

# THE TAXONOMIC TREATMENT OF *CAMELLIA LUUANA* (SECT. *DALATIA*) IN THE CENTRAL HIGHLANDS, VIETNAM

Le Nguyet Hai Ninh<sup>a\*</sup>, Shi-Xiong Yang<sup>b</sup>

<sup>a</sup>*Hoa Lu University, Ninh Binh, Vietnam*

<sup>b</sup>*CAS Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming, Yunnan, China*

*\*Corresponding author: Email: lnhninh@hluv.edu.vn*

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## Abstract

*Camellia luuana* Orel & Curry is known only from its type locality, Ta Dung Nature Reserve, now Ta Dung National Park, Dak Nong Province, the Central Highlands of Vietnam. No characteristics of fruit and seeds, which are the most important to divide genera in Theaceae (Chang & Ren, 1998; Ming & Bartholomew, 2007; Sealy, 1958), were presented in its protologue. After carefully reviewing the protologue, specimens, and images of *Camellia luuana*, relevant species and genera, and conducting a field investigation around its type locality, we concluded that this species is not a member of *Camellia*, but a member of *Pyrenaria*.

**Keywords:** *Camellia*; *Pyrenaria*; Taxonomy; Vietnam.

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## 1. INTRODUCTION

*Camellia luuana* Orel & Curry was first published by G. Orel and A. Curry. The species was found in the province of Dak Nong, Ta Dung Nature Reserve, Vietnam, in 2015 by Luu Hong Truong, Nguyen Quoc Dat, and Nguyen Tran Quoc Trung. The holotypes and isotypes are *Luu, Nguyen & Nguyen TD 391* collected on 11 January 2011 and stored in NSW and SGN herbaria (Orel & Curry, 2015, p. 251). The precise provenance details of this species are still withheld for conservation reasons.

Collected specimens of this species do not have mature capsules and seeds, which are the key characteristics to classify species into different genera according to Sealy (1958, p. 7) and Ming and Bartholomew (2007, p. 366).

Due to the arrangement of the tepals in a loose and rather imperfect spiral, this species was classified in the section *Dalatia* Orel, genus *Camellia*.

After carefully studying the protologue and available specimens and images of *Camellia luuana*, it is necessary to reconsider the taxonomic position of this species. Based on the characteristics of the type specimens, previous taxonomic revisions, and the characteristics of *Pyrenaria jonquieriana*, which is distributed in Laos and the Central Highlands of Vietnam, *C. luuana* should be transferred to *Pyrenaria* Bl.

## 2. MATERIALS AND METHODS

The study was based on the morphology and available taxonomic references of *Camellia luuana*, *Pyrenaria jonquieriana*, and the genera *Camellia* and *Pyrenaria* from the research of Blume (1825-1826), Chang and Bartholomew (1984), Chang and Ren (1998), and Ming and Bartholomew (2007), Pitard (1910), Sealy (1958). The specimens and/or their images/photos from herbaria, IBSC, K, KUN, NSW, P, PE, SGN, and VNM were examined. The acronyms are based on Thiers (2021). The priority of the name is based on Art. 11.4 of the Shenzhen Code (Turland et al., 2018).

## 3. RESULTS AND DISCUSSION

### 3.1. Examination and comparison of specimens and images/photos from herbaria

From the description and photos of *Camellia luuana* (Orel & Curry, 2015, pp. 251-256), this species looks similar to *Pyrenaria jonquieriana*, which belongs to genus *Pyrenaria* Blume and is found in central Vietnam and Laos. It has been recorded in the Central Highland provinces of Gia Lai, Dak Lak, and Lam Dong (Luong, 2019, pp. 45-56) and Kon Tum (Nguyễn, 2017, pp. 281-283). Specimens in different herbaria indicate that the species can be found in five more provinces: Quang Tri, Hue, Da Nang, Khanh Hoa, and Ninh Thuan.

### 3.1.1. *Specimens examined:*

- *Pyrenaria jonquieriana* Pierre

**Type** (lectotype):—LAOS. [Attapeu]: *regni Siamici et ad sinistram fluvii sur King prope Bassae*, 3/1877, L. Pierre 4005 (P00130113!, <http://coldb.mnhn.fr/catalognumber/mnhn/p/p00130113>; isolectotypes P00130114!, P04510993!).

- *Camellia luuana* Orel & Curry in Orel and Curry (2015, p. 251), *syn. nov.*

**Type**:—VIETNAM. Province of Dak Nong: Ta Dung Nature Reserve, 11 January 2011, *Luu, Nguyen & Nguyen TD 391* (holotype NSW901733 [image!]; isotype SGN).

### 3.1.2. *Other examined specimens*

VIETNAM. Quang Tri: *Chevalier 40063* (P05278741[image!]); *Poilane 1130* (K, VNM00003684). Hue: *Poilane 29790* (K). Da Nang (Tourane): *Poilane 6940* (K); *Poilane 7210* (K, VNM00003695, VNM00003696); *Poilane 29205* (K, VNM00003702); *Poilane 7637* (P04510979 [image!]). Khanh Hoa: *S. X. Yang et al. 6207* (KUN); *Poilane 6814* (K, VNM00003690, VNM00003691, VNM00003692, VNM00003693, VNM00003694), *6788* (P04511078, P04511079 [image!]); *Poilane 6422* (K, VNM00003685, VNM00003686, VNM00003687, VNM00003688, VNM00003689). Ninh Thuan: *Poilane 1758* (K). Lam Dong (Haut Donnai): *Poilane 21901* (IBSC0277292, P04510980 [image!]); *Poilane 22298* (P05278743 [image!]); *Poilane 22700* (P05278744 [image!]); *Poilane 23764* (P04510977 [image!]); *Schmid s.n.* (P04511075 [image!]), *Schmid s.n.* (P04511089 [image!]); *Poilane 31048* (PE01513977); *Evard 317* (P04500341 [image!]); *Evard 1810* (P04510988, P04510991 [image!]); *Schmid s.n.* (P04511090 [image!]); *T. Smitinand & E. C. Abbe 6385* (K); *Poilane 23954* (IBSC0277294, IBSC0277296, VNM00003699); *ibid.*, *Poilane 24388* (P04510989 [image!]); *ibid.*, *Poilane 24551* (VNM00003700); *S. X. Yang et al. 6236* (KUN); *S. X. Yang et al. 6220, 6221, 6223, 6224, 6225, 6226* (KUN); *ibid.*, *Chevalier 30824* (P05108963, P05278742 [image!]), *30844* (P04510975, P05278745 [image!]).

LAOS. Attapeu: *Harmand 1159* (P00130115, P00130116, P04510992). Champasak (Bassac): *Poilane 15620* (VNM00003697); *Poilane 28501* (VNM00003701), *28521* (K); *Poilane 15666* (VNM00003698); *Munzinger & Engelmann 267* (P00217377 [image!]); *Poilane 15800* (IBSC0277293, IBSC0277295, P04511086 [image!]); *Poilane 15872* (P04511082 [image!]).

The characteristics of the plants, i.e., flower buds, ovary, and especially the sepals of *Camellia luuana* based on the types and photos in the protologue are quite common in the genus *Pyrenaria* and have many similarities with the specimens of *P. jonquieriana* examined above.

## 3.2. **Morphological comparison of *Camellia luuana* with collected materials**

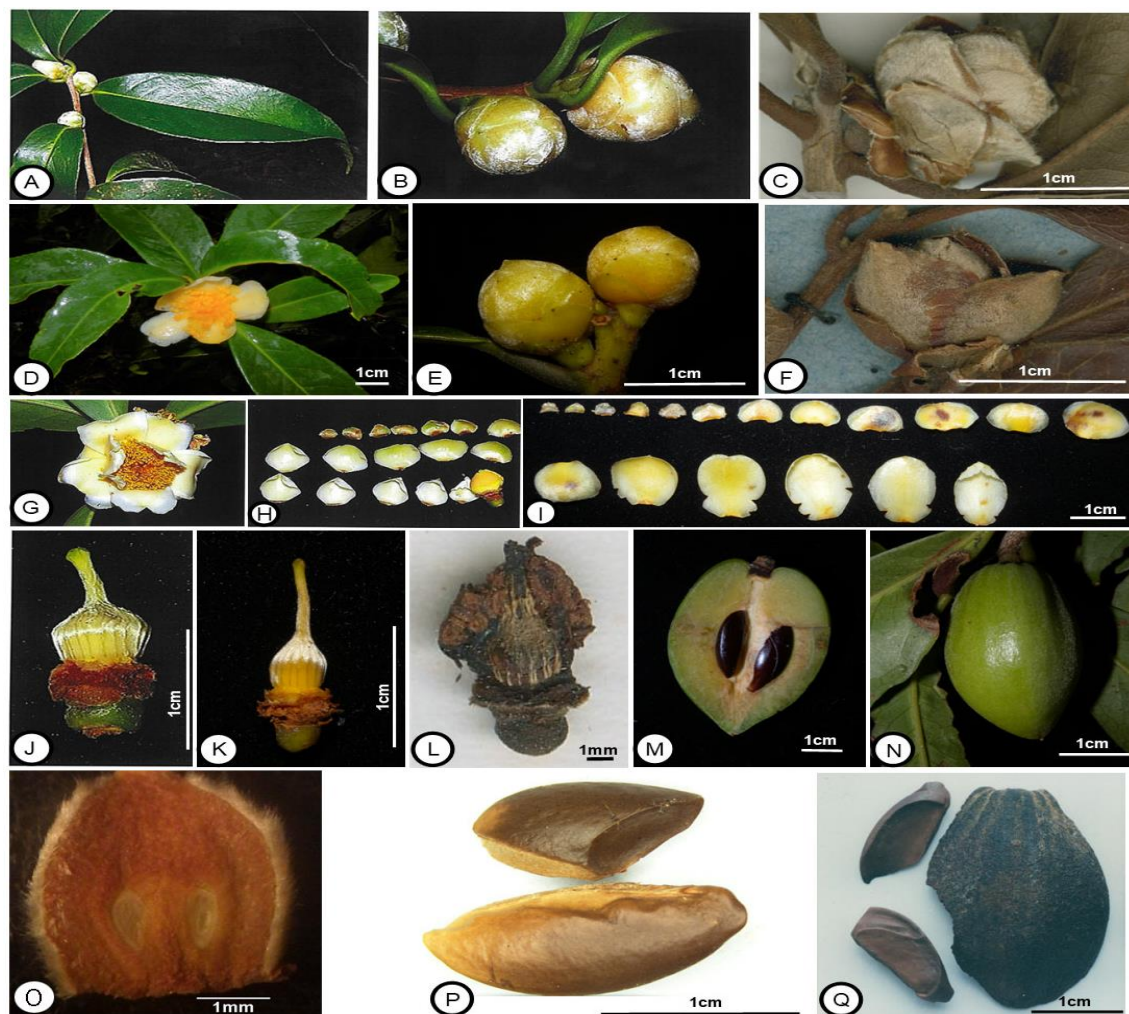
Based on the examined specimens, the protologues of names, and other relevant taxonomic literature, a comparison has been made between the characteristics of *Camellia luuana* and *Pyrenaria jonquieriana*. The results are presented in Table 1.

**Table 1. Comparison of the characteristics of *C. luuana* with *P. jonquieriana***

Morphological characteristics	<i>C. luuana</i> (Orel & Curry, 2015)	<i>P. jonquieriana</i> (Nguyễn, 2017; Lương, 2019)*
Tree	Shrub	Tree
Juvenile branches	Smooth, axillary leaf buds finely tomentose	Tomentose, after that glabrous
Petiole	10–15 mm, shiny, scabrous to finely tomentose	5–12 mm, glabrous to nearly glabrous
Leaf blade	Very narrow elliptic to narrow elliptic, oval, smaller leaves elliptic, 14.0–15.0(–16.0) cm long, 4.0–5.0 cm wide, glabrous on both sides, slightly coriaceous	Oblong or lanceolate, 7.0–16.0 cm long, 2–5.5 cm wide, above glabrous, below hairy at first, after that glabrous (according to Lương, 2019, “glabrous on both sides”), thinly coriaceous
Leaf apex	Cuspidate to acuminate	Acute
Leaf base	Acute	Acute
Margin	Serrations sparse, blunt, shallow	Serrations shallow
Veins	Primary vein narrowly sunken on adaxial side, on abaxial side prominent; secondary venation well defined, with 10–12(–14) pairs of veins	Primary vein sunken on adaxial side, on abaxial side prominent; secondary venation well defined with 7–11 pairs of veins
Flower position	Solitary or geminate, generally occurring toward the branch terminals, terminal axillary	Solitary, axillary (Nguyễn, 2017), branch terminals (Lương, 2019)
Flower diameter	3.0–3.5(–4.5) cm	3.0–3.5 cm (Lương, 2019)
Pedicel	Sessile or almost sessile	1–1.5 mm long (Nguyễn, 2017); 3–5 mm (Lương, 2019)
Bracteoles	(Not mentioned)	2
Sepals	7 Finely tomentose on the abaxial side	5 Yellow tomentose on the abaxial side
Petals	10 Light yellow, abaxial surfaces thickly tomentose	5 (Nguyễn, 2017); 8–9 (Lương, 2018) Light yellow or white, abaxial surfaces tomentose
Stamens	Filaments glabrous Outer filaments basally joined for 1.0–3.0 mm	Filaments glabrous Outer filaments basally joined for 3.0–4.0 mm
Ovary	Rotund, widest at its equator Tomentum 3–4 chambered	Oblong Tomentum 3-celled
Styles	Single Tomentose for two-thirds of its length, the distal one-third glabrous or nearly so 5.0–6.0 mm long	Single Tomentose 7.0–8.0 mm long
Stigma	Bullous, with 4–6 indistinct lobes Glabrous or almost so	Obtuse, 3 lobes Glabrous

Note: \*Based on Nguyễn (2017, pp. 281-282) and Lương (2019, pp. 45-46).

It can be recognized that the two species have many similar characteristics, including serration at the leaf margins, primary vein as well as secondary venation, position of the flowers, very short pedicel, single style, and the shape of the stigma. The differences of the two species, such as habit, leaf, number of lateral veins, and number of tepals, can be considered as variations.



**Figure 1. Morphological comparison between *Camellia luuana* (A-C, G, H, J) and *Pyrenaria jonquieriana* (D-F, I, K-Q, O)**

Note: A. Leaves and flower buds; B-C, E-F. Flower buds; D. Leaves and flower; G. Flower; H-I. Flower parts. J-L. Ovary; M. Fruit; N, Q. Fruit and seeds; O. Ovules; P. Seeds. A-B, G, H, J from the protologue of *C. luuana*; C from the holotype of *C. luuana* (NSW901733); F, L, Q from the lectotype of *P. jonquieriana* (P00130113); D-E, I, K, M-N, P from specimens S. X. Yang *et al.* 6220 (KUN).

In November 2019, some specimens were collected (S. X. Yang *et al.* 6207, 6220, 6221, 6223, 6224, 6225, 6226, 6236) (Figure 1 D-E, I, K, M-N, P) near the type locality of *Camellia luuana*. They include mature fruit and seeds. The fruit, which is drupaceous and indehiscent (Figure 1 M-N) (vs. capsule dehiscent from the apex), and the seeds, which are longitudinally compressed (vs. globose, semiglobose, or polygonal) with linear

hilum (vs. umbilicate) (Figure 1 M, P) demonstrably show that these specimens are *Pyrenaria jonquieriana* (Figure 1 Q). Photos of fresh specimens are provided in Figure 1.

Based on the types and photos in Orel and Curry (2015, pp. 251–256), the outer surface of *Camellia luuana* sepals is densely tomentose, and the inner surface is glabrous (Figure 1, A-C), which is somewhat rare in *Camellia*, but common in *Pyrenaria*. The ovary of *C. luuana* has more than 10 longitudinal ridges and grooves (Figure 1 J). The above morphological characteristic is similar to *P. jonquieriana*, which has 19–22 ridges on the ovary surface according to Nguyễn (2017) and Luong (2019). The multi-ridged ovary (Figure 1 L) is one of the distinct diagnostic features of *P. jonquieriana* (Pierre, 1887, p. 120), a species widely distributed in central Vietnam with the same distribution range as *Camellia luuana*. The seed morphology, as well as its position on the column, are the other important characteristics in Theaceae. Although the types of *Camellia luuana* do not have fruit and seeds, we noticed the seed characteristics in a figure captioned “Transverse section of an ovary of *C. luuana*” (Orel & Curry, 2015, p. 256). The compressed (vs. globose) ovules bearing in the middle (vs. at the top) of the column (Figure 1O) of *P. jonquieriana* strongly indicate that the species is a member of *Pyrenaria*.

To further strengthen the claim that the taxonomic position of *C. luuana* is as a member of *Pyrenaria*, we compare the described characteristics of *Camellia luuana* with the taxonomic characteristics of genus *Pyrenaria* (Table 2). The taxonomic characteristics of genus *Pyrenaria* are based on Blume (1825-1826), Nguyễn (2017), Pitard (1910), and Sealy (1958).

**Table 2. Comparison of the characteristics of *C. luuana* with those of genus *Pyrenaria***

Characteristics species/genus	<i>Pyrenaria</i> (Blume, 1825-1826)	<i>Pyrenaria</i> (Pitard, 1910)	<i>Pyrenaria</i> (Sealy, 1958)	<i>Pyrenaria</i> (Nguyễn, 2017)	<i>C. luuana</i> (Orel & Curry, 2015)
Sepals	5 Imbricate -	5 - Transfer gradually from bracts to petals	5 - Clearly distinct from the corolla	5(–6) Imbricate Increasing in size from bracts to bracts	7 Imperfect spiral Increasing distally in size
Petals	5 Basally overlapping	- United at the base	5 or 6, or 10, or 12 United at the base	5(–6) or more Imbricate united at the base	10 Basally overlapping
Stamens	Numerous Outer filaments basally joined and united at the base with petals	Numerous United at the base with petals	- United at the base with petals	Numerous Outer filaments basally joined and united at the base with petals	Numerous Outer filaments basally joined
Anther	Dorsifixed	-	-	-	Dorsifixed
Ovary	5-celled	3–5-celled	5-celled	3–5(–7)-celled	3–4-chambered

Note: - means not mentioned in the respective author’s opinion.

**Table 2. Comparison of the characteristics of *C. luuana* with those of genus *Pyrenaria* (cont.)**

Characteristics species/genus	<i>Pyrenaria</i> (Blume, 1825-1826)	<i>Pyrenaria</i> (Pitard, 1910)	<i>Pyrenaria</i> (Sealy, 1958)	<i>Pyrenaria</i> (Nguyễn, 2017)	<i>C. luuana</i> (Orel & Curry, 2015)
Styles	5	3–5	5-lobed stigma or 5-fid stigma, or there may be 5	Same as number of cells, usually 5; number of stigmas same as number of cells	4–6 indistinct lobes stigma
	Adnate	Free or partially adnate	Single	Free or partially adnate	Single
Tree	-	Tree or shrub	-	Tree or shrub	Shrub
Leaf	-	-	Large elliptic or oblanceolate	Oblong or elliptic	Very narrow elliptic to narrow elliptic, oval
	-	Serrations	-	-	Serrations
	-	Submembranous	-	Submembranous or coriaceous	Slightly coriaceous
Flowers	-	Sessile or subsessile	Short stout pedicel or subsessile	Subsessile	Sessile or almost sessile
	-	Axillary	-	Axillary	Terminal and axillary

Note: - means not mentioned in the respective author’s opinion.

From the comparative data in Table 2, *C. luuana* shares characteristics similar to those of genus *Pyrenaria*, such as a single stigma, outer filaments fused at the base, and basally overlapping petals. The only significant difference is the number of sepals (7 vs. 5–6). However, it should be added that Orel and Curry (2015) did not mention the number of bracts, only the seven sepals, whereas Blume (1825-1826), Nguyễn (2017), and Sealy (1958) all stated that genus *Pyrenaria* has five sepals and two bracts.

In addition, we contrast the diagnosis of *Camellia luuana* with the characteristics of genus *Camellia* (Table 3). Some *Camellia* taxonomic descriptions, such as Chang and Bartholomew (1984), Ming and Bartholomew (2007), and Sealy (1958) which are currently widely accepted, have been used.

**Table 3. Comparison of the characteristics of *Camellia luuana* with those of genus *Camellia***

Characteristics species/genus	<i>C. luuana</i> (Orel & Curry, 2015)	<i>Camellia</i> (Sealy, 1958)	<i>Camellia</i> (Chang & Bartholomew, 1984)	<i>Camellia</i> (Ming & Bartholomew, 2007)
Pedicel	Sessile or almost sessile	Pedicellate, more or less obvious, or no apparent	Pedicellate or sessile	Clearly pedicellate or apparently sessile, with a short stout pedicel

Note: - means not mentioned in the respective author’s opinion.

**Table 3. Comparison of the characteristics of *Camellia luuana* with those of genus *Camellia* (cont.)**

Characteristics species/genus	<i>C. luuana</i> (Orel & Curry, 2015)	<i>Camellia</i> (Sealy, 1958)	<i>Camellia</i> (Chang & Bartholomew, 1984)	<i>Camellia</i> (Ming & Bartholomew, 2007)
No. flowers at one position	Solitary or geminate	Vary greatly	Solitary or in clusters	Solitary or rarely 3 in a cluster
Flower position	Terminal and axillary	Terminal and axillary	Branch terminals or leaf axils	Axillary or subterminal
Flower color	Light yellow flowers, with central and proximal petal areas mid-yellow	(including other colors) yellow or yellowish	(including other colors) yellow	(including other colors) yellow
Flower diameter	3.0–3.5 (–4.5) cm	1.0 to 12–14 cm	-	-
Sepals	7 Arranged in a loose and rather imperfect spiral	(4)5 -	Usually 5–6 -	5(or 6) Distinct or basally connate
Petals	10 Basally overlapping, also in a loose and imperfect spiral	4–14 (mostly 5–8) More than 5 petals, the outermost are usually free, and the remaining petals are attached to the androecium	5–12 Basally connate, petals base adnate to filament tube	5–8(–12) Basally ± connate, adnate to stamens
Anthers	Dorsifixed	-	Dorsifixed or occasionally basifixed	Dorsifixed
Styles	Single, short and stout  Yellowish green Finely tomentose for two-thirds of its length	Commonly the styles are almost completely united, but the united part may be quite short and exceeded by the free arms  - Quite glabrous or completely tomentose except for the style arms	- - -	- - -
Ovary	Superior, rotund Dense white tomentum	- Quite glabrous or tomentose	Superior -	Superior -

Note: - means not mentioned in the respective author's opinion.



*Camellia* is the largest genus in Theaceae. The characteristics of the *Camellia* genus have great variation, which can be recognized by the characteristics of the pedicel, the position, number, and color of the flowers, and the number of petals. These characteristics of *Camellia luuana* are also within the range of the genus.

However, *C. luuana* differs in the number of sepals, the union of the petals, and the fusion of the petals with the stamens compared with most known taxonomic descriptions of *Camellia*. In addition, the stigma of *Camellia* is well described by Sealy (1958, p. 18) as being “completely united, but the united part may be quite short and exceeded by the free arms,” while *Camellia luuana* is single, short, and stout, with a stigma that is rather indistinct, bullous, and has four to six indistinct lobes.

In addition to the morphological characteristics listed in Table 3, all of the above taxonomic descriptions agree that *Camellia* flowers have no bracts – “no bracteoles” or “1 or 2 borne close to the sepals” or more (Sealy, 1958), “usually 2–8” (Chang & Bartholomew, 1984), or “2–10” (Ming & Bartholomew, 2007). However, the species description of *Camellia luuana* does not mention this characteristic. The petals and sepals are arranged in a loose and rather imperfect spiral, and the color of the pistil, which are considered diagnostic for this species, are not mentioned in any taxonomic description.

#### 4. CONCLUSION

In summary, the morphological characteristics of *Camellia luuana* are poorly matched with those of the genus *Camellia*, whereas the characteristics of *C. luuana* are strongly similar to those of *Pyrenaria jonquieriana*. Hence, it would be reasonable to transfer this species into the genus *Pyrenaria* and combine it as a synonym of *P. jonquieriana*. With that treatment, the distribution of *P. jonquieriana* will encompass all five provinces of the Central Highlands, Vietnam.

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