Two new species of *Camellia* (Theaceae) from Vietnam

Lieu Thi NGUYEN, Ninh TRAN¹, Uematsu CHIYOMI, Katayama HIRONORI²,
Dung Van LUONG³, Son Thanh HOANG^{4*}, Ky Danh NGUYEN⁵,
Hung Viet NGUYEN⁵ and Toan Canh THAI⁵

Graduate School of Science, Botanical Gardens of Osaka City University, Osaka 558-8585, Japan

¹Faculty of Biology, VNU University of Science, Hanoi 100000, Vietnam

²Food Resources Research and Education Center, Graduate School of Agricultural Science, Kobe University, Kobe 657-8501, Japan

³Department of Biology, Da Lat University, Dalat 670000, Vietnam

⁴Silviculture Research Institute, Hanoi 100000, Vietnam

⁵Vu Quang National Park, Hatinh 480000, Vietnam

(Received 23 January 2018; Revised 11 April 2018; Accepted 1 May 2018)

ABSTRACT: Two new species of *Camellia* (Theaceae) are described from Vietnam: *Camellia vuquangensis* Luong, Tran & L. T. Nguyen and *Camellia hatinhensis* Luong, Tran & L. T. Nguyen. The new taxa were collected from Vu Quang National Park in the center of Vietnam. The new finds are morphologically dissimilar to all known *Camellia* species. Recent *Camellia* discoveries have increased the number of species recorded in Vietnam from 50 to 75, making Vietnam a center of diversity and a crucial area for more research into the diversity and distributions of *Camellia*.

Keywords: *Camellia*, Ha Tinh, new species, Vietnam, Vu Quang

Camellia is the largest genus of the Theaceae, with an estimated 120 to 300 species (Chang and Bartholomew, 1984; Ming and Bartholomew, 2007). According to Sealy (1958), Chang and Bartholomew (1984), Gao et al. (2005), Ming and Bartholomew (2007), about 80% of these species are found in China and others are found in Cambodia, Indonesia, Japan, Laos PDR, Philippines, Thailand, and Vietnam.

In Vietnam, about 50 species of *Camellia* were recognized prior to the mid-2000's (Ho, 1999; Ninh, 2002). However, in recent years additional species of *Camellia* have been discovered and described from Vietnam, increasing the total to 75 species and making Vietnam the centre of *Camellia* diversity (Orel and Wilson, 2010, 2012; Ninh and Dung, 2012, 2013; Orel et al., 2012, 2013, 2014a, 2014b; Luu et al., 2015; Ninh and Ninh, 2015; Dung et al., 2016; Ninh and Dung, 2016).

Vu Quang National Park with about 1,678 species of vascular plants, 94 species of mammals, 315 species of birds, 58 species of reptiles, and 31 species of amphibians, including many endemic and rare species, have been recorded,

indicating that Vu Quang National Park is one of the centers of biodiversity for Vietnam (Vu Quang National Park Management Board, 2014).

During a field trip in 2016 to survey on *Camellia* in the Vu Quang National Park, we collected two species of *Camellia*. Careful examination of the morphological characters indicated and more than 300 dried specimens kept in the following herbaria were also examined: VAFS, DLU, HN, VNM as well as digitized plant specimen images available on the web of Muséum National d'Histoire Naturelle (<https://science.mnhn.fr/>) and Chinese Virtual Herbarium (<http://www.cvh.org.cn/>) that did not match any described species.

Taxonomic Treatment

1. *Camellia vuquangensis* Luong, Tran & L. T. Nguyen, *sp. nov.* (Figs. 1, 2).—**TYPE:** VIETNAM. Ha Tinh province, Vu Quang district, 21 Aug 2017 (fl), *Luong Van Dung, Tran*

*Author for correspondence: hoangsonfsiv@gmail.com

Open Access

<http://e-kjpt.org>. © 2018 the Korean Society of Plant Taxonomists. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Fig. 1. *Camellia vuquangensis* Luong, Tran & L. T. Nguyen. **A.** Leaf, adaxial surface. **B.** Venation detail of leaf (abaxial surface). **C.** Venation of leaf (adaxial surface). **D.** Flower, lateral view. **E.** Flower, top view. **F.** Perules (inner surfaces shown). **G.** Petals (inner surfaces). **H.** Stamens. **I.** Pedicel and gynoecium (other floral parts removed) (drawn by Luong Van Dung).

Fig. 2. *Camellia vuquangensis* Luong, Tran & L. T. Nguyen. A. Branches. B. Flower bud. C. Flower, lateral view. D. Flower, top view.

Ninh, Nguyen Thi Lieu, Do Cong Thuan, Thai Canh Toan, Le Van Toan, Hoang Van Hoan VN.0358 (holotype: DLU, Isotype: VAFS).

Shrub, 3–4 m tall, young branches and leaves light violet and pubescent. Leaves stalked; blade thick and coriaceous, oblong, 12–23 cm long and 4–7 cm wide, glabrous above, hirsute below, the apex acuminate to long caudate, the base auriculate with some teeth, the margins sharply serrulate, the midribs sunken above and protruding below with 17 to 22

pairs of lateral veins, sunken above and protruding below the main leaf surface; the petioles 8–10 mm long, hirsute. Flowers 1 or 2, positioned on the terminal or axillary of branches, 8–9.5 cm in diameter, shortly pedicellate. Perules 6 or 7, scale shaped to nearly rounded, 0.4–2.2 cm high, 0.4–1.6 cm wide, pubescent on both sides, ciliate margins. Petals 13 or 14, elliptic, obovate, oblanceolate, entire, light yellow, 2.5–6.0 cm long, 1.5–2.5 cm wide, emarginated, glabrous on inner surfaces, pubescent central region of outer surfaces, united

Table 1. Morphological comparison between *C. vuquangensis* with *C. dilinhensis*.

Characters	<i>Camellia vuquangensis</i>	<i>Camellia dilinhensis</i>
Leaf blade shape	Oblong	Oblong elliptic or elliptic, glabrous
Leaf size	12–23 cm long and 4–7 cm wide	16–24.5 cm long, 5.5–9.5 cm wide
Leaf apex	Acuminate to long caudate	Acuminate
Leaf base	Auriculate with some teeth	Cuneate
Petiole	8–10 mm long, hirsute	1–1.9 cm long, glabrous
Flowers	1 or 2, terminal or axillary	1 to 3 in each group in axillary
Flower diameter (cm)	8–9.5	3.5–3.7
Pedice	Absent	5–7 mm long, glabrous
Petal number	13 or 14	8 or 9
Petal shape	Elliptic, obovate, oblanceolate	Nearly rounded to elliptic
Petal size	2.5–6.0 cm high, 1.5–2.5 cm wide	1.5–1.7 cm long, 1.2–1.4 cm wide
Petal hairiness	Pubescent on middle outer surfaces	Glabrous on both sides
Stamens	290 stamens, 5 or 6 circles	350 stamens, 4 or 5 circles
Filaments	3.5–4.5 cm long, pubescent to 1/2 from the base	5–9 mm long, glabrous
Style	3, free to the base, 1–1.3 cm long, pubescent to 1/2 from the base	3, free to the base, 5 mm long, pubescent

with outermost filaments 0.6–1.8 cm at the base. Androecium over 290 stamens, in 6 or 7 circles, light yellow, 3.5–4.5 cm long, pubescent to 1/2 from the base, outer filaments united for 2–2.4 mm from the base and form a short cup. Ovary cylindrical, 3-locular, 5–6 mm long, pubescent; styles 3, free to the base, 1–1.3 cm long, pubescent to 1/2 from the base. Capsule not seen.

Distribution and phenology: This species was found in the forest of Vu Quang International Park, Vu Quang district, Ha Tinh province, at the elevation of 50–100 m. Blooming season: Spring, August to September.

Etymology: The specific epithet of the new species refers to the location of discovery, Vu Quang National Park, Vietnam.

IUCN Red List category: The Area of Occupancy (AOO) for *C. vuquangensis* is estimated to be less than 1 km², as extensive surveys in the wider region have not located this species elsewhere. Despite a further search of the area around the type locality, only eight additional mature trees were found. The total known population of the species is fewer than 50 individuals, and it would be qualified as Critically Endangered (CR) under criterion D (IUCN, 2011).

Taxonomic remarks: This species most closely resembles *Camellia dilinhensis* of sect. *Obvoidae* Tran et Luong (Ninh and Dung, 2013) as the leaf is elliptic oblong; flowers are yellow and are either solitary or a pair at the ends of branches;

ovary 3-locular, cylindrical, pubescent; style 3, free. Thus based on morphological similarity, this species should be assigned to sect. *Obvoidae* Tran et Luong. The main similarities and differences between *Camellia vuquangensis* with *Camellia dilinhensis* are summarized in Table 1.

2. *Camellia hatinhensis* Luong, Tran & L. T. Nguyen, *sp. nov.* (Figs. 3, 4).—**TYPE:** VIETNAM. Ha Tinh province, Vu Quang district, 27 Aug 2017, *Luong Van Dung, Tran Ninh, Nguyen Thi Lieu, Do Cong Thuan, Nguyen Viet Hung VN.0354* (holotype, isotype: DLU).

Shrubs or small trees, 4–6 m tall, young branches villous becoming glabrous with age. Leaves stalked; blade thick and coriaceous, oblong, 11–15 cm long and 3–5 cm wide, glabrous above, villous below, the apex acuminate to long caudate; the base broadly cuneate or nearly rounded, the midribs sunken above and protruding below main leaf, 10 to 14 pairs of lateral veins sunken above and protruding below the main leaf, the margins serrulate or serrate; petioles 1–1.3 mm long, villous. Flowers solitary at branch apices, white, 8–9 cm in diameter, the pedicel absent. Perules 9 or 10, nearly rounded, 0.4–2.3 cm high, 0.3–2.1 cm wide, pubescent on both sides, persistent, margins ciliate. Petals 10 or 11, elliptical, nearly rounded, obovate, retire, 2.7–4.8 cm long, 2.3–4.5 cm wide, pubescent on both sides, united with

Fig. 3. *Camellia hatinhensis* Luong, Tran & L. T. Nguyen. **A.** Leaf, adaxial surface. **B.** Venation detail of leaf (abaxial surface). **C.** Venation of leaf (adaxial surface). **D.** Flower bud. **E.** Flower, top view. **F.** Perules (inner surfaces shown). **G.** Petals (inner surfaces). **H.** Perules and gynoecium. **I.** Stamens. **J.** Capsule with persisting styles. **K.** Pericarpa. **L.** Seeds (drawn by Luong Van Dung).

Fig. 4. *Camellia hatinhensis* Luong, Tran & L. T. Nguyen. A. Branches. B. Fruit. C. Flower bud. D. Flower.

outermost filaments 0.5–1.3 cm at the base. Androecium over 300 stamens, in 6 or 7 circles, 3–3.5 cm long, pubescent, outer filaments united from the base and forming a short cup, united 1.3–1.6 cm at the base. Ovary nearly rounded, 3-locular, tomentose, 0.5 cm long, 0.4 cm wide; styles 3, free to the base, 3–3.3 cm long, tomentose. Fruits globose, pubescent, 3.5–4 cm in diameter, 3-locular, with 1 or 2 seeds in each locule, columella abortive. Seeds cuneate or semiglobose, 1.6–1.9 cm high, 1.1–1.4 cm wide, glabrous.

Distribution and phenology: This species was found in the forest of Vu Quang National Park, Vu Quang district, Ha

Tinh province, at the elevation over 100 m. Flowering: August to September; Fruiting: October to November.

Etymology: The specific epithet of the new species refers to the location of discovery, Ha Tinh province, Vietnam.

IUCN Red List category: The AOO for *C. hatinhensis* is estimated to be less than 1 km². Despite a further search of the area around the type locality and other forests in the vicinity, only eight additional mature trees were found. The total known population of the species is fewer than 50 individuals, and it would be qualified as CR under criterion D (IUCN, 2011).

Table 2. Morphological comparison between *C. hatinhensis* with *C. gauchowensis*, *C. oleifera*, *C. sasanqua*, and *C. vietnamensis*.

Characters	<i>C. hatinhensis</i>	<i>C. gauchowensis</i>	<i>C. oleifera</i>	<i>C. sasanqua</i>	<i>C. vietnamensis</i>
Young shoots	Villous	Villous	Glabrous to villous	Villous	Villous
Leaf blade shape	Oblong	Elliptic to mostly obovate	Elliptic to broadly elliptic	Elliptical	Elliptic to ovate, rarely obovate
Leaf size	11–15 cm long, 3–5 cm wide	6.8–9.0 cm long, 2.9–5.0 cm wide	4.0–11.7 cm long, 1.4–5.1 cm wide	2.6–6.3 cm long, 0.9–3.2 cm wide	5.4–13.1 cm long, 2.7–6.7 cm wide
Leaf apex	Acuminate to long caudate	Acute to obtuse or short acuminate	Acute to short acuminate	Acute or variously acuminate to occasionally cuspidate	Acute to mostly short acuminate
Leaf base	Broadly cuneate or nearly rounded	Cuneate	Cuneate to mostly rounded	Cuneate	Cuneate to mostly rounded
Upper surface	Glabrous	Smooth, midrib densely puberulent	Smooth, midrib moderately puberulent	Smooth, hirsutulous along the midrib	Smooth, the midrib puberulent
Lower surface	Villous	Midrib villous	Rarely with few hairs, midrib sparsely villous or glabrous	Smooth, with a few hairs along the midrib.	Smooth, midrib glabrous to villous
Petiole	1–1.3 mm long, villous	5–10 mm long, puberulent	3–6 mm long, villous	4–6 mm long, villous	5–12 mm long, puberulent
Flower diameter	8–9 cm	6.0–7.5 cm	5.5–7.0 cm	5.0–7.6 cm	7.5–13.9 cm
Perules	9 or 10, persistent, pubescent on both sides	10 to 12, deciduous	8, deciduous, outside heavily pubescent, inside glabrous	8 to 10, deciduous, more or less pubescent on the outside, inside glabrous	9 or 10, deciduous, outside pubescent, inside glabrous
Petal number	10 or 11	7 or 8	7 or 8	7 or 8	8 to 10
Petal shape	Elliptic, nearly rounded, obovate, united with outermost filaments	Obovate, cleft at the tip, nearly free at the base with little or no fusion to the staminal column	Obovate to obcordate, cleft at tip, fused with the staminal column	Oblanceolate to obovate, cleft at the tip, petals free	Obcordate, cleft at tip, petals free
Petal size	2.7–4.8 cm long, 2.3–4.5 cm wide	3.0–3.8 cm long, 1.5–2.6 cm wide	3.2–3.9 cm long, 1.5–2.4 cm wide	3.0–3.7 cm long, 1.4–2.4 cm wide	3.9–7.5 cm long, 3.0–4.9 cm wide
Androecium hairiness	Pubescent	Glabrous	Glabrous	Glabrous	Glabrous
Androecium length	3–3.5 cm	1.0–1.2 cm	1.8 cm	1.1–1.6 cm	1.2–2.0 cm
Gynoecium length	3.5–3.8 cm	1.0 cm	1.2–1.6 cm	1.1–1.5 cm	1.2–2.0 cm
Style	3, tomentose, free to the base	3 to 5, glabrous, free at the base	3 to 5, glabrous, fused 1/2 from the base	3, glabrous, styles, range from fused 1/4?2/3 from the base	3 to 5, glabrous, free or fused up to 1/2 from the base

Taxonomic remarks: *Camellia hatinhensis* possesses some morphological characteristics common to the species *C. gauchowensis* Chang, *C. oleifera* Abel; *C. sasanqua* Thunb. and *C. vietnamensis* Huang ex Hu (Gao et al., 2005) belonging to Section *Oleifera* Hung T. Chang (Chang and Bartholomew, 1984). All these species have terminal flowers which are sessile and white; bracteoles and sepals are not differentiated, coriaceous; ovaries 3-locular; styles 3–5. Therefore the species should be classified into Sect. *Oleifera* Hung T. Chang. The main similarities and differences between *C. hatinhensis* with *C. gauchowensis*, *C. oleifera*, *C. sasanqua*, and *C. vietnamensis* are summarized in Table 2.

Acknowledgments

The authors would like to express their sincere thanks to Mr. Hoang Van Hoan and Mr. Le Van Toan who provided valuable information leading to the discovery of those species. We are also grateful for the support provided through the JSPS KAKENHI Grant Number JP16K07239, Japan.

Conflict of Interest

Authors declare that there is no conflict of interest.

Literature Cited

- Chang, H. T. & B. Bartholomew. 1984. *Camellias*. B.T. Bastford Ltd., London, 211 pp.
- Dung, L. V., L. Anna, N. T. Hanh and N. T. Lieu. 2016. *Camellia thuongiana*: a new yellow *Camellia* species from Vietnam. *Dalat University Journal of Science* 6: 338–344.
- Gao, J., R. P. Clifford, Y. Q. Du. 2005. Collected species of the genus *Camellia*: an illustrated outline. Zhejiang Science and Technology Press, Guangzhou, 302 pp.
- Ho, P. H. 1999: Theaceae. In *Cây cỏ Việt Nam* [An illustrated flora of Vietnam], Vol. 1. Pham-hoang, H. (ed.), Youth Publishing House, Ho Chi Minh City. Pp. 412–434. (in Vietnamese with English summary)
- IUCN. 2011. International Union for Conservation of Nature, Red List Categories and Criteria, Version 3.1. Retrieved Mar. 2, 2011, available from <http://www.iucnredlist.org>.
- Ming, T. L. and B. Bartholomew. 2007. Theaceae. In *Flora of China*. Vol. 12. Hippocastanaceae through Theaceae. Wu, Z.-Y., P. H. Raven and D. Y. Hong (eds.), Science Press, Beijing and Missouri Botanical Garden Press, St. Louis, MO. Pp. 366–478.
- Ninh, L. N. H. and L. V. Dung. 2016. General information about the Yellow *Camellia* species in Vietnam. In *Proceedings of Dali International Camellia Congress*, Dali, Yunnan, China.
- Ninh, T. 2002. Biodiversity of the genus *Camellia* of Vietnam. *International Camellia Journal* 34: 80–88.
- Ninh, T. and L. V. Dung. 2012. *Camellia dalatensis*: a new species and precious gene should be conserved. *VNU Journal of Science, Natural Sciences and Technology* 28(2S): 34–36.
- Ninh, T. and L. V. Dung. 2013. *Camellia dilinhensis*: a new species from Vietnam. In *Proceedings of the 3rd International Academic Forum on Yellow Camellias*. International Camellia Society. Li, J. Y., Z. H. Li, Y. J. Luo and Z. Q. Fan (eds.), Nanning. P. 79.
- Ninh, T. and L. T. H. Ninh. 2015. A new yellow *Camellia* species from North Vietnam. *International Camellia Journal* 47: 36–39.
- Orel, G. and P. G. Wilson. 2010. *Camellia luteocerata* sp. nov. and a new section of *Camellia* (*Dalatia*) from Vietnam. *Nordic Journal of Botany* 28: 280–284.
- Orel, G. and P. G. Wilson. 2012. *Camellia cattienensis*: a new species of *Camellia* (sect. *Archaeacamellia*: Theaceae) from Vietnam. *Kew Bulletin* 66: 565–569.
- Orel, G., P. G. Wilson, A. S. Curry and L. H. Truong. 2012. *Camellia imitata* (Theaceae), a new species forming a new section (*Bidoupia*) from Vietnam. *Edinburgh Journal of Botany* 69: 347–355.
- Orel, G., P. G. Wilson, A. S. Curry and L. H. Truong. 2013. *Camellia oconoriana* (Theaceae), a new species from Vietnam. *Edinburgh Journal of Botany* 70: 439–447.
- Orel, G., P. G. Wilson, A. S. Curry and L. H. Truong. 2014a. Four new species and two new sections of *Camellia* (Theaceae) from Vietnam. *Novon* 23: 307–318.
- Orel, G., P. G. Wilson and L. H. Truong. 2014b. *Camellia curryana* and *C. longii* spp. nov. (Theaceae) from Vietnam. *Nordic Journal of Botany* 32: 42–50.
- Sealy, J. R. 1958. A revision of the genus *Camellia*. The Royal Horticultural Society, London, 239 pp.
- Luu, H. T., V. D. Luong, Q. D. Nguyen and T. Q. T. Nguyen. 2015. *Camellia sonthaiensis* (Theaceae), a new species from Vietnam. *Annales Botanici Fennici* 52: 289–295.
- Vu Quang National Park Management Board. 2014. Planning for conservation and development of Vu Quang National Park 2015–2020. The Author. (in Vietnamese)