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Capparis paucistaminata Sy, D.V.Hai & Fici, sp. nov. (Capparaceae, Brassicales), a new species from Gia Lai Province in Vietnam

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Capparis paucistaminata Sy, D.V.Hai & Fici, sp. nov. (Capparaceae, Brassicales), a new species from Gia Lai Province in Vietnam

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KEY WORDS
Binh Dinh Province, Capparaceae, *Capparis*, sect. *Monostichocalyx*, *Capparis micracantha*, *Capparis paucistaminata*, *Capparis rigida*, new species.

ABSTRACT
Capparis paucistaminata Sy, D.V.Hai & Fici, sp. nov. from Gia Lai Province is here described and illustrated. The new species belongs to *Capparis* sect. *Monostichocalyx* Radlk. and is morphologically similar to *C. micracantha* subsp. *micracantha* var. *micracantha* DC. but differs in several characters such as length of thorn, shape of leaf, emarginate leaf apex, hairy margin of sepals, lower number of stamens and shape of ovary. Its habitat and conservation status are provided along with a taxonomic key to the closely allied species. The conservation status of the new species is assessed as Data Deficient (DD).

MOTS CLÉS
Province de Binh Dinh, Capparaceae, *Capparis*, sect. *Monostichocalyx*, *Capparis micracantha*, *Capparis paucistaminata*, *Capparis rigida*, espèce nouvelle.

RÉSUMÉ
Capparis paucistaminata *Sy, D.V.Hai & Fici, sp. nov. (Capparaceae, Brassicales), une espèce nouvelle de la province de Gia Lai au Vietnam.*
Capparis paucistaminata Sy, D.V.Hai & Fici, sp. nov. de la province de Gia Lai est décrite ici et illustrée. L'espèce nouvelle appartient à la section *Capparis* sect. *Monostichocalyx* Radlk. et est morphologiquement similaire à *C. micracantha* subsp. *micracantha* var. *micracantha* DC., mais elle se distingue par plusieurs caractères tels que la longueur des épines, la forme des feuilles, l'apex émarginé des feuilles, la marge poilue des sépales, un nombre inférieur d'étamines et la forme de l'ovaire. Son habitat et son statut de conservation sont fournis, accompagnés d'une clé taxonomique pour les espèces proches. Le statut de conservation de la nouvelle espèce est évalué comme Données Insuffisantes (DD).

INTRODUCTION

Capparis L. is the largest genus in Capparaceae, with 150 species, widely distributed in tropical and subtropical regions of the Old World, even in some areas of the Mediterranean and Central Asia (POWO 2025). From 2013 to present, eight new species of the genus *Capparis* have been described from Vietnam, including *Capparis daknongensis* D.T.Sy, G.C.Tucker, Cornejo & Joongku Lee, *Capparis gialaiensis* Sy, *Capparis dongvanensis* Sy, B.H.Quang & D.V.Hai, *Capparis bachii* Sy, R.K.Choudhary & Joongku Lee, *Capparis kbangensis* Sy & D.V.Hai and *Capparis oxycarpa* Fici, Averyanov & Sy, while a few intrageneric taxa were firstly recorded from the country, i.e. *Capparis fengii* B.S.Sun, *Capparis pubifolia* B.S. Sun, *Capparis sikkimensis* subsp. *masaikai* (H.Lév.) M.Jacobs, *Capparis montis-aquae* Fici & Sy and *Capparis rupicola* Fici & Sy (Thuong *et al.* 2013a, b, 2015, 2017a, b, c, 2020; Thuong 2016; Fici *et al.* 2022; Fici 2023; Fici & Thuong 2025a, b). Gia Lai province is located in the South Central Coast region with relatively complex and diverse terrain, so it has a rich vascular flora. Investigations carried out in this area in recent years allowed to describe some new vascular plant species such as: *Xanthophytum antoanense* Luu, H.C.Nguyen, X.B.Nguyen-Le & Q.D.Nguyen, *Aspidistra thuongiana* Vislobokov, Nuraliev, V.C.Nguyen & V.T.Pham, *Garcinia phuongmaiensis* V.S.Dang, H.Toyama & D.L.A.Tuan (Pham *et al.* 2021; Dang *et al.* 2023; Nguyen *et al.* 2024). During a field survey in Binh Dinh province in 2016, we discovered a *Capparis* population showing the following characteristics: stem and leaf glabrous; stipular thorns very short, 2-3 mm long, present only on old branches; both surfaces of leaf green and shiny; flowers serial, 3-4 in supra-axillary rows; stamens 6-9. Based on the study of herbarium collections and monographs on the genus *Capparis*, the material obtained from this population turned out to belong to a new species of sect. *Monostichocalyx* Radlk. This new species is here described and illustrated, and data on its ecology, conservation status and relationships to closely related species are provided.

MATERIAL AND METHODS

The new species was observed and collected by one of us (D.V.Hai) in March 2016 with a few individuals encountered. The specimen is stored at the herbarium of Institute of Biology – Vietnam Academy of Science and Technology (HN). The description and illustration are based on collected specimens. The terminology of vegetative and reproductive structures is based on Jacobs (1965). Species names and author names are based on the International Plant Names Index version 2025 (IPNI 2025). The conservation status has been assessed according to IUCN categories and criteria (version 16) (IUCN 2024).

Herbarium abbreviations

HN Herbarium of Vietnam Academy of Science and Technology, Ha Noi;

KRIB Herbarium of Korea Research Institute of Bioscience and Biotechnology, Daejeon.

TAXONOMIC TREATMENT

Family Capparaceae Juss.
Genus *Capparis* L.

Section *Monostichocalyx* Radlk.

Capparis paucistaminata Sy, D.V.Hai & Fici, sp. nov.
(Figs 1-3; Table 1)

Diagnosis. — *Capparis paucistaminata* Sy, D.V.Hai & Fici, sp. nov. is morphologically most similar to *C. rigida* M.Jacobs, and can be distinguished from the latter species mainly by stipular thorns 2-3 mm long, present on the old branches (vs very weak and only present on the innovations, later obsolete in *C. rigida*); base of leaf rounded to nearly cordate (vs acute in *C. rigida*); apex of leaf acute (vs subacuminate in *C. rigida*); flowers 3-4 in supra-axillary rows (vs 2 in *C. rigida*). The new species is also related to *C. micracantha* subsp. *micracantha* var. *micracantha* by which it is distinguished by stipular thorns 2-3 mm long (vs 6-7 mm long in *C. micracantha* subsp. *micracantha* var. *micracantha*); pedicels 2-3 cm long (vs 0.6-1 cm long in *C. micracantha* subsp. *micracantha* var. *micracantha*); sepals lanceolate, glabrous (vs ovate-elliptic, with margins tomentose in *C. micracantha* subsp. *micracantha* var. *micracantha*); petals obovate, hairy only at the base of upper pair (vs linear-oblong, puberulous on both sides in *C. micracantha* subsp. *micracantha* var. *micracantha*); stamens 6-9 (vs 12-16 in *C. micracantha* subsp. *micracantha* var. *micracantha*); ovary nearly cylindric (vs ovoid to ellipsoid in *C. micracantha* subsp. *micracantha* var. *micracantha*) (Table 1).

Type material. — **Vietnam** • Gia Lai Province, Quy Nhon Nam ward; *c.* 2 m a.s.l. 13°44’34.6”N, 109°12’40.9”E; 6.III.2016; *Tran The Bach, Tran Duc Binh, Vu Tien Chinh, Do Van Hai, Hoang Hong Son VK 6775*; holotype: HN!, isotype: KRIB!

Distribution, habitat and phenology. — The new species is so far known from a single location in the Ghenh Rang ward, Quy Nhon City, Binh Dinh Province, at 13°44’34.6”N, 109°12’40.9”E. It was found growing on rocky soil along the roads, at an elevation of around 100 m, with *Lantana camara* L., *Basella alba* L., *Cassia* L. sp. The flowering occurs from March to May.

Etymology. — The specific epithet is composed of the Latin words “pauci”, meaning “few”, and “staminatus”, “staminate”.

Conservation status. — *Capparis paucistaminata* Sy, D.V.Hai & Fici, sp. nov. is known from the type locality only, occurring in Gia Lai Province, where a few individuals were observed. Based on our observations, the number of individuals is very small and these are localized near roads. Therefore, it is greatly affected by human activities. Survey of the adjacent forests and long-term monitoring of the type locality is required to obtain more information of this species. So that, the new species is assessed here as Data Deficient (DD) according to IUCN Red List Categories and Criteria (IUCN 2024).

Description

Ascending shrub 4-5 m tall. Branches green, bearing small knobs surmounted by a thorn; twigs glabrous, at the base usually surrounded by cataphylls. Thorns straight *c.* 2-3 mm long, directed downwards, or slightly recurved, present on the old branches. Petioles 6.5-7 mm long, glabrous. Leaf blades coriaceous, glabrous, obovate or narrow elliptic, *c.* 2.8-3 times as long as wide, 5.5-5.7 × 1.8-2 cm; base rounded to nearly cordate; apex acute; secondary veins 5-6 on each side of the midvein; reticulation distinct; upper surface bold green and



FIG. 1. — *Capparis paucistaminata* Sy, D.V.Hai & Fici, sp. nov.: **A**, flowering branch; **B**, stem showing thorns; **C**, adaxial side of leaf; **D**, abaxial side of leaf; **E**, bud; **F**, sepals; **G**, petals; **H**, stamen; **I**, sepals, gynophore and ovary; **J**, gynophore and ovary; **K**, disc. Drawn from holotype (*T.T. Bach et al. VK 6775*) by Le Kim Chi. Scale bars: A, C, D, 6 cm; B, F, I, J, 5 mm; E, G, 1 cm; H, K, 2 mm.



Fig. 2. — *Capparis paucistaminata* Sy, D.V.Hai & Fici, sp. nov.: **A**, habit; **B**, stem showing thorns; **C**, flowering branch. Photos by Do Van Hai & Danh T. Sy. Scale bars: A, 10 cm; B, 3 mm; C, 2 cm.

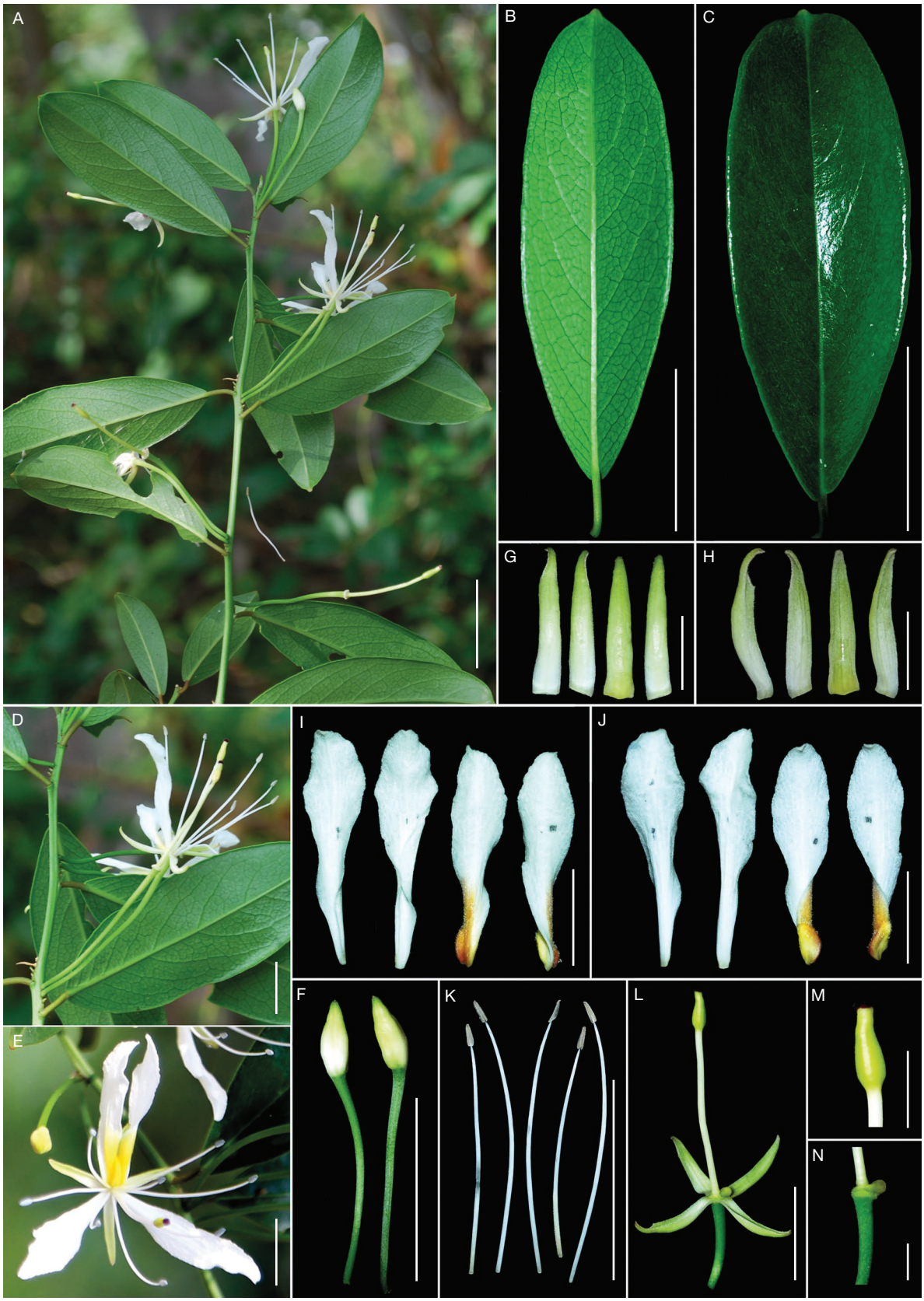


FIG. 3. — *Capparis paucistaminata* Sy, D.V.Hai & Fici, sp. nov.: **A**, flowering branch; **B**, abaxial side of leaf; **C**, adaxial side of leaf; **D**, inflorescences; **E**, flower (front view); **F**, buds; **G**, sepals (outside view); **H**, sepals (inside view); **I**, petals (inside view); **J**, petals (outside view); **K**, stamens; **L**, sepals, gynophore and ovary; **M**, ovary; **N**, disc. Photos by Do Van Hai & Danh T. Sy. Scale bars: A-C, F, K, 2 cm; D, E, I, J, L, 1 cm; G, H, 5 mm; M, 4 mm; N, 3 mm.

TABLE 1. — Diagnostic characters among *Capparis paucistaminata* Sy, D.V.Hai & Fici, sp. nov. and related taxa.

	***Capparis paucistaminata* Sy, D.V.Hai & Fici, sp. nov.**	***Capparis micracantha* subsp. *micracantha* var. *micracantha* DC.**	***C. rigida* M.Jacobs**
Habit	Shrub	Shrub or small tree, rarely climber	Shrub or climber
Height (m)	4-5 m	2-6(-10) m	Shrub around or climber 7-8 m
Indumentum of twigs	Glabrous	Sparsely pubescent when young	Glabrous
Thorn	Straight *c.* 2-3 mm long, directed downwards or slightly recurved, present on the old branches	Patent or directed upwards, straight or slighdy curved, 6-7 mm long	Very weak and only present on the innovations, later obsolete
Length of petiole (mm)	6.5-7	6-10(-15)	8-12
Leaf blade	Obovate or narrow elliptic, 5.5-5.7 × 1.8-2 cm	Oblong, elliptic or ovate, 8-12.5 × 3.5-5.5 cm	Elliptic, 5,5-7,5 × 2,2-3,7 cm
Base of leaf	Rounded to nearly cordate	Rounded to slightly cuneate	Acute
Apex of leaf	Acute	Rounded and with a mucronulate callus	Subacuminate
Number of flowers	3-4, appearing on twigs with leaves	2-6, often appearing before new leaves on young twigs	2, appearing on twigs with leaves, or small bundles of empty bracts in their place
Pedicel length (mm)	20-30	6-10	18
Sepals	Lanceolate, 10-13 × 2-2.5 mm, glabrous	Ovate-elliptic, 6-10 × 3-4 mm, margin tomentose	Unknown
Petals	Obovate, 23-25 × 4-6 mm, upper pair hairy at the base	Linear-oblong, 11-12 × 3-3.5 mm, puberulous on both sides	Unknown
Stamens	6-9, with filaments 2-2.5 cm long	12-16, with filaments 2-3 cm long	Unknown
Ovary	Nearly cylindric, 4-5 mm long	Ovoid to ellipsoid, 2.5-3 mm long	Unknown

shiny, lower surface light green. Bud flower lanceolate, with a point at the top. Flowers white, serial, 3-4 in supra-axillary rows; pedicels 2-3 cm long, green, glabrous. Sepals 1-1.3 × 0.2-0.25 cm, light green, glabrous on both sides, lanceolate. Petals obovate, 2.3-2.5 × 0.4-0.6 cm; upper pair white with yellow or purple honey-guide, hairy at the base; lower pair white and glabrous. Stamens 6-9; filaments *c.* 2-2.5 cm long; anthers *c.* 2 mm long. The disk is knob-shaped and positioned at the base of the gynophore. Gynophore 1.8-2 cm long, glabrous; ovary nearly cylindric, 4-5 × 1.5-2 mm, glabrous; stigma head-sharp, dark red. Fruit unknown.

DISCUSSION

To date, the genus *Capparis* in Vietnam includes 38 species, eleven subspecies and three varieties, all belonging to sect. *Monostichocalyx* (Fici *et al.* 2022). With its wide latitudinal range and diverse ecological conditions, Vietnam shows a large diversity of vascular flora, including the one of the genus *Capparis*. The Bach Ma mountain range (part of the Truong Son Range running close to the sea) is the natural boundary between the northern territory (from Hue city northwards) and the southern territory (from Da Nang city southwards). The southern territory has a hot climate all year round and an average annual temperature above 25°C. Of the 38 species, eleven subspecies and three varieties of the genus *Capparis* recorded in Vietnam, 32 species, seven subspecies and three varieties are distributed in the southern territory. As reported above, since 2013, six new species have been discovered in this area: among these *Capparis daknongensis* was found in Lam Dong province, *C. gialaiensis*, *C. khangensis* and *C. paucistaminata* Sy, D.V.Hai & Fici, sp. nov. were found in Gia Lai province, *Capparis bachii* was found in Dong Nai province and *Capparis oxycarpa* was found in Khanh Hoa province. Future investigations and detailed studies of the flora in the southern territory of Vietnam will certainly add new data on the diversity of the genus *Capparis* in Vietnam.

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REFERENCES

DANG L. A. T., TOYAMA H., NGUYEN X. M. A., PHAN T. T. N., TRUONG B. V. & DANG V. S. 2023. — *Garcinia phuongmaiensis*, a new species of *Garcinia* sect. *Xanthochymus* (Clusiaceae) from central Vietnam. *Kew Bulletin* 78: 189-195. https://doi.org/10.1007/s12225-023-10077-0

FICI S. 2023. —The genus *Capparis* L. (Capparaceae) in Laos and Cambodia. *Kew Bulletin* 78: 1-41. https://doi.org/10.1007/s12225-022-10071-y

FICI S., AVERYANOV L. V. & THUONG S. D. 2022. — An Updated Checklist of the Genus *Capparis* L. (Capparaceae) in Vietnam, including a New Species from Hon Tre Island. *Plants* 11 (23): 3402. https://doi.org/10.3390/plants11233402

FICI S. & THUONG S. D. 2025a. — *Capparis montis-aquae*, a new species of Capparaceae from Da nang Province, central Vietnam. *Kew Bulletin* 80: 725-731. https://doi.org/10.1007/s12225-025-10293-w

FICI S. & THUONG S. D. 2025b. — A new species of *Capparis* (Capparaceae) from Bac Kan Province, Vietnam. *Blumea* 69: 270-274. https://doi.org/10.3767/blumea.2024.69.03.06

IPNI 2025. — *International Plant Names Index*. Available from: http://www.ipni.org [accessed 25 April 2025].

IUCN 2024. — *Guidelines for Using the IUCN Red List Categories and Criteria* (version 16). the Standards and Petitions Committee.

Jacobs M. 1965. — The genus *Capparis* (Capparaceae) from the Indus to the Pacific. *Blumea* 12: 385-541.

Nguyen H. C., Nguyen L. X. B., Nguyen Q. D., Nguyen T. Q. T. & Luu H. T. 2024. — *Xanthophytum antoanense* (Rubiaceae, Ophiorrhizeae), a new species from Vietnam. *PhytoKeys* 250: 215-222. https://doi.org/10.3897/phytokeys.250.137482

Pham V. T., Nguyen V. C., Phan K. L., Tran T. V. T., Nguyen V. K., Nuraliev M. S. & Vislobokov N. A. 2021. — *Aspidistra thuongiana* (Asparagaceae, Nolinoideae), a new species from the South Central Coast region of Vietnam. *Phytotaxa* 496: 261-268. https://doi.org/10.11646/phytotaxa.496.3.4

POWO 2025. — *Plants of the World Online*. Facilitated by the Royal Botanic Gardens: Kew. Available from: http://www.plantsoftheworldonline.org/ [accessed 24 April 2025].

Thuong S. D. 2016. — *Capparis fengii* B. S. Sun (Capparaceae Juss.) – A new record for flora of Vietnam. *In Proceedings of the Scientific conference for students and young staff of national pedagogical universities.* University of Education Publishing House, Ho Chi Minh City: 979-983.

Thuong S. D., Bach T. T., Choudhary R. K., Tucker G. C., Cornejo X. & Lee J. 2013a. — *Capparis daknongensis* (Capparaceae) a new species from Vietnam. *Annales Botanici Fennici* 50 (1-2): 99-102. https://doi.org/10.5735/085.050.0119

Thuong S. D., Bach T. T., Tucker G. C., Cornejo X. & Lee J. 2013b. — *Capparis sikkimensis* Kurz subsp. *masaikai* (H. Lév.) Jacobs (Capparaceae): a new distributional record for Vietnam. *Korean Journal of Plant Taxonomy* 43 (2): 103-105. https://doi.org/10.11110/kjpt.2013.43.2.103

Thuong S. D., Bach T. T., Choudhary R. K., Tucker G. C., Hai D. V., Quang B. H., Chinh V. T. & Lee J. 2015. — *Capparis gialaiensis* (Capparaceae) a new species from Vietnam. *Annales Botanici Fennici* 52 (3-4): 219-223. https://doi.org/10.5735/085.052.0314

Thuong S. D., Choudhary R. K., Bach T. T., Hai D. V., Quang B. H., Mau C. H., Choi S. & Eum S. 2017a. — *Capparis pubifolia* B.S.Sun (Capparaceae): a newly recorded species for the flora of Vietnam. *Korean Journal of Plant Taxonomy* 47 (2): 106-111. https://doi.org/10.11110/kjpt.2017.47.2.106

Thuong S. D., Choudhary R. K., Bach T. T., Hai D. V., Quang B. H., Tucker G. C., Mau C. H., Lee J., Lee C. & Eum S. 2017b. — *Capparis dongvanensis* sp. nov. (Capparaceae) from Vietnam. *Nordic Journal of Botany* 35: 272-275. https://doi.org/10.1111/njb.01326

Thuong S. D., Choudhary R. K., Tucker G. C., Mau C. H., Nguyen T. T. N., Nguyen H. Q. & Lee J. 2017c. — *Capparis bachii* (Capparaceae) a new species from southern Vietnam. *Annales Botanici Fennici* 55 (1-3): 31-35. https://doi.org/10.5735/085.055.0105

Thuong S. D., Hai D. V., Choudhary R. K., Bach T. T., Mau C. H., Quan N. H., Nga N. T. T., Tucker G. C. & Lee J. 2020. — *Capparis kbangensis* (Capparaceae), a new species from central Vietnam. *PhytoKeys* 151: 83-91. http://doi.org/10.3897/phytokeys.151.50477

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