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## ***Camellia sinensis* var. *dulcamara* (Camellia, Theaceae), a new var. and subvar. recorded for sect. *Thea* from Northern Vietnam**

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| **Received:** 12 January 2020 | **Accepted:** 02 March 2020 |

**How to cite:** Le Q, Nguyen D, Lay L. 2020. *Camellia sinensis* var. *dulcamara* (Camellia, Theaceae), a new var. and subvar. recorded for sect. *Thea* from Northern Vietnam. J New Biol Rep 9(1): 44-49.

### ABSTRACT

*Camellia sinensis* var. *dulcamara* is described and illustrated from Bac Kan province in northern Vietnam. The newly described species possesses mostly solitary, axillary or sometimes terminal flowers with  $*K_5C_{5-7}A_x\bar{G}_{(1-3)}$  formula; wide leaves, thin lanceolate with a strongly acuminate apex slightly curving and coherent secondary veins forming convex cavities on adaxial surface; leaf buds being white to slightly yellowish green; densely white pubescent newborn leaf; Sub-globose ovary tomentose. Fruits contain 1-4 capsules forming a globose, an isosceles triangle or a square. Interestingly, the taste of all parts including leaf, stem and root is cloyingly sweet. The tea does not induce insomnia when drinking and sedative effect, while these properties could be not found in normal tea, which may be potential valuable in practical application, tea drinking culture and traditional medicine. The morphological data support a placement in *Camellia* sect. *Thea* and we propose the IUCN conservation status for *C. var. dulcamara* as vulnerable.

**Key words:** Vietnam, new species, *Camellia sinensis* var. *dulcamara*, sect. *Thea*, Theaceae.

### INTRODUCTION

*Camellia* being a member of the tea family (*Theaceae*) is widespreadly distributed in Vietnam and China. During the 1920s, the number of species in *Camellia* genus was estimated to be 40 (Melchior 1925). A further 100 species were reported in the 1950s (Sealy 1958). This number had been estimated from 120 to 300 (Chang and Bartholomew 1984; Gao et al. 2005; Ming and Bartholomew 2007). Vietnam was considered

major centre of diversity for the genus, where some 20% of the *Camellia* species can be found (Sealy 1958, Chang and Bartholomew 1984). Recently, many additional new species of *Camellia* have been discovered and described in Vietnam (Ninh et al., 2012; Orel et al., 2012, 2014; Ninh and Dung, 2013; Orel and Curry 2014; Ninh and Ninh, 2015; Luong et al., 2016).

Ming and Bartholomew (2007) divided *Camellia* into two subgenera (*Thea* and *Camellia*) and 14 sections. In particular, Subgenus *Camellia*

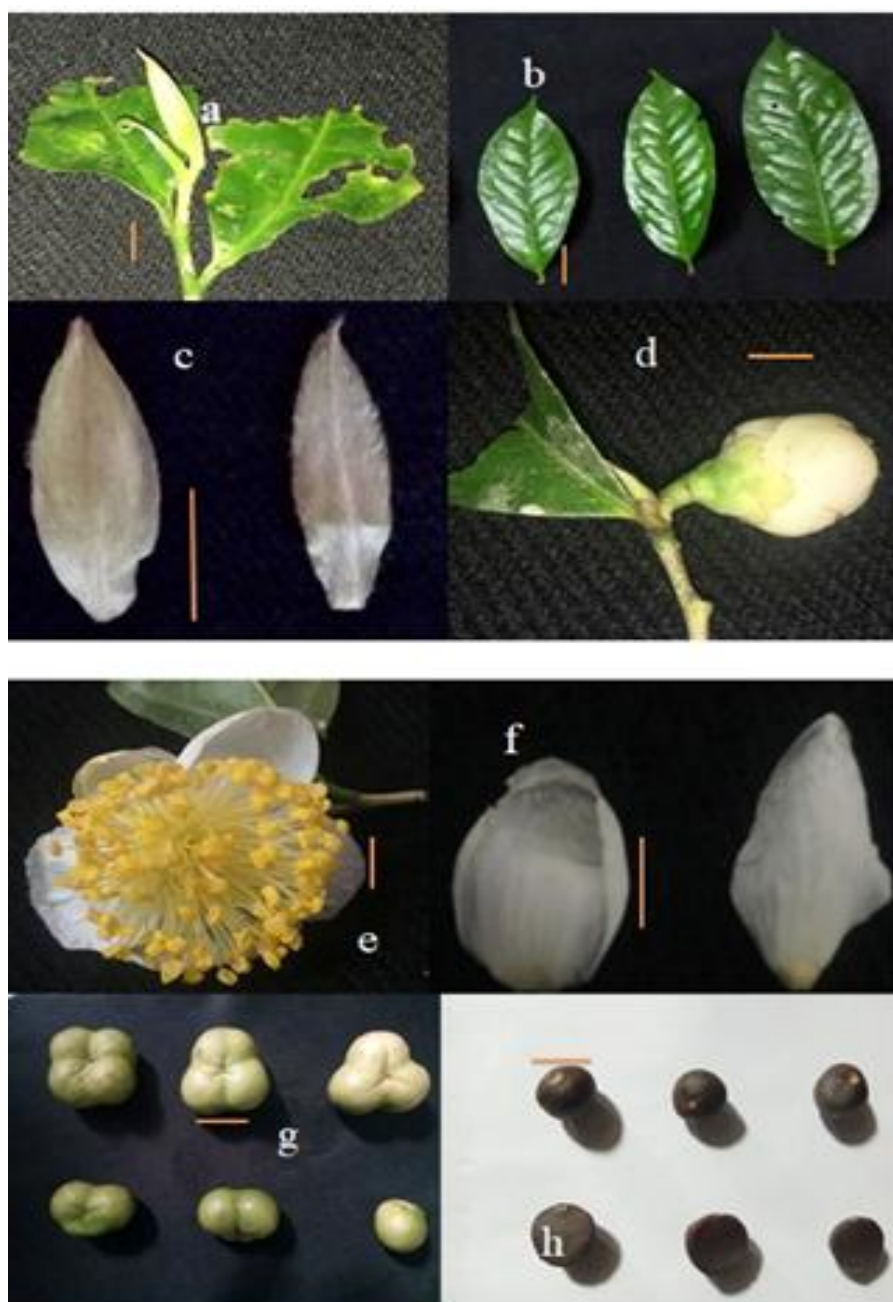
includes six sections and subgenus *Thea* includes eight sections. *Thea* belongs subgenus *Thea*.

General morphology characteristics of the species in the *Camellia* sect. *Thea* are: Pedicel thick, thickened toward apex; bracteoles 2 (or 3), caduceous. Sepals persistent. Petals white. Stamens numerous, in 4 or 5 whorls, glabrous; outer filament whorl basally connate into a tube. Ovary 3-5-loculed; style apically 3-5-parted or -lobed.

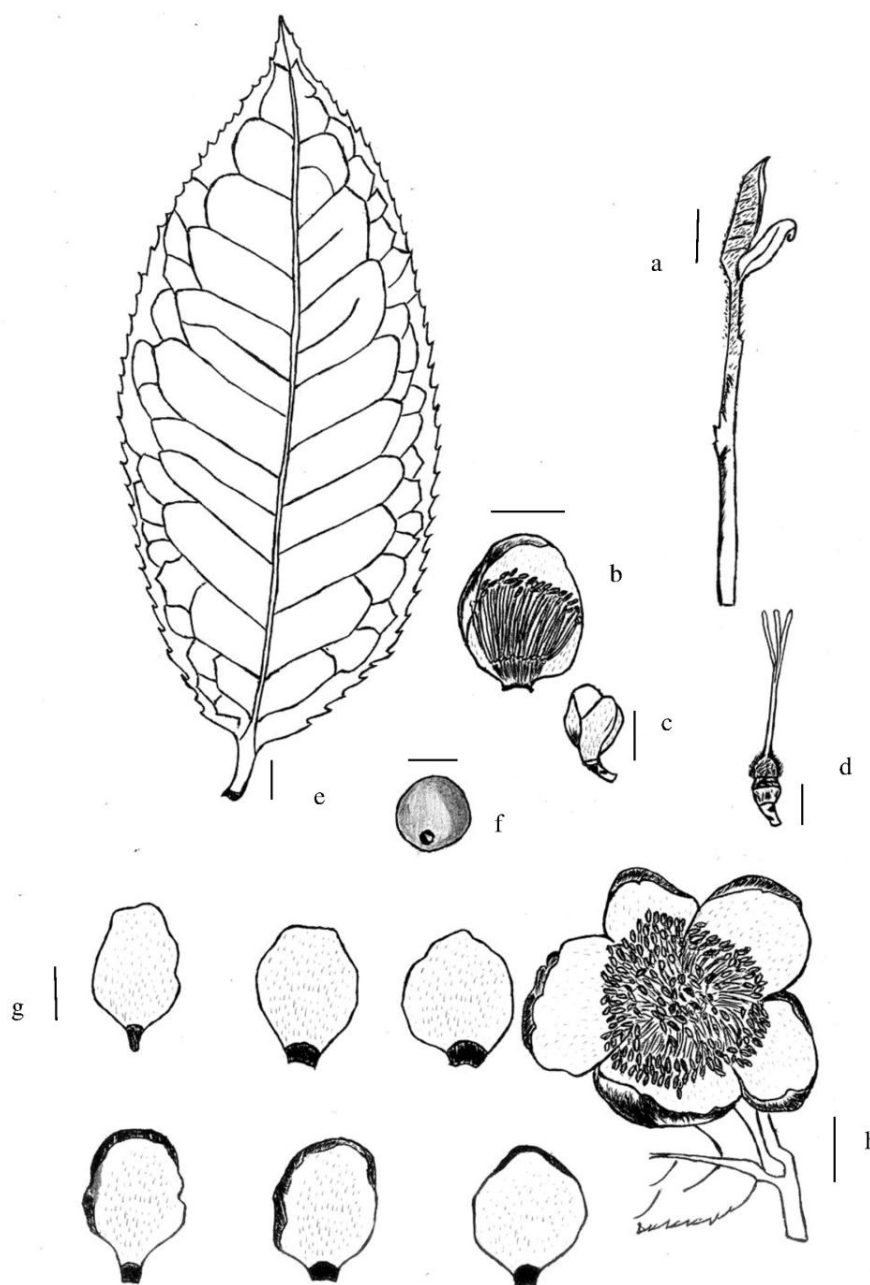
As a result of the biodiversity survey of nature herbal species during six years, the new species was gathered in the forest of Na Ri district, Bac Kan province in Viet Nam at 400-500 m alt. After analyzing and comparing the morphological characteristics with close species, we suggest that a

new varietas is named as *Camellia sinensis* var. *dulcamara*

Some morphological features allow us to place this new subspecies in *Camellia* sect. *Thea* such as: Pedicel thick, thickened toward apex; bracteoles 2 (or 3), caduceous. Sepals persistent. Petals white. Stamens numerous, in 4 or 5 whorls, glabrous; outer filament whorl basally connate into a tube. Ovary 3-loculed; style apically 3-lobed. *Camellia sinensis* var. *dulcamara* is described and its taxonomic position assessed in classification systems of Ming and Bartholomew (2007) because this is the latest system of *Camellia* and is more frequently used by taxonomists. *Camellia sinensis* var. *dulcamara* Q.U. Le & Nguyen (Figs. 1 & 2).



**Fig. 1.** *Camellia sinensis* var. *dulcamara*. a. leaf bud, b. mature leaf, c. new born leaf apex, d. flower bud, e. inflorescence, f. petals abaxials(left) and adaxial (right) views, g. mature fruit, h. seeds. Scale bars: a, c, d, e, f = 1.0 cm; b = 3.0 cm, g= 2.5 cm, h= 2.0. Photos and design by Thanh Tuan.



**Fig. 2.** *Camellia sinensis* var. *dulcamara* Q.U. Le & Nguyen. a. leaf bud, b. corolla a part of androecium, c. sepals, d. ovary and styles, e. mature leaf, f. seed, g. petals, h. flower, top view. Drawn by Thanh Tuan. Scale bars: a, c, d, e, f, g, h = 1.0 cm; b = 1.2 cm.

*Camellia sinensis* var. *dulcamara* Q.U. Le, & Nguyen. –Type: Viet Nam, Bac Kan province, in the forest of Na Ri district; on very steep humid soil slope in rich secondary broad-leaved evergreen forest, elevation 400 - 500 m above sea level; 22° 14' 41" N, 106° 1' 9" E; february 20, 2018; Le Ung TN20012018 (holotype: VNM!; isotype: TN!).

**Diagnosis:** The new species is a perennial plant, medium to large, evergreen shrub to 8 m high, 10-25 cm diameter; with upright habit; mature branches glabrous, bark brown-gray; branchlets thin while pubescent when young. Petiole slightly curved and rounded in cross section, same color as the leaves, glabrous, 8-17 mm long, 1.8-3 (-3.5) mm wide. Axillary leaf buds are white to slightly

yellowish-green, pubescent; newborn leaves being white, velvet smooth densely pubescent. Mature leaves are variable in size, cuneiform leaves base, 11-25.5 cm long, 5-9.5 cm wide, thin lanceolate; leaf apex strongly acuminate, slightly curved to one side, 0.8 -1.6 cm long; margins regularly serrate; adaxial leaf surface dark green, glabrous; abaxial leaf surface light green; midrib also light green, sunken on adaxial surface and raised on abaxial surface; secondary venation pinnate, with 6-9 pairs of veins connecting together to form convex cavities on adaxial surface. Mature flowers slightly scented, white, mostly axillary, sometimes terminal, mostly solitary, 3.5-4.2 cm in diameter; flower formula of  $*K_5C_{5-7}A_{\infty}\underline{G}_{(1-3)}$ ; sepals 5, sub-

orbicular to orbicular, 0.6-0.8 cm long, 0.4-0.7 cm wide, outside white pubescent, shiny, pale green with yellowish green to white green margin; petals 5(-7), white with pubescent in both faces, arranged in 2-3 whorls, obovate, oblong, narrowly oblong or broadly lanceolate in shape with yellowish base, 1.5 -2.8 cm long, 1.1-2.0 cm wide, basally connate to outer stamens. The flower peduncle is 0.6-0.8 cm long and has vestige of 2-3 caducous bracteoles. Stamens arranged in 4-5 whorls, white to slightly yellowish white, glabrous. Stamens in inner whorl with 1.4-1.5 cm long; these in outer whorl with 1.8-2 cm long. Outer filament whorl basally regular connate for 3.5 mm into a tube; inner filaments sparse, anthers yellow, 1.5-2 mm, mostly shorter and bigger than outer filament. Sub-globose ovary has tomentose, 2.0-3.2 mm height, 2.0-3.0 mm wide, 3-loculed, 2 mini seeds per lobe. Styles are 1.6-1.7 cm long, white, glabrous, split

into 3-lobed, free to one over three of style length, 0.6-0.7 cm long. Fruits contain 1-4 capsules forming a globose, an isosceles triangle or a square, 3.4-4 cm diameter, 1.7-2.8 cm height, each capsules containing one globose to sub-globose seed, sometime being a hemisphere seed, glabrous to rough, brown, and 1.5-2.0 cm diameter. Dry fruits may persist on plant until next season's flowering.

**Phenology:** Flowering was observed from November to December. Fruiting started from October in the following year.

**Etymology:** The specific epithet is derived from the Latin *dulc-*(dulcis=sweet) and *amara-*(bitter), bitter-sweet taste of tea.

**Distribution:** *Camellia sinensis* var. *dulcamara* is only found from the type locality which is situated on the slope of Tam Tau Mountain, Bac Kan province in Vietnam (Fig. 3).



**Fig. 3.** Distribution of *Camellia sinensis* var. *dulcamara*. Location in Bac Kan Province is marked by blue rounds.

**Ecology:** The new var. was discovered in broad-leaved evergreen forest. It grows with species of *Paris vietnamensis*, *Prynium placentarium*, *Musa acuminata*, *Dendrocalaamuss membranaceus* Munro and other species.

**Conservation status:** *Camellia sinensis* var. *dulcamara* was recorded only from Bac Kan province in Vietnam. The area of occupancy for this species is estimated to be less than 2 km<sup>2</sup>. Despite a further search of the area around the type locality, only 12 additional mature trees were found. The total known population of the species is fewer than 50 individuals. This species found do not belong to any protected forest. Moreover, the habitats are highly disturbed by local people collecting forest products. Based on our information, we propose a conservation status of *Camellia sinensis* var. *dulcamara* as critically endangered under criterion D (IUCN, 2011).

**Vernacular name:** Vietnamese name is Chè Tam Son

**Outstanding quality of Tam Son Tea:** It tasted firstly bitter and then cloyingly sweet. Bitter is similar to taste of *Gynostemma pentaphyllum* and cloyingly sweet is similar to taste of *Radix glycyrrhiza uralensis*. Interestingly, the tea does not induce insomnia when drinking.

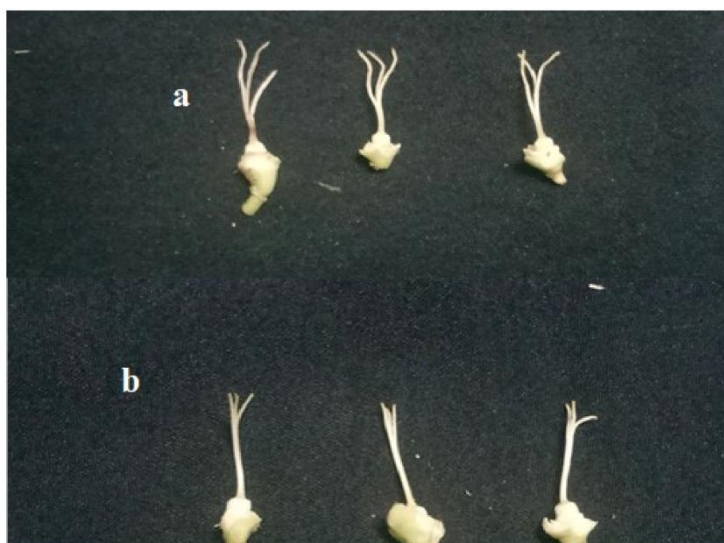
**Discussion:** *Camellia sinensis* var. *dulcamara* distributes in a relatively small geographical area which is a part of the thick residual subtropical forest where it forms a part of the dense understory. The new subspecies grows along streams and tolerates filtered sunlight and damp cool atmospheric condition. The new discovery considerably supplements the biodiversity resource for *Camellia* specieses. After also analyzing and comparing the morphological characteristics with other close varieties. The new finds are morphologically dissimilar to known *Camellia sinensis* var. *assamica*, which displayed that the different from *Camellia sinensis* var. *assamica* is petals white with pubescent in both faces (Table 1). It tasted firstly bitter and then cloyingly sweet,

which can be valuable property in practical application as also as medicine. In addition, some trees have style splits into 3-lobed, free to two over three of their length, which suggest its placement as

a subvar. of *Camellia sinensis* var. *dulcamara*, which is displayed in Figure 4. This record supported evidences in biodiversity of *Camellia sinensis* species in the nature.

**Table 1.** Morphological comparison between *C. sinensis* var. *dulcamara* with *C. sinensis* var. *assamica*.

Characters	<i>Camellia sinensis</i> var. <i>assamica</i>	<i>Camellia sinensis</i> var. <i>dulcamara</i>
Leaf blade shape	Elliptic, thicker lanceolate	Oblong, thin lanceolate
Newborn leaves	white or red, shiny pubescent	white, velvet smooth densely pubescent
Mature leaf hairiness	Abaxially densely spreading villous along midvein	Glabrous
Leaf size	8-29 cm long, 3.5-10 cm wide	11-25.5 cm long, 5-9.5 cm wide
Petiole	2-9 cm long, puberulous	slightly curved, glabrous, 8-17 mm long, 1.8-3 (-3.5) mm wide
Flower diameter (cm)	2-3.5 cm	3.5-4.2 cm
Flower pedicel	4-14 mm long	4-8 mm long
Flower booming period	December to february	November to december
Petal number	5-7, 1-2 whorls	5-7, 2-3 whorls
Petal size	1–2.5 cm × 1–2 cm	1.5-2(-2.8) cm long, 1.1-2.0 cm wide
Petal color	White, with a tinge of green at apex	whole white
Petal hairiness	Glabrous in both faces	pubescent in both faces
Filaments	0.7-1.6 cm long	1.8-2 cm long
Anthers	yellow, sub-globose, 0.8-1 mm	yellow, ellipse 1.5-2 mm
Style	0.6-1.5 cm long, apically (2)3(-4)-lobed for 1–3 mm	1.6-1.7 cm, apically splits into 3-lobed for 5-8 mm
Ovary	Ovary apically glabrous	Whole tomentose
Taste	acid	bitter and then cloyingly sweet



**Fig. 4.** Comparison in styles between *Camellia sinensis* subvar. *dulcamara* (a) with *Camellia sinensis* var. *dulcamara* (b)

#### ACKNOWLEDGEMENTS

The authors would like to thank Dr. Duong Huu Phung from Thai Nguyen University. He being a researcher on plant breeding, taxonomy and anatomy has much contribution on our work.

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