

Eastern Asiatic Species of *Mucuna* (Leguminosae)

YOICHI TATEISHI AND HIROYOSHI OHASHI

*Biological Institute, Faculty of Science, Tohoku University,
Sendai 980*

All the native taxa of *Mucuna* hitherto known in Eastern Asia were reexamined and the following four species with one subspecies were recognized as distinct; *M. macrocarpa*, *M. sempervirens*, *M. membranacea* and *M. gigantea* with subsp. *tashiroi*. A new key for distinguishing these taxa and new circumscription for each species were prepared. Differences between *M. membranacea* and *M. nigricans* were clarified.

Key words: Eastern Asia — Leguminosae — *Mucuna* — Taxonomy.

The genus *Mucuna* is comprised of 100-120 species occurring in the tropics and subtropics of both hemispheres. In Eastern Asia only *Mucuna capitata* (Roxb.) Wight et Arnott has been cultivated and no wild species had been known before 1899. Since then, however, about 10 species have been reported from this area of which eight species and one variety were described as being new to science. Matsumura (1899) recorded for the first time four native species of the genus from the Ryukyus and Formosa including one new species, *M. ferruginea* Matsumura. Successively the following new taxa came to be known; *M. subferruginea* Hayata (1913) from Formosa, *M. tashiroi* Hayata (1913) from Formosa, *M. membranacea* Hayata (1913) from Formosa, *M. toyoshimai* Nakai (1921) from the Bonin, *M. japonica* Nakai (1932) from Kyushu, *M. irukanda* Ohwi (1936) from the Ryukyus, *M. iriomotensis* Ohwi (1936) from the Ryukyus and *M. irukanda* var. *bungoensis* Ohwi (1965b) from Kyushu. From the other regions of Eastern Asia no native species of the genus have been reported. These taxa, on the contrary, have been regarded by later taxonomists especially since 1971 to be identical with previously known species most of which are widely distributed in tropical and subtropical Asia. *M. japonica* was treated by Koidzumi (1932) and Ohwi (1963, 1965a, b) as a synonym of *M. sempervirens* Hemsley of southern and southwestern China. As only one individual of this species is growing in Japan, it is sometimes considered to be not native but introduced from China. In the Flora of Ryukyus Hatusima (1971) recognized two species, *M. nigricans* (Lour.) Steud. and *M. irukanda* Ohwi, and treated *M. iriomotensis* and *M. membranacea* as synonyms of *M. nigricans*. Later he (1975) added *M. gigantea* to the flora. Ohashi and Tateishi (1976) regarded *M. ferruginea*, *M. subferruginea*, *M. irukanda* and *M. irukanda* var. *bungoensis* as identical with *M. macrocarpa* and, also, *M. toyoshimai* as identical with *M. gigantea*. Moreover, they treated *M. tashiroi* as a subspecies of *M. gigantea*, as *M.*

gigantea subsp. *tashiroi* (Hayata) Ohashi et Tateishi. Hatusima (1976) agreed with these treatments on *M. macrocarpa* and *M. gigantea* and recognized the following four species as distinct in Japan, the Ryukyus and the Bonin; *M. sempervirens*, *M. macrocarpa*, *M. gigantea* and *M. nigricans*. Walker (1976) adopted two species of *Mucuna* as being distinct in the Ryukyus, i.e. *M. nigricans* and *M. irukanda*. In the Flora of Taiwan, Huang and Ohashi (1977) recognized three species of *Mucuna* in Formosa, i.e. *M. gigantea*, *M. macrocarpa*, and *M. nigricans*. In this Flora *M. ferruginea*, *M. subferruginea*, *M. tashiroi* and *M. membranacea* are regarded as synonyms of the recognized three species.

Accordingly, by these studies four species of *Mucuna* have been retained as distinct in Eastern Asia, of which one species is possibly introduced. However, these taxa should be reexamined because *M. membranacea* and *M. iriomotensis* are not identical with *M. nigricans*. Moreover, characters which have hitherto been used for distinguishing these Eastern Asiatic taxa are often variable and insufficient. Therefore, it becomes necessary to revise all the taxa of the genus *Mucuna* in Eastern Asia.

Key to the species and subspecies of *Mucuna* of Eastern Asia

1. Leaves estipellate. Wing-petals shorter than keel-petals. Pods linear, longer than 20 cm, without wing along sutures 2.
 2. Leaflets with obscure reticulate veinlets, with dense brownish yellow hairs on both surfaces when young, later glabrescent above. Flowers 5.5–7 cm long. Standard greenish gray, ciliate *M. macrocarpa*
 2. Leaflets with prominent reticulate veinlets on both surfaces, with sparse white hairs only in young. Flowers 7–8.5 cm long. Standard purple, glabrous *M. sempervirens*
1. Leaves stipellate. Wing-petals as long as or longer than keel-petals. Pods oblong or ovate, 4–14 cm long, winged along both sides of sutures 3.
 3. Leaflets densely to sparsely short white hairy on both surfaces; terminal leaflets elliptic to rhomboid, with (4–)5–6 pairs of lateral veins. Inflorescences racemose. Flowers dark purple, 5–6 cm long. Lower calyx-lobe 5–10 mm long, longer than 2/3 of tube. Pods with many plates across valves, with spreading long stinging brown hairs *M. membranacea*
 3. Leaflets sparsely short white hairy in young but later glabrous; terminal leaflets oval-oblong or ovate, with 3–4(–5) pairs of lateral veins. Inflorescences corymbose. Flowers greenish, 3–4 cm long. Lower calyx-lobe 2–3 mm long, less than 1/3 of tube. Pods smooth and glabrous *M. gigantea*
 4. Upper two calyx-lobes connate near the top. Standard nearly 3/4 of wings in length; claws of wings shorter than 1/4 of the whole length of wings subsp. *gigantea*
 4. Upper two calyx-lobes more loosely connate than those in above. Standard more than 4/5 of wings in length; claws of wings about 1/3 of the whole length of wings subsp. *tashiroi*

1) *Mucuna gigantea* (Willd.) DC., Prodr. 2: 405 (1825)–Trimen, Handb. Fl. Ceylon 2: 62 (1894) – Ohashi & Tateishi in J. Jap. Bot. 51: 164 (1976) – Hatusima, Woody Pl. Jap. 560 (1976) – Thuân in Fl. Cambodge Laos Viêt-Nam 17: 35 (1979) – Verdcourt, Man. New Guinea Legum. 443, f. 106 F (1979).

1-a) subsp. *gigantea*: Ohashi & Tateishi, l. c. 164, f. 2 (1976).

Dolichos giganteus Willd., Sp. Pl. 3: 1041 (1802).

Carpopogon giganteus (Willd.) Roxb., Hort. Beng. 54 (1814); Fl. Ind. 3: 287 (1832).

Stizolobium giganteum (Willd.) Sprengel, Syst. Cur. Post. 281 (1827).

Mucuna Toyoshimae Nakai in Bot. Mag. Tokyo 35: 144 (1921).

[Detailed literature see Ohashi & Tateishi, l. c. 164 & 166 (1976)].

A woody climber; branches slender, glabrous. Stipules subulate, 3–5 mm long, 0.8–1 mm wide, sparsely appressed hairy outside, very early deciduous. Leaves stipellate; stipels subulate, 3–5 mm long. Leaflets chartaceous to subcoriaceous, thinly white appressed hairy on both surfaces in young, afterwards glabrescent; petioles 5–12 cm long, glabrous; petiolules glabrescent; terminal leaflets oval-oblong or ovate, 6–18 cm long, 4–12 cm broad, obtuse and abruptly acuminate at apex, obtuse to rounded at base, 3–4(–5)-nerved on both sides of midrib; lateral leaflets oblique.

Inflorescences paniculate but look like corymb through abbreviation of rachis, 9–30-flowered, long-pedunculate, pendulous, glabrous; lateral branchlets 3–10, 4–10 mm long, with shortened internode, (1–)3-flowered, umbell-like. Primary bracts lanceolate, sparsely short appressed hairy outside, glabrous inside, 4–5 mm long in bud, caducous; secondary bracts elliptic, cymbiformis, hairy as primary bract, 3 mm long in bud, caducous. Pedicels 1.5–3 cm long, with densely short appressed white hairs. Bracteoles elliptic, cymbiformis, 1–2 cm long, caducous before anthesis.

Flowers greenish, 3–4 cm long. Calyx broadly campanulate, sparsely to densely clothed with appressed short brownish hairs (0.1–0.4 mm long) outside and near the margin of lobes inside, and with sparsely long stinging brown hairs (1–2 mm long, snap and leave their gland-like base) outside, 5-lobed, but upper two lobes connate near the top, about 1 cm long; lateral lobes broadly triangular 2 mm long, lower lobe broadly triangular, 2–3 mm long, shorter than tube.

Standard glabrous, obovate, about $\frac{3}{4}$ of wings in length, 2–2.5 cm long including short claw of about 4 mm long, retuse or rounded at apex, 2-auriculate at base. Wings as long as keel-petals, about 3 cm long including claw about 6 mm long, obtuse to rounded at apex, auriculate at base of lamina, cymbiformis in upper portion of lamina, densely pubescent on auricle outside and along upper and lower margin of claw. Keel-petals incurved, beaked, coriaceous near apex, about 3 cm long including claw of about 6 mm long, ciliate on upper and lower margin of claw.

Stamens diadelphous, filaments and anthers 2-formed; orbicular anthers about 1 mm long, dorsifixed to thicker filaments, with long hairs on dorsal side of loculus and connectives; oblong anthers 2–2.5 mm long, subbasifixed to thinner filaments, glabrous. Ovary about 5 mm long, densely appressed long hairy, surrounded by tubular disk at base. Stigma capitate, surrounded with long hairs.

Pods compressed, oblong, 8–14 cm long, 3.5–5.5 cm wide, winged along both sides of sutures, densely brown hairy when young, afterwards subglabrous; wings 3–10 mm wide, entire or erose-dentate along margin, endocarp pergamentaceous, separating as a whole.

Seeds 1–5, compressed, orbicular, 2–3 cm in diameter, reddish brown with black spots or blackish brown; hylum extending around the seed-margin for about three-

quarters of the circumference, 1.5–2 mm wide.

Distribution. Bonin, Ryukyus, Pacific islands, China (Hainan), S.E. Asia, India, Malaysia and Australia. Fig. 1.

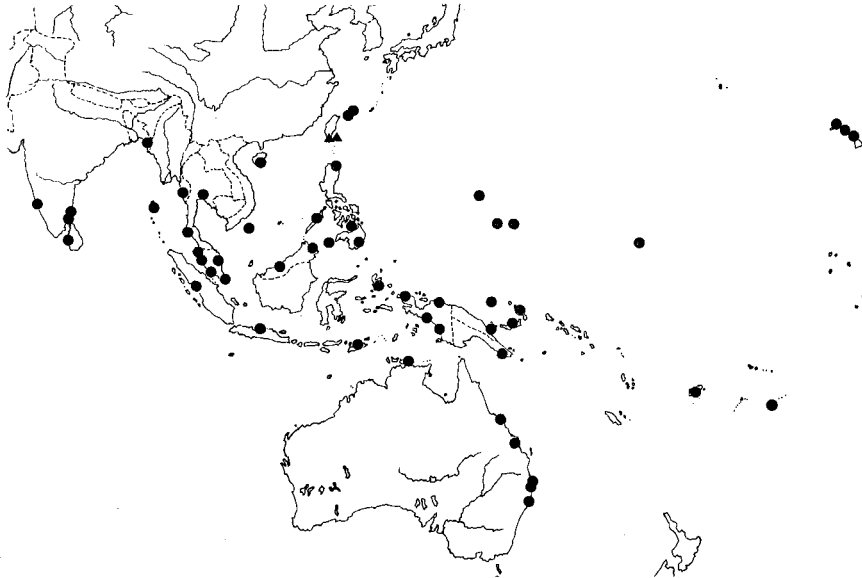


Fig. 1. Distribution of *Mucuna gigantea* subsp. *gigantea* (●) and subsp. *tashiroi* (▲) in Asia and the Pacific regions.

Specimens examined. Bonin. Isl. Muko-jima: Western part (T. Tuyama, 6 Dec. 1935 π); Eastern part (T. Tuyama, 5 Dec. 1935 π). Isl. Ototo-jima: (T. Nakai, Jul. 1926 π); (T. Tuyama, 15 Aug. 1933 π); Kurohama (A. Yamamoto, 5 Aug. 1930 π). Isl. Chichijima: (T. Nakai, 18 Jun. 1920 π —Lectotype and islectotype of *M. Toyoshimai* Nakai); (T. Nakai, 20 Jun. 1920 π —Syntype of *M. Toyoshimai* Nakai); Hatsuneyama (T. Tuyama, 16 Nov. 1935 π); Mikazukiyama (T. Tuyama, 18 Nov. 1935 π); Mikazukiyama, alt. 100 m, in shady evergreen forest, climbing liana, flower green (T. Yamazaki & K. Enomoto 220, 23 May 1970 π); beach at the foot of Mt. Mikazuki (Y. Momiyama, S. Kobayashi & M. Ono, 13 Mar. 1972 π). Isl. Haha-jima: (T. Nakai, 16 Jul. 1920 π —Syntype of *M. Toyoshimai* Nakai); Kuwanoki-yama (T. Tsuyama, 30 Jul. 1933 π); Kuwanoki (T. Tuyama, 1 Aug. 1933 π); Kuwanoki (M. Ogata, Jun. 1938 π).

Isls. Sulphur. Isl. Nakaiwo-to (T. Nakai, 22 Jun. 1920 π).

Ryukyus. Isl. Ishigaki-jima: Inudahama (S. Tanaka 281, 2 Jul. 1891 π); Oota (C. Ohama, 22 Feb. 1976 π); Tomino-Oota (H. Ohashi & Y. Tateishi 1277, 12 Nov. 1976 π , TUS); Yoshihara (Y. Tateishi 4091, 15 Mar. 1978 π); Yonehara (H. Ohashi & Y. Tateishi 1266, 12 Nov. 1976 π , TUS); Yonehara, alt. 30 m (Y. Tateishi & J. Murata 4984, 8 Feb. 1980 π , TUS). Isl. Iriomote-jima: Toyohara, seaside (Y. Tateishi & J. Murata 4833, 4 Feb. 1980 π , TUS).

1-b) subsp. **tashiroi** (Hayata) Ohashi & Tateishi in *J. Jap. Bot.* **51**: 166, f. 3 (1976).

M. Tashiroi Hayata, *Icon. Pl. Formos.* **3**: 75 (1913).

[Literature and discussion on the subspecies see Ohashi & Tateishi, l. c. 166–167 (1976)].

Distribution. Southern Formosa. Fig. 1.

Specimens examined. Formosa. Pingtung: Hengchun, Kuraru (Y. Tashiro, Apr. 1909 TT—Holotype and isotype of *M. Tashiroi* Hayata).

2) ***Mucuna macrocarpa*** Wall., Pl. As. Rar. 1: 41, t. 47 (1830) – Hand.-Mzt., Symb. Sin. 7(3): 580 (1933) – Ohashi & Tateishi in J. Jap. Bot. 51: 162 (1976) – Hatusima, Woody Pl. Jap. 560 (1976) – Huang & Ohashi in Fl. Taiwan 3: 343, pl. 621 (1977) – Thuân in Fl. Cambodge Laos Viêt-Nam 17: 35 (1979). Fig. 2.

M. ferruginea Matsum. in Ito et Matsum., Tent. Fl. Lutch. 422 (1899).

M. bodinieri Lév. in Bull. Soc. Fr. 55: 408 (1908).

M. subferruginea Hayata, Icon. Pl. Formos. 3: 74 (1913).

M. colletii Lace in Kew Bull. 1915: 398 (1915) – Craib, Fl. Siam. Enum. 1: 443 (1928).

M. irukanda Ohwi in J. Jap. Bot. 12: 659 (1936).

M. irukanda var. *bungoensis* Ohwi, Fl. Jap. rev. ed. 1439 (1965).

M. ferruginea var. *irukanda* (Ohwi) Ohwi, Fl. Jap. new ed. 1453 (1975).

M. ferruginea var. *bungoensis* (Ohwi) Ohwi, Fl. Jap. new ed. 1453 (1975).

[Additional literature was cited by Ohashi & Tateishi, l. c. 162–163 (1976)].

A large woody climber, with retrorse brown hairs on young branchlets. Stipules narrowly ovate, 3–5 mm long, 1–1.5 mm wide, densely brown hairy outside, caducous. Leaves estipellate. Leaflets chartaceous, ferruginous-tomentose on both surfaces while young, afterwards glabrescent above, but mostly persistent below, reticulate veinlets obscure; petiole long, hairy as branchlets; petiolule very densely brown hairy; terminal leaflets oblong or narrowly ovate, 8–18 cm long and 4–10 cm broad, acuminate to cuspidate at apex, obtuse or rounded at base, with 4–5 pairs of lateral veins; lateral leaflets oblique.

Inflorescences paniculate, but look like raceme through abbreviation of lateral branches, 15–30 cm long, subsessile, brown-velvety; lateral branches reduced to tuber-like organ, many, (1–)3-flowered, fasciculate. Bracts caducous. Pedicels 1–2 cm long, hairy as rachis. Bracteoles caducous.

Flowers 5.5–7 cm long, dark purple but with standard of greenish gray and keel-petal of purplish. Calyx obliquely campanulate, brown-velvety on both sides and with sparsely long stinging brown hairs (0.5–1 mm long) outside, 4-lobed; upper lobe broadly triangular, obtuse to rounded at apex, 4–5 mm long, lower one 7–9 mm long, as long as or shorter than tube.

Standard ciliate on upper margin, suborbicular or broadly ovate, contracted near center, about 3/4 of wings and 2/3 of keel-petals in length, 3.5–4.5 cm long including short claw of about 5 mm long, obtuse to retuse at apex, 2-auriculate at base. Wings distinctly shorter than keel-petals, 5–6 cm long including claw 6–10 mm long, rounded at apex, auriculate at base of lamina, cymbiformis in upper portion of lamina, densely short hairy along margin of upper part of lamina, densely short brown hairy on auricle and near the margin of claw outside. Keel-petals subfalcate, incurved, beaked, coriaceous at apex, clawed, 5.5–7 cm long including claw 7–8.5 mm long.

Stamens diadelphous, filaments and anthers 2-formed; orbicular anthers about

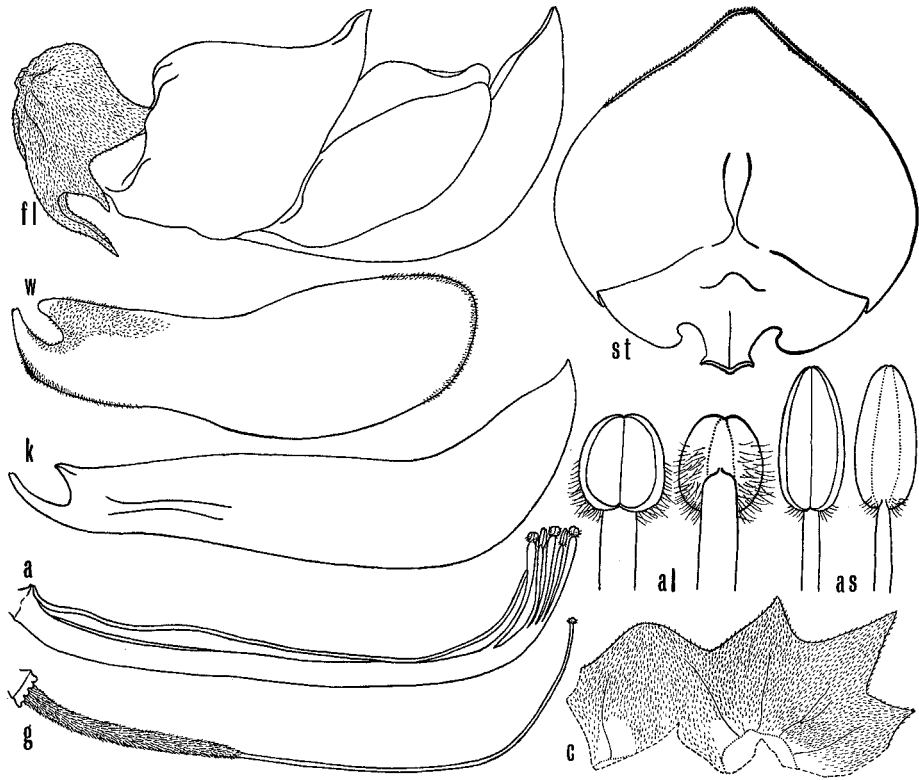


Fig. 2. *Mucuna macrocarpa*. fl: Flower, $\times 1.2$. st: Standard, $\times 1.2$. w: Wing, $\times 1.2$. k: Keel-petal, $\times 1.2$. a: Stamens, $\times 1.2$. g: Pistil with disk around base, $\times 1.2$. al: Upper portion of longer stamens, $\times 6$. as: Upper portion of shorter stamens, $\times 6$. c: Calyx dissected, $\times 1.2$. al and as from Taiwan, U. Mori, 27 Mar. 1914 (TI), the others from Ryukyu, Kuroiwa s.n. (TI).

2 mm long, dorsifixed to thicker and longer filaments, with densely long hairs on dorsal side of loculus; oblong anther about 3 mm long, subbasifixed or dorsifixed, attached near the base to thinner and shorter filaments, a little hairy near the base of dorsal side of loculus. Ovary densely long brown hairy; stigma capitate, glabrous.

Pods compressed, linear, 20–50 cm long, 3–5 cm wide, woody, septate, angled but not winged along both sides near margin, 4–12-seeded, loosely constricted between seeds, ferruginous-tomentose.

Seeds broadly elliptic, compressed, dark brown, 2.2–2.5 cm in longer dimension, about 2 cm in shorter dimension; hylum extending around the seed-margin for 4/5 of the circumference, 3 mm wide.

Distribution. S. Japan (Kyushu), Ryukyus (Isls. Amami, Isls. Okinawa), Formosa, China (Yunnan), Indo-China, Thailand, Burma, India (Assam) and E. Himalaya.

Specimens examined. Japan. Kyushu: Prov. Bungo, Kamae-machi, Kazurabara (M. Nagasawa, 4 May 1968 TI); (M. Togashi, 27 Nov. 1968 TI); Prov. Ohsumi, Isl. Mage-jima, Kaitaku (S. Ohuchiyama, 2 May 1954 KYO).

Ryukyus. Isl. Amami-ooshima: Yuwan (H. Migo, 2 Aug. 1964 τ s). Isl. Tokunoshima: Setaki (H. Migo, 29 Jul. 1964 τ s). Isl. Iheya (H. Kuroiwa, Aug. 1898 τ i). Isl. Okinawa: (H. Kuroiwa s.n. τ i); Kunigami, Ginama (H. Migo, 26 Apr. 1962 τ s); Kunigami, Yona, Experimental forest of Ryukyu Univ. (K. Iwatsuki *et al.* 107, 29 Oct. 1973 τ i); Kunigami, Hentona - Mt. Yonahadake (Y. Kimura & I. Hurusawa, 17 Sep. 1940 τ i); Motobu, Nago-Awa (Y. Kimura & I. Hurusawa, 20 Sept. 1940 τ i); Motobu, Mt. Nagodake (G. Nakahara, Apr. 1907 τ i); Motobu, Mt. Katsuudake (H. Ohashi & Y. Tateishi 1000, 5 Nov. 1976 τ i); Mt. Katsuudake, alt. 400 m, climbing tree (T. Yamazaki, 24 Jun. 1971 τ i); Mt. Onnadake (S. Tawada 346, κ yo-Holotype of *M. irukanda* Ohwi); (T. Ito 1061, 23 Aug. 1894 τ i); Kunchan (J. Matsumura s.n. τ i).

Formosa. (K. Sawada, 1905 τ i); (B. Hayata, 27 Apr. 1914 τ i); (B. Hayata, 1912 τ i); Hoozan, 6500 ped. alt. (B. Hayata, 8 Apr. 1916 τ i); Taipei: Wulai (I. Sasaki 178, 11 Sep. 1965 τ i); Hsinchu: Mt. Wutzushan (T. Kawakami 1291, Dec. 1905 τ i); Nantou: Jihyuehtan (M. Togashi, 29 Mar. 1977 τ i, τ s); Jenai (Musha) (B. Hayata, 25 Apr. 1916 τ i); Jenai, alt. 1000 m (Y. Ando, Y. Tateishi & M. Watanabe 409, 7 Aug. 1969 τ i); Chia: Fenchiu - Yaoliping (B. Hayata, 27 Mar. 1914 τ i); Kaohsiung: Likuei-Mt. Peinan-chushan, along Lao-nung-chi, Teng-Chih, 1600 m (T. Yamazaki, T. Namba & F. Yamazaki 666, 30 Aug. 1969 τ i); Taitung: Ako, Mt. Buisan, ad 5000 ped. alt. (S. Sasaki, 24 Mar. 1910 τ i-Holotype and isotype of *M. subferruginea* Hayata); Cholu (T. Namba *et al.*, 17 Aug. 1968 & 18 Aug. 1968 τ i); Pingtung: Shuitiliao (C. Owatari, 17 Jan. 1898 τ i-Holotype and isotype of *M. ferruginea* Matsumura).

3) ***Mucuna membranacea*** Hayata, Icon. Pl. Formos. 3: 73 (1913); Gen. Ind. Fl. Formos. 21 (1917)-Matsumura, Shokubutsu-mei-i 257 (1916)-Makino & Nemoto, Fl. Jap. 743 (1925) - Masamune in Sci. Rep. Kanazawa Univ. 3: 136 (1955). Figs. 3 & 5b.

M. iriomotensis Ohwi in Act. Phytotax. Geobot. 5: 181 (1936) - Masamune, l. c. 136 (1955).

M. nigricans (Lour.) Steudel sensu auct. Jap. et Formos.: Sasaki, Cat. Government Herb. Formos. 280 (1930)-Makino & Nemoto, Fl. Jap. ed. 2, 589 (1931)-Hatusima in Sci. Bull. Univ. Ryukyus 3: 19 (1956); Fl. Ryukyus 320 (1971); ed. rev. 320 (1975); Woody Pl. Jap. 560 (1976)-Li, Woody Fl. Taiwan 355 (1963)-Hatusima & Amano, Fl. Ryukyus 52 (1967); ed. 2, 64 (1977)-Walker, Fl. Okinawa 586 (1976)-Huang & Ohashi in Fl. Taiwan 3: 343 (1977).

A woody climber; branchlets glabrous. Stipules subulate, acuminate at apex, 7-8 mm long, 1 mm wide, long appressed hairy outside, glabrous inside, caducous. Leaves stipellate; stipels subulate, about 2 mm long. Leaflets membranous to chartaceous, densely to sparsely white appressed hairy on both surfaces, with reticulate veinlets beneath; petioles 3-10 cm long, sparsely white appressed hairy; petiolule sparsely to densely appressed hairy; terminal leaflets elliptic to rhomboid, 8-12 cm long, 6-8 cm wide, obtuse and abruptly acute at apex, cuneate to obtuse at base, (4-)5-6-nerved on each side of midrib; lateral leaflets more or less oblique.

Inflorescences paniculate, but look like raceme through abbreviation of lateral branches, about 10 cm long, pedunculate, pendulous, sparsely to densely short appressed hairy; lateral branches reduced to tuber-like organ, (1-)3-flowered, fasciculate. Primary bracts ovate to broadly ovate, cymbiformis, 12-15 mm long, 7-10 mm wide, densely short appressed white hairy on both surfaces and with stinging brown hairs outside, caducous before anthesis; secondary bracts oblong, about 15 mm long and 7 mm wide, hairy as primary bracts, caducous. Pedicels 6-10 mm long, hairy as inflorescence-rachis. Bracteoles lanceolate, hairy as bracts, caducous.

Flowers dark purple, 5–6 cm long. Calyx broadly campanulate, densely clothed with appressed short soft grayish hairs (0.1–0.4 mm long) on both surfaces and with sparsely long stinging brown hairs (1–2 mm long) outside, 5-lobed, but upper two lobes connate near the top, about 1 cm long, lower lobes lanceolate, 10–12 mm long, subequal to tube in length.

Standard glabrous, broadly ovate, about 2/3 of wings in length, 3–3.5 cm long including short claw of about 3 mm long, obtuse to retuse at apex, 2-auriculate at base. Wings as long as or a little longer than keel-petals, about 5 cm long including claw of about 7 mm long, about 2 cm wide, obtuse to rounded at apex, auriculate at base of lamina, cymbiformis in upper portion of lamina, densely pubescent on auricle outside and along upper margin of claw. Keel-petals incurved, beaked, coriaceous at apex,

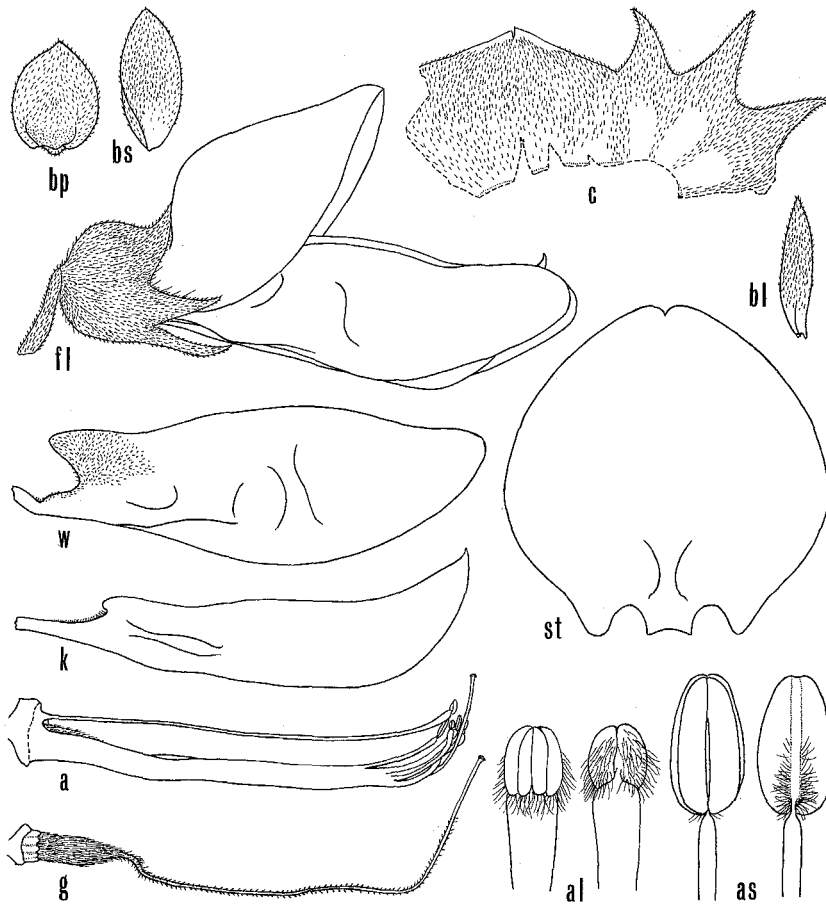


Fig. 3. *Mucuna membranacea*. bp: Primary bract, $\times 1.2$. bs: Secondary bract, $\times 1.2$. bl: Bracteole, $\times 1.2$. fl: Flower, $\times 1.2$. st: Standard, $\times 1.2$. w: Wing, $\times 1.2$. k: Keel-petal, $\times 1.2$. a: Stamens and pistil, $\times 1.2$. g: Pistil with disk around base, $\times 1.2$. al: Upper portion of longer stamens, $\times 6$. as: Upper portion of shorter stamens, $\times 6$. c: Calyx dissected, $\times 1.2$. All from Ryukyu, Y. Tateishi & J. Murata 4992 (tr).

clawed, about 5 cm long including claw of about 1 cm long, ciliate on upper margin of claw.

Stamens diadelphous, anther and filament 2-formed; elliptic short anthers 1.5 mm long, dorsifixed to thicker and longer filaments, densely clothed with long hairs on dorsal side of loculus; longer and oblong anthers about 3 mm long, dorsifixed, but attached near the base to thinner and shorter filaments, with sparsely long hairs on dorsal side of loculus and lower portion of connectives. Ovary about 1 cm long, densely long appressed hairy, surrounded by tubular disk at base; stigma capitate, glabrous.

Pods compressed, elliptic-ovate to oblong, 4–7 cm long, 5 cm wide, with erose-denticulate wings along both sides of sutures, plated across valves, but plates mostly interrupted halfway, bearing brown spreading stinging hairs.

Seeds compressed, suborbicular, about 2 cm in diameter, hylum extending around the seed-margin for about three-quarters of the circumference.

Distribution. Ryukyus (Isles. Ishigaki, Iriomote and Yonaguni) and Formosa. Fig. 6.

Specimens examined. Ryukyus. Isl. Ishigaki-jima: Hirakubo, climbing liane in evergreen forests (T. Yamazaki 328, 19 Jun. 1971 π); Hirano, alt. 20 m (Y. Tateishi & J. Murata 4992, 8 Feb. 1980 π); Akaishi, in evergreen forest of seaside (T. Yamazaki, 19 Jun. 1971 π); Yonehara (H. Ohashi & Y. Tateishi 1269, 12 Nov. 1976 π). Isl. Iriomote-jima: (Unknown Collector s.n. π); (G. Koidzumi, 1–20 Jul. 1923 κ yo), Ootomi, alt. ca. 30 m (Y. Tateishi & J. Murata 4690, 3 Feb. 1980 π); Takana (S. Sonohara, 11 May 1936 κ yo—Holotype of *M. iriomotensis* Ohwi), Funaura, seaside (H. Ohashi & Y. Tateishi 1976, 3 Dec. 1978 π); near Sonai (Y. Kimura & I. Hurusawa, 4 & 14 Oct. 1940 π); river side of Urauchi Riv. (Y. Kimura & I. Hurusawa, 5–8 Oct. 1940 π). Isl. Yonaguni-jima: (G. Koidzumi, 11–13 Jul. 1923 κ yo), near Mt. Urabu-yama (S. Tawada 481, 1 Aug. 1936 κ yo), Kubura, alt. 10 m (Hatusima *et al.*, 1 Oct. 1973 π , TNS), at the foot of calcareous cliff south of air field, alt. 10 m (Hatusima *et al.* 732624, 2 Oct. 1973 TNS).

Formosa. Lu Tao (G. Nakahara 7050, Feb. 1906 π -Syntype); Lan-yu (S. Kusano, Dec. 1909 π -Lectotype); (S. Sasaki, 8 May 1924 TNS; 4 Jun. 1926 TNS).

Plants which were referred to *Mucuna nigricans* from the Ryukyus and Formosa do not belong to true *M. nigricans*. They rightly belong to *M. membranacea*. As enumerated above, however, all of the recent represented floras on the areas adopted *M. nigricans* for this species. The two species differ clearly as shown in Table 1.

Mucuna nigricans is a widely distributed polymorphic species. It occurs in China (Hainan), Indo-China, Malaysia, Thailand, Burma, India and eastern Himalaya (Nepal, Sikkim and Bhutan), while *M. membranacea* is confined to the Ryukyus and

Table 1. Differences between *M. nigricans* and *M. membranacea*

	<i>M. nigricans</i>	<i>M. membranacea</i>
Leaflets	rounded at base	cuneate to obtuse at base
Standard	about 1/2 of length of keel-petals	about 2/3 of length of keel-petals
Pods	longer than twice width; plates on valves continuous	shorter than twice width; plates on valves mostly interrupted halfway
Seeds	reniform; hylum about 1/2 of circumference of seeds	suborbicular; hylum 3/4 of circumference of seeds

Formosa. In the present paper we regard *M. hainanensis* Hayata and *M. suberosa* Gagnepain as synonyms of *M. nigricans*, though they were often distinguished from the latter by their smaller leaves and pods. Detailed literature and synonyms of *M. nigricans* are as follows:

Mucuna nigricans (Lour.) Steudel, Nom. Bot. ed. 2, 2: 163 (1841)—Merrill in Philip. J. Sci. 5: 116 (1910); in Enum. Philip. Fl. Pl. 2: 309 (1923); in Trans. Amer. Philip. Soc. 24: 209 (1935)—Ohashi in Fl. E. Himal. 160 (1966); in Enum. Fl. Pl. Nep. 2: 126 (1979)—Thothathri in Rec. Bot. Serv. Ind. 20: 79 (1973)—Thuân in Fl. Cambodge Laos Viêt-Nam 28: 36 (1979). Figs. 4 & 5a.

Citta nigricans Loureiro, Fl. Cochinch. 456 (1770).

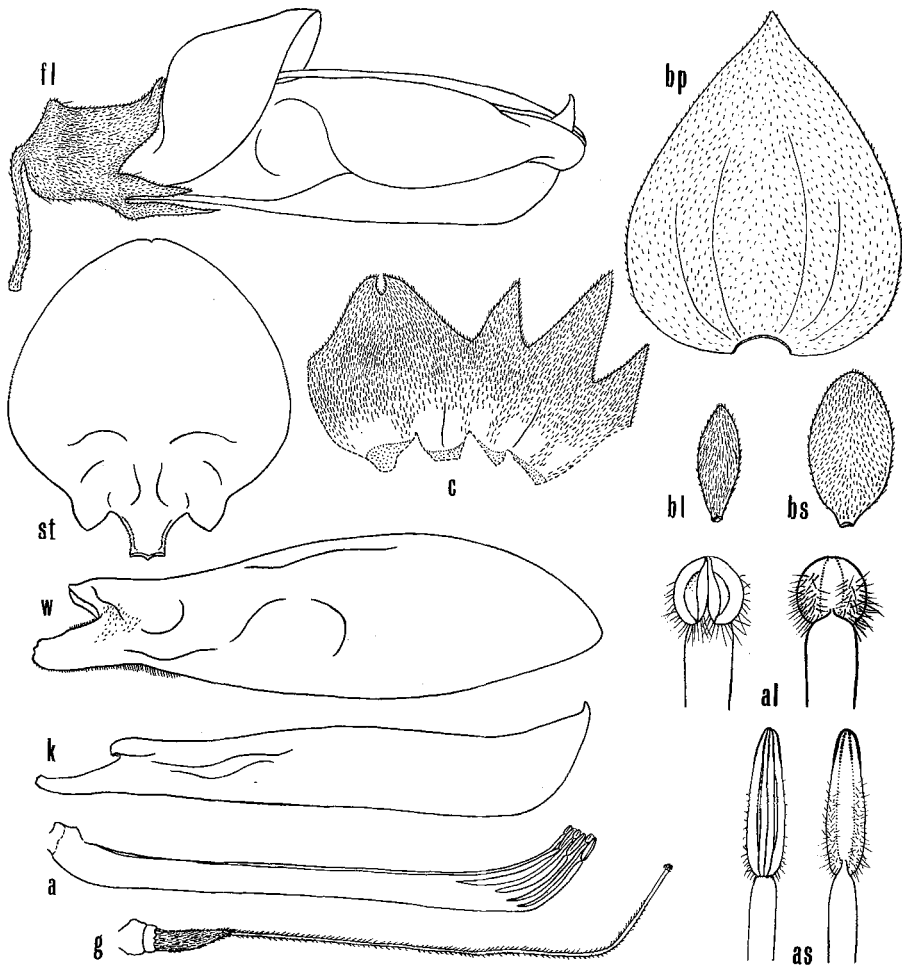


Fig. 4. *Mucuna nigricans*. bp: Primary bract, $\times 1.2$. bs: Secondary bract, $\times 1.2$. bl: Bracteole, $\times 1.2$. fl: Flower, $\times 1.2$. st: Standard, $\times 1.2$. w: Wing, $\times 1.2$. k: Keel-petal, $\times 1.2$. a: Stamens, $\times 1.2$. g: Pistil with disk around base, $\times 1.2$. al: Upper portion of longer stamens, $\times 6$. as: Upper portion of shorter stamens, $\times 6$. c: Calyx dissected, $\times 1.2$. All from Nepal, Ohashi *et al.* 771387 (TT).

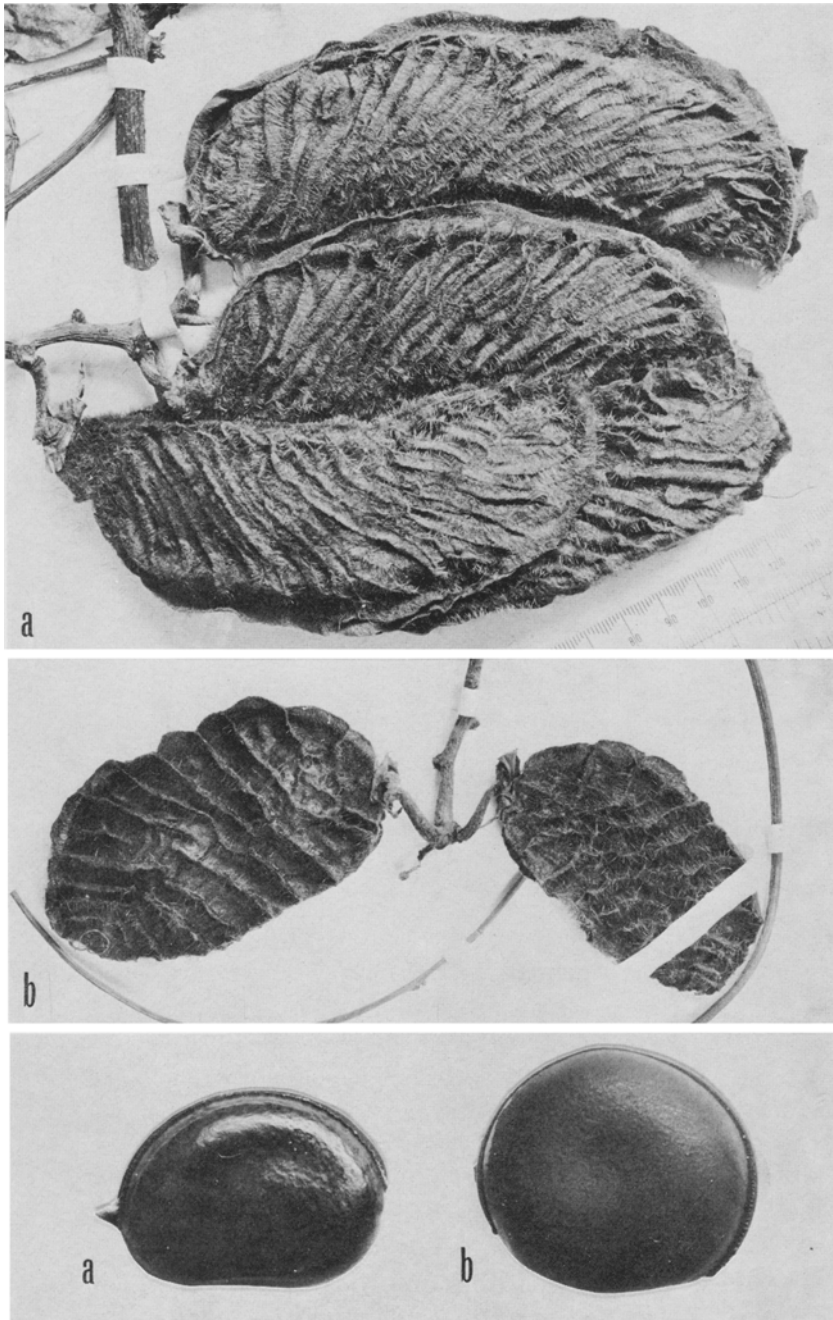


Fig. 5. Pods ($\times 0.54$) and Seeds ($\times 1.44$) of *Mucuna nigricans* and *M. membranacea*. a: *M. nigricans* from Nepal, Hara *et al.* 6301405 (TI). b: *M. membranacea* from Ryukyu, T. Yamazaki 328 (TI).

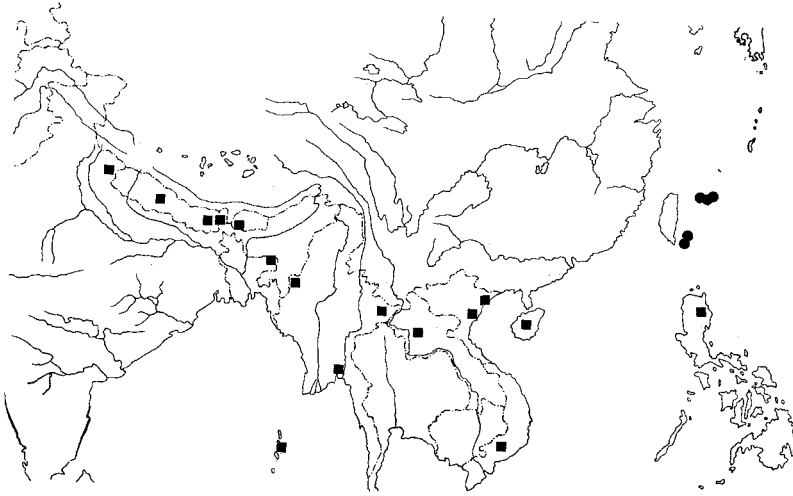


Fig. 6. Distribution of *Mucuna membranacea* (●) and *M. nigricans* (■).

Carpopogon imbricatum Roxb., Hort. Beng. 54 (1814), nom. nud.

Mucuna gigantea DC. var. *nigricans* (Lour.) DC., Prodr. 2: 405 (1825).

M. imbricata DC., Prodr. 2: 406 (1825)–Baker in Fl. Brit. Ind. 2: 185 (1876)–Prain in J. Asiat. Soc. Beng. 66, pt. 2, 407 (1897)–Merrill in Govt. Lab. Publ. (Philip.) 27: 38 (1905); in Philip. J. Sci. 1: Suppl. 67 (1906)–Gagnepain in Fl. Indo-Chine 2: 320 (1916)–Osmaston, Forest Fl. Kumaon 171 (1927).

Stizolobium imbricatum (DC.) O. Kuntze, Rev. Gen. Pl. 1: 208 (1891).

M. hainanensis Hayata, Icon. Pl. Formos. 3: 72 (1913)–Matsumura, Shokubutsu-me-i, ed. rev. & enl., pt. 2, 257 (1916)–Makino & Nemoto, Fl. Jap. 743 (1925); ed. 2, 588 (1931)–Merrill in Lignan Sci. J. 5: 97 (1927)–Chun & Chang, Fl. Hainan 2: 314 (1965)–Thuân in Fl. Cambodge Laos Viêt-Nam 28: 39 (1979), syn. nov.

M. suberosa Gagnepain in Lecomte, Not. Syst. 3: 27 (1914); in Fl. Indo-Chine 2: 319 (1916), syn. nov.

M. imbricata var. *bispicata* Gagnepain in Fl. Indo-Chine 2: 320 (1916).

Distribution. E. Himalaya (Nepal, Sikkim, Bhutan), India, Burma, Thailand, Indo-China, China (Hainan), and Malaysia. Fig. 6.

4) ***Mucuna sempervirens*** Hemsley in J. Linn. Soc. Bot. 23: 190 (1887); in Curtis Bot. Mag. t. 7978 (1904)–Craib in Sargent, Pl. Wilson. 2: 117 (1916)–Koidzumi in Act. Phytotax. Geobot. 1: 164 & 180–2 (1932)–Makino, Ill. Fl. Jap. Suppl. 1174 (1955); New Ill. Fl. Jap. 323 (1961)–Ohwi in J. Jap. Bot. 38: 127 (1963); Fl. Jap. Engl. ed. 569 (1965); Fl. Jap. rev. ed. 806, pl. 18 (1965)–Murakami & Hamada in J. Jap. Bot. 42: 327 (1967)–Kitamura & Murata, Col. Ill. Woody Pl. Jap. 1: 350, pl. 70, fig. 225 (1971)–Hatusima, Woody Pl. Jap. 560 (1976). Fig. 7.

M. japonica Nakai in Bot. Mag. Tokyo 46: 57 & 631 (1932); in Icon. Pl. Asiae Orient. 1(2): 39, f. 17 (1936).

A large woody climber; branchlets with sparsely appressed yellowish hairs in young. Stipules caducous. Leaves estipellate, long-petiolate. Leaflets coriaceous, sparsely white appressed hairy on both surfaces in young, afterwards glabrous, lustrous above, with prominent reticulate veinlets on both surfaces; petiole long,

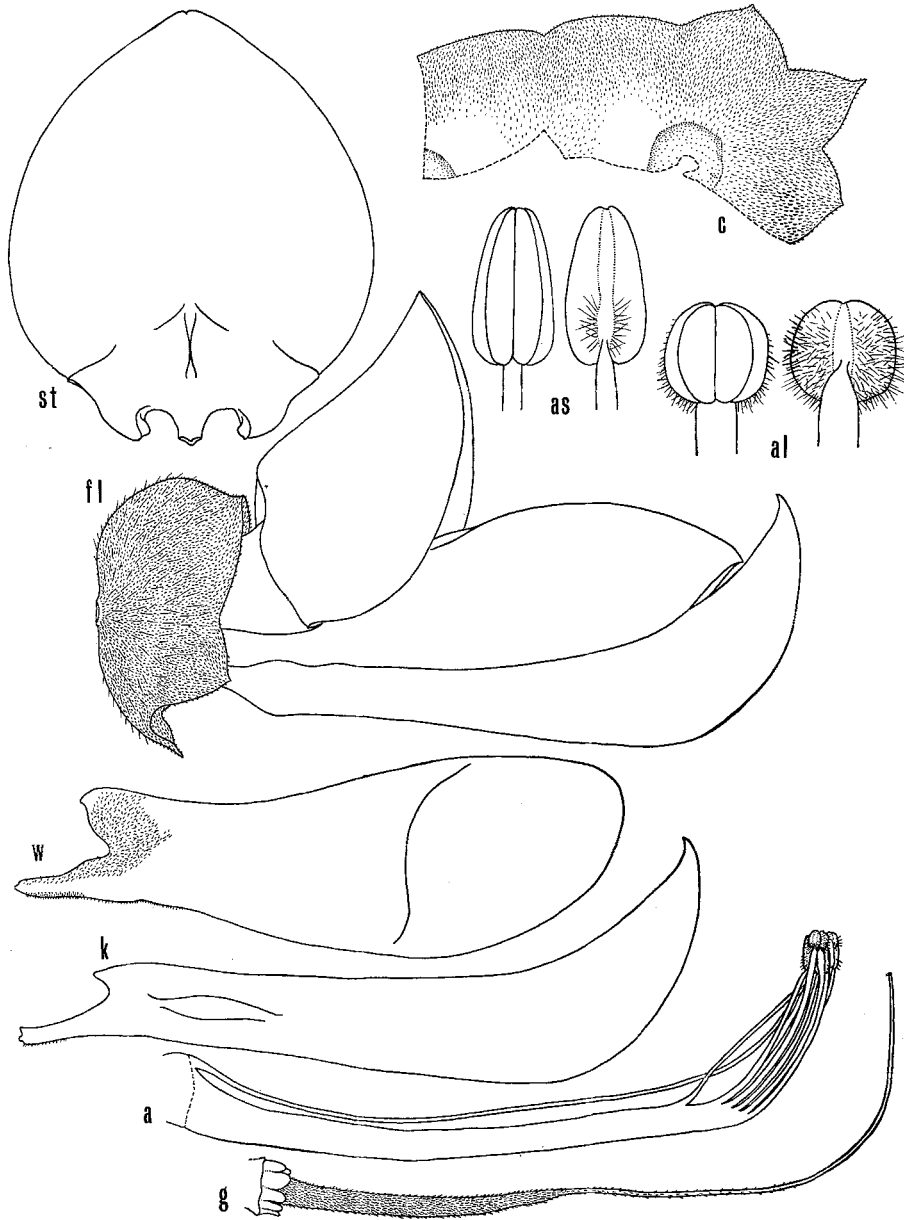


Fig. 7. *Mucuna sempervirens*. fl: Flower, $\times 1.2$. st: Standard, $\times 1.2$. w: Wing, $\times 1.2$. k: Keel-petal, $\times 1.2$. a: Stamens, $\times 1.2$. g: Pistil with disk around base, $\times 1.2$. al: Upper portion of longer stamens, $\times 6$. as: Upper portion of shorter stamens, $\times 6$. c: Calyx dissected, $\times 1.2$. All from Japan, G. Koidzumi, 16 May 1932 (τ).

glabrous; petiolule glabrescent; terminal leaflets oblong, 7–15 cm long, 4–8 cm wide, acuminate at apex, obtuse to rounded at base, with 6–7 pairs of lateral veins; lateral leaflets oblique.

Inflorescences axillary, on nodes of old branch or main stem, paniculate but look like raceme through abbreviation of lateral branches, pendulous, pedunculate, 3–20-flowered; peduncle 3–6.5 cm long, densely long appressed dark brown hairy and with sparsely long brown stinging hairs; lateral branches reduced to tuber-like organs, (1–) 3-flowered, fasciculate. Bracts caducous. Pedicels 10–12 mm long, densely appressed brown hairy and with sparsely long stinging brown hairs.

Flowers dark purple, 7–8.5 cm long. Calyx campanulate, brown velvety on both sides and with long stinging brown hairs (0.5–1 mm long) outside, 4-lobed; upper lobe retuse at apex, subcucullate, 1–2 mm long, lower one about 7 mm long, shorter than tube.

Standard glabrous, ovate, contracted near center, $2/3$ – $3/4$ of wings and $2/3$ of keel-petals in length, 4.5–5 cm long including short claw about 4 mm long, obtuse at apex, 2-auriculate at base. Wings shorter than keel-petals, 6.5–7 mm long including claw about 11 mm long, rounded at apex, auriculate at base of lamina, cymbiformis in upper portion of lamina, densely short brown hairy on auricle outside and near margin of claw on both sides. Keel-petals subfalcate, incurved, beaked, coriaceous at apex, clawed, about 7 cm long including claw about 11 mm long, slightly appressed hairy on claw inside.

Stamens diadelphous, filaments and anthers 2-formed; orbicular anthers about 2 mm long, dorsifixed to thicker and longer filaments, densely clothed with long hairs on dorsal side of loculus; narrowly ovate anthers about 3.5 mm long, dorsifixed but attached near the base to thinner and shorter filaments, sparsely clothed with long hairs on dorsal side of loculus near connectives. Ovary about 3 cm long, densely long brown hairy; stigma capitate, glabrous.

Pods compressed, linear, 40–60 cm long, 3.5–4 cm wide, woody, slightly thickened along both sutures, 7–10-seeded, distinctly constricted between seeds, ferruginous-tomentose.

Seeds reniform, compressed, grayish brown, about 3 cm in longer dimension and about 2.5 cm in shorter dimension; hylum extending around the seed-margin for three-quarters of the circumference, about 3 mm wide.

Distribution. Japan (Kyushu, probably introduced) and Southern and South-western China.

Specimens examined (except Chinese ones). Japan. Kyushu: Prov. Higo, Aira (H. Kodzuma, May 1932 τ —Lectotype of *M. japonica* Nakai); (K. Nakahara s.n. τ —Syntype of *M. japonica* Nakai); (T. Ikeda 290, May 1929 τ); (G. Koidzumi, 16 May 1932 τ); (S. Senda, 27 Jan. 1934 τ ; Feb. 1934 τ ; 18 May 1934 τ); (H. Matsumura, 5 May 1938 τ ; 1944 τ), (F. Maekawa, 88-CO4, 30 Aug. 1938 τ); (T. Nakai, 25 Dec. 1939 τ); (A. Senda, May 1942 τ).

Our thanks are due to the curators of the following herbaria for the privilege of examining specimens in their charge: Botanical Gardens, Koishikawa, Faculty of Science, University of Tokyo (cited as τ); Department of Botany, Faculty of Science,

Kyoto University (KYO); and The National Science Museum, Tokyo (TNS). The present study was supported in part by Grants-in-Aid for Co-operative Research (No. 434036 in 1979 and 1980) from the Ministry of Education, Science and Culture of Japan.

References

- HATUSIMA, S. 1971. *Mucuna*. In: Flora of the Ryukyus p. 320-321 (in Japanese). Okinawa Seibutsu-kyoiku Kenkyukai, Naha.
- . 1975. *Mucuna*. In: Flora of the Ryukyus, add. & corr. ed., p. 320-321, 882 (in Japanese). Okinawa Seibutsu-kyoiku Kenkyukai, Naha.
- . 1976. *Mucuna*. In: Woody Plants of Japan p. 559-560 (in Japanese). Kodansha, Tokyo.
- HUANG, T.C. AND H. OHASHI. 1977. *Mucuna*. In: Flora of Taiwan 3: 342-343. Epoch publishing Co., Taipei.
- KOIDZUMI, G. 1932. Contributiones ad cognitionem florae Asiae orientalis. Act. Phytotax. Geobot. 1: 164.
- MATSUMURA, J. 1899. *Mucuna*. In: T. Ito and J. Matsumura, Tentamen Florae Lutchuensis. J. Coll. Sci. Univ. Tokyo 12: 420-423.
- OHASHI, H. AND Y. TATEISHI. 1976. *Mucuna macrocarpa* and *M. gigantea* (Leguminosae) in Japan and Formosa. J. Jap. Bot. 51: 161-168.
- OHWI, J. 1963. The fruits of Japanese *Mucuna*. J. Jap. Bot. 38: 127 (in Japanese).
- . 1965a. *Mucuna*. In: Flora of Japan, Engl. ed., p. 569-570. Smithsonian Inst., Washington.
- . 1965b. *Mucuna*. In: Flora of Japan, rev. ed. p. 806-807, 1439 (in Japanese). Shibundo, Tokyo.
- WALKER, E.H. 1976. *Mucuna*. In: Flora of Okinawa and the Southern Ryukyu Islands p. 585-587. Smithsonian Inst. Press, Washington.

Received October 22, 1980