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Notes on the *Hibiscus trionum* complex in India with a new record of *Hibiscus verdcourtii* (Malvaceae) in Asia

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Abstract: *Hibiscus trionum* L., the 'flower of an hour', has so far been reported in India from the Northeast and South India. However, specimens of this taxon available in Indian herbaria represent two different species: *H. tridactylites* Lindl., a species that is widely distributed throughout India but often mistaken for *H. trionum*, and *H. verdcourtii* Craven, an Australian species that is being reported here for the first time in Asia.

Keywords: Bladder Ketmia, Flower of an hour, *Hibiscus,* India.

Introduction

Hibiscus L. is one of the largest genera of Malvaceae with 429 species worldwide, having its distribution from tropics and subtropics to North America (POWO, 2023). It is represented in India by about 35 species in 10 sections (Rakshit & Kundu, 1970; Paul, 1993; Sivarajan & Pradeep, 1996). Species of *Hibiscus* sect. *Trionum* DC. are commonly known as 'Bladder Ketmia' due to their peculiar bladder-like calyx enclosing the capsule. Its members are widely distributed in Africa, Europe, and some parts of Australia. Their leaves and floral structures exhibit a great deal of variation. Craven *et al.* (2011) recently segregated four distinct species from *Hibiscus trionum* complex: *Hibiscus richardsonii* Sweet ex Lindl., *H. trionum* L., *H. tridactylites* Lindl. and *H. verdcourtii* Craven.

During revisionary studies of the genus *Hibiscus* in Peninsular India, the authors examined two morphologically distinct populations of *H. trionum* complex. The critical examination, consultation of literature and specimens and expert comments on these two populations it is revealed that the name *Hibiscus trionum* has been misapplied for two different species in India, *i.e., H. tridactylites* and *H. verdcourtii*. *Hibiscus tridactylites* is a widely distributed species in India, whereas *H. verdcourtii* hitherto known from the Australian continent is reported here for the first time from Asia. The present study would be useful to know the species included in the complex in India with taxonomic details, photographs and an identification key.

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Material and Methods

The specimens of *Hibiscus* sect. *Trionum* were collected from Nashik, Pune and Sangli districts of Maharashtra and identified using relevant taxonomic literature (Rakshit & Kundu, 1970; Paul, 1993; Craven *et al*., 2011; Badry *et al.,* 2019). Herbarium specimens were prepared following Sharma and Rao (1990). The photographs of all the morphological parts were captured using a D6000 camera (Nikon, Japan) and photo-plates were prepared. Seed and microscopic parts were photographed under a CZM6 microscope (Labomed, India). For scanning electron microprogram studies, one mature seed of each species was gently taken from a dried capsule. The seed was coated with gold/palladium for 75 s on a Quorum SC7620 sputter coater and examined under Jeol scanning electron microscope (JSM IT200, Japan, housed at Y.C.I.S. Satara, M.S., India) with 30X-40X magnification at 5.0 kV & 10 kV power. Observations on the entire seed, testa ornamentation, and cell were made at different magnifications. Editing of the electrogram

has been carried out using Adobe Photoshop 7.0 software. The identity of the species belonging to the *H. trionum* complex was verified by comparing specimens collected by previous authors (Craven *et al.,* 2011; Badry *et al.,* 2019) with the types and protologs. A dichotomous key is provided for identifying the species of the *H. trionum* complex in India.

Key to the species of Hibiscus trionum complex in India

1. Leaves dissected up to base ..... *H. tridactylites*
1. Leaves not dissected up to base 2
2. Corolla with dark purple or maroon spot; epicalyx segments 12–16; seeds more or less tuberculate .....*H. trionum (not found in India)*
2. Corolla without purple or maroon spot; epicalyx segments usually 9, rarely 10–11; seeds smooth ..... *H. verdcourtii*

Taxonomic Treatment

Hibiscus tridactylites Lindl. in Mitchell, Three Exped. Australia 1: 85. 1838; Craven *et al.,* New Zealand J. Bot. 49(1): 27. 2011; Badry *et al*., Phytotaxa 416(4): 279. 2019; *Hibiscus trionum sensu* Mast. in Hook.f., Fl. Brit. India 334: 1874; Hochreuniter, Ann. Cons. Jard. Bot. Geneve 4: 144. 1900; Gamble, Fl. Madras 1: 88. 1915; Cooke, Fl. Bombay 1: 111. 1958 (Repr. ed.); Rakshit & Kundu, Bull. Bot. Surv. India 12: 186. 1970(1972); Saldanha & Nicolson, Fl. Hassan Dist. 152: 1976; Saldanha, Fl. Karnataka 253: 1984; Lakshmin. & Sharma, Fl. Nasik Dist., 89. 1991; T.K. Paul in Sharma & Sanjappa (eds.), Fl. India 3: 341. 1993; Sivaraj. & Pradeep, Malv. South. P. India 146: 1996; Venkanna & Das in Singh & Karthik. (eds.), Fl. Maharashtra 1: 316. 2000; Pull. & D.M. Rao, Fl. Eastern Ghats 133. 2002; M.Mohanan & A.V.N.Rao in P.Daniel (ed.), Fl. Kerala 1: 425. 2005; Kshirsagar & Patil, Fl. Jalgaon Dist. 58. 2008; Yadav & Sardesai, Fl. Kolhapur 69–72. 2002. *Lectotype* (designated by Craven *et al.,* 2011): AUSTRALIA, **New South Wales**, between the Gwydir and Namoi, longitude *c*. 150° E, 1832, *T.L. Mitchell s.n.* (CGE digital image!). **Fig. 1**

Annual, erect to decumbent, much-branched herbs, to 30–60 cm high; stems 0.3–0.6 mm in diam., herbaceous, terete, covered with tubercle-based hairs. Leaves alternate, 2.5–7.5 × 1.5–6.5 cm, stipulate; stipules filiform, 3–6 mm long; petioles terete, 0.5–4.5 cm, strigose hairy with simple and stellate hairs; basal leaves broadly-ovate, tripartite, round at base, obtuse at apex, margins irregularly crenate to serrulate; middle and distal leaves 3-palmatisect, lobes extended to the apex of the petiole. Flowers in solitary cymes, axillary, rarely terminal; peduncles 0.5–2 cm long, terete, strigose hairy, intermixed with coarse and simple stellate hairs; pedicels 0.5–2 cm long, coarsely hairy. Epicalyx *c.* 2.5 cm in diam., 12–14 segmented; segments filiform, 0.8–1 cm long, pointed towards apex, strigose hairy throughout with stellate hairs at the center. Calyx *c.* 2.8 × *c.* 1.5 cm, 5-lobed; lobes ovate, acute at apex, 3–5-nerved, densely strigose, stellate tubercle hairs on nerves, simple stellate hairs on the margins. Petals 5, obovate, *c.* 3 × *c.* 0.8 cm, pale yellow to yellow, 8–9-nerved with dark purple or maroon spot at base. Stamens many; staminal column *c*. 1.3 cm long; anthers *c*. 1 mm long. Ovary globose, 0.2–0.3 cm diam., glabrous; style 0.3–0.7 cm long, straight, glabrous divided at apex into five segments; stigmas discoid with papillate hairs, 0.2–0.3 cm across. Capsules globose, 1.5–2.7 cm in diam., slightly depressed at apex, hairy enclosed in a bladder like persistent calyx. Seeds 15–30, more or less reniform, 2.3–2.6 mm diam., mature ones glandular-papillose, rugose.

Flowering & fruiting: Flowering from July to November and fruiting from September to January.

Distribution: Angola, Botswana, Burkina, Cape Provinces, Chad, Djibouti, Egypt, Eritrea, Ethiopia, Free State, Kenya, KwaZulu-Natal, Lesotho, Mali, Mauritania, Mozambique, Namibia, New South Wales, Niger, Northern Provinces, Northern Territory, Oman, Queensland, Saudi Arabia, Senegal, Sinai, Somalia, South Australia, St. Helena, Sudan, Swaziland, Tanzania, Uganda, Victoria, Yemen, Zambia, Zimbabwe (Boulos, 2000, 2009; Craven, 2011; POWO, 2023), India (Fig. 3).

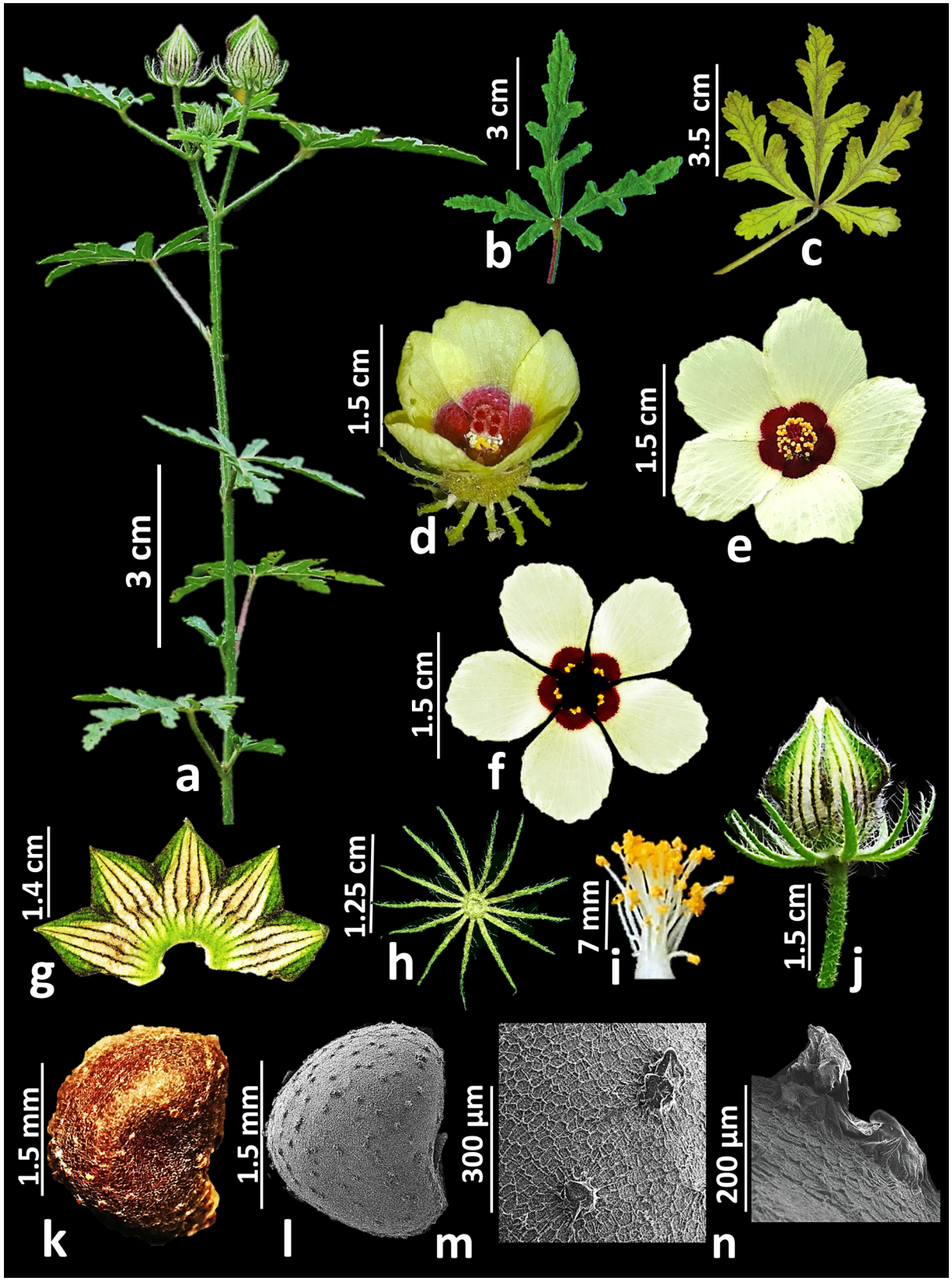

Fig. 1. *Hibiscus tridactylites* Lindl. **a**. Flowering twig; **b** & **c**. Leaf shape variation; **d** Flower-lateral view; **e**. Flower-top view; **f**. Dissected corolla; **g**. Part-dissected calyx; **h**. Epicalyx; **i**. Staminal column; **j**. Capsule with calyx and epicalyx; **k**. Seed; **l**. Scanning electrogram of seed; **m**. Closeup view of testa cells with polygonal cells interrupted with tubercles; **n**. Marginal view of tubercle with distinct dome shaped tubercles (from *N.A. Madhav, J.V. Dalavi & A.V. Mohite* JVD-1701; photos by Nilesh Madhav & Jagdish Dalavi).

Specimens/images examined: INDIA, **Andhra Pradesh**, January 1863, *Roxburgh s.n.* (BR [BR0000013466749] digital image); **Jammu**, Srinagar, Barzalla, 27.08.1961, *A.K. Dutt* 5383 (IIIM); Gulmarg, *s.d.*, *A.R. Naqshi* 514 (KASH); Kashmir University, *s.d., A.R. Naqshi* 195 (KASH); Kokernag, *s.d., I.M. Nahvi s.n.* (KASH); Srinagar, *s.d., G.N. Javeid* 360 (KASH); Dachigam, *s.d., G. Singh* 888 (KASH); Ganderbal, *s.d., G.H. Dar* 3004 (KASH), Shuhama, Ganderbal, *s.d., G.H. Dar* 2943, 2944 (KASH); Sarich (Ganderbal), *s.d., G.H. Dar* 1767-68 (KASH); Narbal, *s.d., A.R. Naqshi & G.N. Dar* 8173, 8175 (KASH); South Srinagar, August 1982, *P.W. Mackinnon* 54765 (CAL). **Karnataka**, Hassan, Arsikere, 19.12.1968, *C. J. Saldanha* 11940 (JCB); Mysore, February, *s. coll.* 1872 (K [K000659806] digital image); **Maharashtra**, Nashik, Panchavati, 06.12.2020, *N.A. Madhav, J.V. Dalavi & A.V. Mohite* JVD-1701 (SUK); Pune, Junnar, Shiveneri Fort, 15.09.2021, *S.R. Yadav* JVD-1702 (SUK); **Tamil Nadu**, Thiruvanmalai, 29.08.2001, *R. Vijayashankar* 38435 (FRLH); **Telangana,** Hyderabad, 20.08.1898. *B. Heyene s.n.* (K [K000659807] digital image).

Hibiscus verdcourtii Craven in Craven *et al.,* New Zealand J. Bot. 49: 35: 2011. *Type:* AUSTRALIA, **Northern Territory**, *c.* 168 km SW of 'Calvert Hills' on road to 'Creswell Downs', 16.05.1974, *R. Pullen* 9279 (holo CANB digital image!; iso DNA!). **Fig. 2**

Annual erect to decumbent herbs, 20–150 cm high; stems with fine stellate hairs. Leaves 2.5–7 × 2–5 cm, mid-stem to distal leaves more or less 3-lobed, lobes not extended to the apex of the petiole or upto extreme base of the leaf, primary lobes scarcely lobed with palmate venation. Flowers in solitary cymes or paired, axillary, pedunculate; peduncles 0.5–0.9 cm long, with fine stellate hairs and fine bristles; pedicels 0.5–1.5 cm long, indumentum generally similar to that of the peduncle. Epicalyx 2.3–2.5 cm across, segments (9-)10(-11); segments linear, slightly flat, shorter than or equal to the calyx. Calyx 5-lobed, *c.* 2.5 cm in diam., distinctly accrescent in fruit, with stellate hairs; lobes triangular, acute or acuminate at the apex, with prominent 3–5 nerves. Petals 5, obovate, 2.7–5 cm, yellow, fading to white in older flowers, generally with basal pale petal spot. Stamens many; staminal column 0.7–1.2 cm long; anthers *c.* 1 mm long. Ovary globose, 0.2-0.4 cm in diam., hairy; style 0.3–0.7 cm long, straight, glabrous divided at apex into five segments; stigmas capitate with white hairs, 0.6–0.8 mm across. Capsules globose, 1.1–1.3 cm long, hairy, enclosed in papery calyx lobes. Seeds 4–20, sub-reniform, 2.4–2.5 mm long, glabrous, smooth, dark brown to black.

Flowering & fruiting: Flowering from August to December and fruiting from September to January.

Distribution: New South Wales, Northern Territory, Queensland, South Australia, Western Australia; India (Fig. 3).

Specimens examined: INDIA, **Maharashtra**, Sangli district, Siddhewadi, N 16°54'57.9672", E 74°42'44.2728", 19.10.2020, *V.V. Khot & J.V. Dalavi* AVM-131 (SUK); Solapur district, Sangola, Sangola-Jath Road, N 17°21'58.0356", E 75°11'37.8456", 21.09.2021, *A.V. Mohite, J.V. Dalavi, V.V. Khot & S.R. Yadav* AVM-147 (SUK).

Discussion

Until now, *Hibiscus* sect. *Trionum* was represented by a single species *H. trionum* on the Indian subcontinent. The species was reported from almost all the states of Peninsular India, North and North East India, mainly in open areas, wastelands and cultivated fields. The present study based on fresh samples and herbarium specimens of different populations of *H.* sect. *Trionum* revealed that the Indian plants referred to as *Hibiscus trionum* in the past are actually *H. tridactylites* Lindl. and *H. verdcourtii* Craven. According to Craven *et al.* (2011) and Badry *et al.* (2019) *H. trionum* proper is a diploid species (2n=28), native from eastern to central Europe and from the Mediterranean region to Western Himalaya and spreading as exotic weed in America, Central Asia and Western Europe, and *H. tridactylites* is a tetraploid (2n=56) and is distributed in Africa and Australia.

The specimens housed at various Indian herbaria under the name *H. trionum* have upper and middle leaves deeply dissected up to the tip of the petiole, 12–14 epicalyx segments, faint lemon-

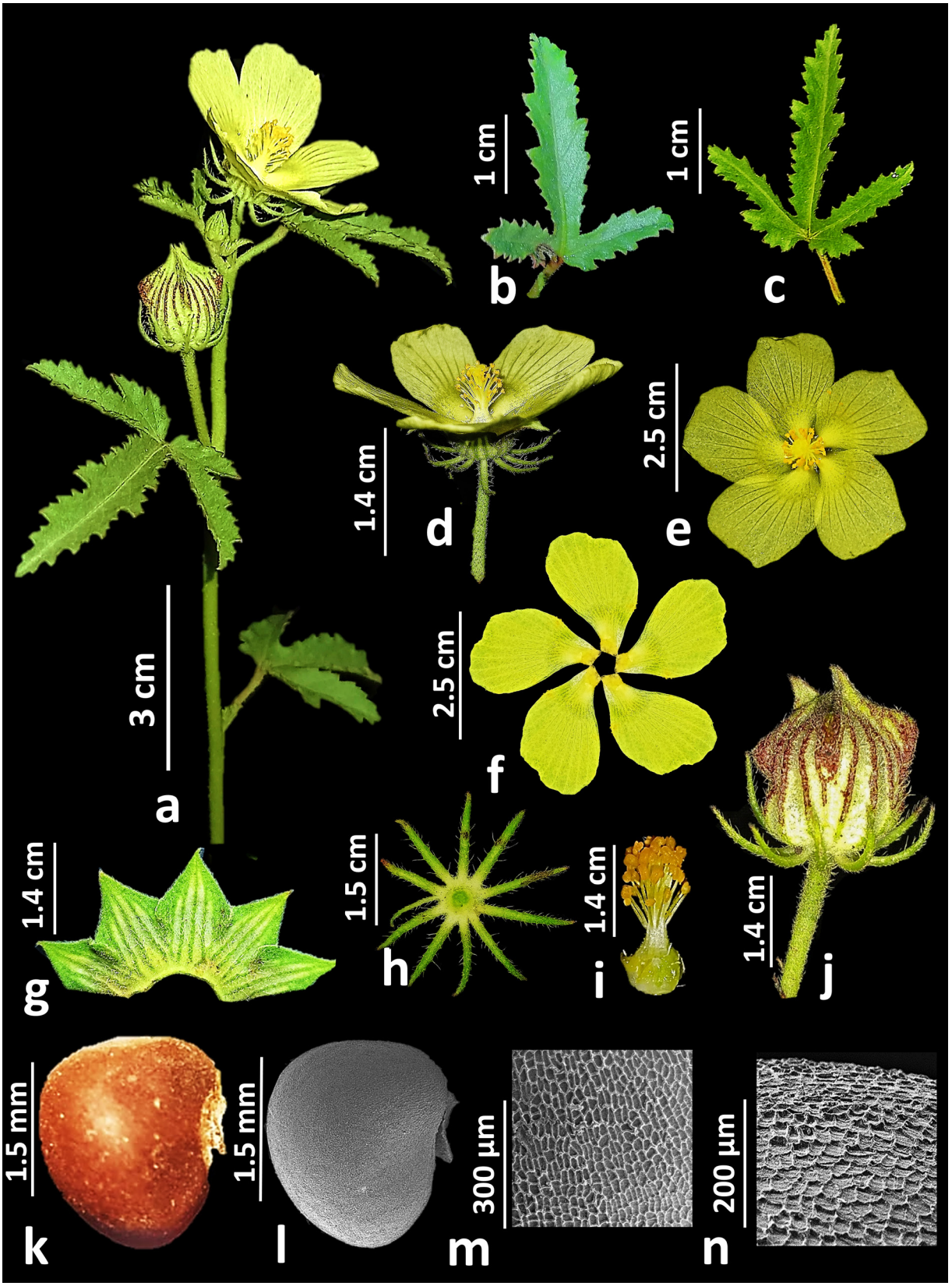

Fig. 2. *Hibiscus verdcourtii* Craven **a**. Flowering twig; **b** & **c**. Leaf shape variation; **d** & **e**. Flower; **f**. Dissected corolla; **g**. Part-dissected calyx; **h**. Epicalyx; **i**. Staminal column; **j**. Capsule with calyx and epicalyx; **k**. Seed; **l.** Scanning electron electrogram of seed; **m**. Closeup of testa surface showing uniform isodimetric cells; **n**. Marginal view of seed without tubercles (from *V.V. Khot & J.V. Dalavi* AVM-131; photos by Jagdish Dalavi & Vasundhara Khot).

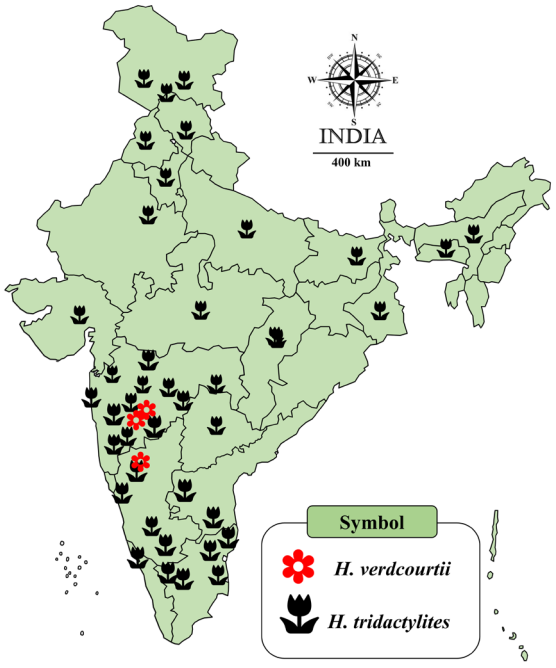

Fig. 3. Distribution of *H. tridactylites* Lindl. & *H. verdcourtii* Craven in India.

yellow colored corolla with dark maroon blotch at the center and tubercled seeds. These characters corroborate with *H. tridactylites* not *H. trionum* which has shallowly lobed leaves, never dissected up to the tip of the petiole, 14–16 epicalyx segments, pale lemon-yellow corollas with a dark purple blotch in the center and tuberculate to hairy seeds. These findings are supported by studies of Dasgupta and Bhatt (1981) who reported tetraploidy (2n=56) for Indian population, and deeply dissected leaves. Hence it is now evident that the specimens kept under the name *H. trionum* actually belong to *H. tridactylites* Lindl.

Additionally, *H. verdcourtii* Craven, hitherto known only from Australia, has been collected from Sangli and Solapur districts of Maharashtra. This taxon is very distinct from all the species of sect. *Trionum* in having flowers without dark blotch at the center, 9–11 epicalyx segments and glabrous seeds. The present report its first distributional record from Asia. A morphological comparison of these three species are provided in Table 1. Furthermore, a thorough revision and additional sampling of species of *Hibiscus* from different parts of the country is necessary to ascertain whether more species of the *H. trionum* complex are represented in the Indian flora.

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Table 1. Morphological comparison of *H. trionum* complex previously and presently regarded as occurring in India

Characters	*H. tridactylites* Lindl.	*H. trionum* L. (not found in India)	*H. verdcourtii* Craven
Leaves	Dissected up to apex of petiole	Not dissected up to apex of petiole	Not dissected up to the apex of petiole
Epicalyx segments	12–14	12–16	Usually 10, rarely 9 or 11
Corolla	Faint lemon yellow or yellow with dark maroon spot at base	Pale lemon yellow to yellow with dark purple spot at base. Flowers fading into white	Bright yellow without any central spot or slightly dark yellow ring at base. Flowers never fading into white.
Style branches	2–3 mm long	2.3–5.2 mm long	0.5–1 mm long
Seed indumentum	Tuberculate	Tuberculate/ hairy	Glabrous smooth

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