

## A Taxonomic Revision of the Genus *Momordica* L. (Cucurbitaceae) in India

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The genus *Momordica* L. is revised for India. Six species are recognized: *M. balsamina* L., *M. charantia* L., *M. dioica* Roxb., *M. sahyadrica* Joseph & Antony, *M. subangulata* Blume [ssp. *renigera* (G. Don) WJ de Wilde] and *M. cochinchinensis* (Lour.) Spreng. *M. dioica* sensu stricto comprises delicate forms with evening anthesis and intensely musky scented flowers, distributed in low elevation areas in Western Ghats, peninsular and central India. Stout forms with day anthesis and large showy flowers occurring in mid and high elevation Western Ghats are separated as a new species (*M. sahyadrica* Joseph & Antony). North eastern elements, presently treated under *M. dioica*, are placed under *M. subangulata* ssp. *renigera*. *M. macrophylla* Gage has been placed in synonymy with *M. cochinchinensis*. Presence *M. denudata* (Thwaites) CB Clarke in India is doubtful in the absence of valid herbarium specimens or field collections from the reported localities. Generic and specific descriptions, key to species, and notes on distribution, habitat and ecology are also provided.

**Key Words:** Distribution, Ecogeography, *Momordica*, Systematics, Taxonomy

### Introduction

The genus *Momordica* L., best known for the bitter gourd, derives its name from Latin 'mordeo' (momordi=to bite) in allusion to the jagged seeds as though bitten (Drury, 1864), ironically though the type genus (*M. balsamina* L.) do not follow this generic character. It belongs to the tribe Joliffieae Schrad. of Cucurbitaceae (Jeffrey, 1980) and is a native of the Paleotropics (Robinson and Decker-Walters, 1997). Besides their importance as wild relative of bitter gourd, they also have direct utility as nutritious vegetables and multipurpose medicinal plants.

Generic and species descriptions (along with keys in some cases) are found in various monographic and floristic treatises (Linnaeus, 1753; 1754; Willdenow, 1805; Blume, 1826; Seringe, 1828; Roxburgh, 1832; Wight and Arnot, 1834; Thwaites, 1864; Hooker, 1871; Clarke, 1879; Trimen, 1894; Cooke, 1903; Gamble, 1919; Keraudren, 1975; Chakravarty, 1982; Jeffrey, 1980; 2001; de Wilde and Duyfjes, 2002). It got a prominent mention in Rheede's *Hortus Malabaricus* (Vol. 8, 1688), the oldest regional flora for any part of the world, with descriptions and plates of four entities. Many of the provincial (regional), state and district floras in India also provide a small description of various *Momordica* species (Duthie, 1903; Prain, 1903; Gage, 1908; Kanjilal *et al.*, 1938; Santapau, 1953; Mathew, 1983; Saldhana, 1985; Narasimhan and Sharma, 1991; Deshpande *et al.*, 1993; Singh *et al.*, 2002, to cite a few). Often, descriptions

of dioecious *Momordica* species in national and district floras are based on insufficient herbarium material and the descriptions of morphological features of some species are incorrect or incomplete (Joseph, 2005). A perusal of the herbarium sheets lodged in major herbaria in India reveals innumerable instances of incomplete labelling and misidentification.

Inter-specific diversity in the genus *Momordica* in India has been estimated differentially by different workers. Chakravarty (1982) in Fascicles of Cucurbitaceae recognized seven species under the genus in India. Jeffrey (1980; 2001) recognized only five species occurring in the Indian subcontinent. According to de Wilde and Duyfjes (2002), ten species are reported in South East Asia, of which six each occur in Malaysia and India, where *M. balsamina* L., *M. charantia* L., *M. subangulata* Blume [(ssp. *renigera* (G. Don) WJ de Wilde)] and *M. cochinchinensis* (Lour.) Spreng. are common. Many of the regional and provincial checklists and inventories are also replete with instances of wrong species identification and erroneous distribution data. This is perhaps understandable as many of these works are essentially bibliographic enumerations rather than taxonomic revisions. As evident, there is no clarity and consensus in the inter-specific taxonomy of the genus in India and the botanical names and common names are often used incorrectly or interchangeably (Joseph, 2005; Joseph *et al.*, 2006).

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The classification of *Momordica* most widely used in the Indian context is that of Chakravarty (1982). However, it does not address the distinct entities of dioecious *Momordica*, which as per his identified specimens, are all *M. dioica*. His study does not specifically identify or cite *M. subangulata* specimens even though he broadly stated their distribution in Western Ghats of Karnataka and Maharashtra. Similarly, there are no reports of field collection or spotting of *M. denudata* (Thwaites) CB Clarke from Kerala and *M. cochinchinensis* from Tamil Nadu, other than his statement in Fascicles of Cucurbitaceae (1982). He has retained separate taxon status for *M. macrophylla* Gage, as distinct from *M. cochinchinensis*, for the unlobed nature of the leaves. In fact, heterophylly is observed in all dioecious species and hence, leaf shape may not be a reliable character in distinguishing species in this group. The descriptions are incomplete like many other previous treatments in the sense either male or female plant could not be studied and the fruit and seed morphology details are often scanty. Perennial nature of the plant and its tuber morphology do not find a place in his treatment. Moreover, he ignored important traits such as anthesis time, nectar guides on petals and ridged nature of the fruit. The morphological features of the flower, which is very striking within the dioecious group representing lower elevations and arid belt, mid and high elevation Western Ghats and North Eastern Hills, were not taken into account while devising the key. Jeffrey (1980) rightly stated longitudinally alate or ridged fruits as the key character for *M. subangulata* and purple-blotched petals are very specific to *M. subangulata* and *M. cochinchinensis*.

Subsequent to Chakravarty's Fascicles, there has been no critical appraisal of the genus in India, though Kumar and Pandey (2002) have made a taxonomic study of the genus. However, it did not vary substantially from that of Chakravarty (1982) and reported the same number of species and distribution in India. This has prompted an in depth study of the morphological variability present in the genus across the country and a taxonomic revision based on herbarium and field study.

### Materials and Methods

As part of the ecogeographic study of the genus, the first author visited the major national Herbaria in India, viz., Botanical Survey of India, Calcutta (CAL), BSI Southern Circle, Coimbatore (MH); BSI Western Circle, Pune (BSI); BSI Arid Zone Circle, Jodhpur (BSIJO); BSI Eastern Circle, Shillong (BSISH); St. Joseph's

College, Tiruchirapalli (RHT); BSI, A&N Circle, Port Blair (PBL); Agharkar Research Institute, Maharashtra Association for the Cultivation of Science, Pune (AHMA); St. Xavier's College, Bombay (BLAT); National herbarium of cultivated plants, NBPGR, New Delhi, (NHCP); Kerala Forest Research Institute, Trichur (KFRI); Tropical Botanical Garden and Research Institute, Trivandrum (TBGT) and University of Calicut, Calicut (CALI), and studied about 700 herbarium sheets (including type specimens) from India, Sri Lanka, Myanmar, Bangladesh, Philippines, Malaysia and Africa. For brevity, only a handful of geographically representative and historical sheets are enumerated in the specimen citation. To supplement the herbarium information, the entire stretch of Western Ghats besides specific sites in Deccan plateau, Central India, Andaman Islands and North East India were surveyed for collection of germplasm and ecological data. All the taxa were studied in the field (in the wild) between 2003 and 2006, and collections made for herbarium and field planting.

### Taxonomic treatment

#### *Momordica L.*

1753, Sp. Pl.: 1009; id. 1754, Gen. Pl., ed. 5: 440; Chakrav. 1959, Rec. Bot. Surv. India 17, 1: 86; id. 1982, in SK Jain *et al.*, Fasc. Fl. India 11: 87; Keraudren 1975, in Aubrev. et J.-F. Leroy, Fl. Camb., Laos, Vietnam 15: 36; de Wilde & Duyfjes 2002, Bot. zhuarn. 87 (3): 133.

#### **Type:** *Momordica balsamina L.*

Climbers, annual or perennial; glabrous or pubescent. **Leaves** simple, entire or lobed, or (sub) pedately 3-5 (12-15 in African) foliate. **Tendrils** simple, unbranched. **Flowers** medium to large, monoecious or dioecious, sometimes  $\pm$  zygomorphic, petals imbricate, off-white, cream or yellow. **Male flowers** solitary or in short loose pseudo-racemes, each flower stalk with a persistent hooded bract; pedicels short or long, receptacle-tube short, cupular or saucer shaped; calyx lobes entire or scarious, adnate at base; petals 5, free, entire, 1-3 with an incurved scale inside at the base-receptacle juncture; stamens 3, anthers one 1-theous, two 2-theous, filaments very short, free, inserted at the mouth of the receptacle tube; thecae usually coherent, connective sometimes swollen; pistillode absent. **Female flowers** solitary, in axils, also with a conspicuous or rudimentary bract; calyx narrow; petals as in the male; ovary oblong-fusiform, ribbed, warty or soft papillose; ovules mostly

many, horizontal; stigma 3-lobed; staminodes absent. **Fruit** ovoid-ellipsoid or fusiform, fleshy, ornamented with soft spines, warts or tubercles and ridges, irregularly or regularly 3-valved, dehiscent. **Seeds** many, enclosed in orange red sarcotesta (aril), small or large, flattened or turgid on faces, smooth or sculptured, margins often undulate and dentate.

**Distribution:** Throughout India

**Uses:** The genus *Momordica* is unique in the sense that all are medicinal plants and vegetables. *M. charantia* is a cultivated and wild gathered vegetable. *M. dioica* and *M. sahyadrica* are extensively gathered for tender fruit vegetable purpose and tubers are medicinal. Ethnobotanical uses of these taxa in Western Ghats are reported (Joseph and Antony, 2008). *M. subangulata* subsp. *renigera* and *M. cochinchinensis* are cultivated for their fruits used as vegetables. *M. balsamina* is a medicinal plant and famine vegetable in Rajasthan.

**Taxonomic notes:** The genus as treated here has only six valid species, which can be grouped under two heads: *M. charantia* L. and *M. balsamina* L. representing the monoecious group and *M. dioica* Roxb., *M. sahyadrica* Joseph & Antony, *M. cochinchinensis* (Lour.) Spreng., and *M. subangulata* Blume [(ssp. *renigera* (G. Don) W.J.J.deWilde)] representing the dioecious group. Crossability relationships and chromosome number also support the natural of this grouping (Table 1).

The genus, as circumscribed here, do not include *M. cymbalaria* Fenzl [*Luffa cymbalaria* Fenzl ex Naud.= *M. tuberosa* (Roxb.) Cogn.], though few workers still treat it under *Momordica* as in de Wilde and Duyfjes (2002). Hooker (1871) removed it from *Luffa* (where Roxburgh placed it) and placed it under *Momordica* because of its simple tendrils (Clarke, 1879) and

Chakravarty (1982) rightly restored it to *Luffa* (as *Luffa tuberosa* Roxb.). Our observations of live specimens from Tamil Nadu asserted its distinctness from *Momordica* for flowers being white, fruit a dry dehiscent one with fibrous mesocarp on ripening, scanty, white seed aril with no pulp and fruits not showing any colour change on ripening. All the six valid species treated here have fleshy scarlet-red fruits and fleshy red aril, which are adaptations for bird dispersal. Besides, the monoecious species have basic chromosome number n=11 and the dioecious group has n=14, whereas *M. cymbalaria* (*Luffa cymbalaria* Fenzl ex Naud.) has the basic number n=8.

### Key to species

- 1a. Germination epigeal, annual, taproot non-tuberous, plants monoecious, nectary in male flowers not closed with scales, fruits muricate or tubercled.
- 2a. Bracts of male flowers about the middle or below the middle of the flower stalk; fruits small or large, softly tubercled or muricate with long broken ridges; seeds thick, flat on surface, margins edged, thick on sides, broadly rectangular, no distinction between chalazal or micropylar ends, ends sub tridentate, heavily or feebly sculptured. ***M. charantia***
- 2b. Bracts of male flowers at the apex of the peduncle; fruits small, distantly soft tubercled, no bumps or ridges; seeds very thin, sides not thick, margins not wedged, broadly ovate round with tapering micropylar end, ends roundish, finely pitted and feebly sculptured. ***M. balsamina***
- 1b. Germination hypogeal, perennial, taproot tuberous, plants dioecious, nectary of the male flowers closed with prominent scales, fruits echinate.

**Table 1. Distinguishing characters in the sub generic grouping**

Character	Monoecious	Dioecious
Basic chromosome no.	n=11	n=14
Germination	Epigeal	Hypogeal
Perennation	Annual, non-tuberous	Perennial-tuberous taproot
Fruit surface	Muricate-tubercled	Echinate-soft papillate
Seed sides	Rectangular, squarish	Cog wheel, round, oval, stellate
Seed colour	Brown-yellow	Black or grey
Leaf shape	Angular	Roundish
Male flower bract position	Mid way or towards axis- not protective	Just below the flower-protective
Male flower calyx	Broad, touching each other, protecting the nectary	Narrow, spaced and less protection to the nectary
Male flower nectary	Open from above	Closed by corolla scales
Relative size of ♂ and ♀ flowers (corolla)	♂ flowers larger than ♀	Of equal size

- 3a. Petals (3 inner) with black purple blotch, male calyx-hypanthium saucer shaped.
- 4a. Leaf cordate, unlobed, margins dentate, petiole eglandular, male calyx blackish purple, broad, tip round-oval, fruits faintly or prominently ridged, softly echinate, seeds medium sized, pitted on surface, rectangularly cog wheel shaped.

*M. subangulata*

- 4b. Leaf unlobed or shallowly 3 lobed, margins undulate, petiole gland dotted (6-12 bead like structures, often the lamina base also), male calyx green, broad, tip triangular, fruits with short conical projections, seeds large, smooth on surface, hexa-octagonal, subtridentate on ends.

*M. cochinchinensis*

- 3b. Petals without purple blotch, male calyx-hypanthium cup shaped.
- 5a. Anthesis in the early morning, flowers large showy, bright yellow, feebly scented, male calyx blackish purple, sepals of male flower broad, tip oval, round or scarious.

*M. sahyadrica*

- 5b. Anthesis in the evening, flowers small, pale yellow, intensely musky scented, male calyx whitish yellow, sepals of male flower narrow acute.

*M. dioica*

1. *M. balsamina* L. 1753, Sp. Pl.: 1009; Ser. 1828, in A. DC., Prodr. 3: 311; Wight et Arn. 1834, Prodr. Fl. Ind. Orient. 1: 348; CB Clarke 1879, in Hook. f., Fl. Brit. India 2: 617; Cooke 1903, Fl. Pres. Bomb. 1: 529; Duthie 1903, Fl. Upper Gang. Pl. 1: 370; Chakrav. 1959, Rec. Bot. Surv. India 17, 1: 90, p.p.; id. 1982, in SK Jain *et al.*, Fasc. Fl. India 11: 88; C. Jeffrey 1980, Kew Bull. 34: 790, p.p.; id. 2001, in Hanelt, Mansf. Encyl. Agric. Hort. 3: 1523; de Wilde and Duyfjes 2002, Bot. zhuarn. 87(3): 134.

Slender trailing herb, 1.5-3.0 m high, annual; subglabrous; monoecious; **Stems** round, internodes 5.5-6 cm; tendrils delicate, 11-13 cm long, basal 1-1.5 cm uncoiled. **Leaves** 3-5 (-7)-lobed to c. halfway or more, subcircular in outline, 4-6 cm dia., base cordate with a cuneate petiole-blade juncture, apex mucronate, lobes rhomboid, margins acutely 3-7 lobulate; petiole 1-4 cm long, slender, puberulous. **Flowers** solitary. **Male flowers** 2-3 cm across, bigger than in female; peduncles slender (2-) 3-5 cm long; bract subapical, suborbicular, up to 0.6 x 0.5 cm, pale green, filmy, cordate at base, margins

finely dentate; pedicel 0.3-0.4 cm long, ± pubescent; receptacle-tube cup-shaped (obconical), upto 0.2 mm long; sepals ovate, up to 0.7 x 0.3 mm, obtuse, faint green or pale cream, pubescent; petals obovate, 1-1.3 x 0.7-0.9 cm, pale yellow to creamish-yellow with green sub-parallel veins and undulate margins, scales in 2 petals only; filaments up to 0.2 mm long, inserted on the rim of the receptacle tube, anthers up to 1.2-1.8 mm long, ± coherent at base only; thecae bright yellow, disc inconspicuous by deep orange coloured nectary, open from above. **Female flowers** 1.7-1.8 cm across; peduncles 0.2-0.3 cm long; pedicels 0.4-0.6 cm long; bract small; calyx minute, thread like, thin, recurved; petals 0.8 x 0.8 cm, pale yellow to creamish-yellow with green sub parallel veins and undulate margins; ovary ovoid to fusiform, shortly rostrate, 5-7 mm long, ± pubescent, finely remotely warty in rows, style short, slender, whitish yellow. **Fruits** broadly ovoid-ellipsoid, bulged at middle, 2.5-3.5 (4.0) cm long, 1.8-2.0 cm in circumference and stalk 1-2 cm long, shortly rostrate, ashy-olive green with 2-3 white tubercles in lines across the whole length of fruits, bumps (mucication in interspace between ridges) absent; fruits turning orange and later scarlet red on ripening; pericarp thin. **Seeds** 3-5, covered by deep red sarcotesta, ovate oblong, compressed, 8.5-9.5 x 5.9-6.2 mm, and margins finely grooved, crenulate; testa grey or light brown, delicately verrucose.

**Type:** South Africa, Naal River, Burke 81 (K)

**Specimens examined:** India, Rajasthan, Jodhpur: Birai dam site, 26 August 1977, AN Singh 4398 (BSIJO); Jhurjhunun: on the way to Jaosrapur, 29 September 1994, PJ Parmer 12379 (BSIJO); Pali: Samaji ka gudda, near Kantol, 305 m, 20 August 1975, BV Shetty 1825 (CAL, BSIJO); Ajmer: Pachkund, 20 March 1959, SK Jain 49685 (BSI); Gujarat, Mehasana: Pushpavati river banks, 90 m, 26 July 1977, V Singh 5462 (CAL, BSIJO); Bharuch, 20 October 1957, PS Tour 25878 (BSI); Nakhatrana, 15 September 1969, RSO Raghavan 114827 (BSI); Jodhpur, Kailana lake road, 24 September 2003, K Joseph John 3880 RHK.

**Distribution:** Rajasthan, Gujarath, Haryana, and adjoining arid North Western plains. Not known from South India or Western Ghats. It cannot naturalize in the heavy monsoon climate and obviously South India is far outside its natural range (geographically and in its climatic amplitude). The lone report of its occurrence in South India (from Aryankavu, Kollam District of Kerala) by Subramanian (1970) is based on wrong identification

of collection 77,286 (accession no. 35124 of BSI, Pune, originally identified as *M. balsamina* on 1.xii.1961 and subsequently determined as *M. dioica* on 22.x.1962). Hence, the enumeration of *M. balsamina* in the floristic diversity of Kerala (Sasidharan, 2004; Nayar *et al.*, 2006) does not stand valid.

**Vernacular names:** Barakarela (Rajasthan), Karelo-jangro (Sindhi).

**Habitat and Ecology:** Disturbed habitats in semi-arid and arid tropics, roadsides, farm borders and fences on medium heavy soils with slightly alkaline pH. *Prosopis cineraria* (L.) Druce was found to be the associated vegetation.

**Taxonomic notes:** The species is allied to *M. charantia* var. *muricata* and other African taxa for leaf lobing and dissection. Flowers are very distinct; the female flower is always smaller than the male flower and male flower has red nectar guides.

**2. *M. charantia* L.** 1753, Sp. Pl.: 1009; Willd 1805, Sp. Pl. 4: 602; Blume 1826, Bijdr.: 927; CB Clarke 1879, in Hook. f. Fl. Brit. India 2: 616; Cooke 1903, Fl. Pres. Bomb. 1: 528; Duthie 1903, Fl. Upper Gang. Pl. 1: 369; Prain 1903, Beng. Pl. 1: 521; Gamble 1919, Fl. Pres. Madr. 3: 532; Kanjilal *et al.*, 1938, Fl. Assam 2: 330; Chakrav. 1959, Rec. Bot. Surv. India 17, 1: 88; id. 1982, in SK Jain *et al.*, Fasc. Fl. India 11: 89, f. 8-10; Backer 1963, in Backer *et al.*, Fl. Java I: 299; Keraudren 1975, in Aubrev. *et al.*, Fl. Camb., Laos, Vietnam, 15: 42; C. Jeffrey 1980, Kew Bull. 34: 789, p.p; id. 2001, in Hanelt, Mansf. Encycl. Agric. Hort. 3: 1523-24; de Wilde & Duyfjes 2002, Bot. zhuarn. 87 (3): 135; *M. muricata* Willd., 1805, Sp. Pl. 4: 602; *M. charantia* var. *muricata* (Willd.) Chakrav. 1982, in SK Jain *et al.*, Fasc. Fl. India 2: 92, f. 1-7; *M. charantia* L. var. *abbreviata* Ser. 1828, in DC. Prodr. 3: 311.

Annual, slender climber, 2-4 m high, scarcely to densely pubescent (tender parts wooly), monoecious. **Leaves** usually deeply palmately 5-9 lobed, reniform to orbicular or sub orbicular in outline, 2.5-8 x 4-10 cm, cordate at base, acute or acuminate at apex, lobes ovate or obovate, narrowed at base, margins sinuate to undulate, mucronate; petioles 1.5-5 cm long. **Flowers** solitary, pubescent; petals yellow. **Male flower** stalks slender with bract midway or towards base; peduncle 2-5 cm long; bract reniform, 5-11 mm diam., green, with mucronate apex and margins entire; pedicel 2-6

cm long; receptacle-tube cup-shaped, 2-4 mm long and 2-3 mm wide; sepals ovate-elliptic, 4-6 x 2-3 mm, pale green, touching each other and protecting the corolla tube; petals obovate, 10-20 x 7-15 mm, mucronate at apex, scales 2; filaments 1.5-2 mm long, inserted in the throat of the receptacle tube; anthers coherent; disc shortly cup shaped, c. 1.5 mm diam. **Female flower** peduncle 1-6 cm long; bract 1-9 mm diameter; pedicel 1-8 cm long; sepals narrow, oblong-lanceolate, 2-5 mm long; petals smaller than or equal to that in male, 7-10 mm long; ovary fusiform, narrowly rostrate, 5-11 x 2-3 mm, mucronate, tuberculate or longitudinally ridged; style c. 2 mm long; nectary 3, at styler base. **Fruits** pendulous, stalk 2-8 cm long; fruit discoid, ovoid, ellipsoid to oblong or blocky, often narrowed at ends, sometimes finely rostrate, 3-20 x 2-5 cm, white or green turning orange on maturity, soft tuberculate with 8-10 broken or continuous ridges, splitting from base into 3 irregular valves. **Seeds** 5-30, squarish rectangular, ends subtridentate, faces compressed, sculptured, 5-9 x 3-6 mm, margins grooved; testa brown or black.

**Type:** Plate 10 in Rheede's *Hort. Mal. Ind.* 8. 1688 (*M. charantia* var. *muricata*) **Lectotype:** from a plant cultivated at Hartekamp, Netherlands (*M. charantia*)

**Specimens examined:** India, Gujarat, Bharuch: Broach river bank, 4 November 1955, GL Shah Shah 6311 (BLAT); Rajkot: Rajkot jilla park, H Santapau 16915 (BSI); Kerala, Palakkad: Silent valley, Panthenthode border, 1,100 m, 21 August 1982, T Sabu SV 10680 (CALI); Anamuli hill slopes, 300 m, 13 October 1979, NC Nair 64604 (CAL); Travencore, Quilon, 11 November 1913, M Rama Rao 2189 (CAL); Tamil Nadu, Tiruchirappally, Kudamuruti, 65 m, 30 March 1984, KM Mathew RHT 29973 (RHT); Rajasthan, Ganganagar: Raisingh nagar, 250 m, 14 November 1976, GP Roy 3,875 (CAL); Sikkim, West District: Singtam, 1,500ft, 12 May 1967, MC Mazumdar 174 (CAL); Gangtok, G King 187 (CAL); Assam, Lakhimpur: Ranga reserve forest, 23 November 1957, G Panigrahy 11,500 (CAL); Andaman & Nicobar: Car Nicobar Islands, Kakana, 18. September 1976, NG Nair 4438 (CAL); Andhra Pradesh, Cuddappa, July 1885, JS Gambles.n. (CAL); Maharashtra, Bombay: Mazgaon hill, February 1925, AC Ackland 491 (BSI); Karnataka, Uttar Kannad: Yellapur, 20 October 1883, WA Talbot 4814 (BSI); Tumkur: Maralu bavi, 15 October 1978, KP Srinath KFP2749 (CAL)

**Distribution:** Large fruited forms cultivated all over

India as vegetable and small wild forms occur in forest pockets across Western Ghats and beyond in Eastern Ghats, Chhattisgarh (Bastar), Jharkhand and almost all over Central and South India.

**Common and vernacular names:** Bittergourd (Eng.), Uchchhe, Oochya, Oochi (Beng.), Jangli karela (Hindi, Mar.), Gidda hagala (Kan.), Kadu hagali (Tulu), Kattu pavaka (Mal.), Pavuka, Chinna pavala (Tam.), Tulsi karela (Oriya).

**Ecology:** The species has wider adaptability as evidenced by herbarium records. It grows from sea level to 1700 m in sub-Himalayas and from arid Rajasthan to cool climate in high ranges of Western Ghats. A range of soil types from river alluvium to red laterite, black cotton and clay loam has been recorded. By far, this is the most adaptable taxa in the genus.

**Taxonomic notes:** Chakravarty has made a distinction between large and small-fruited forms, the former being *M. charantia* var. *charantia* (cultivated type) and the latter *M. charantia* var. *muricata* (wild type). However, citing the Plate 10 in Rheede (1688) as Type, he has described the small-fruited cultivated form ('Uchchhe' of West Bengal), as *M. charantia* var. *muricata*. Even then, this is not shown in the determinavit slips in any of the herbaria in India even though most of the *M. charantia* sheets belong to the small-fruited wild category. Often, herbarium labels refer to them as escapes from cultivation. The cultivated form is generally large fruited. The small-fruited types occur wild in nature often as a component of primary and secondary forests or as weeds in agro ecosystems. The small fruited types are variously described as *M. charantia* var. *abbreviata* Ser., *M. muricata* Willd. and *M. charantia* var. *muricata* (Willd.) Chakrav. by various workers in different areas of its distribution.

### Key to the varieties

Vines robust, branches few, leaves large, fruits bulged, 5-30 cm, weighing 30-400 g, seeds large, flat subtridentate, brown, senescence early, cultivated

#### *M. charantia* var. *charantia*

Vines thin, leaves small to medium, fruits small, 3-9 cm, 5-15 g, seeds small to medium, flat, subtridentate, brown, white, black or mottled, senescence late, wild or rarely cultivated

#### *M. charantia* var. *muricata*

**3. *M. dioica* Roxb. ex Willd.** 1805, Sp. Pl. 4: 605; Ser. 1828, in A. DC., Prodr. 3: 312; Roxb. 1832, Fl. Ind. 3: 709; Wight et Arn. 1834, Prodr. Fl. Ind. Orient.:

348; Wight 1841, Icon. Plant. Ind. Orient.: t. 505, 506; Thwaites 1859, Enum. Pl. Zeyl.: 126; CB Clarke 1879, in Hook. f., Fl. Brit. Ind. 2: 617; Trimen 1894, Handb. Fl. Ceylon 2: 249; Cooke 1903, Fl. Pres. Bomb. 1: 529; Duthie 1903, Fl. Upper Gang. Pl. 1: 370; Gamble 1919, Fl. Madras 1: 532; Chakrav. 1959, Rec. Bot. Surv. India 17: 91, p.p.; id. 1982, in SK Jain *et al.*, Fasc. Fl. India 11: 94, pp; C Jeffrey 1980, Kew Bull. 34: 790, p.p.; id. 2001, in P. Hanelt, Mansf. Encycl. Agric. Hort. 3: 1522; KM Mathew 1983, Fl. Tamilnadu Carnatic 3: 648; de Wilde & Duyfjes 2002, Bot. zhuarn. 87(3): 142-144.

A dioecious vine, climbing up to 3-10 m high; the tap root perennial (up to 5 years), tuberous, fusiform in first year, subsequently getting elongated and bulged, rarely branched below, 9-18 x 6-11 cm, weighing between 180 to 350 g, occasionally up to 800 g. **Stems** slender, the internodes 3-8 cm long, cylindrical, nodes in the mature basal region, quadrangular. **Tendrils** axillary, 4-12 cm long, the basal 2-4 cm straight and the rest spiral. **Leaves** thin, light green to green, ovate-cordate, nearly triangular in outline, lobed and sub-lobed to various degrees or unlobed, cordate and cuneate at base, acute or acuminate at apex, the margins entire, undulate, irregularly or coarsely crenulate or regularly dentate; venation ending up in spatulate hydathodes which is sometimes like broad short bristles at margins and dent tips, lateral veins 4-5 pairs on each side of the midrib, the lower most pair running parallelly close to the margin of the cordate sinus, but soon branching out in to 3-4 veinlets; the upper surface and margins with scattered short hairs (10x), the lower surface densely short hairy; petiole slender to medium thick, 3-7 cm long, 1-1.5 mm in diameter, longitudinally grooved. **Staminate flowers** solitary in axils or often a loose fascicle with a separate lower one; peduncles 3-7.5 cm long (usually 5-6 cm), light green, thin; pedicels sub sessile, 2-3 mm long, whitish-yellow, subtended by and protected inside a reniform clasping swollen bract, 4-5 x 8-10 mm, light green, cucullate, with 8-12 longitudinal veins attached to the pedicel by base at one side; calyx (cup) funnel-shaped, lobes 5, light green, narrow acute, up to 6 x 1 mm; petals 5, free, pale yellow, glandular, oblong-lanceolate, 12-22 x 5-8 mm; acute at apex with 3-5 sub parallel veins branching sideways. Stamens 5, two of them with a pair of anthers and the other with a single anther, filaments 2-3 mm long, anthers subtriangular, 2-3 mm long, extrose, yellowish-brown on inner side, each anther with a single 'S' shaped pollen locule,

filaments at base extended to petal base covering the nectary; disc inconspicuous. **Pistillate flowers** solitary in leaf axils; peduncles thin, very short 0.5-2.0 cm long; pedicels thin, 2-4 cm long, subtended by a small bract of 3-4 × 2-6 mm; bracts reniform with acute tip just like in male but of small size; sepals 5, semi persistent, green, narrow, 3-6 × 0.8 mm, acute at apex; petals 5, same as in male flower; ovary oblong-ovoid to urn-shaped, 6-9 × 2-3 mm, rounded at base, clothed with short soft glandular spines all over the surface except receptacle base; nectary 5, small, white, butt-like cylindrical structures between petals at stylar base on the disc; styles short, up to 4 mm long, glandular hairy, stigmatic lobes 3, each lobe 'V' shaped, up to 3 × 5 mm, lemon-yellow, cushiony, glandular. **Fruits** broadly ovoid-oblong, rounded at base, abruptly conical with rostrate tip at apex, 3-4 × 2-3 cm, the entire surface covered with soft short spines (except the beak), light green or dark green, turning uniformly orange on ripening, splitting from base into three irregular pieces and rolling back exposing scarlet red arils (seeds). **Seeds** 2-3 mm across, black lustrous and golden-lined (when fresh), sculptured on surfaces, small round to slightly oval or shortly stellate (round-ovate and smooth in Central Indian specimens), seed coat brittle, shell hard, membrane thin, whitish, endosperm oily with characteristic aromatic odour when crushed.

**Type:** Peninsular India Orientalis, Nandaradah, *Rottler s.n.* (K).

**Specimens examined:** India, Kerala, Iddukki: Kattappana, 23 October 1997, M. Dan 14135 (TBGT); West Bengal, South 24-parganas: Sundarbans, Ghata pak, August 1902, D Prain s.n. (CAL); Bihar, Champaran: Motihari, 18 August 1964, SP Banerjee 1145 (CAL); Haryana, Hissar: Hissar bir, 10 August 1885, JF Duthie s.n. (CAL); Jammu & Kashmir, Naovshera, 30 June 1876, CB Clarke s.n. (CAL); Karnataka, Mysore: Biligirirangan hills, 8 September 1978, SR Ramesh kfp 2667 (CAL); Tamil Nadu, Courtalam (Kuttalam), 27 June 1901, CA Barber s.n. (MH); Kanyakumari: Vallathithodu, 500 m, 6 September 1976, AN Henry 48241 (MH); Salem: Rasipuram, 1,150 m, 14 July 1978, KM Mathew and Rajendran 14833 (RHT); Bombay: Trombay, September 1907, A Meebold 8906 (CAL); Raigarh: Neral, Thaburuwadi, 2 July 1959, NA Irani NI 4174 (BLAT); Andhra Pradesh, Vishakhapatnam: Kotturu (Koduru), 250 m, 28 November 1961, NP Balakrishnan 864 (CAL); Gujarat, Junagadh: Sasan, Gir Forests, 22 July 1957,

GS Puri 30028 (BSI); Rajasthan, Pali: Sarandana, 396 m, 18 August 1975, BV Shetty 1792 (CAL, BSIJO)

**Distribution:** Highest distribution in the Deccan Plateau and to a small extent in coastal Kerala (South of Palakkad gap), Gujarat, Orissa, West Bengal, Rajasthan, Madhya Pradesh, Uttar Pradesh, plains of Punjab and rarely in Jammu and Kashmir.

**Vernacular names:** kakrol (Hindi), kartoli (Mar.), karonda (Raj.), erumapaval, venpaval (Mal.), thulapava, kuruvithalaipavai, palupakkai (Tam.), Akakara (Telugu).

**Ecology:** The taxon prefers low elevation forests and openings in Western Ghats up to 350 m. Soil types vary from sandy loam in coastal Kerala to clay loam to alluvial soil in riverbeds (major habitat) to laterite soils and hard laterite rock crevices and black cotton soil in Deccan plateau or clay loam in Bundelkhand.

**Taxonomic notes:** Following Chakravarty's revision of Cucurbitaceae (1982), three distinct entities have been identified as *M. dioica* in all the Indian herbaria, without even designating them sub-specific or varietal status. *M. dioica sensu stricto* should be restricted to small forms adapted to plains, low elevations and coastal areas with anthesis in the evening and having small, pale yellow, and intensely musky scented flowers. Stout forms with day anthesis and large showy flowers occurring in mid and high elevation Western Ghats are separated out as a new species and are discussed in detail under *M. sahyadrica*. Material from North Eastern India is treated as *M. subangulata* ssp. *renigera*. Even though, there is a general resemblance overlying the three different taxa, they show clear-cut morphological distinction in floral guides, flower colour, size, calyx structure and colour and petal colour, besides pollinator specificity and distinction in anthesis time (Joseph *et al.*, 2006).

**4. *M. sahyadrica* Joseph and Antony 2007, *Nord. J. Bot.* 24(5): 539-542.**

A dioecious robust tendrillar climber, vines up to 5-6 m high, the tap root perennial (up to 5 years), tuberous, fusiform when young, subglobose or bulged irregularly when matures, 10-18 cm long, 5-10 cm. across, outer skin brownish and inner flesh whitish yellow. **Stems** stout, cylindrical turning quadrangular as it matures, the internodes 5-10 cm long, nodes quadrangular, blackish green, distinctly long hairy. **Tendrils** medium thick, unbranched, 8-15 cm long, 4-5 cm of base uncoiled, remaining coiled. **Leaves** heterophyllous; petiole 3-8 cm

long, 1-1.5 mm in dia, medium thick, longitudinally grooved above; blades medium thick, ovate, broadly triangular in outline, 3-5 lobed or entire, 10-16 × 8-18 cm, deeply cordate at base with a subangulate juncture with petiole, sometimes hastate, acute or acuminate at apex, margins highly variable, entire, undulate or coarsely crenulate, lateral veins 5-7 pairs, the lower pair running close to the margin of the subangulate petiole juncture, hairs short, scattered without, snowy white within. **Male flowers** axillary, solitary or a loose fasciculate of 5-7 (up to 15) flowers and in such case the lowermost flower produced separately and early; peduncles 2-5 cm long; dark green, pedicels short, 0.8-1 cm long, whitish green subtended and covered by an inflated bract, up to 1 × 1.5 cm, reniform, margins cucullate; calyx base funnel shaped, up to 8 mm long and 1 cm across, purplish black, lobes free, up to 1 × 0.6 cm, yellowish white at centre and blackish purple at base and margins, elliptic-oblong, recurved at apex, margins and apex scarious, densely hairy within and sparsely hairy without; petals 5, free, fleshy, obovate, up to 4 × 1.5 cm, bright yellow with a greenish yellow narrow base, veins prominent (embossed), each petal bearing a small tongue like ciliate appendage near the base; stamens 3, 2 of them with a pair of anthers, the other with a single anther, filaments up to 3 mm long, anther 2-3 × 1-2 mm, extrose, thecae dull black, 'S' shaped with abundant orange pollen, pollen grains tricolpate. **Pistillate flowers** solitary in leaf axils; peduncles 0.5- 2.0 cm, often less than 1 cm; pedicel short, up to 0.5 cm long, subtended by a small rudimentary bract, 1-3 × 0.5-5 mm; sepals 5, green, persistent, 0.8-1.3 × 1-3 mm, equal, lanceolate, acuminate at apex densely glandular hairy within and without; petals 5, free, fleshy, up to 4 × 2 cm, narrow, greenish yellow and ciliate at base, widening towards middle, bright yellow; veins 5-7, sub parallel; nectary 5, white, short cylindrical, alternating with petals, protected by a spur at the base of petals; ovary inferior, oblong-ovoid, 1-1.5 × 0.2-0.4 cm, more or less densely clothed with soft papillae of 1 mm length; style up to 6 mm long, whitish yellow, stigma up to 4.0 × 9.0 mm, cushiony, trifold, each lobe again sub lobed dichotomously. **Fruits** broadly ellipsoid, ovoid to fusiform or top shaped with round blossom end and rostrate distal end, 5-7.5 × 3-4.2 cm in size, 9-12 cm in circumference, 35-50 g in weight, dark green turning bright orange on ripening, densely clothed with soft short spines; spines 2-4 mm long; arils sweet to taste, ripe fruits aromatic and slightly

bitter. **Seeds** black, shining, loosing its luster on drying, round stellate to slightly cog wheel shaped, warty-dentate on margins sculptured on faces with irregular furrows and ridges, 0.2-0.3 × 0.2-0.3 cm, seed coat brittle, hard shell like, the membrane very thin, smooth, blackish green, conspicuously veined, endosperm oily, distinctly aromatic when crushed.

**Type:** INDIA, Kerala, Thrissur District: NH-47, Thrissur-Palakkad road at Erumbupalam, outskirts of Peechivazhani wildlife sanctuary, 23 October 2003, Joseph John 133 (Holotype, CAL; Isotype, MH).

**Specimens examined:** INDIA, Maharashtra, Rajgarh: Kanakeswar, 30 October 1982, HD Sane 2147 (AHMA); Rajgarh: Amba ghat, 17 September 1961, C Saldhana CS 7205, CS 7206 (BSI); Tamil Nadu, Coimbatore: Siruvani, 21 August 1960, AN Henry ANH 371 (BLAT); Coimbatore: Karian shola, Anaimalai, 1,012 ft, 1 October 1912, CEC Fisher s.n. (CAL); Nilgiris: Kodaikanal Ghat, 17 November 1897, CA Barber s.n. (MH); Guddalur: Rockwood R.F, 1,000 m, 5 August 1975, E Vajravelu 90447 (MH); Goa, South Goa: Perideterm, Cumbari, 500 ft, 5 October 1970, NP Singh s.n. (BSI); Karnataka, Chickmagalur: Mudigere-Bantwal rd, 850 m, 7 October 1979, CJ Saldhana s.n. (CAL); Dakshin Kannada: Sampaje, 8 November 1900, CA Barber s.n. (MH); Uttar Kannada: Hulekal Ghat, 9 September 1962, RS Raghavan 83073 (BSI); Kerala, Palakkad: Sholayar, Malakkarappa, 800 m, 29 October 1999, K Joseph John 3111 (IARI); Idukki: Kulamavu, 700 m, 3 October 1983, CN Mohanan 152254 (MH).

**Distribution:** Endemic to Western Ghats of Kerala, Tamil Nadu, Karnataka, Goa and Maharashtra.

**Ecology:** The taxon is highly niche specific. Restricted to acidic forest soil in moist forests, it grows on well-drained slopes. Altitudinal preference was noticed for mid and high ranges of Western Ghats from 250-800 m with higher frequency at 600-800 m coffee and cardomom estates are the ideal habitats.

**Vernacular names:** Madahagalikkai (in Dakshin Kannada, Uttar Kannada, Coorg and Shimoga), Katteli and Kadu hagali (in Uttar Kannada District), Kadu peerakai (in parts of Dakshin Kannada), Pothupaval, Vaikka, Kakkachi, Karayachakka, Kattupaval and Mullen paval (in Kerala).

**Taxonomic notes:** This taxon is a new species described from Western Ghats (Joseph and Antony, 2007). It was treated as *M. dioica* in Chakravarty's revision of



Cucurbitaceae and hence all the specimens were labelled as *M. dioica*. However, collections from Mahabaleswar-Kanakeswar (Maharashtra) were labelled as *M. subangulata* Blume (AHMA). *M. subangulata* was reported as rare in semi-evergreen and evergreen forests in Belgaum, Western Karnataka by Saldhana (1985), probably based on this taxon. It differs from Wight's icon of *M. dioica* in its flower being large (5 times bigger than *M. dioica*), showy, opening in the day, not being musky scented and robust plant growth manifested in all organs. However, the fruits resemble *M. dioica*, besides being a tuberous perennial. The material has a general resemblance to *M. subangulata* Blume ssp. *subangulata* (Scortechini 549, CAL) in the leaves, male bract, petals with incurved scales (= spurs/appendages). However, the male flower sepals are not typically broad ovate; male flower calyx is cupular (not saucer shaped) and fruits are not ridged or longitudinally alate but softly densely echinate.

**5. *M. subangulata* Blume** 1826, Bijdr. Fl. Ned. Ind. 15: 928; CB Clarke 1879, in Hook.f., Fl. Brit. India 2: 617, p.p.; Cooke 1903, Fl. Pres. Bomb. 1: 530; Gamble 1919, Fl. Pres. Madr. 3: 532; Chakrav. 1959, Rec. Bot. Surv. India 1: 97, p.p.; id.1982, in SK Jain *et al.*, Fasc. Fl. India 11: 95, p.p.; Backer 1963, in Backer et Bakh. f., Fl. Java I: 299; Keraudren 1975, in Aubrev. et. J.-F. Leroy, Fl. Camb., Laos, Vietnam, 15:41; C Jeffrey 1980, Kew Bull. 34: 790; de Wilde and Duyfjes 2002, Bot. zhuarn. 87(3): 145-148.

**Taxonomic notes:** CB Clarke, Gamble and Chakravarty have enumerated this species in their treatments, without assigning any subspecific status. De Willde and Duyfjes (2002) has bifurcated this species to two subspecific entities, of which only one (ssp. *renigera*) occurs in India.

### Key to Subspecies

1a. Plants stout, fruits 5-8 cm long, densely soft spiny with remnant ridges **ssp. *renigera***

1b. Plants delicate, fruits 3-5 cm long, irregularly ridged or longitudinally alate on surface **ssp. *subangulata***

***Momordica subangulata* ssp. *renigera*** (G. Don) WJ de Wilde 2002, Bot. zhuarn. 87(3): 147-148.

A dioecious vine, climbing up to 8-10 m high, the roots (tap root, secondary and tertiary roots) tuberous, tubers both sessile and non sessile, fusiform to globoid or subgloboid to irregularly bulged, often branched, 3-7 × 2-5 cm. **Stems** stout, the internodes 7-11 cm,

quadrangular, grooved, nodes slightly bulged, often twisted. **Tendrils** simple, axillary, 15-17 cm long, the basal 5-7 cm erect, the rest when uncoiled measuring up to 10-12 cm long. **Leaf** (blade) medium thick, light green, ovate cordate, unlobed, 8-12 × 7-11 cm, acuminate at apex, cuneate at base, the basal flaps almost touching the petiole or overlapping giving rise to two sinus or cavities, the margins undulate and coarsely denticulate with fine bristles projecting as continuation of veinlets; veins 3-5, ascending and many pinnate from midrib ending up in fine network of areoles, 4-5 mm across, glabrous above, glandular hairy below; petioles 7-10 cm long, thick, channeled longitudinally, margins finely ridged. **Flowers** large, solitary (male occasionally a loose fascicle of 3-7 flowers), axillary, showy, creamish-yellow, up to 9 cm across, opening early in the morning, withering by afternoon and falling (petals) by evening. **Staminate flowers** with peduncles 4-6 cm long, pedicel 0.5-1 cm long, subtended and covered inside a reniform bract, 2 × 2.5 cm, light green, plicate with about 15 ribs, shining, glabrescent inside, pubescent outside; calyx cup saucer shaped, sepals 5, greenish crimson, united at the base, 10 × 7mm, ovate, acuminate at apex; petals 5, 5-6 × 3-4 cm, free, fleshy, prominently networked with 5-7 sub parallel veins and intricate cross veins, creamish-yellow with intense colouration towards base, obovate, acuminate at apex, narrow at base, highly imbricate, 3 inner petals with blackish purple blotch of 7 × 6 mm size and long glandular hairs; nectary, orange yellow, enclosed in calyx cup, scales 3, very prominent, flap like; stamens 3, two of them with a pair of anthers, the other with a single anther, filaments up to 4 mm long, black on sides, thecae yellowish white and dull brown bearing abundant orange yellow pollen. **Pistillate flowers** with peduncles short, 1-1.3 cm long, pedicels 10-17 cm long (Mizoram, Gangtok, Kahikuchi specimens); bracts minute, rudimentary, near axil, often a scar of 2 × 1 mm size; sepals 5, 5-9 × 1-1.5 mm persistent, acute at apex; corolla and scales as in male; ovary oblong ovoid, dark green, 1.5-2 × 0.6 cm, rounded at base, finely echinate on surface; nectary 5, white butt like cylindrical structures protected inside the petal base, touching the style; style 5 to 7 mm long, pale yellow, stigma cushiony, up to 4 × 6 mm, trilobed. **Fruits** broadly ovoid-ellipsoid, with doom shaped ends and a prominent rostration (3-5 mm) at base, 7-8 × 13-14 cm, each weighing 50-80 g; densely softly echinate, rarely with remnant ridges at base, spines 2-3 mm long, light green turning yellow and finally bright orange on

ripening, exposing the seeds (35-50 per fruit) by basal splitting of the fruit and rolling back of the split lobes; flesh thick, (5-6 mm), aril deep red; **Seeds** black, flat, sub-orbicular to sub-tridentate, rectangularly stellate-cog wheel shaped, 6 × 3 mm and up to 4 mm thick, sculptured on faces with grooves and dented edges, margins with a double row of wart like small protruberances.

**Type:** Wall. Cat. No: 6743, Prome hills, Myanmar (CAL)

**Specimens examined:** India, Arunachal Pradesh, Lohit: Deopani riverbank, 2 October 1969, AS Rao 48182 (CAL); Tripura, West Tripura: Kumargarh, 25 July 1957, DB Deb 900 (CAL); Nagaland, Kohima: Naga Hills, September 1886, D Prain s.n. (CAL); Meghalaya, Jaintia Hills: Garampani, east of Jowar, 30 October 1956, G Panigrahi 4216 (CAL); Sikkim, above goreedora, 30 September 1868, LS Kurz s.n. (CAL); Gangtok, 21 October 2003, K Joseph John 3927 (RHK); Assam, North Cachar: Halfong, 10 August 1908, WG Craib s.n. (CAL); North Lakhimpur: Lakhimpur, 2 June 1919, U. Kanjilal 7563 (BSISH); Nagaon, Doboka RF, 3.5 miles, 450 m, NP Balakrishnan 39519A (BSISH); Andaman & Nicobar Islands, Havlock Island, 30 August 2002, K Joseph John 3825 (RHK).

**Distribution:** Observed both wild and in cultivation in the North Eastern states with a preponderance in Khasi, Garo and Jaintia hills of Meghalaya, hill jungles of Kokrajhar and Kamrup district in Assam.

**Ecology:** Clay loam, forest soils; have wider adaptability to varying altitudes from sea levels in Andaman Islands to 1,800 m in Sikkim.

**Common names and vernacular names:** Teasle gourd, bhat karela (stuffed fruits cooked along with rice in Assam, hence the name bhat karela), Lamkarote (Manipur), Meeta chottele (Nepal-Sikkim), Kaksa (Bihar), Kakrol (Bengal), Karkul (Mizoram).

**Taxonomic notes:** Chakravarty treated these specimens under *M. dioica* even when recognizing the extra long fruit stalks. It is clearly distinct for many characters like cordate unlobed leaf lamina, very distinct petal blotches, large creamish-white petals, very large and kidney shaped male flower bracts, broad ovate and blackish purple male calyx and saucer shaped receptacle cup. It does not match with Wight's icon of *M. cochinchinensis* or Philippine-Andaman-Assamese *M. cochinchinensis* specimens lodged at CAL and PBL either. Petiole and lamina bases are not gland-dotted and seeds are smaller than that of *M. cochinchinensis*.

Further, seed shape is rectangular unlike the broad octagonal-stellate shape in *M. cochinchinensis*. Following Chakravaty, this taxa has been treated as *M. dioica* by Indian botanists whereas, the agricultural scientists refers to it as *M. cochinchinensis*. Some workers made a distinction by treating it as a tetraploid form of *M. dioica* (Mishra *et al.*, 1983).

**6. *M. cochinchinensis* (Lour.) Spreng.** 1826, Syst. Veg. 3: 14; CB Clarke 1879, in Hook. f., Fl. Brit. India 2: 618; Cooke 1903, Fl. Pres. Bomb. 1: 530; Duthie 1903, Fl. Upper Gang. Pl. 1: 370; Prain 1903, Beng. Pl. 1: 522; Gamble 1919, Fl. Pres. Madras 3: 532; Kanjilal *et al.* Fl. Assam 2: 330. 1938; Chakrav. 1959, Rec. Bot. Surv. India 17,1: 95, p.p.; id.1982, in SK Jain *et al.*, Fasc. Fl. India 11: 92; Keraudren 1975, in Aubrev. *et. J.-F. Leroy*, Fl. Camb., Laos, Vietnam: 38, f.8; C. Jeffrey 1980, Kew Bull. 34: 790, p.p, id. 2001, in Hanelt, Mansf. Encycl. Agric. Hort. 3: 1521-22; de Wilde & Duyfjes 2002, Bot. zhuarn. 87(3): 137-138; *Muricia cochinchinensis* Lour. 1790, Fl. Cochinch. 2: 596; Ser. 1828, in A. DC., Prodr. 3: 318; *M. mixta* Roxb. 1832, Fl. Ind. 3:709; Wight *et Arn.* 1834, Prodr. Fl. Ind. Orient.1: 349; *M. macrophylla* Gage 1908, Rec. Bot. Surv. India 3: 6; Chakrav. 1959, Rec. Bot. Surv. India 17,1: 94, id.1982, in SK Jain *et al.*, Fasc. Fl. India 11: 94.

**Type:** Cochin China (Vietnam), *Loureiro s.n.* (BM) Dioecious, stout perennial climber up to 20 m high, roots tuberous, woody, all parts glabrous. **Leaves** entire or 3-5, palmately lobed, or 3 foliolate (leaflets ± elliptic with minute petiole), broadly ovate or sub-orbicular in outline, up to 10 x 16 cm, base cordate (sometimes with 2-4 glandular bead like projections towards cordate margin), acute or acuminate at apex or acuminate, margins entire, undulate or remotely dentate; petiole 5-12 cm long, usually with 2-6 conspicuous bead like crateriform glands (Assam and Andaman specimens). **Flowers** solitary, axillary, male sometimes in a loose fascicle of 5-7, with a separate basal one. **Male flowers** with subapical bract; peduncles 8-12 cm long, bract cucullate, suborbicular or reniform, 20-40 mm wide, ± scabrous, rounded at base, acute at apex, margins undulate, veins subparallel, very prominent outside; pedicels 5-8 mm long, receptacle tube saucer shaped, 4-5 × 8-12 mm, blackish outside; sepals coriaceous, 10-12 × 4-8 mm, ovate-oblong or triangular, acute at apex, blackish, finely scabrid; petals subelliptic, 2.5-4 × 6-7 cm, conspicuously sub parallel

veined, scales 3, at the base of the blotched petals, protecting the nectary; inner 3 petals with purple bull's eye mark at base, filaments short, fleshy, 5-6 mm long, inserted at the base of the receptacle tube, anthers variable in size, 'S' shaped, connective swollen. **Female flower** with small or rudimentary bract; sepals linear oblong, 4-10 mm long; petals as in male; ovary ellipsoid oblong, 12-15 mm long, densely soft muricate; style 8-9 mm long. **Fruit** ovoid or oblongoid, bulged at middle, 10-15 × 6-10 cm, rostrate at base and stalk 5-12 cm long; pericarp densely tuberculate with uniformly short round conical structures or interspersed with larger tubercles; single fruit weighing between 350-500 g or more, green turning orange on ripening and bursting irregularly; **Seeds** many, variable in size, 1-1.5 × 0.8-1.2 cm, broadly ovate hexa-octagonal with flat sculptured surfaces, subtridentate at ends and margins, testa black.

**Specimens examined:** Philippines, Luzon: Luzon Island, May 1906, Elmer 7526 (CAL); Bangla Desh, Chittagong hill tract, April 1911, G King 49 (CAL); Burma (Myanmar), Mergui, April 1911, A Meebold s.n. (CAL); India, Andaman Islands: South Andamans, Haldayapur hill jungle, 1892, King s.n. (CAL); South Andamans, Humfreygunj, 27 May 1973, NP Balakrishnan 165 (PBL); South Andaman, Adasig, 11 July 2002, K Joseph John 4526 (RHK); Assam, Sibsagar, May 1886, AT Gage s.n. (CAL); Cachar: Badarpur, 12 August 1903, AT Gage s.n. (CAL)

**Distribution:** Widespread in South and South East Asia from North East India, Myanmar and Chittagong hill tracts of Bangladesh, China, Taiwan, Malaysia, Vietnam to Philippines. In India, it occurs rarely in the wild in Assam, Manipur and occasional in South Andamans and to a small extent cultivated in Assam, Jharkhand and Andaman Islands as a homestead vegetable. Even though, reported from Deccan and Western Ghats (South Canara and Mysore) by Gamble (1919) and Chakravarty (1982), there are no specimens in Indian Herbaria from peninsular South India, but only from Andamans and North Eastern states.

**Habitat and ecology:** Open forests and coastal scrub jungles (Andamans) and tropical evergreen openings in Assam up to 1000 m.

**Common and vernacular names:** Crow cucumber, Golkakra (Beng.), Hathikarela (Assam), Cochinchina gourd, Spike fruited crow cucumber, Sweet gourd.

**Taxonomic notes:** *M. cochinchinensis* and *M. macrophylla*

Gage have been treated as two distinct entities by Chakravarty (1982) citing the lobed (former) and unlobed (latter) nature of leaves. Leaf lobing is more of an environmental character in dioecious taxa as evidenced by both lobed and unlobed leaves in the same plant at different stages of plant growth. *M. cochinchinensis* shows various leaf lobing patterns even nearly 3-foleolate with minute petiolule, giving the superficial appearance of a palmately compound leaf. Hence, our study leads us to agree with Jeffrey (1980; 2001) and de Wilde and Duyfjes (2002) in treating *M. macrophylla* as synonymous with *M. cochinchinensis*.

### Doubtful Taxa

**1. *M. denudata* (Thwaites) CB Clarke** 1879, in Hook. F., Fl. Brit. India 2: 618; Trimen 1894, Handb. Fl. Ceylon 2:249; Chakrav. 1946, Ind. J. Agric. Sci. 16, 1: 50; id. 1959, Rec. Bot. Surv. India 17, 1: 98; id. 1982, in SK Jain *et al.*, Fasc. Fl. India 11: 93; *M. dioica* Willd. var. *denudata* Thwaites 1859, Enum. Pl. Zeyl.: 126.

**Type:** Sri Lanka, C.P. 1615 s. coll. (Holotype, PDA; Isotype, CAL)

**Notes:** The Travencore specimens (Meebold 12241, 'Kavala Cochi' and Meebold 12769, 'near Kottayam and Kavalay'), originally labelled as *M. dioica*, have been determined by Chakravarty as *M. denudata*, which in fact are typical specimens of *M. dioica*. It is not clear how he arrived at this identification. Interpretation of male inflorescence needs clarification. It might probably be a case of the male flowers in 'loose fascicles' and many flowers emerging from the same axil, giving the false appearance of a 'branched inflorescence' (as reported to be in *M. denudata*). This feature is common in all the taxa from the high rainfall areas.

de Wilde explicitly states that he has listed the species exclusively based on bibliographic compilation and that he has not seen the Type specimen. It is true in all other cases as well and probably a case of perpetuation of 'the original error' in judgement. Even after conducting extensive field surveys throughout reported areas of occurrence in Kerala, *i.e.*, low elevation coastal areas especially Quilon (Gamble, 1919) and Thrissur (Chakravarty, 1946), we failed to locate a live specimen matching with Type specimen CP 1615 (CAL). Based on descriptions of the species by Trimen (1894), Cooke (1903), de Wilde and Duyfjes (2002) and our own observations of the type specimen (CP 1615), presence of *M. denudata* in Kerala (India) is fairly doubtful. This

taxon requires a great deal of further research with living material and until complete specimen with seeds and tubers has been studied in detail, no conclusions could be arrived at the validity of *M. denudata*.

### Taxonomic Summary

Of the seven species placed by Chakravarty (1982) in the genus *Momordica*, four are accepted at species level in this treatment. They are *M. balsamina* L., *M. charantia* L., *M. cochinchinensis* (Lour.) Spreng. and *M. dioica* Roxb. (in a strict sense). As treated here, the *M. dioica* sensu stricto consists of the delicate forms distributed in the Deccan plateau and Central India; North Eastern elements of *M. dioica* is placed under *M. subangulata* Blume ssp. *renigera* (G Don) WJ de Wilde and stout forms from Western Ghats separated as new species (*M. sahyadrica* Joseph and Antony). *M. subangulata* Blume (as described by him) do not occur in South and Western India and the specimens ascribed therein are *M. sahyadrica*. Its reported occurrence in North East India must be true and those specimens must be placed under ssp. *renigera*. Of the remaining three species, *M. macrophylla* Gage is placed in synonymy with *M. cochinchinensis*. Presence *M. denudata* (Thwaites) CB Clarke in India is doubtful in the absence of valid herbarium specimens or field collections. *M. cymbalaria*, rightly placed under *Luffa* by Chakravarty, is more allied to *Luffa* than *Momordica* and therefore should be placed under the former genus, though some workers continue to treat it under *Momordica*.

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