

Identification of Japanese *Lecanorchis* (Orchidaceae) Species in Fruiting Stage

Hirokazu Fukunaga¹, Yutaka Sawa² & Shinichiro Sawa³

¹ Tokushima-cho, Tokushima city, Tokushima, Japan

² Sawa Orchid Laboratory, Ikku, Kochi city, Kochi, Japan

³ Kumamoto University, Graduate school of Science and Technology, Kumamoto, Japan

Correspondence: Shinichiro Sawa, Kumamoto University, Graduate school of Science and Technology, Department of Sciences, 2-39-1 Kurokami, Kumamoto 860-8555, Japan. Tel: 81-96-342-3439. E-mail: sawa@sci.kumamoto-u.ac.jp

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Abstract

Plants of *Lecanorchis* species are heteromycotrophic and they lack green leaves. Although flowering time is short, plants with fruits can be easily found in the forests. Here we discuss the features of nine taxa namely *L. triloba*, *L. trachycaula*, *L. nigricans*, *L. amethystea*, *L. kiusiana*, *L. suginoana*, *L. japonica*, *L. hokurikuensis*, and *L. flavicans* var. *acutiloba*. From the detailed phenotypes of aerial parts of fruiting plants, we propose a method to identify the Japanese *Lecanorchis* species.

Keywords: *Lecanorchis*, Japanese orchids, Orchidaceae, diagnosis method, fruiting plants

1. Introduction

Lecanorchis Blume (Orchidaceae) comprises a group of mycoparasitic plants with numerous clustered, tuberous roots and an erect, branched or unbranched stem (Blume, 1856). The genus comprises about thirty taxadistributed across a large area between Southeast Asia, Taiwan, New Guinea, and Japan (Garay & Sweet, 1974; Seidenfaden, 1978; Lin, 1987; Hashimoto, 1990; Pearce & Cribb, 1999; Szlachetko & Mytnik, 2000; Averyanov, 2005; Sing-chi, Cribb, & Gale, 2009; Suddee & Pedersen, 2011; Tsukaya & Okada, 2013). In Japan, ten species and/or varieties are reported (Honda, 1931; Tuyama, 1955; Masamune, 1963; Ohwi, 1965; Satomi, 1982; Tuyama, 1982; Hashimoto, 1990; Serizawa, 2005; S. Sawa, Fukunaga, & Y. Sawa, 2006; Fukunaga, S. Sawa, & Y. Sawa, 2008; BG Plants, 2013). Most of Orchidaceae members that lack green leaves produce stem, flowers and seeds, and they wither and die in a short time. However, *Lecanorchis* species maintain withered plants at upper ground for a longer period, and the fruiting plants can be easily found in the forests. So, a diagnostic method using fruitingspecimens is needed to identify the species of *Lecanorchis*.

Here we have provided a simple method to identify eight *Lecanorchis* species namely *L. triloba*, *L. trachycaula*, *L. nigricans*, *L. amethystea*, *L. kiusiana*, *L. suginoana*, *L. japonica*, and *L. hokurikuensis*, and one variety, *L. flavicans* var. *acutiloba*. Other Japanese *Lecanorchis* taxa namely *L. flavicans* Fukuy., *L. virella* T. Hashim., *L. japonica* var. *tubufolmis* T. Hashim., *L. nigricans* var. *patipetala* Y. Sawa and *L. nigricans* var. *yakushimensis* T. Hashim. are uncommon and excluded from this diagnosis.

2. Materials and Methods

Field surveys were conducted in Kochi, Tokushima, Ehime, Kagawa, Osaka, Wakayama, Hyogo, Kyoto, Shimane, Shizuoka, Aichi, Gifu, Fukui, Ishikawa, Toyama, Fukuoka, Kagoshima, Miyazaki, and Okinawa prefectures. Herbarium specimens were deposited at MBK, OSA, KANA, TUAT, and mainly at TI herbaria.

Capsule angle was measured between stem and peduncle. Specimens of opened capsules were reconstituted by treating with hot water for a few second.

Obtuse excrescence produced on capsules and upper part of infructescence is sometimes used as a taxonomic character (Masamune, 1963; Satomi, 1982) (Figure 1A). However, in some cases the phenotype was not observed. Further, the phenotype is induced by sapping by Flatidae (Figure 1B), aphid (Figure 1C), or scale insect (Sawa, 1980), and in some cases, this obtuse excrescence was not considered as a taxonomic character

(Serizawa, 2005). In this article, we exclude this phenotype as a character for classification.



Figure 1. Obtuse excrescence and insects. A: Obtuse excrescence produced in *L. hokurikuensis*. B: Flatidae on the peduncle of *L. hokurikuensis*. C: Aphid on the peduncle of *L. hokurikuensis*. Scale bar: 1 cm

3. Results and Discussion

Stem length, stem width, length of infructescence (stem with fruits), peduncle length, bract length, calyculus length, capsule number, color of capsule and stem, protuberance on capsule and stem, capsule angle, capsule shape, and branching pattern were examined by using eight *Lecanorchis* species, *L. triloba*, *L. nigricans*, *L. amethystea*, *L. kiusiana*, *L. suginoana*, *L. japonica*, and *L. hokurikuensis*, and one variety, *L. flavicans* var. *acutiloba* (Table 1).

Table 1. Japanese *Lecanorchis* characters

	<i>L. triloba</i>	<i>L. trachycaula</i>	<i>L. nigricans</i>	<i>L. amethystea</i>	<i>L. flavicans</i> var. <i>acutiloba</i>	<i>L. kiusiana</i>	<i>L. suginoana</i>	<i>L. japonica</i>	<i>L. hokurikuensis</i>
stem length (average) (cm)	14.5-42.0 (34.6)	23.5-41.7 (32.1)	11.4-27.7 (19.1)	22.2-42.7 (33.6)	14.0-35.1 (23.3)	3.9-25.4 (17.3)	12.0-29.8 (20.5)	21.2-45.2 (30.9)	17.6-50.4 (30.5)
	n=8	n=8	n=38	n=12	n=13	n=246	n=38	n=18	n=59
stem diameter (mm)	0.8-2.2	0.5-3.5	1.0-2.2	1.4-2.5	0.5-1.3	0.5-2.2	1.7-3.5	1.0-2.6	1.3-3.6
	n=8	n=8	n=38	n=12	n=13	n=246	n=38	n=18	n=59
inflorescence length (average) (cm)	1.9-5.8 (4.0)	2.8-15.0 (6.1)	1.7-16 (5.2)	8.5-17.0 (13.1)	1.0-6.0 (3.2)	1.5-10 (4.6)	3.5-8.0 (5.6)	2.0-14.0 (7.1)	3.0-8.5 (5.7)
	n=8	n=17	n=27	n=9	n=11	n=17	n=5	n=11	n=8
capsule length (average) (cm)	1.3-1.7(1.4)	2.4-3.2(2.7)	2.1-3.6 (2.6)	1.9-3.3 (2.6)	2.3-2.7 (2.5)	1.9-3.0 (2.4)	2.0-3.0 (2.7)	3.1-4.4 (3.7)	3.1-4.8 (3.8)
	n=24	n=5	n=66	n=51	n=6	n=381	n=72	n=15	n=111
peduncle length (mm)	0.5-1.5	0.5-2.5	1.5-2.5	1.5-2.0	1-1.5	0.5-5.5	2.0-3.5	1.0-7.0	2.0-7.5
	n=24	n=5	n=15	n=51	n=3	n=156	n=72	n=15	n=81
bract length (mm)	1.5-2.2	1.4-2.5	1.3-3.0	1.8-2.5	1.2-2.2	1.7-5.2	2.2-4.2	2.2-6.0	3.0-5.5
	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6
calyculus length (mm)	0.4-1.3	0.5-1.4	0.5-1.5	0.3-1.0	0.3-1.0	0.5-1.2	0.5-1.0	0.5-2.2	0.7-1.5
	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6
capsule number (average)	3-14 (6.7)	1-11 (5.3)	2-11 (5.7)	3-15 (6.4)	1-7 (3.9)	1-7 (3.6)	3-6 (4.7)	4-10 (6.2)	2-10 (5)
	n=11	n=10	n=42	n=11	n=13	n=248	n=36	n=18	n=60
capsule angle to stem	10-45°	20-70°	0-75°	5-60°	5-70°	0-20°	0-30°	0-35°	5-90°
	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6	n=6



Figure 2. Fruiting plants of *Lecanorchis* spp. A: *L. triloba*, B: *L. trachycaula*, C: *L. nigricans*, D: *L. amethystea*, E: *L. flavicans* var. *acutiloba*, F: *L. kiusiana*, G: *L. suginoana*, H: *L. japonica*, I: *L. hokurikuensis*. Scale bar: 3 cm

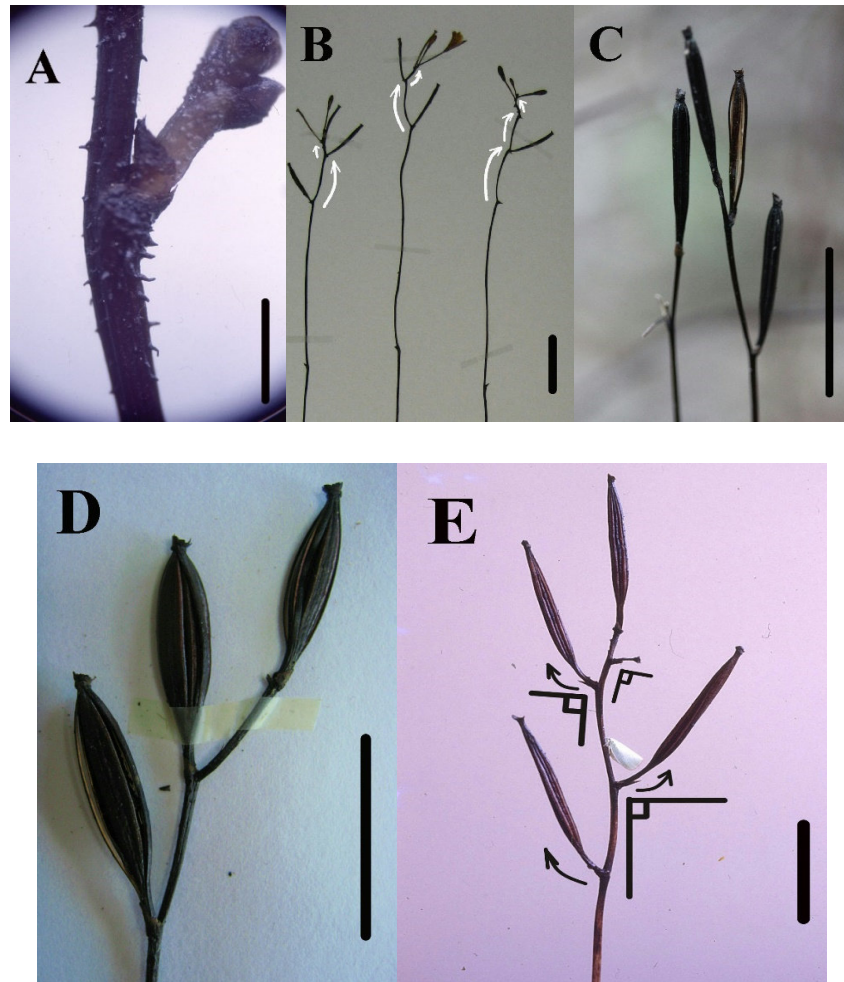


Figure 3. Characteristic phenotypes of *Lecanorchis*. A: Pointed, short prickles of *L. trachycaula*. B: Curved stem of *L. flavicans* var. *acutiloba*. C: Thin cylindrical to fusiform capsule of *L. kiusiana*. D: Roundish fusiform capsule of *L. suginoana*. E: Curved peduncle with a bract in 45-90° of *L. hokurikuensis*. Scale bar: 5 mm (A) 3 cm (B-E)

3.1 *Lecanorchistriloba* J. J. Sm.

Lecanorchistriloba J. J. Sm. in Bull. Dep. Agric. Indes Neerl. 19: 26. 1908; Hashimoto in Ann. Tsukuba Bot. Gard. (9): 35. 1990; T. C. Hsu & S. W. Chung in Taiwania 54: 83. 2009; *L. brachycarpa* Ohwi, in Acta Phytotax. Geobot. 7: 35. 1938; Tuyama in J. Jap. Bot. 30: 184. ff. 3 c&d. 1955; Garay & Sweet, Orchids of southern Ryukyu Islands 52. f.3-k. 1974; *L. multiflora* var. *brachycarpa* (Ohwi) T. Hashim., Hashimoto in Ann. Tsukuba Bot. Gard. (8): 6. 1989. (Figure 2A).

Characteristic features: Short infructescence, short peduncles, and small capsules.

Stems 14.5-42 cm long, 0.8-2.2 mm in diameter, solitary, rarely branched, black to brownish black. Scale leaves 3-4 mm long, acute triangle. Infructescence (stem with fruits) 1.9-5.8 cm long, with 3-14 fruits. Bract 1.5-2.2 mm long, acute, round to triangle. Capsule 1.3-1.7 cm long, fusiform, 10-45° in capsule angle, densely produced at the top. Peduncle 0.5-1.5 mm long, Calyculus 0.4-1.3 mm long, irregularly denticulate. Fruits black to brownish black.

Specimen Examined:

Y. Taira 158, Jan. 22, 1938, Type of *L. brachycarpa* Ohwi (KYO); *Y. Kimura* s. n., Oct. 13, 1940 (TI); *H. Ito* s. n., Oct. 21, 1936 (TI); *T. Hashimoto* s. n., Feb. 19, 1990 (TNS-9504619); *Y. Hanei* s. n., May 29, 1989 (TNS-9504456); *Y. Hanei* s. n., Oct. 11, 1990 (TNS-9504683); *T. Hashimoto* s. n., Feb. 20, 1990 (TNS-9504620); *T. Hashimoto*, Feb. 20, 1990 (TNS-9504621); *T. Amano* 7735, Nov. 27, 1957 (TNS-139953); *M. Tawada* s. n.,

Dec. 28, 1941 (TNS-226051).

3.2 *Lecanorchis trachycaula* Ohwi

Lecanorchis trachycaula Ohwi, in Fl. Jap., ed. Rev. 1438. 1965; Hatus., Fl. Ryukyus 808. 1971; Satomi in Satake et al., Wild Fl. Jap. Herb. 1: 206. 1982; Hashimoto in Ann. Tsukuba Bot. Gard. 9: 19. 1990. (Figures 2B & 3A).

Characteristic features: Pointed, short prickle-like protuberances were found on stem and capsules, and the protuberances were obvious in later capsule stages (Figure 3A). Furthermore, non-glossy black capsules were produced laterally except for the uppermost and the lowermost capsules, and the stems were frequently branched.

Stems 23.5-41.7 cm long, 0.5-3.5 mm in diameter, 2-4 order branched, non-glossy black to purplish black, occasionally with pointed protuberances. Scale sheath 3-5 mm long. Infructescence 2.8-15 cm long, with 1-11 fruits. Bract 1.4-2.5 mm long, round to triangle. Capsule 2.4 cm-3.2 cm long, fusiform, 20-70° in capsule angle except for the uppermost and the lowermost capsules, with occasional protuberances. Peduncle 0.5-2.5 mm long, Calyculus 0.5-1.4 mm long, irregularly denticulate. Fruits non-glossy black.

Specimen Examined:

C. Abe 49821, Jun. 11, 1974 (TKPM-214352); *S. Takafuzi s. n.*, Oct. 27, 1963 (KANA); *T. Hashimoto s. n.*, Feb. 24, 1990 (TNS-940462); *J. Nakayama s. n.*, Aug. 10, 1936 (TUS); *F. Maekawa s. n.*, Jun. 16, 1976 (TUAT-87954); *S. Sugaya s. n.*, Aug. 14, 1958 (TUS-26508); *S. Sugaya s. n.*, Aug. 15, 1958 (TUS-26509); *N. Satomi s. n.*, Jul. 20, 1962 (KANA-158148).

3.3 *Lecanorchis nigricans* Honda

Lecanorchis nigricans Honda, in Bot. Mag. Tokyo 45: 470. 1931; Tuyama, in J. Jpn. Bot. 30: 184. ff. 3A&B. 1955; Ohwi, Fl. Jap., Engl. Ed. 336. 1955; Kitamura et al., in Col. Ill. Herb. Pl. Jap. 3: 28. 1969; F. Maekawa, in Wild Orch. Jap. Col. 239. 1971; Satomi, in Satake et al., in Wild Fl. Jap. Herb. 1: 206. 1982; Hashimoto, in Ann. Tsukuba Bot. Gard. (9): 27. 1990; Serizawa, Bunrui 5: 34. 2005. (Figure 2C).

Characteristic features: Non-glossy black capsules were produced sideway except for top and bottom capsules. Protuberances were not produced compared with *Lecanorchistrachycaula* Ohwi.

Stems 11.4-27.7 cm long, 1.0-2.2 mm in diameter, non-glossy black, smooth surface, solitary, occasionally branched basally. Scale sheath 3mm long. Infructescence 1.7-16 cm long, with 2-11 fruits. Bract 1.3-3 mm long, acute triangle. Capsule 2.1 cm-3.6 cm long, thin fusiform, smooth surfaced, 0-75° in capsule angle except for the uppermost and the lowermost capsule. Peduncle 1.5-2.5 mm long, Calyculus 0.5-1.5 mm long, irregularly denticulate. Fruits non-glossy black.

Specimen Examined:

Type-*K. Kashiyama s. n.*, 1931 (TI); *T. Hashimoto s. n.*, Mar. 18, 1990 (TNS-9504625); *E. Yamahata s. n.*, Jan. 6, 1976, det. by *Y. Sawa* (OSA), *Y. Hanei s. n.*, Aug. 12, 1989 (TNS-9504539); *Y. Kurosawa s. n.*, Aug. 8, 1978 (TUAT); *K. Gunzi s. n.*, Oct. 13, 1963 (IBAR); *T. Hino s. n.*, Oct. 16, 1928 det. by G. Murata (KYO), (OSA-19436), (KPM-NA-102387), (KPM-NA-162332), (KPM-NA-105066), (KPM-NA-73112), (KPM-NA-72853); *Y. Sawa* 2277, 16 Mar. 1999, (TI); *I. Yamashita s. n.*, Oct. 16, 1965 (KANA-158148), *T. Ogawa* 26679 (KANA); *Y. Sawa* 2725, Aug. 18, 1998. (TI); *Y. Sawa* 2726, Aug. 18, 1998 (TI).

3.4 *Lecanorchis amethystea* Y. Sawa, Fukunaga & S. Sawa

Lecanorchis amethystea Y. Sawa, Fukunaga & S. Sawa, in Acta Phytotax. Geobot. 57: 123. 2006; Hsu, T.-C. & S.-W. Chung, in Taiwaniana 55: 366. 2010. (Figure 2D).

Characteristic features: Brown stems and capsules. Infructescences and stems were longer than that of *Lecanorchisnigricans* Honda (Sawa et al., 2006).

Stems 22.2-42.7 cm long, 1.4-2.5 mm in diameter, rarely branched basally, dark brown. Scale sheath 3-5 mm long, acute. Infructescence 8.5-17 cm long, with 3-15 fruits. Bract 1.8-2.5 mm long, acute triangle. Capsule 1.9 cm-3.3 cm long, fusiform, smooth surface, 5-60° in capsule angle. Peduncle 1.5-2.0 mm long, Calyculus 0.3-1.0 mm long, irregular denticulate. Fruits dark brown.

Specimen Examined:

Type-*Y. Sawa* 1702, July 26, 1987 (TI); *H. Fukunaga & Y. Sawa* 2, Aug. 29, 2000 (MBK); *H. Fukunaga & Y. Sawa* 4, Aug. 29, 2000 (MBK); *H. Fukunaga & Y. Sawa* 7, Aug. 29, 2000 (MBK); *Y. Sawa* 1864, Oct. 27, 1987

(MBK); *Y. Sawa* 1869, Oct. 27, 1987 (MBK); *Y. Sawa* 1863, Oct. 27, 1987 (MBK).

3.5 *Lecanorchis flavicans* Fukuy. var. *acutiloba* T. Hashim.

Lecanorchis flavicans Fukuy. var. *acutiloba* T. Hashim., in Ann. Tsukuba Bot. Gard.(8): 8. 1989; Hashimoto, in Ann. Tsukuba Bot. Gard. (9): 25. 1990. (Figure 2E).

Characteristic features: Thin stems, short capsules and peduncles. Inflorescence produced in zigzag with strong phototropism (Figure 3B).

Stems 14-35.1cm long, 0.5-1.3 mm in diameter, solitary, rarely branched basally, growth in a zigzag way, black to brownish black. Inflorescence 1-6 cm long, with 1-7 fruits. Bract 1.2-2.2 mm long. Capsule 2.3-2.7cm long, thin fusiform, smooth surface, 5-70° in capsule angle. Peduncle 1-1.5 mm long, Calyculus 0.3-1 mm long, irregular denticulate. Fruits brownish black.

Specimen Examined:

Y. Hanei s. n., July 26, 1991 (TNS-9507125); *Y. Hanei s. n.*, July 26, 1991 (TNS-9507126); *Y. Miyagi* 5623, Jun. 25, 1966 (RYU-29181); *Y. Miyagi* 3394, Jun. 25, 1967 (RYU-18494); *G. Murata et al.* 865, det. by *Y. Sawa* (KYO), *Y. Niino s. n.* (RYU-6422), *Y. Sawa s. n.* (TI).

3.6 *Lecanorchis kiusiana* Tuyama

Lecanorchis kiusiana Tuyama, in J. Jpn. Bot. 30: 182. 1955; Ohwi, in Fl. Jap., ed. Rev. 335. 1965; Chuma, in J. Jap. Bot. 55: 306. 1980; Satomi, in Satake et al., Wild Fl. Jap. Herb. 1: 205. 1982; Hashimoto, in Ann. Tsukuba Bot. Gard. (9): 13.1990; Serizawa, Bunrui 5: 37. 2005. (Figure 2F).

Characteristic features: This is the smallest *Lecanorchis* species in Japan. Further, it produces narrowly tubular to fusiform capsules produced upward almost in parallel with the slender shoots (Figure 3C).

Stems 3.9-25.4 cm long, 0.5-2.2 mm in diameter, solitary, moderate gloss black to purplish black. Scale sheath 5-20 mm long, egg shaped at the base, acute at the top, smooth surface. Inflorescence 1.5-10 cm long, with 1-7 fruits. Bract 1.7-5.2 mm long, triangle. Capsule 1.9-3.0 cm long, thin cylindrical to fusiform, smooth, parallel to stem, 0-20° in capsule angle. Peduncle 0.5-5.5 mm long, Calyculus 0.5-1.2 mm long, irregular denticulate. Fruits moderate gloss black to purplish black.

Specimen Examined:

N. Satomi 1010, Oct. 4, 1951 det. by *Y. Sawa* (KANA-148801); *T. Kobayashi* 11259, July 27, 1988 det. by *Y. Sawa* (KYO); *N. Satomi* 22755, Mar. 29, 1964 det. by *Y. Sawa* (KANA148804); *N. Satomi* 16782, Mar. 28, 1961 det. by *Y. Sawa* (KANA148800); *K. Inami s. n.*, Jun. 17, 1975, det. by *Y. Sawa* & *G. Murata* (KYO); *H. Ono s.n.*, Nov. 17, 1968, det. by *Y. Sawa* (KAG); *G. Ikeda s.n.*, Jul. 30, 1965, det. by *Y. Sawa* (KAG); *I. Yamashita* 3, Jun. 1979 (TUAT-87990), *Y. Sawa* 891 (OSA-47829, 167462); *Y. Sawa* & *H. Fukunaga* 2572, Feb. 4 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2722, Mar. 16, 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2721, Mar. 16 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2729, Mar. 16 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2730, Mar. 16 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2732, Mar. 16 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2724, Mar. 16 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2731, Mar. 16 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2747, Mar. 17 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2748, Mar. 17 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2749, Mar. 17 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2279, Jan. 23 1999 (TI); *Y. Sawa* & *H. Fukunaga* 2719, Aug. 6 1998 (TI); *N. Satomi* 22755 Mar. 29, 1964 (KANA-148804); *N. Satomi* 25033, Apr. 2, 1965 (KANA-147795); *E. Ikeda* 21674, Jun. 2, 1963 (KANA-134468); *N. Satomi* 16782, Mar. 28, 1961 (KANA-148800); *N. Satomi* 26845, Jul. 16, 1973 (KANA-148805); *N. Satomi* 148801, Oct. 4, 1951 (KANA-148801).

3.7 *Lecanorchis suginoana* (Tuyama) Seriz

Lecanorchis suginoana (Tuyama) Seriz, in Bunrui 5: 38. 2005; *L. japonica* var. *sugioana* Tuyama, in J. Jpn. Bot. 57: 211. 1982; *L. kiusiana* Tuyama var. *sugioana* Hashim, In Ann. Tsukuba Bot. Gard. (9): 18. 1990. (Figure 2G).

Characteristic features: Small plants with non-glossy brown to black, and round capsules (Figure 3D). Lower part of the shoot is thicker than that of *L. kiusiana*.

Stems 12-29.8 cm long, 1.7-3.5 mm in diameter, solitary, smooth surface, brown to black. Scale sheath 5-10 mm long. Inflorescence 3.5-8 cm long, with 3-6 fruits. Bract 2.2-4.2 mm long, acute triangle. Capsule 2-3 cm long, roundish fusiform, 0-30° in capsule angle. Peduncle 2-3.5 mm long. Calyculus 0.5-1 mm long, irregular denticulate, 0.5-1 mm long. Fruits non-glossy brownish black to black.

Specimen Examined:

M. Wadas s. n. Jul. 5, 1983 (TI); *M. Tanaka* 3856 (OSA); *T. Umehara* 4836 (OSA-91409); *Y. Sawa* 2524, Feb. 20, 1998 (TI); *Y. Sawa* 2524, Feb. 20, 1999 (TI); *Y. Sawa* 2524, Feb. 20, 2526, (TI); *Y. Sawa* 2527, Feb. 20, 1999, (TI); *Y. Sawa* 2533, Feb. 20, 1999 (TI); *Y. Sawa* 2763, Feb. 20, 1999 (TI); *Y. Sawa* 2766, Feb. 20, 1999 (TI); *Y. Sawa* 2538, Feb. 20, 1999 (TI); *Y. Sawa* 1439, May 18, 1987 (TI); *Y. Sawa* 1584, Jun. 12, 1987 (TI); *Y. Sawa* 872, May 23, 1987 (TI); *Y. Sawa* 875, May 18, 1987 (TI); *Y. Sawa* 871, May 18, 1987 (TI); *Y. Sawa* 945, Apr. 5, 1984 (TI); *Y. Sawa* 948, Apr. 5, 1984 (TI); *Y. Sawa* 949, Apr. 5, 1984 (TI); *Y. Sawa* 882, Jun. 15, 1984 (TI).

3.8 *Lecanorchis japonica* Blume

Lecanorchis japonica Blume, in Mus. Bot. Ludg. Bat. 2: 188. 1856; Kitamura et al., in Col. Ill. Herb. Pl. Jap. 3: 28. 1969; F. Maekawa, in Wild Orch. Jap. Col. 236. 1971; Satomi in Satake et al., in Wild Fl. Jap. Herb. 1: 206. 1982; Hashimoto, in Ann. Tsukuba Bot. Gard. (9): 3. 1990; Serizawa Bunrui 5: 35. 2005. (Figure 2H).

Characteristic features: This is the largest *Lecanorchis* species in Japan. Further it produces capsules slant upward with straight peduncle and capsules.

Stems 21.2-45.2 cm long, 1-2.6 mm in diameter, solitary, black to brownish black. Scale Sheath 6-12 mm long. Inflorescence 2-14 cm long, with 4-10 fruits. Bract 2.2-6 mm long, acute triangle. Capsule 3.1-4.4 cm long, fusiform, 0-35° in capsule angle. Peduncle 1-7 mm long, straight, Calyculus 0.5-2.2 mm long, irregular denticulate. Fruits black to brownish black.

Specimen Examined:

K. Kawanabe 4705, Dec. 7, 1958 det. By *Hatushima* (KAG); *Y. Sawa* 1383, Dec. 26, 1986 (TUAT); *S. Hatusima* 20766, May 14, 1957 (KAG); *Y. Kashiyama* s. n. Jan. 29, 1933 (KYO); *K. Seto* s. n., Jun. 28, 1962 (OSA); *Y. Sawa & H. Fukunaga* 2718, Jan. 12, 1999 (TI); *N. Satomi* 25091, Apr. 25, 1965 (KANA-158145); *N. Satomi* 15232, Aug. 2, 1960 (KANA-158144); *S. Kato* s. n., Sep. 5, 1976 (KANA-145571); *K. Aoki* s. n., Jul. 1, 1970, (KANA-145570); *N. Satomi* 7269, Dec. 31, 1955 (KANA-148807); *T. Omura* s. n., (KANA-147707).

3.9 *Lecanorchis hokurikuensis* Masam.

Lecanorchis hokurikuensis Masam., in J. Geobot. 12: 69. 1963; Satomi in Satake et al., Wild Fl. Jap. Herb. 1: 205. 1982; Bunrui 5: 36. 2005; *L. japonica* Blume var. *hokurikuensis* (Masam.); Hashimoto, in Ann. Tsukuba Bot. Gard. (9): 7. 1990. (Figure 2I).

Characteristic features: The capsule angle (45-90°) to the shoot (Figure 3E), and peduncle is curved to upward (Figure 3E).

Stems 17.6-50.4 cm long, 1.3-3.6 mm in diameter, solitary, light brown to black. Scale Sheath 5-12 mm. Inflorescence 3-8.5 cm long, with 2-10 fruits. Bract 3-5.5 mm long, acute triangle. 45-90° in bract angle. Capsule 3.1-4.8 cm long, fusiform, 5-90° in capsule angle. Peduncle 2-7.5 mm long, upward. Calyculus 0.7-1.5 mm long, irregular denticulate. Fruits brown to brownish black.

Specimen Examined:

I. Yamashita s. n., Jun. 16, 1981, det. by *Y. Sawa*, (TUAT-85827); *Suzuki, Nakamura, Moriguchi & Tasaki* s. n., Oct. 15, 1975, det. by *Y. Sawa* (IBAR); *N. Satomi* 27163, Nov. 19, 1972 (KANA-103715); *A. Kimura* s. n., Oct. 3, 1931, det. by *Y. Sawa* (TUS-26500); *F. Maekawa* s. n., Jan. 1972, det. by *Y. Sawa* (TUAT-87864); *F. Maekawa* s. n., Mar. 4, 1972, det. by *Y. Sawa* (TUAT-87863); *S. Tamaki* s. n., Oct. 1970, det. by *Y. Sawa* (RYU-6832); *Y. Miyagi* 1763, Aug. 1972, det. by *Y. Sawa* (RYU-9966); *N. Satomi* s. n., Oct. 22, 1980 (KANA-94944); *N. Satomi* 27088, Oct. 22, 1978, (KANA-92137); *N. Satomi* 27028, Jul. 10, 1977 (KANA-146686); *N. Satomi* 27030, Jul. 10, 1977 (KANA-146687); *S. Okuda* s. n., May 31, 1970 (KANA-145579); *G. Masamune* 14169, Oct. 16, 1961 (KANA-44546); *N. Satomi* 15430, Sep. 8, 1960 (KANA-146680); *N. Satomi* 27163, Nov. 19, 1972 (KANA-103715); *N. Satomi* 26774, Nov. 3, 1972 (KANA-146685); *N. Satomi* 26941, Nov. 2, 1975 (KANA-146688); *Y. Shirosaki* 27024, (KANA-147792); *N. Satomi* s. n., Oct. 21, 1980 (KANA-97123); *N. Satomi* s. n., Sep. 20, 1953 (KANA-13921); *N. Satomi* 26942, Oct. 15, 1972 (KANA-146689, 81904); *N. Satomi* 27630, Jul. 22, 1986 (KANA-119847); *Y. Sawa* 2645, Jun. 12, 1998 (TI); *Y. Sawa* 2285, Jun. 12, 1998 (TI); *Y. Sawa* 2286, Jun. 12, 1998 (TI); *Y. Sawa* 2287, Jun. 12, 1998 (TI); *N. Satomi* 15181, Jul. 1, 1960 (KANA-147790); *N. Satomi* 15661, Sep. 23, 1960 (KANA-146681); *N. Satomi* 20144, Jun. 25, 1962 (KANA-146682); *N. Satomi* 15167, Jul. 3, 1960 (KANA-146683); *N. Kurosaki*, 2009, Jul. 2, 1966 (KANA-668290); *M. Ihara* s. n., Jul. 1, 1957 (KANA-146684); *Uzihara* s. n., Sep. 4, 1955 (KANA-27649); *N. Satomi* 26846, Jul. 22, 1973 (KANA-145578); *S. Sugaya* s. n., Jun. 12, 1956 (KANA-145572); *H. Kitami* s. n., Jul. 5, 1968 (KANA-145575); *Y. Ueno* 12856, (KANA-145575).

Key to the species of Japanese *Lecanorchis* (fruiting specimens)

1. Capsules 1.3-1.7 cm long *L. triloba*
1. Capsules 1.9-4.8 cm long 2
2. Stems branched at base 3
2. Stems unbranched 6
3. Capsule formation laterally 4
3. Capsule formation upward 5
4. Stems prickled *L. trachycaula*
4. Stems smooth *L. nigricans*
5. Inflorescence straight, 8.5 -17 cm long *L. amethystea*
5. Inflorescence curved, 1-6 cm long *L. flavicans* var. *actiloba*
6. Capsules 1.9-3.0 cm long 7
6. Capsules 3.1-4.8 cm long 8
7. Capsules narrowly cylindrical to fusiform *L. kiusiana*
7. Capsules roundish fusiform *L. suginoana*
8. Peduncles curved, with a bract in 45-90° *L. hokurikuensis*
8. Peduncles straight, with a bract in -45° *L. japonica*

References

- Averyanov, L. V. (2005). New Orchids from Vietnam. *Rheedea*, 15, 83-101.
- BG Plants. (2013). In *Web BG Plants, Y-list*. Retrieved December 25, 2013, from http://bean.bio.chiba-u.jp/bgplants/ylist_main.html
- Blume, C. L. (1856). *Lecanorchis* Bl. *Mus. Bot. Ludg. Bat.* 2, 188. Brill: Leiden.
- Fukunaga, H., Sawa, S., & Sawa, Y. (2008). A new form of *Lecanorchiskiusiana*. *Orchid Rev.*, 116, 106-108.
- Garay, L. A., & Sweet, H. R. (1974). *Orchids of southern Ryukyu Islands*. Massachusetts, MA: Bot. Mus. Harvard Univ. Cambridge-Mass.
- Hashimoto, T. (1990). A taxonomic review of the Japanese *Lecanorchis* (Orchidaceae). *Ann. Tsukuba Bot. Gard.*, 9, 1-40.
- Honda, M. (1931). Nuntia ad Floram Japoniae XIV. *Bot. Mag. Tokyo*, 45, 469-471, 493-494.
- Lin, T. P. (1987). *Native Orchids of Taiwan* 3 (pp. 1-300). Taipei: Southern Materials Center.
- Masamune, G. (1963). *Lecanorchis hokurikuensis*. *J. Geobot.*, 12, 69.
- Ohwi, J. (1965). *Flora of Japan* (Rev. ed.). Tokyo, Japan: Shibundo.
- Pearce, N., & Cribb, P. (1999). Notes Relating to the Flora of Bhutan: XXXVII. New species and records of Orchidaceae from Bhutan and India (Sikkim). *Edinb. J. Bot.*, 56, 273-284. <http://dx.doi.org/10.1017/S096042860000113X>
- Satomi, N. (1982). Ranka (Orchidaceae). In Y. Satake et al. (Eds.), *Wild flowers of Japan: Herbaceous Plants I* (pp. 187-235, pls. 170-208). Tokyo, Japan: Heibonsya Ltd., Pub.
- Sawa Y. (1980). Reconsideration of obtuse excrescence as a taxonomic character. *Annual meeting of the botanical society of Japan*, 45, 54.
- Sawa, S., Fukunaga, H., & Sawa, Y. (2006). *Lecanorchis amethystea* (Orchidaceae), A new species from Kochi. *Acta Phytotax. Geobot.*, 57, 123-128.
- Seidenfaden, G. (1978). Orchid genera in Thailand VI. Neottioideae Lindl. *Dansk Bot. Arkiv*, 32(2), 1-195.
- Serizawa, S. (2005). The genus *Lecanorchis* (Orchidaceae) in Aichi Prefecture, Central Honshu. *Bunrui*, 5, 33-38.
- Sing-chi, C., Cribb, P. J., & Gale, S. W. (2009). *Lecanorchis*. In Z. Y. Wu, P. H. Raven & D. Y. Hong (Eds.), *Flora of China* (Orchidaceae) (Vol. 25, pp. 171-172). Beijing, China and St. Louis, Missouri: Science Press

and Missouri Botanical Garden Press.

- Suddee, S., & Pedersen, H. Æ. (2011). A new species of *Lecanorchis* (Orchidaceae) from Thailand. *Taiwania*, 56, 37-41.
- Szlachetko, D. L., & Mytnik, J. (2000). *Lecanorchis seidenfadeni* (Orchidaceae, Vanilloideae), a new orchid species from Malaya. *Ann. Bot. Fennici*, 37, 227-230.
- Tsukaya, H., & Okada, H. (2013). A new species of *Lecanorchis* (Orchidaceae, Vanilloideae) from Kalimantan, Borneo. *Systematic Botany*, 38, 69-74. <http://www.bioone.org/doi/full/10.1600/036364413X662079>
- Tuyama, T. (1955). A new saprophytic orchid, *Lecanorchis kiusiana*. *J. Jap. Bot.*, 30, 181-187.
- Tuyama, T. (1982). *Lecanorchis japonica* Bl. var. *suginoana* Tuyama, a new variety, with comments on the other taxa of the genus. *J. Jap. Bot.*, 57, 205-211.

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