, 2/3 mm. wide, subsessile.

Taiwan: Mt. Nankotaizan, Rato, Masamune et Fukuyama 3163; Mt. Nankotaizan, Rato, Masamune, Fukuyama et Nakamura 3181.

9. ***Viola kosanensis*** Hay., Icon. Pl. Formos. 3:28. 1913, in Bot. Mag. Tokyo 36:(87). 1922.

Viola thrichopoda Hay., Icon. Pl. Formos. 3:29. 1913; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Plant stemless or with stem; leaves long-petiolate, ovate-cordate, with an obtuse or pointed apex and profoundly cordate base, the margins crenate, hairy or subglabrous, the under surface pale green; petioles 5 cm. long; stipules linear, acuminate at the apex, the margins long-fimbriate, 1 cm. long, 1.5 mm. broad at the base; peduncle 6-8 cm. long; bracts linear, dentate-filiform; sepals lanceolate, unequal, the apex obtuse, the base truncate; flower about 12 mm. large; upper petals 2, obovate-oblong, with a rounded apex and a subunguiculated base; lateral petals semi-oblong or semi-ovate-oblong, the apex obtuse, the base attenuate,

11 mm. long, 3 mm. wide; spurred petal linear-oblong, the spur 3 mm. long; stigma terminal.

Taiwan: Mt. Ari, *Sasaki* 17309 (TF); Taito Chikankei, 1500 m. alt. *Mori* 17310 (TF); Nanto, Keito, *Hayata* 17307 (TF); Mt. Tentana, Sintiku, *Simada* 17305 (TF); Mt. Rontabun, Taito, *Mori* 17306 (TF); Tariku-sya, Taito, *Sasaki* 17211 (TF).

10. ***Viola verecunda*** A. Gray in Mem. Amer. Acad. n. ser. 6:382. 1859; Maxim. in Mél. Biol. 9:750. 187; W. Becker et Moore in Journ. Soc. 17: 379. 1880; Henry in Trans. Asiat. Soc. Japan 24. Suppl.: 18. 1896; Diels in Engl., Bot. Jahrb. 29:477. 1901.

Viola arcuata Blume var. *verecunda* Nakai Bot. Mog. Tokyo 36:38. 1922; Takenouchi in Hist. Nat. Soc. Fukuoka 1:131. 1938.

Plant perennial, glabrous, 5-30 cm. tall; rhizome short, ascending or decumbent, articulate, densely fibrous; stems ascending or slanting, single or in tuft; radical and cauline leaves nearly equal, rounded-reniform, crenate-serrate, very broadly and profoundly cordate at base, acute or often obtuse at the apex; stipules of the radical leaves brown, membranaceous, lanceolate, acute, slightly serrate, 6-10 mm. long, 1-2 mm. broad; stipules of the cauline leaves green, lanceolate, slightly dentate, 8-15 mm. long, 1-3 mm. broad; peduncle with 2 bracts, opposite; flowers small, 1 cm. in diameter, purplish-white; lateral petals beardless, spurred petals greenish white, the spur small; capsules glabrous, oblong-ellipsoid, 5-8 mm. long; seeds ovoid, small.

Taiwan: Eihuku-syo, Sichseigun, *Sasaki* s. n. March 24. 1929.

10a. ***Viola verecunda*** A. Gray form. ***radicans*** Mak. in Bot. Mag. Tokyo 27: 154. 1913; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Stem ascending or decumbent, radicant in nodes after anthesis, otherwise as in the typical form of the species.

Taiwan: Toyen, *Suzuki* 5849; Toen, *Simada* 1165, 1149; Mt. Daiton, *Suzuki* 8289; Tikusi-zan, *Simizu* 2044; Kirun, *Sasaki* 17239 (TF); Hukikaku, Taihoku, *Kawakami* et *Simada* 17245 (TF); Iikusiko, *Ito* 17244 (TF); Sozan, *Sasaki* 17247 (TF); Taihoku, *Kawakami* 17240 (TF); Toen, *Sasaki* 17254 (TF); Kappanzan, Toyen, *Mori* et *Simada* 17251 (TF); Dorawan, Toyen *Simada* 17249 (TF); Tyureki, Toyen, *Simada* 17250 (TF); Inrin, *Kawakami* 17252 (TF); Suisya, Nanto, *Kanehira* et *Sasaki* 17256 (TF).

10b. ***Viola verecunda*** A. Gray form. ***hensoaensis*** Kudo et *Sasaki* in Ann. Rep. Taihoku Bot. Gard. 1:37. 1931.

Leaves rounded, with more or less pointed apex and more acutely cordate base, slightly pubescent, 1.5-2.2 cm. broad, 1.5-4 cm. long, the petioles slender, 6-11 cm. long.

Taiwan: In paludibus insulae innatae in Nichigetsutan prope Mukaiyama, *Kudo* et *Suzuki*

15640.

11. *Viola oblongo-sagittata* Nakai in Bot. Mag. Tokyo 36:37. 1922; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

"*Viola Partini*" sensu Ito & Matsum., Tent. Fl. Lutch. 39. 1889; Matsum., Ind. Pl. Jap. 2:377. 1912; non DC.

Plant terrestrial; rootstock thickened, stemless; petiole 3-15 cm. long, winged; stipules lanceolate, the margins slightly serrate; leaves hastate-sagittate, with an obtuse or pointed apex, 2-7 cm. long, 1-3 cm. wide at the base, the margins crenate; peduncle 11-20 cm. long, longer than the petioles; bracts subulate, 3-5 mm. long, 1-2 mm. wide; sepals broadly lanceolate, with rounded auricle; flowers white, about 15 mm. in diameter; lateral petals bearded, the spur 3 mm. long; style dilated upward; capsules triangular-ellipsoid.

Taiwan: Hori, Taichiu, *Seki* 104; Mt. Sitisei, *Simizu* 633; Toen, *Simizu* 1147; Sozan, *Suzuki* 4193; Daiton Sanroku, *Nakamura* 429; Tikusiko, *Suzuki* 504; Mt. Daiton, *Simada* 1112; Mt. Daiton, *Sho* 49; Tikusiko, Taihoku, *Sasaki* 17353 (TF); Tansui, *Kawakami* & *Simada* 17355 (TF); Hokuto, *Simada* 17352 (TF); Kakyurei, Sinko, *Kawakami* & *Mori* 17354 (TF); Mt. Gosi, Sintiku, *Kawakami* 17356 (TF); Mt. Maiseki, Nanto, *Mori* 17357 (TF); Mt. Ogasawara, *Mori* 17459 (TF); Tiyakandei Taito, *Mori* 17360 (TF); Taisyo, Taito, *Nakahara* 17362 (TF); Isl. Kwasyo-to, *Nakahara* 17361 (TF).

11a. *Viola oblongo-sagittata* Nakai var. *violascens* Nakai in Bot. Mag. Tokyo 36:37. 1922; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Flowers violet, otherwise as the typical form of the species.

Taiwan: Sintiku, *Simada* 1179; Tansui, *Simozawa* 983; Tikusiko, *Simada* 1362; Hokuto, *Murakami* 135; Mt. Sitisei, *Simizu* 633a; Kirigan, *Nakamura* 4228; Musya, *Masamune*, *Mori* & *Nakamura* 2031; Isl. Syaryoto, Kirun, *Hudii* 17365 (TF); Kirun, *Hayata* 17363 (TF); Sekitei, Kirun, *Sasaki* & *Hudii* 17366 (TF); Mt. Sitisei, *Simada*, 17369 (TF); Sozan, *Sasaki* 17368 (TF); Tikusiko, *Simada* 17357 (TF); Syo-kiirun, *Sasaki* 17371 (TF); Tansui, *Simada* 17370 (TF); Tyureki, *Simada* 17372 (TF); Sentohei, Taityu, *Yasukawa* 17374 (TF); Nento, *Simada* 17373 (TF).

12. *Viola taiwaniana* Nakai in Bot. Mag. Tokyo 36:38. 1922; Suzuki in Masamune Short Fl. Formos. 142. 1936.

Plant stemless, perennial; rootstock thickened; stipules lanceolate, glandulose-serrate, adnate to the base of petioles; leaves acutely-sagittate, 4-6 cm. long, 1.5-2 cm. wide at the base, the margins crenate-serrate, hirsutulous on the margins, veins, petioles and peduncles; sepals lanceolate, with square auricles, ciliolate; petals oblong, the lateral petals villose, the spur short, 2-3 mm. long; stigma sub-deltoid; capsules glabrous, about 9 mm. long.

Taiwan: Mt. Tikusi, *Soma* 17468 (TF); Mt. Syabo, *Simada* 17467 (TF); Taihoku, *Nakahara* 17492 (TF); Kokeinani-syo, collector unknown 17469 (TF).

The classification of the species *V. maudshurica* W. Becker, *V. oblongo-*

sagittata Nakai, *V. stenceentra* Nakai and *V. taiwaniana* Nakai is based mainly on the shape of the leaves and the presence or absence of hairs. These characters, however, are not always clear in dry specimens and thus the various species are sometimes confused in the herbarium.

13. ***Viola mandshurica*** W. Becker in Engl., Bot. Jahrb. 54, Beibl. 120:179. 1917; Takenouchi in Hist. Soc. Fukuoka II. 5:182. 1938; Mak., Fl. Jap; 762. 1931.

"*Viola patrinii* DC. var. *chinensis*" sensu Maxim., in Bull. Acad. Sci. St. Petersb. 23:315. 1877; non Ging.

Plant stemless; roots brown or dark brown, single or branched; leaves radical, 1.5–5 cm. long, 1–2.4 cm. wide, glabrous, ovate-lanceolate or oblong-ovoid, truncate or hastate-cordate at the base, the margins crenate-serrate; petioles 2–9 cm. long, glabrous or pubescent; peduncles 4–15 cm. long; bracts 2, linear-lanceolate; flowers violet, deep violet or purplish; sepals lanceolate, the auricles small, rounded; the lateral petals with scattered hairs, the spur oblong, rounded; capsules triangular-ellipsoid, glabrous, 8 mm. long.

13a. ***Viola mandshurica*** W. Becker var. ***ciliata*** Nakai in Bot. Mag. Tokyo 36:(60). 1922; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Plants hairy.

Taiwan: Nako, Tonbaru, Taityu-syu, 2000 m. alt, *Fukuyama 4402, 4404, 4414*.

13b. ***Viola mandshurica*** W. Becker var. ***glabra*** Nakai in Bot. Mag. Tokyo 36:(60). 1922.

Plants glabrous.

Taiwan: Maobiun-Suigenti, *Kudo & Mori 1522*; Kinyan et Piyakan. *Suzuki 6378*; Tansui, *Yamasaki 17313* (TF); Mt. Nitaka, 2400 m. alt, *Kawakami & Mori 17314* (TF).

Takenouchi studies quantitatively the shapes of the leaves and the presence or absence of hairs in the lateral petals, but because of the wide variations of these characters he reaches no definite conclusions (see Takenouchi in Soc. Hist. Nat. Fukuoka 2:180. 1933.). The identification of this species is sometimes much confused in the herbaria.

Formerly most authors refer *V. patrinii* DC. var. *chinesis* Cingings (*V. chinensis* G. Don) as a synonym of *V. mandshurica* W. Becker. However, Nakai (in Bot. Mag. Tokyo 36:(60). 1922) states that actually Cingings's variety, according to De Candolle (Prodr. 1:293. 1824), has glabrous petals, and Don's species, according to Dons's Gardner's Dictionary, is an annual and with glabrous petals. As Becker's species is a perennial with hairy petals, it is distinct from

V. chinensis, which is a southern Chinese species. Maximowicz's plant, which is collected in the Amur region, thus belongs to *V. mandshurica* and not to *V. patrini* var. *chinensis*.

According to Makino (Illust. Fl. Nip. 318. 1940) the species *Viola minor* Mak. is closely related with *V. mandshurica*, but is easily distinguished from it by the whole plant being smaller, the rootstock being white, the leaves being hastate-cordate, and the flowers being smaller. However, according to Nakai (Bot. Mag. Tokyo, 36:(61). 1922), this species is allied to *V. mandshurica* but differs from it by its base of the leaf being dilated and with large dentations and the spur being more slender. These characters, to my knowledge, are not clearcut and distinct in herbarium material. The validity of maintaining *V. minor* as a distinct species is thus questionable.

14. ***Viola stenocentra*** Hay. in Bot. Mag. Tokyo 36:38. 1922; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

"*Viola japonica*" *seneu* Nakai in Journ. Coll. Sci. Tokyo Imp. Univ. 22: 29. (Enum. Pl. Formos.); Hay. in Journ. Coll. Sci. Tokyo Imp. Univ. 25:52 1908. (Fl. Mont. Formos.), Icon. Fl. Formos. I:61. 1913; *non* Langsdorf.

Plant stemless, glabrous; rootstock perennial; leaves caespitose, oblong-hastate or hastate-deltoid, the apex obtuse or acute, 1.5-5 cm. long, 1-2 cm. broad, the margins depressed-crenate; petioles 2-10 cm. long; stipules subulate-attenuate; peduncles 6-15 cm. long; bracts 2, linear; sepals lanceolate, auricled, dentate above, 1-2 mm. long; flower purplish or violet; petals oblong, the lateral ones bearded, the spur slender, 4-7 mm. long; stigma thickened upward, sub-deltoid at the summit; cleistogamous flowers conspicuous after anthesis.

Taiwan: Suigenti *Suzuki s. n.*, June 3, 1929; Kuskus, *Kudo et Suzuki 15961*; Mokusaku, *Masamune 2875*; Musya-Santinozy, *Masamune, Mari et Nakamura 1080*; Lislis, *Kudo et Suzuki 15961*; Urai, Taihoku, *Kudo 411*; South Cape, *Kudo et Suzuki 15752*; Naiko, *Nakamura 4272*; Tansui *Simada 1189*; Wantan, *Simizu 2454*; Nt. Taiton, *Suzuki 10202*; Kirun *Hayata 17409* (TF); Tikusiko, *Kawakami et Sasaki 17421* (TF); Sozan, *Sasaki 17416* (TF); Sizang n, *Simada 17413* (TF).

This species is common around Taipei. Plants that are found in sunny places bear pale violet flowers, with the spur of the flower shorter, and leaves dark green and thick, while those grow in shady places have violet flowers, longer spur, and light green and thin leaves.

15. ***Viola biflora*** L., Sp. Pl. 936. 1753; Maxim. in Mél. Biol. 9:749. 1876; Mak., Fl. Jap. 755. 1931.

Viola tayemonii Hay., Icon. Pl. Formos. 6:3. 1915; Suzuki in Masamune,

Short Fl. Formos. 142. 1936.

Viola Kanoi Sasaki in Trans. Nat. Hist. Soc. Formos. 19:104. 1929.

Rhizome articulate, decumbent, ascending, densely fibrous; pubescent or glabrous; radical leaves with long petioles, 4-10 cm. long, reniform, crenately dentate, 1.2-1.5 cm. long 2.4-3.5 cm. broad; cauline leaves cordate or reniform, crenately dentate, 1-2 cm. long, 2-4 cm. broad; stipules alternate, ovate or oblong-ovate, 1-2; bracts small; flowers yellow, small; sepals linear-lanceolate, with violet lines, conspicuous, small-spurred; capsules ellipsoid, glabrous.

Taiwan: Mt. Tugitaka, Masamune 1255; Mt. Nankotaizan, Bunake, Fukuyama 4664; Mt. Nankotaizan, Bunake, Suzuki, Fukuyama et Simada st 17787.

This species is widely distributed in the high mountain-ranges of Europe, North America, Asia and in the cold regions.

The flowers of other Formosan species of *Viola* are usually violet, sometimes white, and they bloom all the year round except in June, July and August. The present species, however, flowers in July and August, and the flowers are yellow.

Sasaki in Trans. Nat. Hist. Soc. Formos. 19:104. 1929, describes *V. Kanoi* as 'near *V. crassa* Makino, but differs from it in whole plant is smaller and leaves thicker pilose of upper side'. I have found it hardly distinguishable from the present species, and is merely a synonym of *V. biflora*.

Doubtful Species

1. *Viola longistipulata* Hay., Icon. Pl. Formos. 3:29. f. 14. 1913; Suzuki in Masamune, Short Fl. Formos. 142. 1936.

Hayata's originally cited for this species as based on a single collection: "Formosa loco non indicato". This is not available.

For this species there is only one named specimen with flowers, *i. e.*, *Yamada 43*, preserved here. According to the original description and the figures the flowers are about 2 cm. large, the spur 7 mm. long, the stipules 16 mm. long and long-fimbriate; while in the specimen *Yamada 43*, the flowers are about 1.5 cm. large, the spur short, obtuse, about 3 mm. long, the stipules not conspicuously long. Thus judging from the locality and the characters, the Yamada's specimen may be *V. rupicola*. No authenticated specimen of this species is available.

2. *Viola shinchikuensis* Yamamoto in Journ. Soc. Trop. Agr. Taihoku 5:352. 1933; Suzuki in Masamune, Short Fl. Formos. 143. 1936.

Perennial; rootstock thickened; stem sometimes ascending, leafy; leaves mostly radical, cordate, with a cordate base and a pointed apex, the margins serrate, 1.5-3.5 cm. long, 1.2-3 cm. wide, the upper surface glabrous, hairy on the under surface; stipules linear-lanceolate, 8 mm. long, 1 mm. wide, the margins long-fimbriate; cleistogamous capsules on prostrate or short peduncles; bracts 2, opposite, linear-lanceolate, fimbriate, 3-10 mm. long, 1 mm. wide; sepals 5, persistent, densely pubescent without, unequal; auricles with 2-4 lobes; capsules small, triangular-ellipsoid, 4-6 mm. long.

Taiwan: Mt. Yura, Sintiku, 450 m. alt, *Simada 2390c* (type); Tikuto memtoy, 900 m. alt., *Simada 2391c* (syntype).

No flower is found in the two type specimens of Yamamoto's species. Form the vegetative characters, it resembles closely *V. kosanensis* Hay., which is also collected from the type locality of Yamamoto's new species. Both are mountainous plants. While it is hard to say that the two are actually synonymous, their close relationship seems definite.

3. ***Viola oblongo-sagittata*** Nakai form. ***Ishizakii*** Yamamoto in Journ. Soc. Trop. Agr. Taihoku 5:352. 1933; Suzuki ex Masamune, Short Fl. Formos. 142. 1936.

Leaves small, glabrous, 2 cm. long, 5-6 mm. wide, with an obtuse apex and a truncate or obtuse base, the margins crenate; petioles 1.5-2.5 cm. long; peduncles of the petaliferous flowers about 11 cm. long; peduncles of the cleistogamous flowers about 4 cm. long; bracts linear, about 4 mm. long, remotely arranged; flowers 2.5 cm. large; petals 5, subequal obovate, 17 mm. long, 7 mm. broad, the spur 7 mm. long, 3 mm. broad.

Taiwan: Tozan, *Ishizaki s. n.* July 3, 1924 (type).

In the form of leaves, this form appears to be similar to *V. mandshurica* W. Becker rather than to *V. oblongo-sagittata* Nakai. It is probably the same as *V. mandshurica* var. *glabra* Nakai.

Excluded species

Because of lack of material, the following species are not being considered at the present.

1. ***Viola Philippica*** Cav., Ic. 6 (19): t. 529.f. 2. 1801; Poir. in Lam., Encyc. 8:629. 1808; Ging. in DC., Prodr. 1:294. 1824; Miq., Fl. Ind. Bat. 12: 113. 1858-59; F.-Vill., Novis. App. 11. 1880; W. Becker in Philip. Journ. Sci. 19:719. 1921; Merrill, Enum. Philip. Fl. Pl. 3:106. 1928;

Sasaki, List Pl. Formos. 298. 1928.

- 2 ***Viola Pricei*** W. Becker in Bull. Inst. Fard. Bot. Univ. Belgrad. 1:252. 1928, in Kew Bull. Miscel. Inform. 6:252. 1928; Sasaki, List Pl. Formos. 1928.

Based on *W. R. Price 306*, Urai.

3. ***Viola taiwanensis*** W. Becker in F. Fedde, Rep. Sp. Nov. Regn. Veget. 17:315. 1921 (Viol. Nov. Asia.).

Based on *U. Faurie 1719.*, Bunkiko, at 1500 m.

4. ***Viola takasagoensis*** Koidz: in Acta Phyt. Geobot. Tokyo 7:112. 1938.

Based on *J. Ohwi 1700*, Mt. Taibuzan, Takao.

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