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RESEARCH ARTICLE

Sinocrassula vietnamenis (Crassulaceae), New Species and New Generic Record in the Flora of Vietnam

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ABSTRACT: New species, – *Sinocrassula vietnamensis* (*Crassulaceae*) discovered in the Northern Vietnam is described and illustrated. Standard citations of type specimens, description, name etymology, data on ecology, phenology and distribution, as well as short taxonomic remarks for the new species are provided. The species differs from its closest ally *S. diversifolia* in large well developed rosettes, hairy leaves, white flowers and long styles. The discovery of this species in Vietnam remarkably extends the geographical range of the genus southwards.

KEY WORDS: *Crassulaceae*, new species, plant diversity, plant geography, plant taxonomy, *Sinocrassula vietnamensis*, Vietnam.

INTRODUCTION

The genus *Sinocrassula* A. Berger is a small Sino-Himalayan genus of the Crassulaceae family comprising 7 hitherto known species. Its generic area includes Bhutan, Nepal, NE. India, Pakistan and China with 6 species endemic to Yunnan and Sichuan (Fu, Ohba, 2001; Thiede, 2003). One more species of the genus was recently discovered in north-western Vietnam during the field exploration of 2010–2011 in Muong Cha and Tua Chua districts of Dien Bien province of the country (Fig. 1).

The new species was observed growing under light shade and on rather open mossy boulders and cliffs composed by highly eroded solid marble-like limestone. In its habitats the plant often forms colonies of numerous crowded, rather lax rosettes 6–10 cm in diameter with glabrous or sparsely hairy basal leaves which superficially resembles rosettes of *Echeveria agavoides* Lem. originated from Mexico and well known in ornamental cultivation. During field explorations in both discovered localities plants were observed and collected in fruiting stage for herbarium and for cultivation. A year later the collected living plants bloomed in greenhouse that allowed a close examination of their floral morphology and identification. Eventually they were recognized as an unknown species of *Sinocrassula*, the genus not yet recorded in the flora of Vietnam. *Sinocrassula* is the fifth genus of Crassulaceae found in the flora of the country, additionally to *Bryophyllum* Salisb., *Kalanchoe* Adans., *Rhodiola* L., and *Sedum* L. (Gagnepain, 1920; Red data book of Vietnam, 1996; Phạm-hoang Hộ, 1999; Nguyễn Tiến Ban, 2003, personal data). Comparative morphological studies of Vietnamese plants revealed their differences from all other known species of the genus. An illustrated description of the novelty is presented below with notes on its expected relations, ecology, phenology and distribution.

TAXONOMIC TREATMENT

Sinocrassula vietnamensis Aver. et V. Byalt, sp. nov.

Figs. 1, 2A–L.

Described from north-western Vietnam ("Dien Bien province, Muong Cha district, Hua Ngai municipality, Ha La Chu village, …"). Type ("Flowered under cultivation in October-November 2013. Flowers pink, odorless. Type specimen collected from cultivated plants in 25 October 2013, *L. Averyanov, P. Efimov CPC 2041a*") – LE (holotype).

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Terrestrial or lithophytic glabrous or minutely hairy herb with biennial monocarpic rosettes forming occasionally adventitious buds producing new shoots during next year. Sterile stems short, 0.5–1.5 cm tall, simple (rarely branching), slightly thickened to the base, 5–8 mm in diam., herbaceous or semi-woody in fruiting plant. Rosettes of basal leaves rather loose, occasionally with several rosettes per plant, 6–10 cm in diameter, glaucous, dull green, olive-brown, light pink-violet to pink and almost glaucous-white, speckled throughout with fine reddish marks. Rosette leaves spirally arranged, sessile, succulent, fleshy, narrowly lanceolate to narrowly ovate, tapering to the apex and base, acute, 3–4 cm long, 0.8–1.2 cm wide, 2–3 mm thick, broadest usually below middle, adaxially often slightly concave, indistinctly cymbiform, convex and indistinctly keeled abaxially. Floriferous shoot terminal (rarely lateral), elongated, initially erect, later arching to reclining or pendulous (in plants growing on vertical cliffs), 15–25 cm long, leafy throughout with distant, spirally arranged, sessile, narrowly lanceolate to linear, recurved, acute leaves 2–3.5 cm long, 3–4 mm wide. Inflorescence terminal, compound corymb branching near the apex, with branches 2–6 cm long; floral bracts leaf-like, sessile, acute, laxly arranged, erect to down reflexed, (3)5–15 mm long. Flowers 80–120 per inflorescence, erect, actinomorphic, pedicellate, bisexual, 5-merous, of two whorls, 6–8 mm in diameter, pedicellate; pedicles (3)4–5(6) mm long. Calyx cup-shaped; sepals 5, subequal, erect, almost straight, fleshy, narrowly triangular, acute, with broadening base, 2.5–3 mm long, 1.2–1.5 mm wide, dull yellowish-green, with small purple marks, connate at the base for about 0.5 mm, divided by broad U-shaped sinus. Corolla urceolate; petals 5, subequal, almost free, thick, narrowly triangular, S-shaped in longitudinal section, base concave, apically recurved, obtuse, 4–5 mm long, 1.5–2 mm wide, white, speckled toward the apex with many fine purple marks. Stamens 5, inserted between sepals, slightly shorter than petals; filaments white, erect, straight; anthers basifixed, ovoid, about 0.8 mm long and wide, scarlet-purple. Nectar scales entire, subquadrate to transverse-rectangular, 0.3–0.5 mm long, 0.5–0.7 mm wide. Ovary of 5, white carpels, joined at the base for 0.4–0.7 mm. Carpels as long as stamens, ventrally hardly keeled, about 3.5 mm long, rather broad, erect, attenuate at apex into straight styles 1–1.5 mm long terminated in small capitate stigma. Fruit of 5 follicles joined at the vase. Ripe, dry follicles 2.5–3 mm long, 0.8–1 mm wide, many seeded, narrowly ovoid, ventrally keeled, apically with recurved beak, dehiscent from the apex by lateral irregular splits. Seeds ovoid, dull brown, longitudinally grooved, 0.5–0.7 mm long.

Etymology: The specific epithet refers to the country of the species discovery.

Ecology: Terrestrial and lithophytic succulent herb in rather exposed rock outcrops. Primary and secondary evergreen broad-leaved forests on remnant rocky karstic hills composed by marble-like, solid, crystalline limestone at elevations of 1100–1400 m a.s.l., particularly on steep rocky mossy slopes and on shady cliffs.

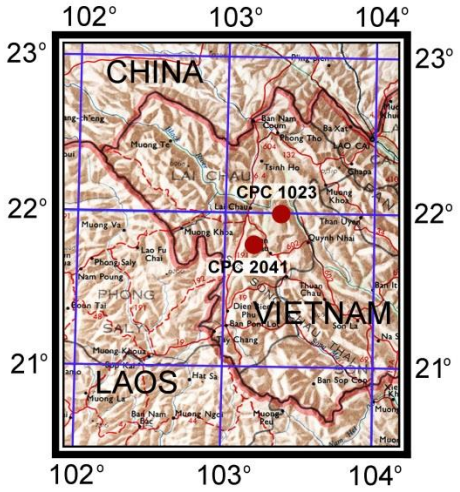


Fig. 1. Location of 2 discovered subpopulations of *Sinocrassula vietnamensis* Aver. et V.Byalt in north-western Vietnam with indication of collection numbers documenting these discoveries.

Phenology: Flowers in September–October, fruits in November–December.

Distribution: The species is probably endemic to a very limited area of karstic rocky limestone in north-western Vietnam within Dien Bien province (Muong Cha and Tua Chua districts). Fig. 1.

Paratypes. N. Vietnam, Dien Bien Prov., Muong Cha Distr., Hua Ngai Municipality, Ha La Chu Village, around point, 21°53’46”N, 103°10’17”E. Highly degraded primary evergreen broad-leaved humid forest on very steep slopes of remnant mountains composed with solid limestone at elevation 1100-1400 m a.s.l. Lithophytic rosulate succulent herb on open mossy cliff. Rare. 7 April 2011, *L. Averyanov, P.K. Loc, N.Q. Hieu, N.T. Vinh CPC 2041* (Herbarium of the Center for Plant Conservation!, LE!). N. Vietnam, Dien Bien Prov., Tua Chua Distr., Ta Phin Municipality, around point, 22°00’21”N, 103°21’39”E. Open secondary scrub on very steep rocky humid mossy slopes of remnant hills composed with highly eroded marble-like solid crystalline limestone at elevation about 1150 m a. s. l. Rosulate succulent herb on open mossy rocks. Leaves dark greenish-gray. Rare, but locally common. 16 December 2010, *L. Averyanov, P.K. Loc, P.V. The, N.T. Vinh CPC 1023*” (Herbarium of the Center for Plant Conservation!, LE!).

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Notes: *Sinocrassula vietnamensis* clearly differs in its morphology from all known species of the genus including the most widespread and variable species *S. Indica* which occurs all over the generic area from Nepal and NE. India to central and southern China

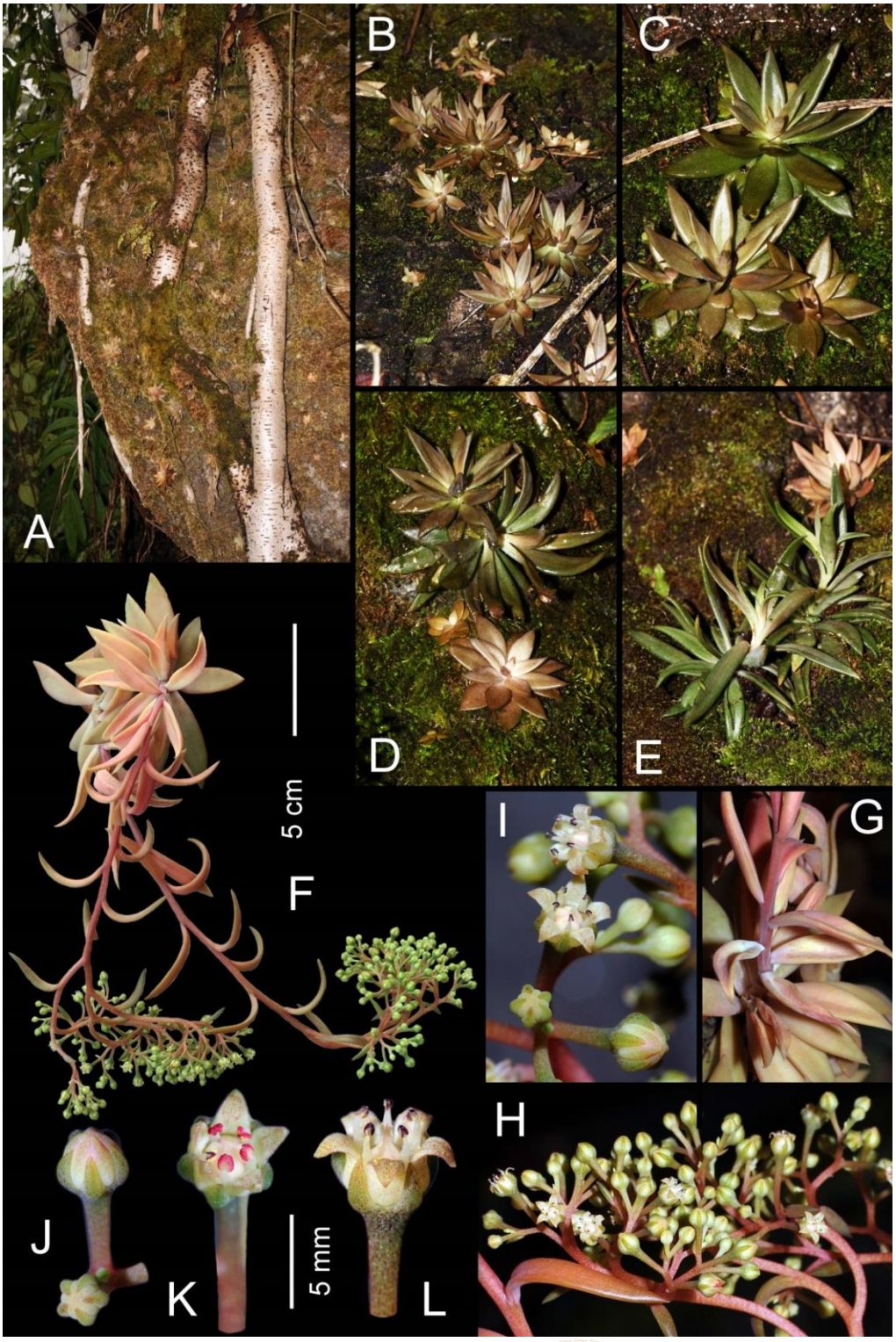


Fig. 2. ***Sinocrasssula vietnamensis*** **Aver. et V. Byalt. A – species colony in typical habitat; B-E – plants in nature; F – flowering plant in cultivation; G – basal portion of fertile shoot; H – portion of inflorescence; I – open flowers and flower buds; J – flower buds, K – opening**

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young flower; L – old flower at later stage of anthesis (A-E – *CPC 2041*, photos of L. Averyanov; F-L – type, *CPC 2041a*, photos of P. Efimov).

Table. Comparison of diagnostic characters between *Sinocrassula vietnamica* and allied species

CHARACTER	*S. vietnamensis*	*S. indica*	*S. diversifolia*	*S. longistyla*
Height of floriferous stem	15-25 cm	5-60 cm	40-50 cm	20-25 cm
Diameter of rosettes	6-10 cm	8-12 cm	6-8 cm	~ 3 cm
Presence of rosettes at anthesis	+	+	–	+
Leaf dimorphism	±	±	+	±
Rosette leaves size	3-4 x 0.8-1.2 cm	3.5-6 x 1-1.5 cm	3-5 x 2-2.7 cm	~ 1.5 x 0.5 cm
Floriferous stem leaves size	2-3.5 x 0.3-0.4 cm	2.5-3 x 0.4-1 cm	3-5 x 0.3-0.8 cm	~ 1.5 x 0.5 cm
Leaf hairiness	– ±	±	–	–
Primary inflorescence branches length	2-6 cm	1-6 cm	4-6	6-10
Flowers per inflorescence	80-120	?	?	30-60
Pedicle	terete	terete	winged	terete
Flower diameter	6-8 mm	4-8 mm	~ 6 mm	~ 6 mm
Flower color	white	red, yellow, greenish	yellow	deep purple
Sepal shape	narrowly triangular	broadly triangular	narrowly triangular	narrowly triangular
Sepal size	2.5-3 x 1.2-1.5 mm	~ 2 x 1 mm	2-2.5 x 1-1.5 mm	1.5-2.5 x 1-1.2 mm
Petal shape	narrowly triangular	lanceolate to ovate	lanceolate	triangular ovate
Petal size	4-5 x 1.5-2 mm	2.5-5 x ~ 2 mm	3.5-4 x 1-1.5 mm	3.5-4 x 1.2 mm
Carpel length	3.5 mm	2.5-3 mm	2.5-3 mm	~ 3 mm
Style length	1-1.2 mm	< 1 mm	0.5-1 mm	~ 1.5 mm

(Ohba, 1992; Fu, Ohba, 2001). Among local Chinese endemics our new species most closely resembles *S. diversifolia* H.Chuang, a rare species recorded from highlands of north-western Yunnan (Chuang, 1997; Fu, Ohba, 2001), from which it differs in large well developed rosettes of basal leaves, subsimilar rosette leaves and leaves of fertile stem, in hairy leaf base, white petals and in relatively long styles reaching about 1/3 of carpel length. The new species has also some similarities with and is probably related to *S. indica* (Decne.) A. Berger and *S. longistyla* (Praeger) S.H. Fu. A detailed comparison of the most important diagnostic characters shared with the new species and its closest allies are presented in table.

A key for identification of all known species of the genus including the novelty is compiled and provided below.

Key to the species of *Sinocrassula* A. Berger

1. Floral stem more than 10 cm tall 2
-. Floral stem less than 10 cm tall.....5

2. Primary branches of inflorescence longer than 6 cm; styles 1.5 mm long.....1. ***S. longistyla***
-. Primary branches of inflorescence usually less than 6 cm long; styles 0.5–1 mm long 3
3. Leaves distinctly dimorphic; basal leaves broadly obovate or elliptic, 2–2.7 cm wide; inflorescence branches and pedicels winged; petals 1–1.5 mm long.....2. ***S. diversifolia***
-. Leaves monomorphic or indistinctly dimorphic; basal leaves broadly oblanceolate to ovate-orbicular, 0.8–1.5 cm wide; inflorescence branches and pedicels terete; petals 1.5–2 mm long 4
4. Leaves monomorphic, all uniformly broadly oblanceolate, obovate, or ovate-orbicular, 0.4–1.5 cm wide; flowers red, yellow or yellowish-green; sepals broadly triangular, 1 mm wide; carpel 2.5–3 mm, style less than 1 mm long.....3. ***S. indica***
-. Leaves indistinctly dimorphic; basal leaves lanceolate to broadly lanceolate, toward stem apex narrowly lanceolate to linear, 3–4 mm wide; flowers white; sepals narrowly triangular, 1.2–1.5 mm wide; carpel about 3.5 mm, style 1–1.2 mm length.....4. ***S. vietnamica***
5(1). Leaves and stems densely pubescent.....5. ***S. yunnanensis***
-. Leaves and stems glabrous, or sparsely hairy..... 6
6. Leaves hairy; flowering stem glabrous.....3. ***S. indica***
-. Leaves glabrous; flowering stem glabrous or sparsely hairy.....7
7. Sepals as long, or longer than petals; caudex branched, 3–6 cm long.....6. ***S. ambigua***
-. Sepals distinctly shorter than petals; caudex simple, shorter than 3 cm long.....8
8. Basal leaves persistent, form compact rosette; petals narrowly triangular.....7. ***S. densirosulata***
-. Basal leaves early caducous, do not form persistent rosette; petals oblong.....8. ***S. techinensis***

The discovery of *S. vietnamensis* in northern Vietnam remarkably extends the geographic area of the genus *Sinocrassula* in southern direction. It is first record of this montane Sino-Himalayan genus in the floras of Indochina, genuine tropics of mainland Southeast Asia.

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(9129-12). They are also grateful to Dr P. Efimov for photography of flowering plant under cultivation.

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