Blumea 59, 2014: 1–5
www.ingentaconnect.com/content/nhn/blumea

RESEARCH ARTICLE

http://dx.doi.org/10.3767/000651914X681117

Herpetospermum operculatum (*Schizopeponeae*, *Cucurbitaceae*), a new species from India, Myanmar and China

K. Pradheep[1], A. Pandey[1], K.C. Bhatt[1], E.R. Nayar[1]

Key words

China
Herpetospermum tonglense
misidentification
Myanmar
north-eastern India
taxonomy

Abstract A new species of *Herpetospermum* (*Schizopeponeae*, *Cucurbitaceae*) is described from north-eastern India, northern Myanmar and southwest China (Xizang and Yunnan). *Herpetospermum operculatum* was previously confused with *Herpetospermum* (= *Biswarea*) *tonglense*, but differs primarily in having smooth yellow-striped fruit with operculum at stylar end, ascendent seed arrangement in fruit and prominent probracts and bracts. At least a part of the collections of *Herpetospermum tonglense* in Myanmar and China represent misidentification of this species.

Published on 3 April 2014

INTRODUCTION

Of the two genera of the tribe *Schizopeponeae* Jeffrey adopted by Schaefer & Renner (2011a), *Herpetospermum* Wall. ex Benth. & Hook.f. s.l. (including unispecific *Edgaria* C.B.Clarke and *Biswarea* Cogn.) is a small genus with three species found among thickets and along riverbanks at altitudes of (1200–) 1500–3000 m in the Himalayas, north-eastern India, Myanmar and south-western China. They are dioecious herbaceous climbers with solitary female flowers, male flowers in racemes, three stamens with conduplicate or straight anther thecae, pendent or horizontal ovules, and fibrous fusiform fruits dehiscing apically and longitudinally by three valves (Schaefer & Renner 2011b). Difference of opinion exists over the merger of these genera into one, as is evident from the recently published Flora of China (Lu et al. 2011) which considered them to be distinct. Clarke (1877), who described *Edgaria* and *Warea* C.B.Clarke (= *Biswarea*), acknowledged the overall resemblance of these taxa with respect to e.g., habitat, habit, proportion of male to female flowers, fruit size, shape and markings, and the resemblance has lead to frequent misidentifications (Chakravarty 1982).

While on survey and exploration tour to Sikkim and Nagaland for germplasm collection of cultivated cucurbits and their wild relatives during 2011 and 2012, the first and third author had come across a few wild plants superficially resembling *Luffa* Mill. in having an operculum at the fruit apex but strikingly different in flowers, internal fruit and seed morphology. While matching these plants with digital images in online herbaria of E, K, P and PE, we found that similar plants from Myanmar and Yunnan and Xizang provinces of China were kept under '*Biswarea* sp. nov.' or '*Biswarea tonglensis*' or '*Herpetospermum pedunculosum*' at E, PE and PE/K, respectively. Jeffrey recognized these as belonging to a new species under *Biswarea* (*G. Forrest 9114* & *T.T. Yu 16473*) at E in 1981, but did not name them. The reason could be the scarcity of mature fruit and seed material, which provide reliable features for identification (Chakravarty 1959, Singh 1967) and also the difficulties involved in matching specimens with female flowers, male flowers and fruit (Jeffrey & Trujillo 1992). Differences among *H. operculatum*, *H. tonglense*, *H. pedunculosum* and *H. darjeelingense* are given in Table 1.

On describing the new species under *Herpetospermum*, there is a need to emend the generic description, as the present one (Schaefer & Renner 2011b) does not cover characters like 4-fid tendril, presence of probract, bracteate male racemes, 8 ovules per locule, ascendent arrangement of ovules, smooth (non angular/non ribbed) fruits and dehiscence through an apical operculum of the fruit. At the same time, we do not foresee any merit in elevating this to a new genus in the light of recent nomenclatural changes at generic level associated with these taxa as the result of molecular phylogenetic, seed coat and pollen studies (Kocyan et al. 2007, Schaefer & Renner 2011a). Also, while commenting on the controversy associated with the transfer of *Luffa tuberosa* Roxb. to *Momordica* by Cogniaux (1881: 454), Chakravarty (1959) in his revision of *Cucurbitaceae* of the Indian subcontinent, pointed out that the character 'operculum in fruit' need not be stressed upon as the generic distinguishing trait, in absence of other persuasive reasons. Therefore, the present species is described under *Herpetospermum*, which is the most convincing option at the present state of knowledge.

Herpetospermum operculatum K.Pradheep, A.Pandey, K.C.Bhatt & E.R.Nayar, *sp. nov.* — Fig. 1, 2; Map 1

Diagnosis: Similar to *H. tonglense* (C.B.Clarke) H.Schaef. & S.S.Renner, but differing in smooth yellow-striped oblong-elliptic fruits with 24 seeds arranged ascendently inside horizontally well-knitted fibre, and dispersed through opercular aperture at apex; prominent probracts and bracts; calyx with subulate sepals almost equal to the length of about-to-open flower bud; seeds ± round with irregular erose margin and subrostrate proximal end, and with prominent projections/markings on either side.

Type. *K. Pradheep 1449* (holo CAL; iso DD, NHCP), India, Sikkim, South District, Sadam, near river bank, N27°08', E88°25', alt. 1500 m, fl. 20 Oct. 2012 (female and male fl [in two sheets]).

Etymology. The species epithet refers to the lid-like structure (operculum) at the stylar end of the fruit, which is not found in other species of *Herpetospermum*.

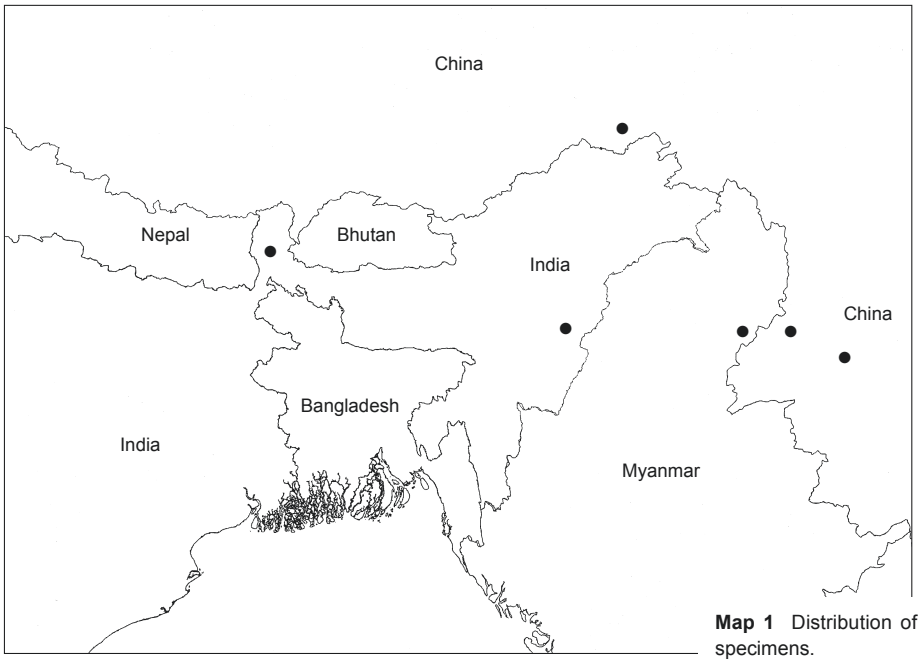
Herbaceous, dioecious climber, up to 10 m long. *Stems* annual, slender, angular-sulcate, subglabrous, young shoots densely pubescent, the juvenile leaves having distinct tail-like terminal projections. *Probract* subulate, 7–9 mm long, curved inwards,

[1] Division of Plant Exploration and Germplasm Collection, National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi 110 012, India; corresponding author e-mail: kpradheep@nbpgr.ernet.in.

Table 1 Morphological attributes that can assist in distinguishing *H. operculatum* from *H. tonglense*, *H. pedunculosum* and *H. darjeelingense.*

Character	*H. operculatum*	*H. tonglense*	*H. pedunculosum*	*H. darjeelingense*
Tendril	4-fid	2(–3)-fid	2(–3)-fid	2-fid
Leaf blade	Cordate-triangular, scarcely 5-lobed	Ovate or often deeply 5–7 lobed	(Ovate-)cordate, unlobed	(deeply) cordate-ovate, unlobed
Probract	Prominent	Absent	Absent	Absent
Male inflorescence				
length (cm)	12–15	15–30	12–40	12–18
Bract	Prominent	Absent	Absent	Absent or inconspicuous
Male flower				
pedicel length (mm)	6–11	12–20	c. 25	5–8(–10)
diam (cm)	6–8	4–5	5–6	4–6
calyx tube length (cm)	4.2–5(–5.5)	3(–3.5)	(2–)2.5	(1.5–)2
sepal length (mm)	10–13(–18)	(5–)7–9	(8–)9–10	3–4
Ovary				
ovules/cell	8	16	4(–6)	2
ovule arrangement	Ascendent	Horizontal	Pendent	Pendent
Fruit				
stalk length (cm)	(4–)6–7(–8)	7–10	1–2	(3–)7.5–10
shape	Oblong to ellipsoid-fusiform	Oblong, narrower at both ends	Broad-oblong, narrower at both ends	Broadly fusiform
surface	Smooth, with yellow irregular stripes	3-angular, 6-ribbed	3-angular, irregularly sinuate-costate	3-angular, 6-ribbed
dehiscence	Through operculum	Splitting by 3-valves	Splitting by 3-valves	Splitting by 3-valves
Seed				
number/fruit	24	48	12(–18)	(3–)6
shape	± round, with acute erose margin, base subrostrate	Oblong-ellipsoid, turgid, margin inconspicuous, base almost round	Oblong-obovate, base truncate, with obtuse margin	Subquadrate, base sub-trilobed; margin slightly undulate
length by width (mm)	11–13(–14) by 11–13(–14)	10–15 by 7–10	(12–)15–16 by (4.5–)5–6	12–14(–16) by (8–)9–11
thickness (mm)	5–6	6	1.5–2(–3)	(1.5–)2
surface	Muricate, often with wavy markings	Muriculate, irregularly pitted	Sculptured, irregularly grooved	Irregularly sculptured

glabrous, green when young, turning pale yellow, caducous. *Tendril* 4-fid, one branch robust, elongate, puberulent. *Leaves* simple, highly strigose-pubescent at juvenile stage; petiole robust, angular-sulcate, 6–10 cm long, puberulent; lamina cordate-triangular, 13–17 by 10–14 cm, with prominent reticulate veins, puberulent abaxially and adaxially along veins, basal sinus narrow, c. 2 cm deep; lobes 5, separated by shallow to medium sinuses, triangular-ovate with cuspidate tips, terminal one about half the length of the lamina, basal ones small; margin irregularly dentate, each tooth terminating in slightly protruding vein tips. *Male inflorescence* two peduncles from one axil, the first one early, 1-flowered, pedicel long, 5–8 cm, the second one racemose, 12–15 cm long, 5–8(–10) flowered; flowers showy, fragrant; bract prominent, 8–12 by 4–7 mm, varying in shape, linear-lanceolate to ovate, inflexed, with venation similar to that of leaves; young buds pilose, hairs c. 3 mm long, sepals twisted together anticlockwise at tip; peduncle robust, 8–11 cm long, pubescent. *Male flower*: unopened flower bud conical-ovate, (opened) flower large, corolla 6–8 cm diam, pedicel short, 6–11(–20) mm long, pubescent; calyx tube elongate, 4.2–5(–5.5) cm long, cylindric part > 3 cm long; at base 3–4 mm broad, widened to 15–20 mm broad at apex, infundibular, subglabrous to sparsely pilose, greenish yellow; sepals 5, valvate, elongate-subulate, apex tail-like, 1–1.3(–1.8) cm, almost level with the about-to-open flower bud; corolla infundibular, petals 5, entire, connate at base, aestivation quincuncial, (ovate-) obovate with green acuminate tip, 3–3.5 by (2–)2.5–2.8 cm, bright yellow, densely papillose-glandular on both sides; androe-



Map 1 Distribution of *Herpetospermum operculatum* based on studied specimens.

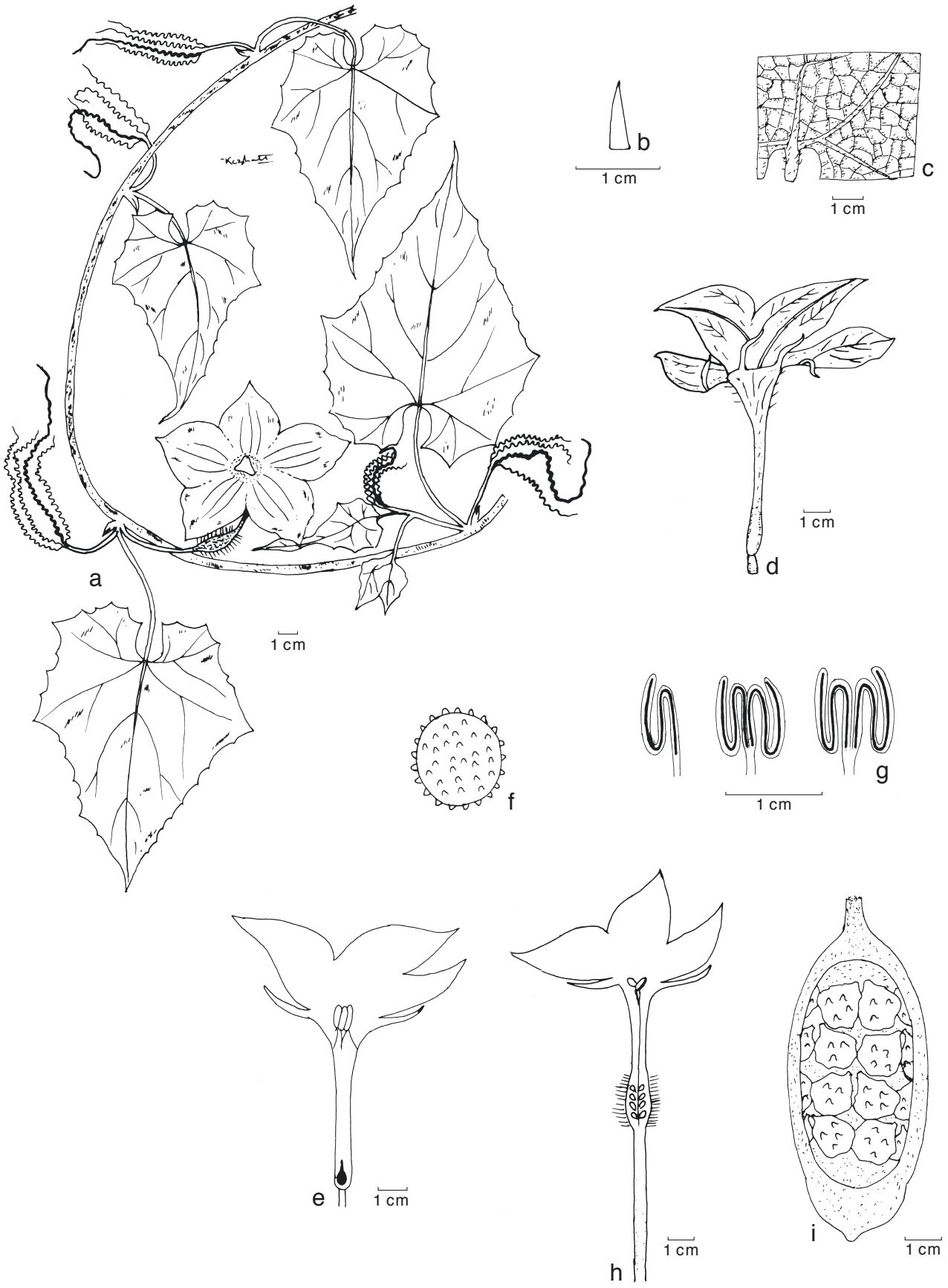


Fig. 1 *Herpetospermum operculatum* K.Pradheep, A.Pandey, K.C.Bhatt & E.R.Nayar. a. Twig with female flower; b. probract; c. portion of abaxial leaf surface; d. male flower (of racemose inflorescence); e. longitudinal section of male flower; f. pollen; g. anthers; h. longitudinal section of female flower; i. seed arrangement in immature fruit (all: *K. Pradheep 1449* (type)).

Fig. 2 *Herpetospermum operculatum* K.Pradheep, A.Pandey, K.C.Bhatt & E.R.Nayar. a. Habit; b. co-axillary male flower and male inflorescence (bud stage); c. close up of female flower showing stigma and petal with green acuminate tip; d. ovary after anthesis (note the probract at the axil); e. longitudinal and cross section of immature fruit showing ascendent arrangement of seeds; f. fruits with marked operculum, the third one from left shows the dehiscence through operculum; g. dry fruits showing horizontally well-knitted fibre, operculum and muricate seeds (a–e: *K. Pradheep 1449* (type); f, g: *K.C. Bhatt 1047*). — Scale bars = 4 cm.

cium: filaments free, inserted below the throat of the calyx tube, 7–9 mm long, glabrous; anthers 3, connate, protruding a little above calyx tube, yellow, two 2-thecous, one 1-thecous, 8–9 mm long, connective narrow, loculi linear; pollen pale yellow, sphaerical, baculate, 125–143 µm diam; pistillode 9–10 mm long, base bulbous, 2–2.5 mm thick. *Female flower* solitary or seldom 2 from the same axil; pedicel robust, (3.2–)4–6 cm long, pubescent; calyx tube stout, 2.5–3.2(–4) cm long, narrowly funnelform, at base 4 mm, at apex 12–15 mm broad; sepals and petals as in male flower. *Ovary* oblong, 1–1.2 cm long, ovules 8 per locule, ascendent in two rows except almost 1/3rd distal end; style firm, 2.5–2.7 cm long; stigmas 3, each 2-lobed, oblong-ovate, 5–6 mm long, yellow. *Fruit* stalk (4–)6–7(–8) cm long, puberulent; immature fruits oblong to ellipsoid-fusiform, 6–8(–10) by 3.5–4(–4.5) cm, smooth, green with 6–7 (pale yellow-)yellow irregular stripes (barring operculum part), pubescent, highly foetid when crushed; mature fruit yellow, seeds packed in horizontally well-knitted fibrous saponaceous pulp, dehiscing apically through an opercular aperture followed by quick release of 24 seeds; operculum 1.5–1.9 cm diam, umbo 2(–3) mm long. *Seed* compressed, ± round with irregular acute erose margin, 1.1–1.3(–1.4) cm diam, 5–6 mm thick, (grey-) black, proximal (hilum) end subrostrate, testa with muricate projections/markings on either side. *Seedling* with cotyledons elliptic-oblong, 2.2–2.5 by 1.6–1.8 cm, pale green; first true leaf triangular, sublobate, pale green, tomentose.

Distribution & Ecology — North-eastern India (Nagaland, Sikkim), Myanmar (Kachin) and China (western Yunnan, south-east Xizang). Little disturbed subtropical to temperate forests: in thickets, over bushes and small trees, upon rock, in open situations, along riverbanks; 1500–2500 m.

Conservation assessment — The first author saw 12 plants in a single population spanning about 0.01 km^2 near the vicinity of Sadam village in South District of Sikkim; the populations are unlikely to face serious habitat loss. The third author saw only two female plants near *jhum* (shifting cultivation) area in Mesulumi village in Phek district of Nagaland; this may be indicative of probable threat to populations due to clearing of natural habitat. T.T. Yu in 1938 (*Yu 16473*) annotated that he had seen these plants commonly in Shunning (Yunnan). All other studied herbarium specimens (collected in 1912, 1982 and 2010) did not reveal anything about population size, abundance, threat, etc. Therefore, it is problematical to infer any trends from these scattered observations, although the fact that this conspicuous species did not attract the attention of taxonomists from three countries suggests a drastic population decline over decades. Considering also that this new species has been confused with two other species, we conclude that sufficient information is lacking to determine the threat status, and that the 'Data Deficient' (DD) category is most suitable, according to the criteria of IUCN (2001, 2013).

Additional specimens. China, Yunnan, Shunning, Hila, alt. 2450 m, 26 June 1938, *Yu*, *T.T. 16473* (E, PE), (female and male fl) ((http://data.rbge.org.uk/herb/E00202140, last accessed 9 June 2013; http://www.nhpe.org/pe/01178252, last accessed 9 June 2013); Nujiang Lisu Autonomous Pref., Bao shan, off provincial road 230 at Gang dang, Bai hua ling, Han long zhai (village) (at the end of Z003 county road), walk to Jin chang he (river), N25.30°, E98.78°, alt. 2133 m, 23 July 2010, *Borosova*, *R.*, *Y. Guo*, *S. Landrein*, *C. Liu*, *J. Osborne* & *T. Zhang 2046* [*10CS 2046*] (K[K000568578]), (female fl) (http://www.svenlandrein.com/scihort/temperate/yunnanimages/specimensimages/images/10CS2046_a.jpg, last accessed 2 July 2013); Xizang, Medog County, alt. 1940 m, 6 Oct. 1982, *Sheng*, *B.L.* & *S.Z. Cheng 1431* (PE), ((female and male fl) (http://www.nhpe.org/pe/01179183, last accessed 9 June 2013). – India, Nagaland, Phek, Mesulumi, N25°34', E94°19', alt. 1838 m, 13 Oct. 2011, *Bhatt*, *K.C. 1047* (NHCP), (st). – Myanmar, Kachin, descent from Sansi Gorge to Sadon, N25–26°, alt. 6–7000 ft, Sept. 1912, *Forrest*, *G. 9114* (E), (male fl) (http://data.rbge.org.uk/herb/E00202141, last accessed 9 June 2013).

Note — Clarke (1877) observed a higher proportion of male to female plants in the other three species of *Herpetospermum* under natural conditions. However, the first author has observed an equal proportion of male and female plants in this species in South District of Sikkim. Big yellow showy flowers in clusters call for further study of its potential as ornamental. *Forrest 9114* (E) recorded flower colour as bright orange; this corresponds to the observation by the first author that just before anthesis, the flower is orangish, and later turns yellow. *Sheng* & *Cheng 1431* (PE), from Medog County in Xizang, has fruits clearly showing an operculum mark. This specimen and *Yu 16473* (E) have a mixture of both male and female flowers on the same herbarium collection. *Borosova*, *Guo*, *Landrein*, *Liu*, *Osborne* & *Zhang 2046* [*10CS 2046*] (K) mentioned that seeds are creamy, probably due to observations at immature stage of fruit. Fully mature seeds are (grey-)black in colour. The line diagram of *Biswarea tonglensis* in vol. 6 of Flora Yunnanica (Wu et al. 1995: 343) belongs to this species. The description in Flora of China (Lu et al. 2011: 33) for the above species with respect to length of bracts (2–3 mm), calyx segments (sometimes up to 20 mm) and pedicel of female flower (25–30 mm) indicates the likely overlap of character states of the new species with that of *H. tonglense*. However, we cannot exclude the possibility that true *H. tonglense* occurs in these countries. This new species is expected to occur in Bhutan and Indian states of Arunachal Pradesh and West Bengal (Darjeeling), and adjoining areas of Nepal.

Acknowledgements The authors express their sincere thanks to the Head of the Division of Plant Exploration and Germplasm Collection and Director, NBPGR, New Delhi for guidance as well as help rendered during the course of study. We would also like to thank the authorities of E, K, PE for providing digital herbarium images, which enabled us to infer the distribution of the new species. We also thank Dr. P.K. Singh, Seed Production Centre, Indian Institute of Vegetable Research, Kushinagar and authorities of Krishi Vigyan Kendra, South District, Sikkim for accompanying the first author during his exploration, and Mr. A.K. Singh, Senior Research Fellow, NBPGR for preparing the distribution map for the present taxon.

REFERENCES

Chakravarty HL. 1959. Monograph on Indian Cucurbitaceae. Recordings of Botanical Survey of India 17, 1: 1–234.

Chakravarty HL. 1982. Fascicles of flora of India 11. Cucurbitaceae. Botanical Survey of India, Calcutta.

Clarke CB. 1877. Botanic notes from Darjeeling to Tonglo. Journal of the Linnean Society, Botany 15: 116–159.

Cogniaux CA. 1881. Cucurbitaceae. In: Candolle A de, Candolle C de (eds), Monographiae phanerogamarum prodromi nunc continuato, nunc revisio auctoribus Alphonso et Casimir De Candolle aliisque botanicis ultra memoratis 3: 325–951. Parisiis, Sumptibus G. Masson, Paris.

IUCN. 2001. IUCN Red List categories and criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

IUCN. 2013. Guidelines for using the IUCN Red List categories and criteria. Version 10. Standards and Petitions Subcommittee, IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

Jeffrey C, Trujillo B. 1992. Cucurbitaceae. In: Morillo G (ed), Flora de Venezuela 5, 1: 1–201. Fundacion Instituto Botanico de Venezuela, Caracas.

Kocyan A, Zhang LB, Schaefer H, Renner SS. 2007. A multilocus chloroplast phylogeny for the Cucurbitaceae and its implications for character evolution and classification. Molecular Phylogenetics and Evolution 44: 553–577.

Lu A, Huang L, Chen S, Jeffrey C. 2011. Cucurbitaceae. In: Zhengyi W, Raven PH, Deyuan H (eds), Flora of China 10: 33–34. Science Press, Beijing.

Schaefer H, Renner SS. 2011a. Cucurbitaceae. In: Kubitzki K (ed), Flowering plants: Eudicots, Sapindales, Cucurbitales, Myrtaceae 10: 112–174. Springer-Verlag, Berlin, Heidelberg.

Schaefer H, Renner SS. 2011b. Phylogenetic relationships in the order Cucurbitales and a new classification of the gourd family (Cucurbitaceae). Taxon 60, 1: 122–138.

Singh D. 1967. Structure and development of seed coat in Cucurbitaceae. I. Seeds of Biswarea Cogn., Edgaria Clarke and Herpetospermum Hook.f. Proceedings of Indian Academy of Sciences, Section B. 65, 6: 267–275.

Wu CY, Chen C, Chen SK (eds). 1995. Flora Yunnanica 6: 343. Science Press, Beijing.