

An Illustrated Guide for the Identification of *Vigna Savi*, *Cucumis* L. and *Abelmoschus* Medik. Species in India



NATIONAL BUREAU OF PLANT GENETIC RESOURCES
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Index words: *Vigna*, *Cucumis*, *Abelmoschus*, taxonomic identity, occurrence, distribution, Indian subcontinent

Cover photo: *Vigna sublobata* (Roxb.), Babu and S.K. Sharma, *Cucumis sativus* forma *hardwickii* (Royle) W. J. de Wilde & Duyfjes, *Abelmoschus angulosus* var. *purpureus* Thwaites

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Foreword

I am happy to introduce this publication; based on a systematic and thoroughly organized research financed under NAIP Component-4; carried out for nearly six years by a well-knit consortium of three outstanding institutions engaged in classical taxonomy, cytogenetics, molecular taxonomy, cytology and plant genetic resources management. The study has successfully endeavored to address some recalcitrant and longstanding taxonomic problems in the indigenous genera *Vigna*, *Cucumis* and *Abelmoschus* through a multi-disciplinary approach. The consortium consisted of a group of competent and experienced scientists from the National Bureau of Plant Genetic Resources (NBPGR), New Delhi; Shivaji University, Kolhapur and North Eastern Hill University (NEHU), Shillong.

The three genera studied have been known to pose difficulties in establishing species identity due to presence of overlapping variations in case of *Vigna*, confusing species descriptions in *Cucumis*, and very high order polyploidy in genus *Abelmoschus*. Through this NAIP sub-project the problems have been overcome by the consortium following a three-pronged approach. The investigators have followed just the basic alpha taxonomic procedures, cytological analysis of F₁ hybrids between the species, molecular cytology to visualize the linear differentiation of chromosomes and gross chromosomal similarities, and analyses of crossability barriers to gene flow which result in species differentiation. The results are authenticated and species identities fine-tuned using the molecular taxonomic approaches by analyzing the DNA sequence variations at taxonomically relevant loci for species identification, classification and phylogeny analyses.

In the course of investigations, the consortium has thus assembled a sizeable collection of correctly identified and well analyzed species diversity from diverse ecological regions; developed derivatives of interspecific crosses with high breeding potential; identified species germplasm with genes for tolerance to mungbean yellow mosaic virus and other traits of economic importance. The genetic resources thus identified, characterized and augmented have very high potential utility in crop improvement programmes in these important pulses and vegetables crops. The consortium has proudly described five new species of the genera studied, and published over 16 research papers in reputed international journals. I am also happy that the consortium agreed to refine information on and map variability in some other indigenous genera of economic importance in the country during the extension phase as additional task.

The pictorial descriptions for the authentic species and other illustrations in this volume are expected to be of immense academic value in taxonomy as well as of practical value in plant genetic resources management and use in the country. I hope this study provides an impetus to initiation of more such research projects in crop-wild relatives of importance to agriculture.

New Delhi
June 15, 2014



(SUDHIR KOCHHAR)
National Coordinator
NAIP Component-4

Preface

The Hindustani Centre of Origin is home for primary diversity of several major crops, such as rice, cotton, jute, and many pulses, vegetables, fruits and spices. Members of genera *Vigna*, *Cucumis* and *Abelmoschus*, including the crops greengram, blackgram, ricebean, adzuki bean and mothbean (all from the genus *Vigna*); cucumber, some vegetables (*kakri* and *kachri* of north, *dosa kai*, *southe* of south) and musk melons (all from genus *Cucumis*), and okra from the genus *Abelmoschus* and their wild relatives contribute to the rich economic botany of the sub-region. But despite this importance and the presence of primary diversity, these crop-wild relatives have been studied in a fragmented manner. There are several gaps and confusion in the understanding on species identities, their relationships and utility. Particularly the utilization of useful genes in these taxa from the wild, in crop improvement programmes, is very limited. On the other hand, efficient and effective germplasm classification system underlined with precise taxonomic identity in these genera could also unravel the useful traits contained in these species and in enhancing the utilization of their genetic resources in crop improvement programmes.

To address the ambiguities and mitigate the gaps in determining species identities through basic and strategic research a competitive grant was approved by the Indian Council of Agricultural Research (ICAR) under the **National Agricultural Innovation Project (NAIP)** to a consortium of three partner institutions; the National Bureau of Plant Genetic Resources (NBPGR), the North Eastern Hill University (NEHU) and Shivaji University, Kolhapur. This volume presents the information generated by the consortium in the sub-project, '**Biosystematics of the genera *Vigna*, *Cucumis* and *Abelmoschus***' aimed at explaining and solving several of the outstanding problems related to species identities and relationships in the three indigenous genera. This consortium based sub-project activity under NAIP could also successfully bring together the relevant expertise of diverse partners such as the competent systematists, cytogeneticist, plant genetic resources (PGR) curators and molecular taxonomists essential for such studies in the long term.

This liberally funded basic and strategic research for over nearly six years has focused on the issues related to occurrence, distribution and prevalence of diversity in species under the genera *Vigna*, *Cucumis* and *Abelmoschus* in India. The activities in the process involved an extensive collection and study of the species and their variants; their description and classification using complementary information from the use of diverse tools. In the efforts to resolve several complications caused by overlapping variations for taxonomic traits reported by earlier workers, the investigators arrived at a conclusion that recognizing the distinct forms as new species bridges the gaps in phylogeny. The consortium has succeeded in generating substantial amount of information on the target genera, in addition to producing over 1500 interspecific derivatives and stabilized lines. Investigating teams have also identified several valuable genetic resources, for example, as sources of genes for tolerance to Mungbean Yellow Mosaic Virus in *Vigna*, Yellow Vein Mosaic Virus in okra, carotenoid rich germplasm in cucumbers, and Downey Mildew resistant lines in melons, etc.

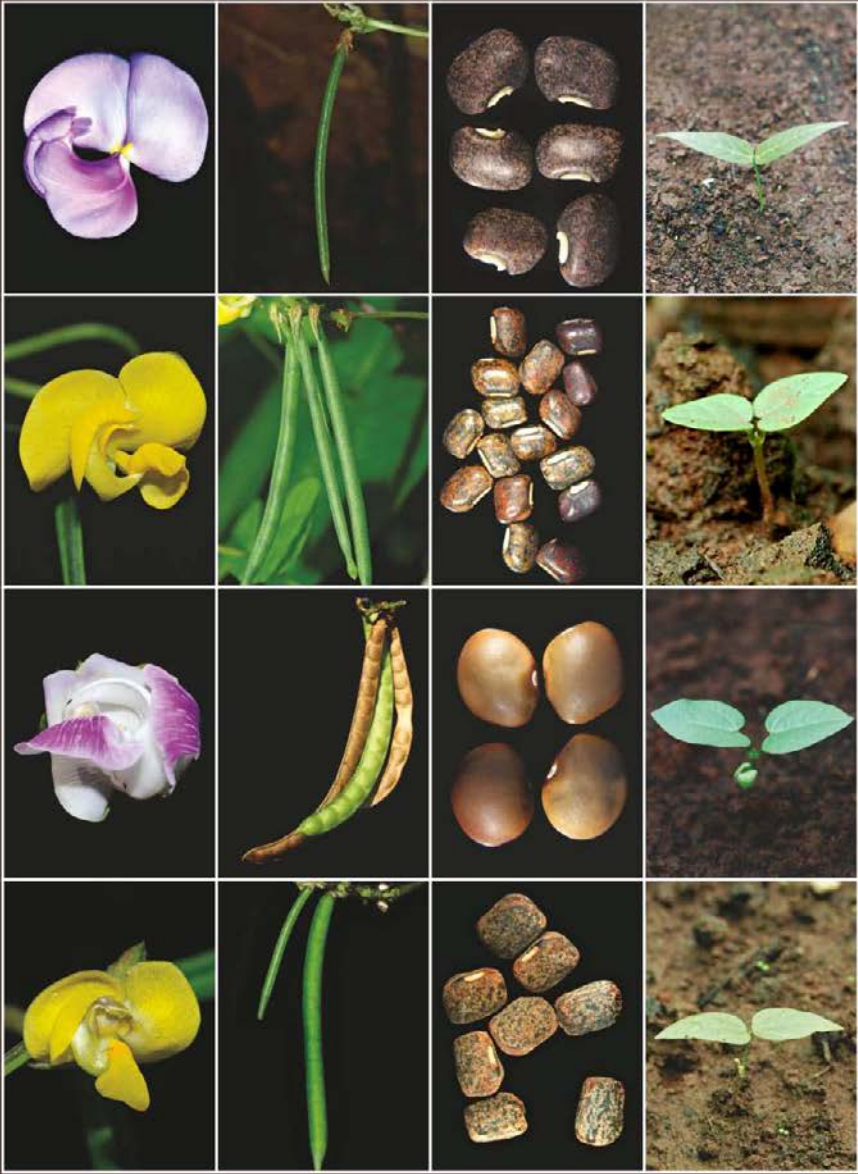
This compilation is based on the study of vast species diversity described and assembled by the consortium which includes above 500 accessions belonging to over 50 species under the target genera collected from diverse eco-geographical regions of the country. The information presented here would help the scientists engaged in plant genetic resources conservation and use in an unambiguous identification of the species diversity in *Vigna*, *Cucumis* and *Abelmoschus* occurring in India thereby ensuring efficient PGR management for crop improvement.

New Delhi
June 15, 2014

KV Bhat
Consortium Principal Investigator

Genus *Vigna* in India

an illustrated guide for species identification

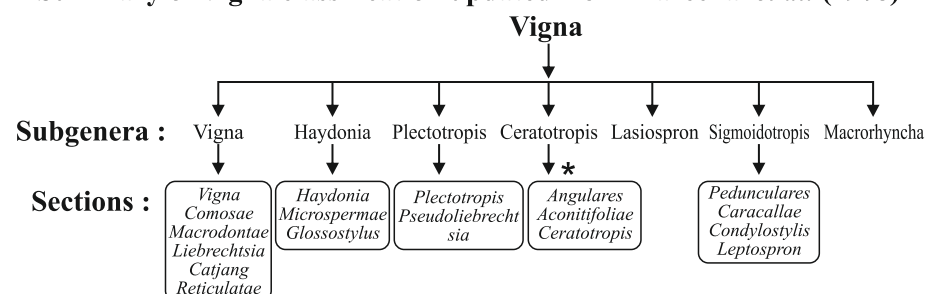


Introduction

Fabaceae, the third largest family of flowering plants with approximately 650 genera and 18,000 species (Polhill & Raven, 1981) of legumes includes important grain, forage and agroforestry species. Legumes are excellent colonizers of disturbed ecosystems and low nitrogen environment which also make them economic and environment friendly crops. Legumes account for 27% of world's primary crop production, with grain legumes alone contributing 33% of dietary protein nitrogen (N) needs of human (Vance *et al.*, 2000).

Vigna, originally published by Savi in 1824 who named it after Domenico Vigna, Professor of Botany at Pisa (Baudoin & Maréchal, 1988). The genus *Vigna* Savi is a large pantropical genus with about 104 (Lewis *et al.*, 2005) species distributed among 7 subgenera *viz.* *Ceratotropis*, *Haydonia*, *Lasiospron*, *Macrorhyncha*, *Plectotropis*, *Sigmoidotropis* and *Vigna* (Marechal *et al.*, 1978). There are 18 cultivated species (Maxted *et al.*, 2004) including pulses like black gram, mung bean, moth bean, cowpea, azuki bean and rice bean. Black gram, mung bean and moth bean were first domesticated in India. Wild relatives of these crop plants are widely distributed in India, exhibit greater diversity and constitute an important source of germplasm for improvement of cultivars. Thus, Indian centre is centre of origin as well as centre of diversity for these crops. India, with 24 species of *Vigna* (Sanjappa, 1992), represents secondary centre of species diversity for all the three sections of subgenus *Ceratotropis* and are also known as Asian *Vigna*. Babu *et al.* (1985) revised Tribe Phaseoleae for India in which 23 species of *Vigna* are reported and described. Asia is the centre of diversity for subgenus *Ceratotropis* in *Vigna*. (Tomooka *et al.*, 2002).

Summary of *Vigna* classification updated from Marechal *et al.* (1978)

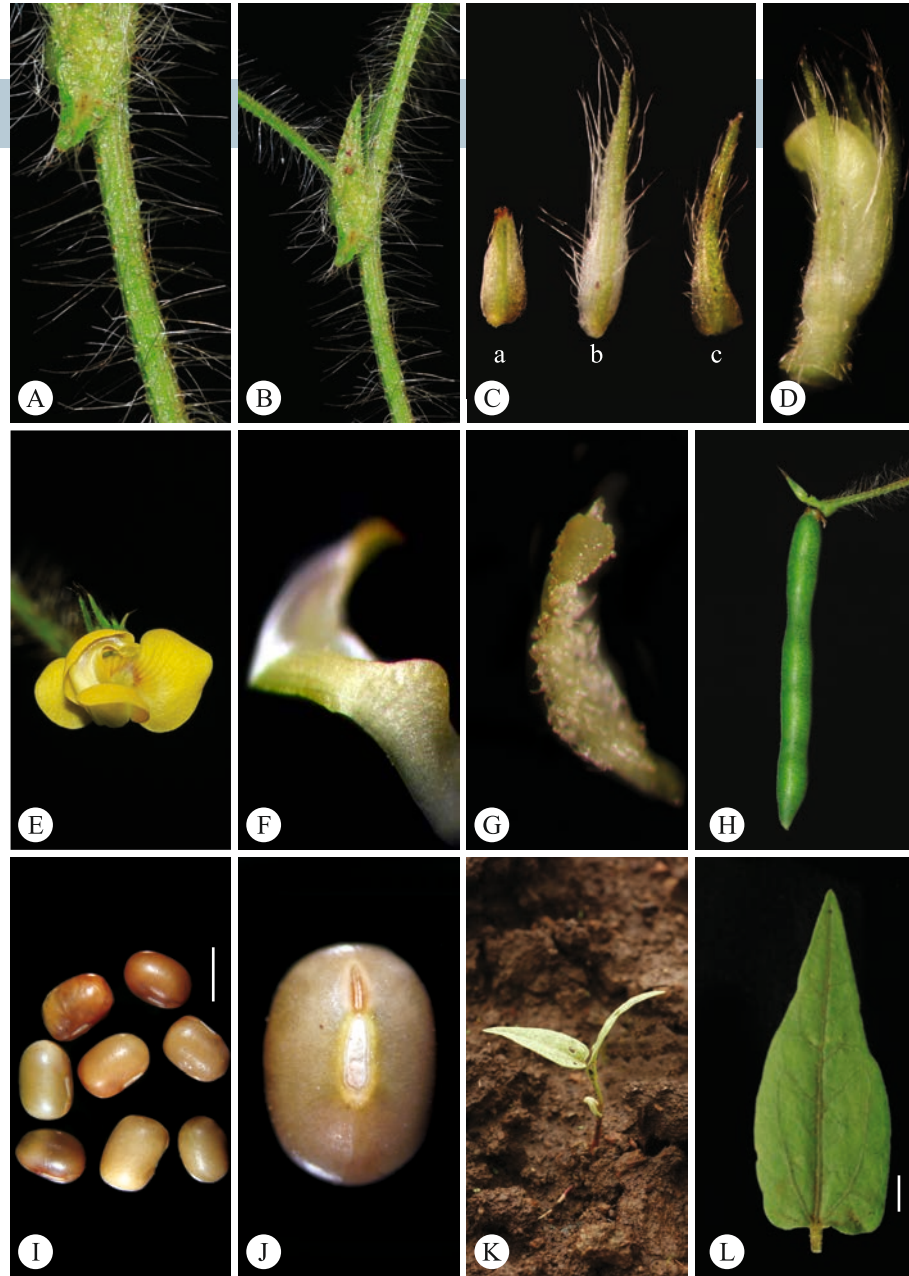


* Added by Tomooka *et al.* (2002)

Diagnostic characters in identification of *Vigna* species are the size and form of stipule, flower colour (various shades of yellow), keel pocket size, stigma beak length and shape, number; orientation and surface characters of pod in an inflorescence, seeds per pod, seed size, shape, surface details and aril development and seedling morphology.

Key to species of genus *Vigna* in India

1. Stipules basifixed.....2
1. Stipules peltate or submedifixed.....4
2. Plants with tuberous rootstock.....3
2. Plants without tuberous rootstock, flowers yellow.....*V. marina*
3. Pods recurved, laterally compressed, pale brown when mature.....
.....*V. adenantha*
3. Pods straight, linear, dark brown to black when mature...*V. vexillata*
4. Stipules ovate.....5
4. Stipules elliptic or elliptic ovate.....11
5. Leaflets lobed.....6
5. Leaflets not lobed.....9
6. Erect herb with large foliaceous stipule.....*V. khandalensis*
6. Trailing herbs, stipules not foliaceous.....7
7. Seeds rough with reticulate surface, aril absent.....*V. indica*
7. Seeds smooth, aril present.....8
8. Mature pod covered with brown hairs, seeds black.....*V. stipulacea*
8. Mature pod glabrous, seeds orange yellow.....*V. trilobata*
9. Flowers pale yellow (rarely greenish yellow), pods 1-3 per inflorescence with white or yellowish white hairs...*V. subramaniana*
9. Flowers greenish yellow, pods 4-8 per inflorescence with ferruginous hairs at maturity10
10. Plants erect, cultivated, seeds green or yellowish brown, shiny with smooth surface.....*V. radiata*
10. Plants trailing or twining, seeds brown-black, rough with reticulate surface.....*V. sublobata*
11. Seeds with smooth surface.....12
11. Seeds with rough surface.....19
12. Flowers bluish or pinkish purple.....*V. unguiculata*
12. Flowers yellow.....13
13. Plants cultivated.....14
13. Plants wild.....16
14. Plants trailing.....*V. aconitifolia*
14. Plants erect.....16
15. Seeds black.....*V. glabrescence*
15. Seeds red or pale yellow.....*V. angularis*
16. Plants trailing, pods 1-3 per inflorescence, seeds 1-3 per pod.....*V. hosei*
16. Plants trailing or twining, pods more than 3 per inflorescence, seeds more than 3 per pod.....17
17. Style beak flat.....*V. dalzelliana*
17. Style beak linear.....18
18. Seeds large, pale yellow or pale brown.....*V. umbellata* (Cult.)
18. Seeds small, black or dark brown.....*V. umbellata* (Wild)
19. Plants erect, cultivated, pod 4-6 seeded.....*V. mungo*
19. Plants twinners, wild, pod with more than 6 pod.....20
20. Aril absent or very poorly developed.....21
20. Aril well developed.....23
21. Leaflets velvety, flowers small, pods covered with very conspicuous white hairs at maturity.....*V. hainiana*
21. Leaflets not as above, flowers large, pods covered with brown hairs at maturity.....22
22. Standard smaller 11 x 17.5 cm, stem densely covered with 2 mm long brown hairs.....*V. trinervea* var. *trinervea*
22. Standard larger 13 x 21 cm, stem densely covered with 1 mm long brown hairs.....*V. trinervea* var. *bourneae*
23. Pods 7-12 per inflorescence, pod 10-15 seeded, seeds rectangular.....*V. sahyadriana*
23. Pods 6-8 per inflorescence, pod 6-8 seeded, seeds round*V. silvestris*



Vigna aconitifolia (Jacq.) Marechal (Cultivated) A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. aconitifolia* (Jacq.) Marechal (Cultivated)**

Erect to semi erect herb. Stems 200 cm long, densely covered with 2-3 mm long white hairs. Leaves 3-foliolate, terminal leaflet deeply 5 lobed, lateral leaflets deeply 4 lobed. Stipules subulate, submedifixed, 10-12 x 2-2.2 mm. Inflorescence axillary, 6-8 flowered; flowers bright yellow, 6 - 6.5 mm in diam. Pods linear, cylindrical, glabrescent, 4-4.5 x 0.3-0.35 cm, buff or pale brown colored when mature. Seeds elliptic, 8-9 per pod, smooth, pale brown, 4 x 2.5 x 2 mm, aril not developed.

Flowering and fruiting: September to November

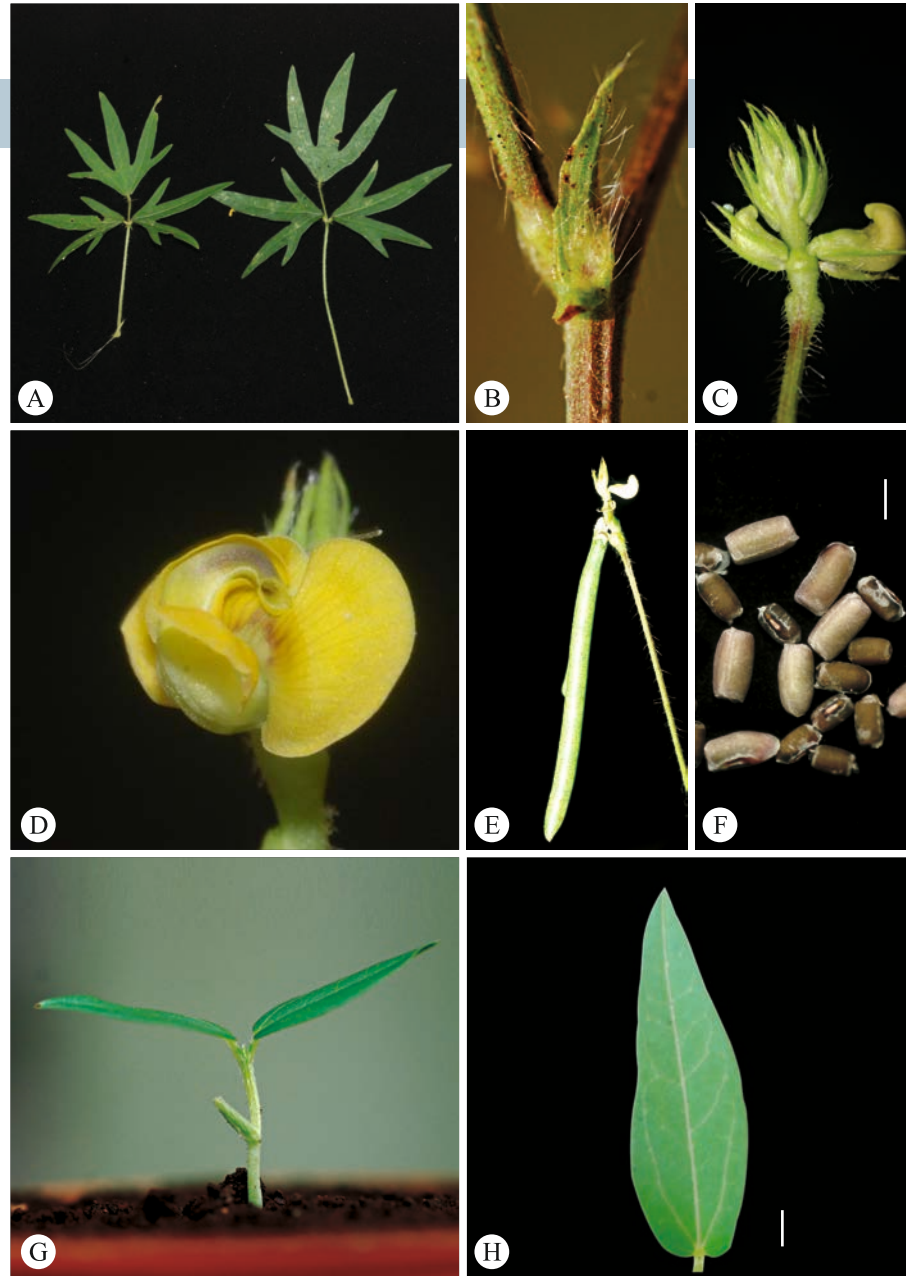
Distribution: Australia, Costa Rica, India, Pakistan, and Sri Lanka.

India: Andhra Pradesh, Bihar, Karnataka, Maharashtra, Punjab, Rajasthan, Uttaranchal and Uttar Pradesh.

Field notes: This species can be identified by its dissected or 4-5-lobed leaflets.

Chromosome number: $2n = 22$





Vigna aconitifolia (Jacq.) Marechal (Wild) A. Leaf variation, B. Stipule, C. Bud, D. Flower, E. Pod, F. Seed, G. Seedling and H. First leaf. Scale bar 3 mm

***V. aconitifolia* (Jacq.) Marechal (Wild)**

Decumbent herb. Stems 200 cm long, densely covered with 2-3 mm long white hairs. Leaves 3-foliolate, terminal leaflet deeply 5 lobed, lateral leaflets deeply 4 lobed. Stipules subulate, submedifixed, 9-11 x 2-2.2 mm. Inflorescence axillary, 5-7 flowered; flowers bright yellow, 6.5-7 mm in diam. Pods linear, cylindrical, glabrescent, 3.8-4.3 x 0.3-0.35 cm buff or pale brown colored when mature. Seeds elliptic, 5-7 per pod, smooth, pale brown, 4.5 x 2.3 x 2 mm, aril not developed.

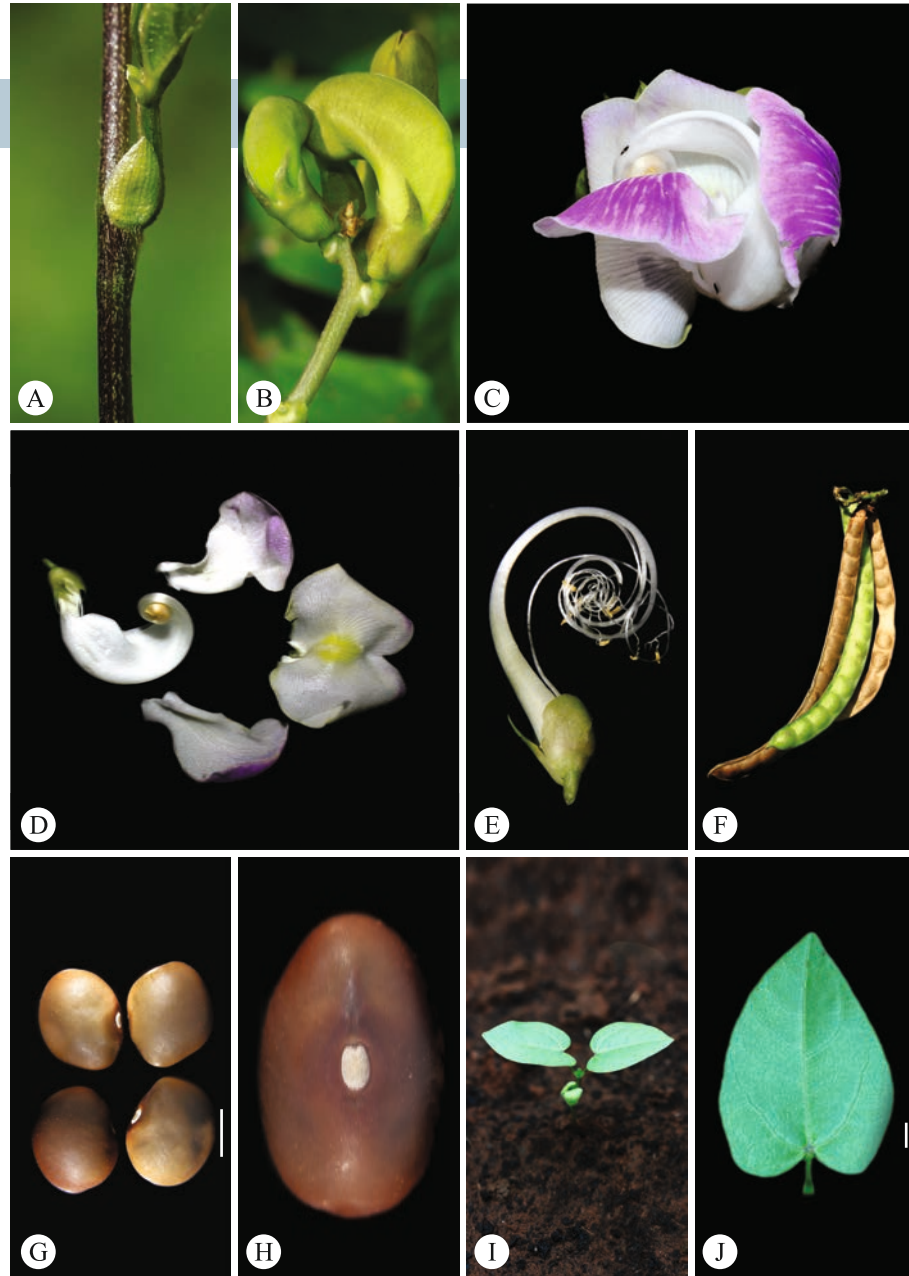
Flowering and fruiting: September to November

Distribution: India: Maharashtra, Orissa, Rajasthan and Eastern India.

Field notes: Found along roadside and on bunds of fields. Easily distinguished by its dissected or 4-5-lobed linear leaflets.

Chromosome number: $2n = 22$





Vigna adenantha (G. F. Meyer) Marechal *et al.* A. Stipule, B. Bud, C. Flower, D. Parts of flower E. Staminal tube, F. Pod, G & H. Seed, I. Seedling and J. First leaf. Scale bar 3 mm

V. adenantha (G. F. Meyer) Maréchal, Mascherpa & Stainier

Twinning or trailing perennial herb, rootstock tuberous. Stem 250-300 cm long, glabrous. Leaves 3-foliolate, shiny, terminal leaflet ovate, lateral leaflets obliquely ovate. Stipules ovate or triangular, basifixed. Inflorescence 10-15 flowered; flowers pinkish violet, 30-31 mm in diam. Pods curved, laterally compressed, glabrous, 12-15 x 1-1.2 cm, buff or pale brown when mature. Seeds rounded, 10-15 per pod, smooth, shiny, grey, 8 x 7.5 x 5.5 mm, aril not developed.

Flowering and fruiting: September to November

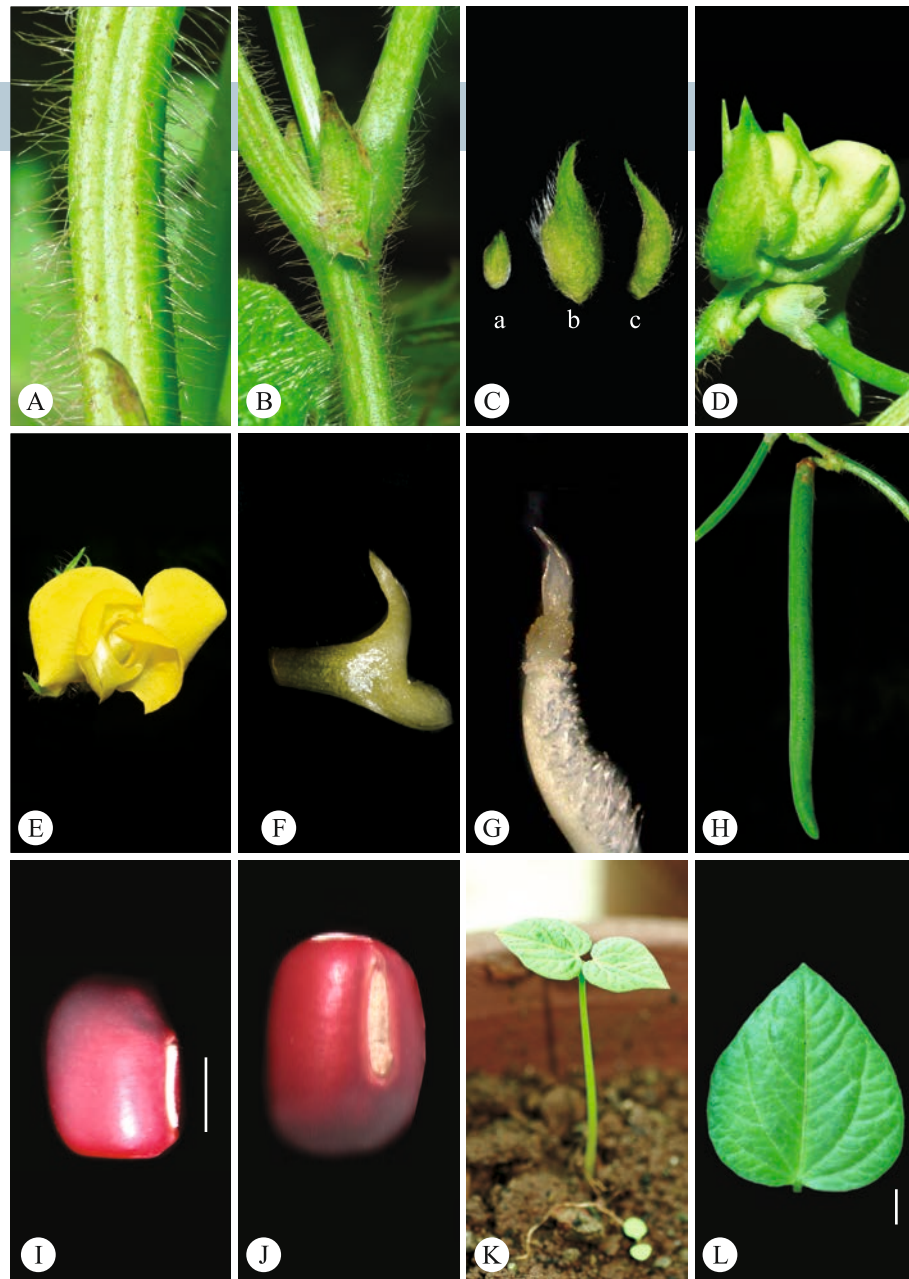
Distribution: Native of South Africa, naturalized and often cultivated in India.

India: Andaman Islands, Bihar, Madhya Pradesh, Orissa, Tamil Nadu and West Bengal.

Field notes: Found along roadsides in waste places. It is an excellent soil conservation crop.

Chromosome number: $2n=22$





Vigna angularis (Willd.) Ohwi & Ohashi A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. angularis* (Willd.) Ohwi & Ohashi**

Erect herb. Stem 70-90 cm long, sparsely to densely covered with 1.8 - 2 mm long white hairs. Leaves 3-foliolate, terminal leaflet ovate to rhomboidal, lateral leaflets obliquely ovate. Stipules narrowly elliptic, medifixed, 13-17 x 3-4 mm. Inflorescence 6-10 flowered; flowers golden yellow, 22-23 mm in diam. Pods linear cylindrical, glabrous, blackish when mature, 6-6.3 x 0.4-0.5 cm. Seeds oblong, 7-8 per pod, smooth, reddish or pale yellow, 7.5 x 5.5 x 5 mm, aril not developed.

Flowering and fruiting: August to November

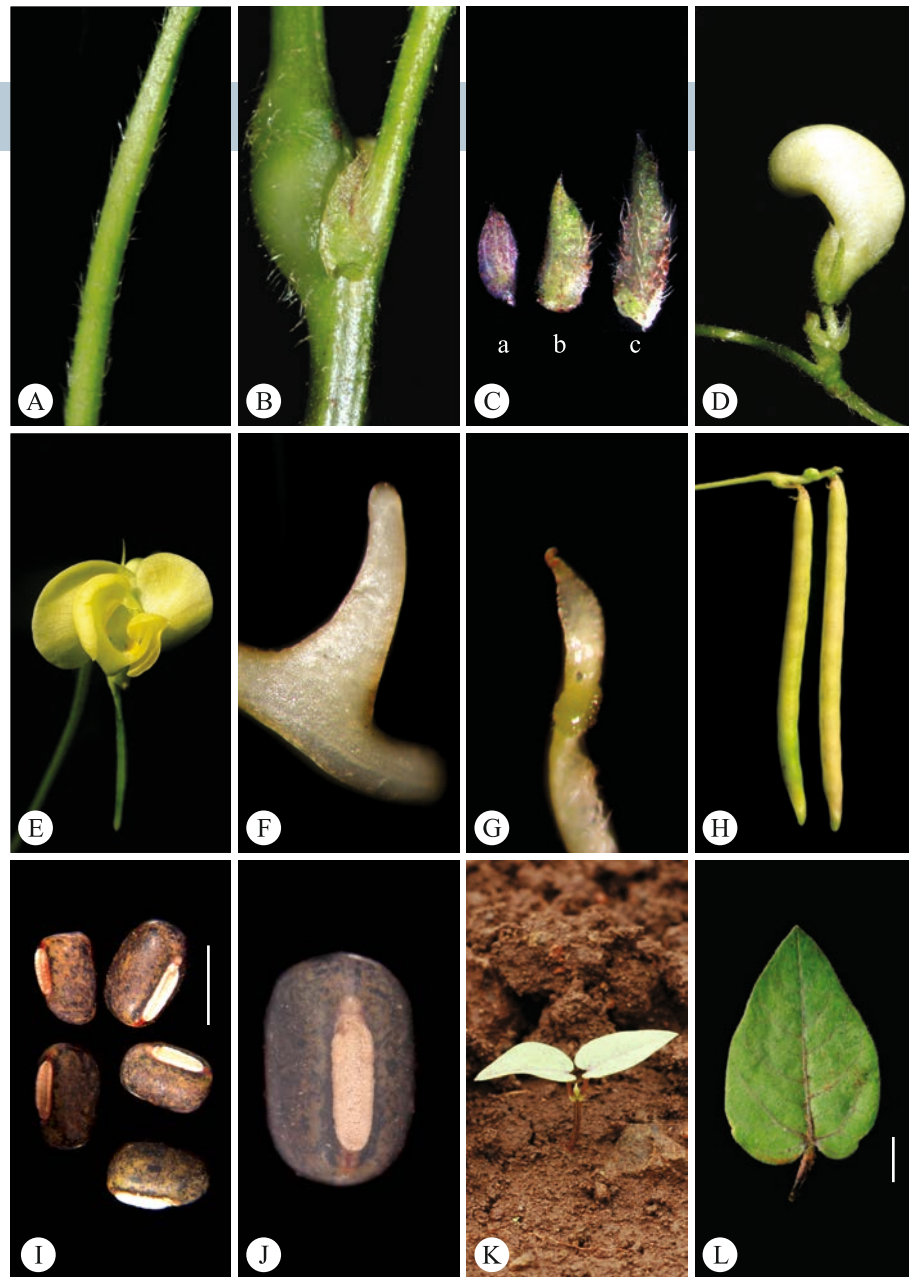
Distribution: It is traditionally cultivated in East Asia and northeastern Vietnam. It seems to be ancient crop in Nepal and Bhutan, also reported from Australia, China, Japan and North America. Cultivated in limited scale in hilly areas of India.

India: Assam, Sikkim Tamil, Nadu and Uttar Pradesh.

Field notes: Cultivated and commonly known as Adzuki Bean.

Chromosome number: $2n = 22$





Vigna dalzelliana (Kuntze) Verdcourt A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. dalzelliana* (Kuntze) Verdcourt**

Prostrate or trailing or twinning herb. Leaves 3-foliolate, terminal leaflet ovate, lateral leaflets obliquely ovate. Stipules elliptic ovate, medifixed, 4-4.2 x 1.2-1.3 mm. Inflorescence 5-6 flowered; flowers pale yellow, 11-12 mm in diam. Pods linear, cylindrical and glabrescent, buff or grayish black colored when mature, 4-4.2 x 0.3-0.35 cm. Seeds rectangular, 9-13 per pod, smooth, shiny, grey mottled, 3 x 2 x 1.6 mm, aril well developed.

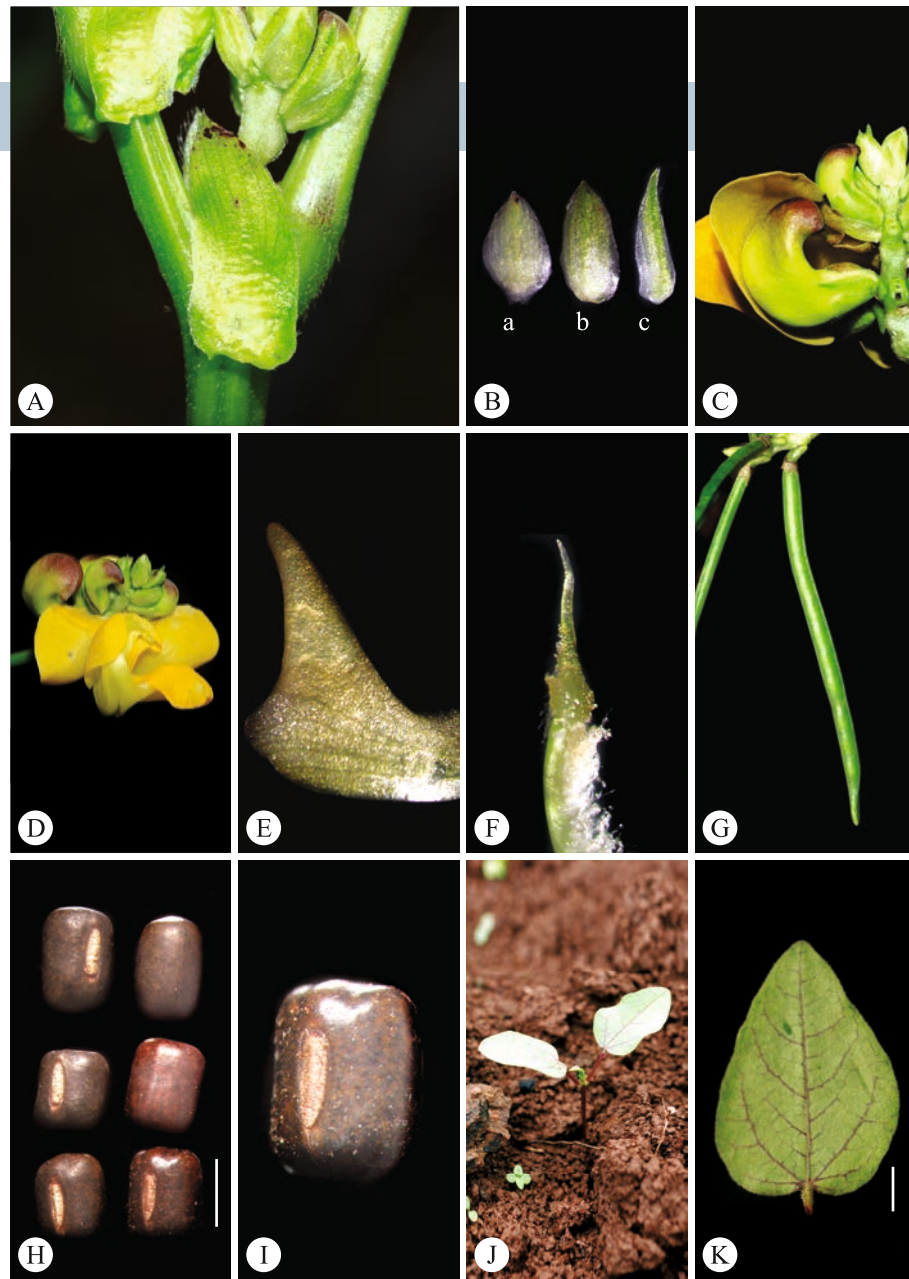
Flowering and fruiting: September to December

Distribution: Cambodia, India, Philippines, Sri Lanka, Thailand and Vietnam.
India: Maharashtra, Karnataka, Kerala, Rajasthan, Tamil Nadu, Orissa, Madhya Pradesh and Bihar.

Field notes: Rooting at nodes. Plants trailing on ground produce cleistogamous subterranean flowers. Forms a component of the ground flora of Monsoon vegetation in forest areas. It grows in places along road side. It resembles with wild form of *V. umbellata*, but can be distinguished by its flat beak.

Chromosome number: 2n = 22





Vigna glabrescens Marechal *et al.* A. Stipule, B. Primary bract (a); Secondary bract (b); Bracteole (c), C. Bud, D. Flower, E. Keel pocket, F. Beak, G. Pod, H & I. Seed, J. Seedling and K. First leaf. Scale bar 3 mm

***V. glabrescens* Marechal Mascherpa & Stainier**

Erect herb. Stem 50 - 70 cm long, glabrous. Leaves 3-foliolate, terminal leaflet narrowly ovate, lateral leaflets obliquely ovate. Stipule obliquely ovate, medifixed, 12-14 x 5-6 mm. Inflorescence 10-20 flowered; flowers golden yellow, 18-20 mm in diam. Pods linear, cylindrical, glabrous, blackish when mature, 9-9.5 x 0.4-0.6 cm. Seeds rectangular, 10-14 per pod, smooth, dark brown to black, 5 x 3.5 x 3.3 mm, aril not developed.

Flowering and fruiting: August to November

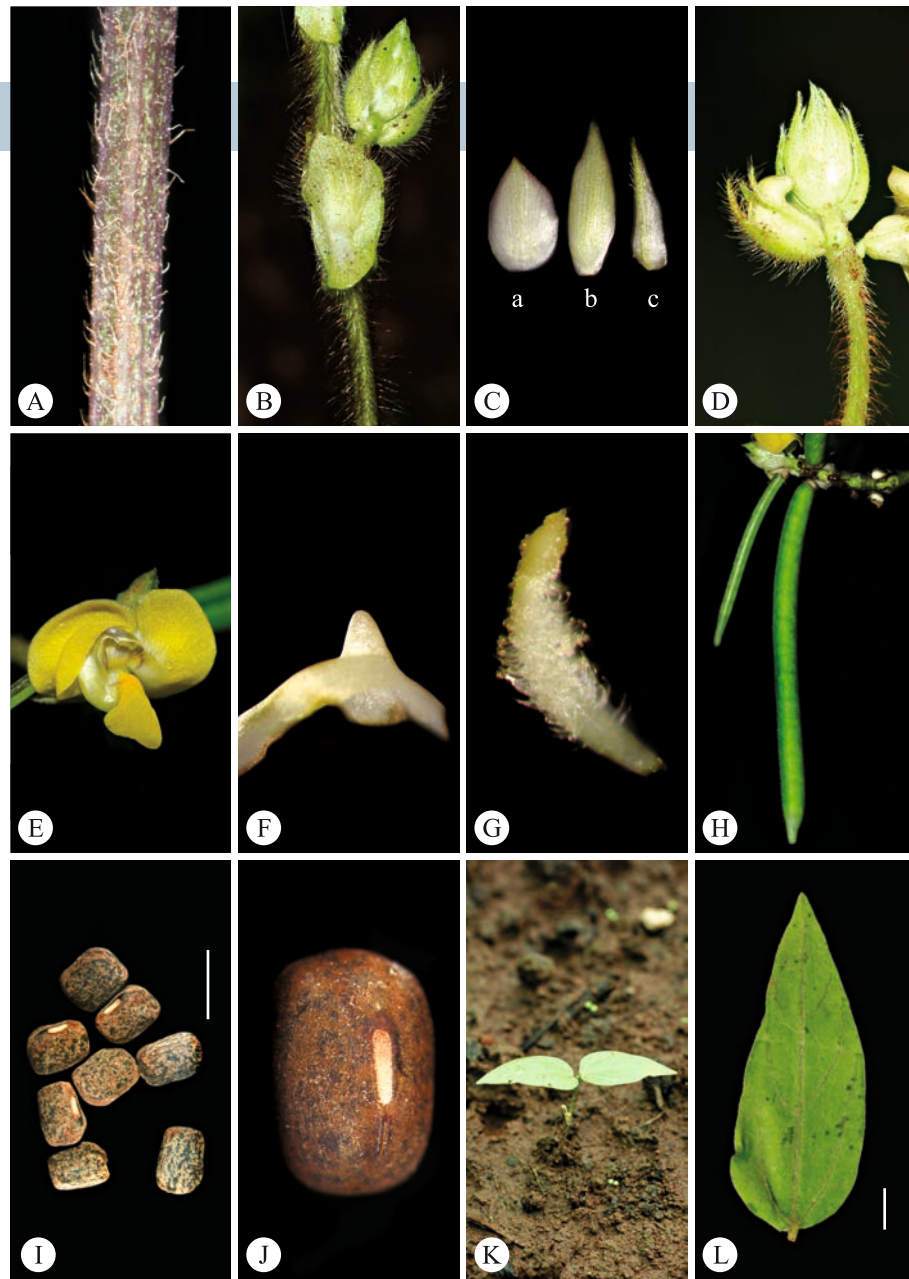
Distribution: India, Japan, Mauritius, Mlingano, Philippines, Tanzania and Vietnam.

India: West Bengal and Orissa.

Field notes: Robust cultivated herb with large golden yellow flowers.

Chromosome number: 2n = 44





Vigna hainiana Babu *et al.* A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. hainiana Babu, Gopinathan & S. K. Sharma

Twinning herb. Stem, 250-300 cm long, densely covered with 3-3.5 mm long, brown hairs. Leaves 3-foliolate, terminal leaflet ovate, lateral leaflets obliquely ovate. Stipule elliptic ovate, medifixed, 1.3-1.6 x 0.6-0.8 mm. Inflorescence 6-8 flowered, flowers yellow, 10.5-11 mm in diam. Pods linear, cylindrical, densely covered with small white hairs, 4-4.5 x 0.3-0.35 cm, blackish when mature. Seeds oblong, 9-10 per pod, rough, blackish grey or brown, 2.5 x 2 x 1.8 mm, aril not developed.

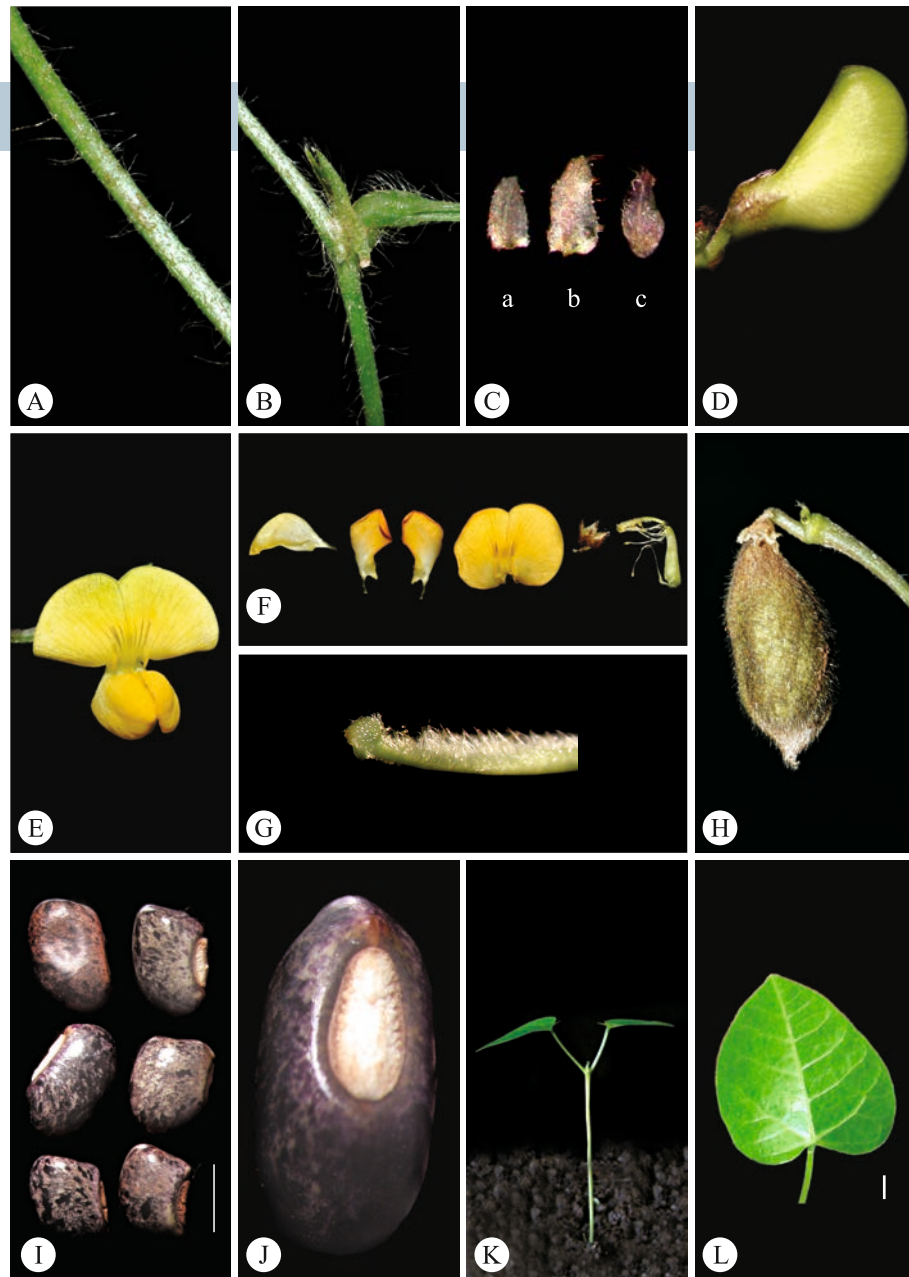
Flowering and fruiting: September to November

Distribution: **India:** Assam, Bihar, Chhattisgarh, Himachal Pradesh, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, Uttaranchal, Uttar Pradesh and West Bengal.

Field notes: A remarkable forest dwelling species found as undergrowth in forest areas. Velvety leaves and small golden yellow flowers are diagnostic characters of the species.

Chromosome number: $2n = 22$.





Vigna hosei (Craib) Backer A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Flower parts, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. hosei* (Craib) Backer**

Creeping herb. Stem 300-350 cm long, sparsely covered with 0.7 mm long, brown hairs. Leaves 3-foliolate, terminal leaflet elliptic ovate, lateral leaflets obliquely ovate. Stipule ovate to triangular, 4-4.2 x 1.5-1.7 mm, basally fixed. Inflorescence 3-4 flowered; flowers golden yellow, 9.5-10 mm in diam. Pods cylindrical, finely pubescent, 1.5-1.8 x 0.4-0.5 cm, pale brown when mature. Seeds obliquely rectangular or elliptic, usually 2 per pod, smooth, shiny, mottled grey or black, 5.5 x 3.2 x 3 mm, aril developed.

Flowering and fruiting: November to February

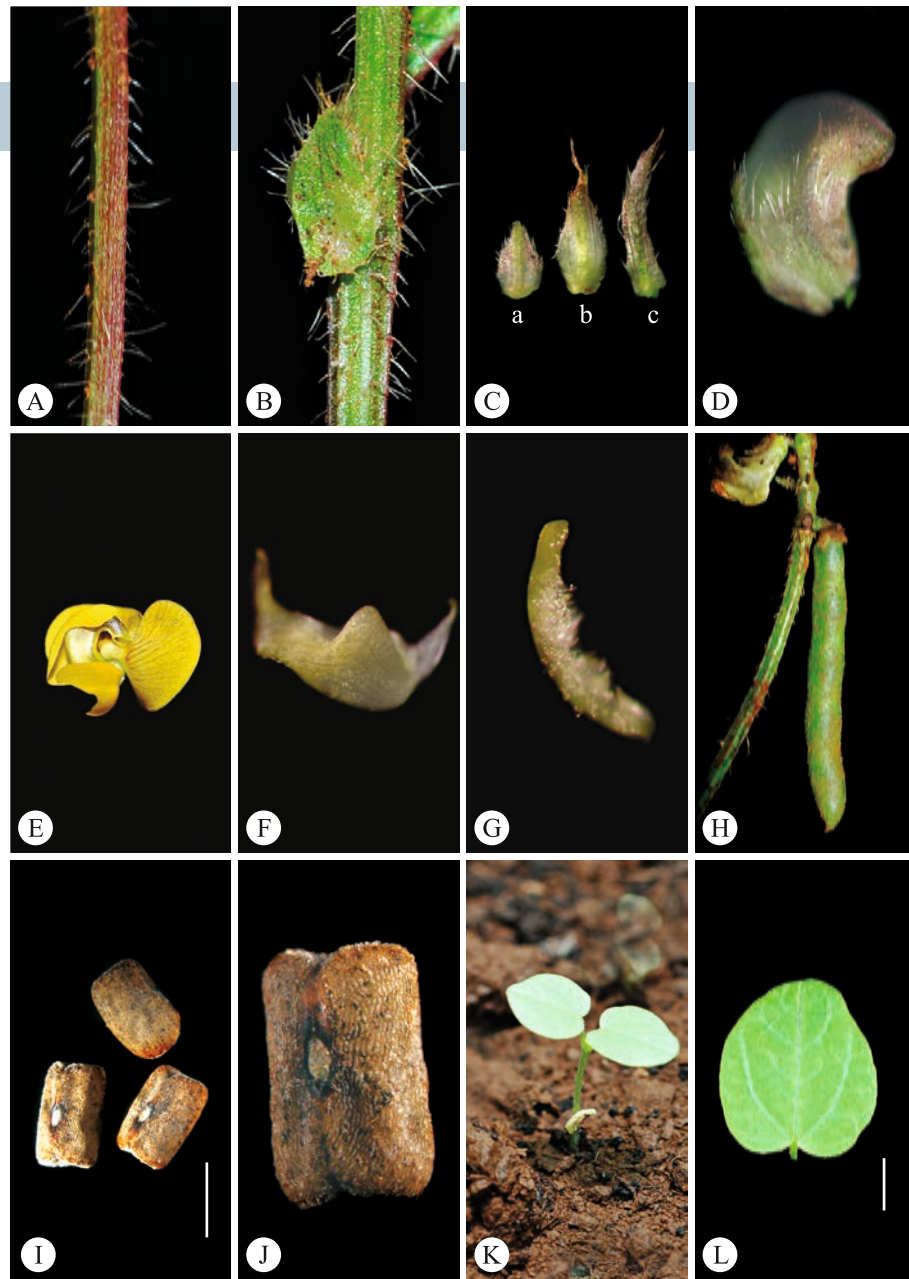
Distribution: Native of N. Borneo, introduced in India, Indonesia, Malaysia, Mozambique, Sri Lanka and Tanzania.

India: Kerala and Orissa.

Field notes: It grows as escape along roadsides. Stem rooting at node. In the genus, it is the only species usually with 2 seeded pod.

Chromosome number: 2n = 22





Vigna indica Dixit *et al.* A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. indica Dixit, K. V. Bhat & S. R. Yadav

Perennial trailing herb. Stem 90-150 cm long, sparsely to densely covered with 0.5-1.5 mm long white hairs. Leaves 3-foliolate, terminal leaflet ovate to rhomboid with 3-5, deep to shallow spatulate lobes or nearly entire, lateral leaflets somewhat oblique with 3-5 spatulate lobes or entire. Stipules ovate to lanceolate, medifixed, 3.3-8 x 1.2-1.8 mm. Inflorescence 5-10 flowered; flowers pale yellow with purplish keel tip, 5.8-6 mm in diam. Pod linear, cylindrical, finely pubescent, 1.5-3.8 x 0.2-0.3 cm, buff or pale brown colored when mature. Seeds rectangular, 4-7 per pod, rough, brown to maroon, 4 x 2.1 x 2.1 mm, aril not developed.

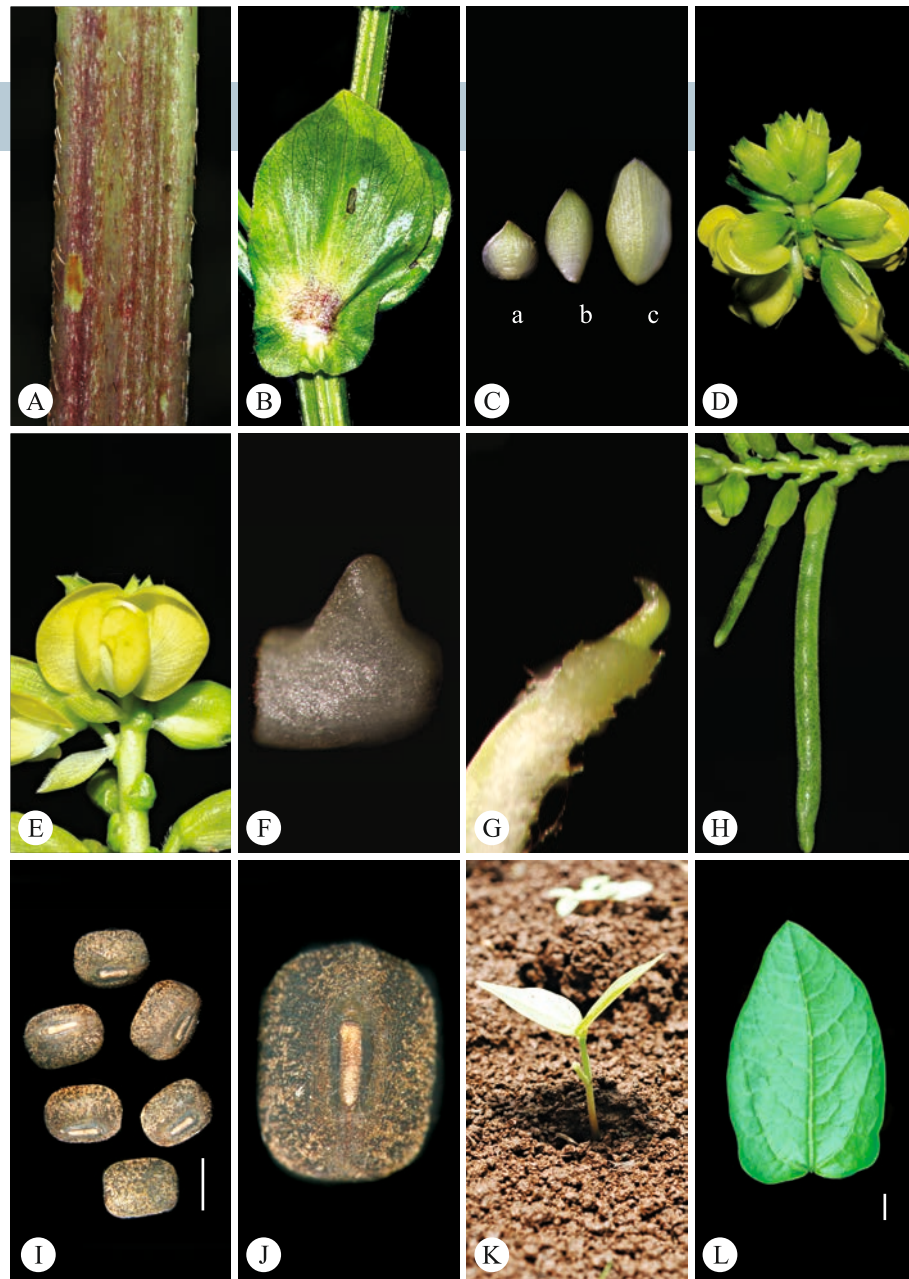
Flowering and fruiting: July to October

Distribution: India: Gujarat, Karnataka, Maharashtra, Madhya Pradesh and Rajasthan.

Field notes: This species can be identified on the basis of reticulate rough adherent perisperm of seed and aril not developed.

Chromosome number: $2n = 22$





Vigna khandalensis (Santapau) Raghavan & Wadhwa A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. khandalensis (Santapau) Raghavan & Wadhwa

Erect robust herb. Stem angular, 150-200 cm long; ridges sparsely covered with 0.8-1 mm long yellowish white hairs. Leaves 3-foliolate, terminal leaflets 3 lobed, lateral leaflets 2-3 lobed. Stipule broadly ovate, medifixed, 3.6-4.7 x 2.4-3.5 cm. Inflorescence 4-10 flowered; flowers creamy or greenish yellow, 1.3-1.4 mm in diam. Pods linear, cylindrical and densely pubescent, 6-6.5 x 0.35-0.4 cm, blackish when mature. Seeds rounded, 10-12 seeds per pod, rough, 4.5 x 3.7 x 3.5 mm, aril not developed.

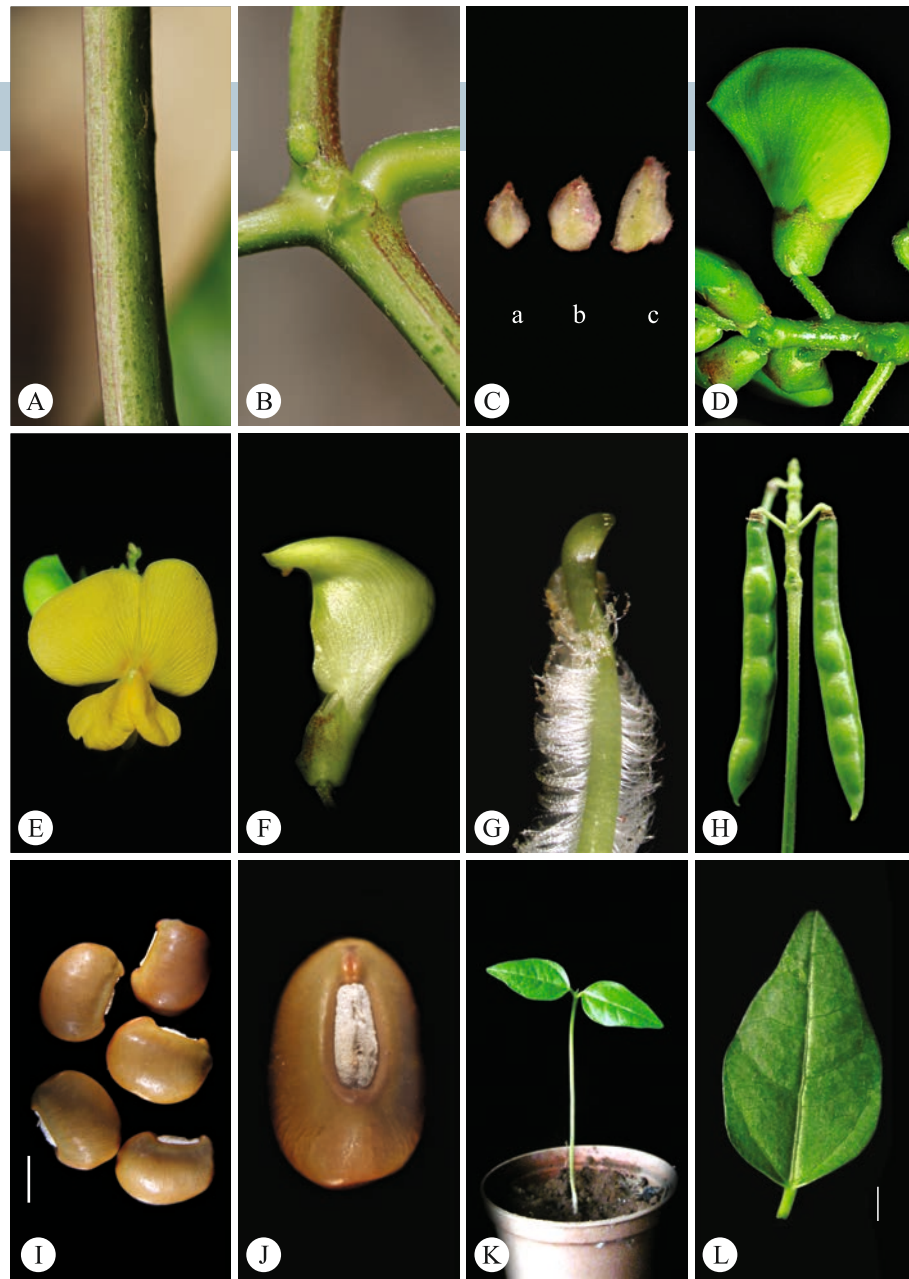
Flowering and fruiting: September to November

Distribution: India: Maharashtra. **Endemic.**

Field notes: A remarkable species in the genus having shrubby appearance, deeply lobed leaflets, conspicuous-foliaceous stipule and boat shaped bracts.

Chromosome number: $2n = 22$





Vigna marina (Burm.) Merr. A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel petal, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. marina* (Burm.) Merr.**

Twinning herb, glabrescent. Stem 350-400 cm long, sparsely covered with 0.6 mm long white hairs. Leaves 3-foliolate, terminal leaflet elliptic ovate, lateral leaflets slightly obliquely ovate. Stipules ovate to triangular, basifixed, 2 - 2.5 x 1.2 - 1.4 mm. Inflorescence 10-15 flowered; flowers bright yellow, 20-21 mm in diam. Pods subcompressed, glabrous or sparsely pubescent, 5-6 x 1-1.2 cm, brown when mature. Seeds rounded, 5-8 per pod, smooth, shiny, grayish brown or reddish, 6.5 x 5 x 4.8 mm, aril poorly developed.

Flowering and fruiting: October to March

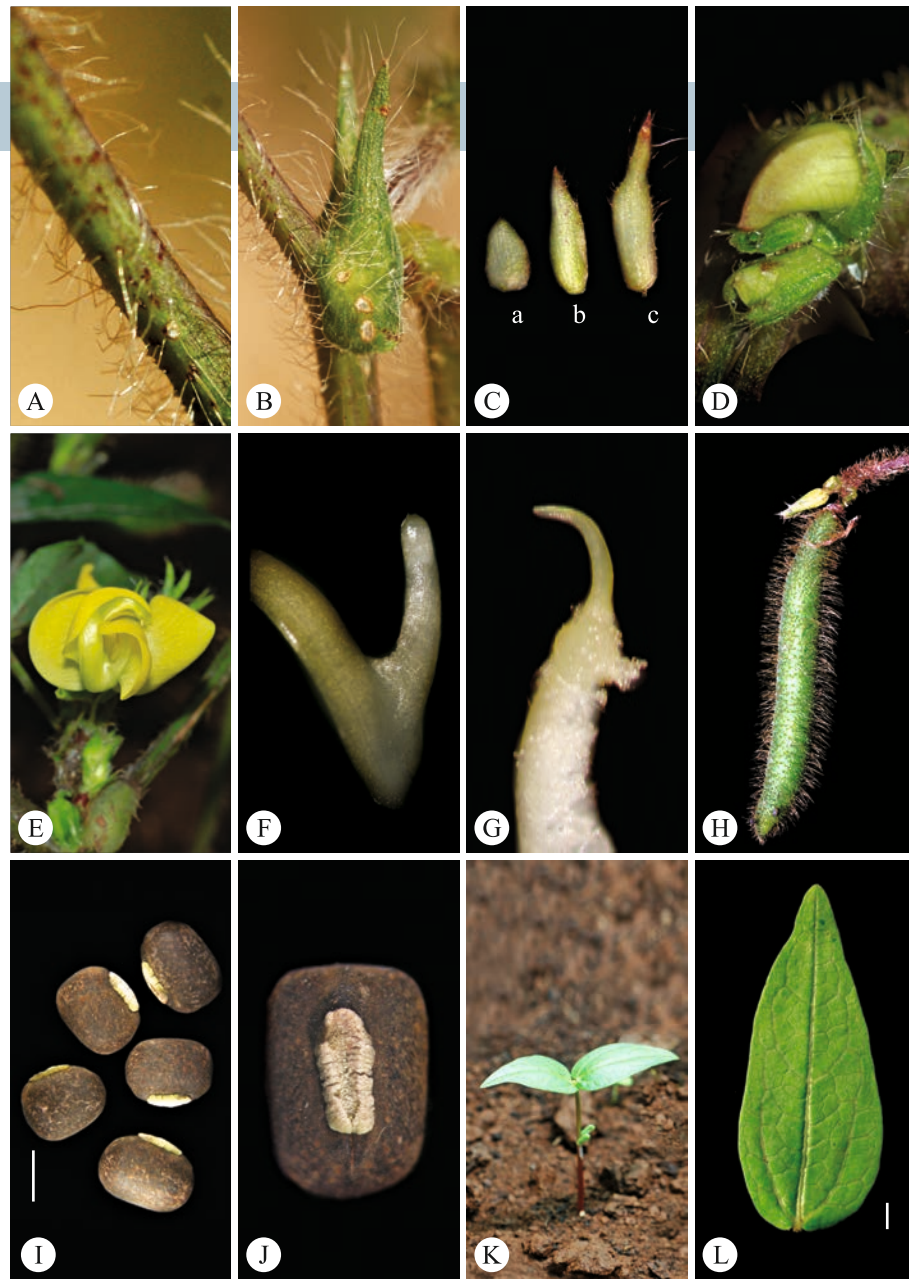
Distribution: Africa, Australia, Burma, Celebes, Fiji, Hawaii, India, Indonesia, Japan, Malaysia, Philippines, Sri Lanka, Tropical America and Vietnam.

India: Andaman Islands and Kerala.

Field notes: Found along sandy coastal tracts. It is robust species with thick stem.

Chromosome number: 2n = 22





Vigna mungo (L.) Hepper A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. mungo* (L.) Hepper**

An erect cultivated herb. Stem 40 - 80 cm long, sparsely to densely covered with 0.2 mm long white hairs. Leaves 3-foliolate, terminal leaflet rhomboidal, lateral leaflets obliquely ovate. Stipule elliptic lanceolate, medifixed, 12-14 x 3-4 mm. Inflorescence 6-8 flowered; flowers bright yellow, 19-20 mm in diam. Pods linear, cylindrical and densely hairy, 4-5 x 0.6-0.65 cm, dark brown or black when mature. Seeds rounded, 6-12 per pod, rough, usually black, 4.5 x 3.5 x 3.3 mm, aril well developed.

Flowering and fruiting: September to January

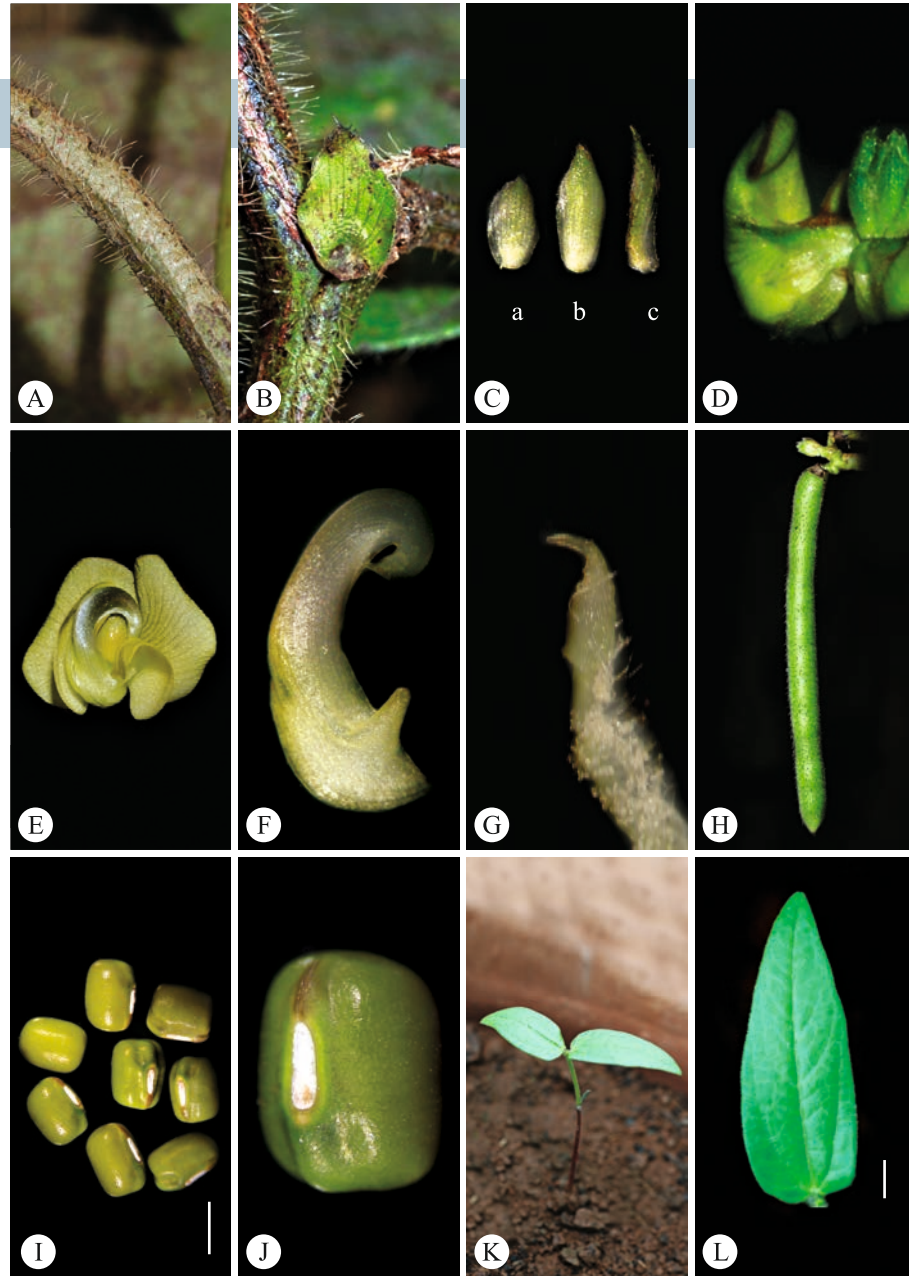
Distribution: Australia, Bangladesh, Ghana, India and Zaire.

India: Maharashtra, Madhya Pradesh, Karnataka, Kerala and Orissa.

Field notes: Cultivated but, sometimes found to be escaped. Escaped form is trailing or twinning.

Chromosome number: 2n = 22.





Vigna radiata (L.) R. Wilczek A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. radiata* (L.) R. Wilczek**

Much branched erect herb. Stem 35-100 cm long, sparsely to densely covered with 0.4-0.6 mm long yellowish white hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to rhomboidal, lateral leaflets obliquely ovate. Stipule ovate, medifixed, 7-8 x 4-5 mm. Inflorescence 6-10 flowered; flowers greenish yellow, 16-17 mm in diam. Pods linear, cylindrical and densely hairy, 6-6.5 x 0.4-0.45 cm, dark brown or blackish when mature. Seeds rectangular to oblong, 10-14 per pod, smooth, shiny, green or pale brown, 4 x 3.2 x 2.8 mm, aril not developed.

Flowering and fruiting: August to February.

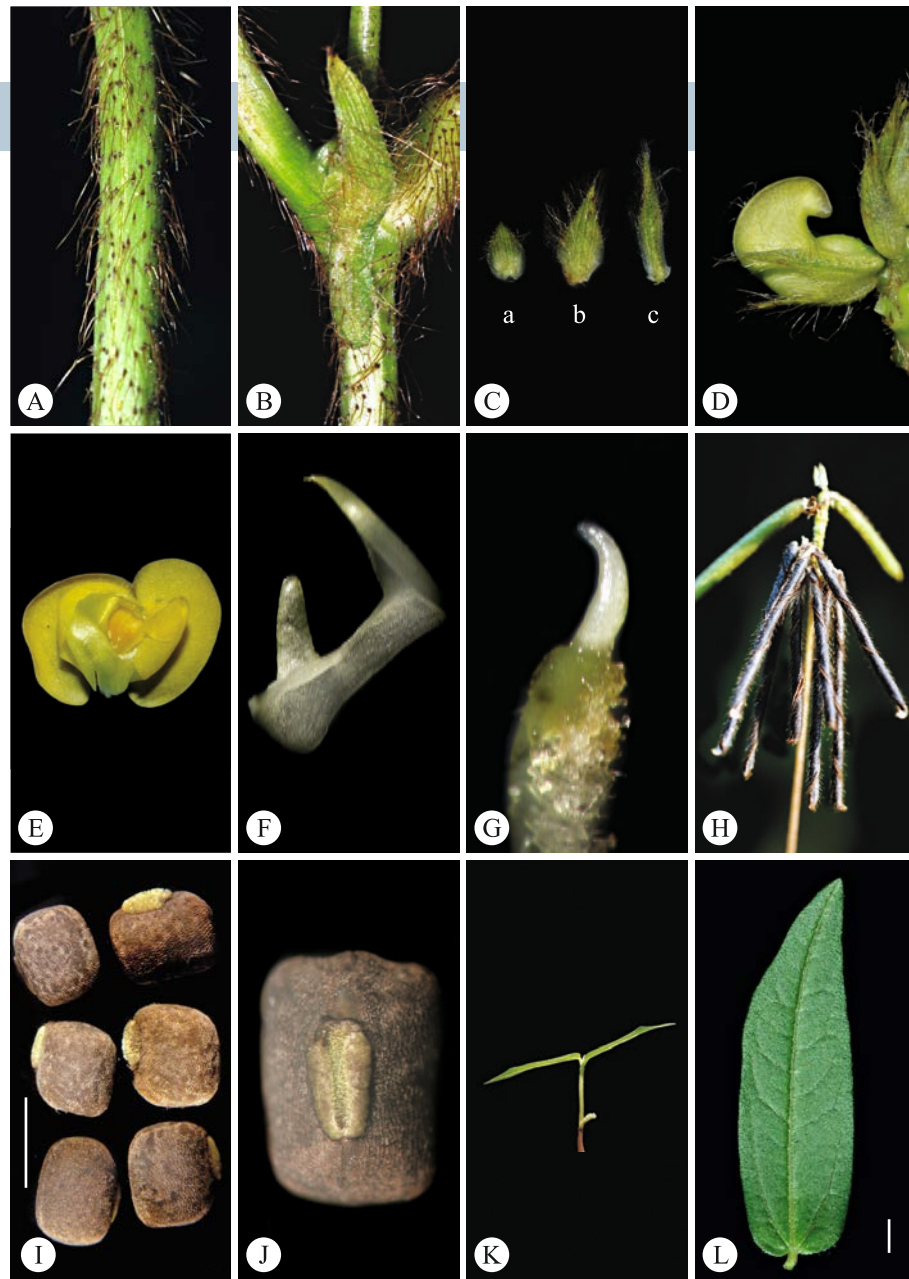
Distribution: Cultivated in India and throughout Tropics.

India: Andhra Pradesh, Bihar, Chhattisgarh, Gujarat, Jharkhand, Karnataka, Kerala, Maharashtra, Orissa, Tamilnadu and Uttar Pradesh.

Field notes: Cultivated.

Chromosome number: 2n = 22.





Vigna sahyadriana Aitawade *et al.* A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pods, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. sahyadriana Aitawade, K. V. Bhat & S. R. Yadav

Twinning herb. Stem 200-300 cm long, densely covered with 3.5 - 4 mm long yellowish brown hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to rhomboidal, lateral leaflets obliquely ovate. Stipules elliptic, medifixed, 13-15 x 3.5-4.5 mm. Inflorescence 20- 22 flowered; flowers creamy to yellow, 11 - 13 mm in diam. Pods linear, cylindrical and densely hairy, 6-6.5 x 0.4-0.5 cm, brown or black when mature. Seeds rectangular, 10-15 per pod, rough, dark brown to maroon, 3 x 2.5 x 2 mm, aril well developed.

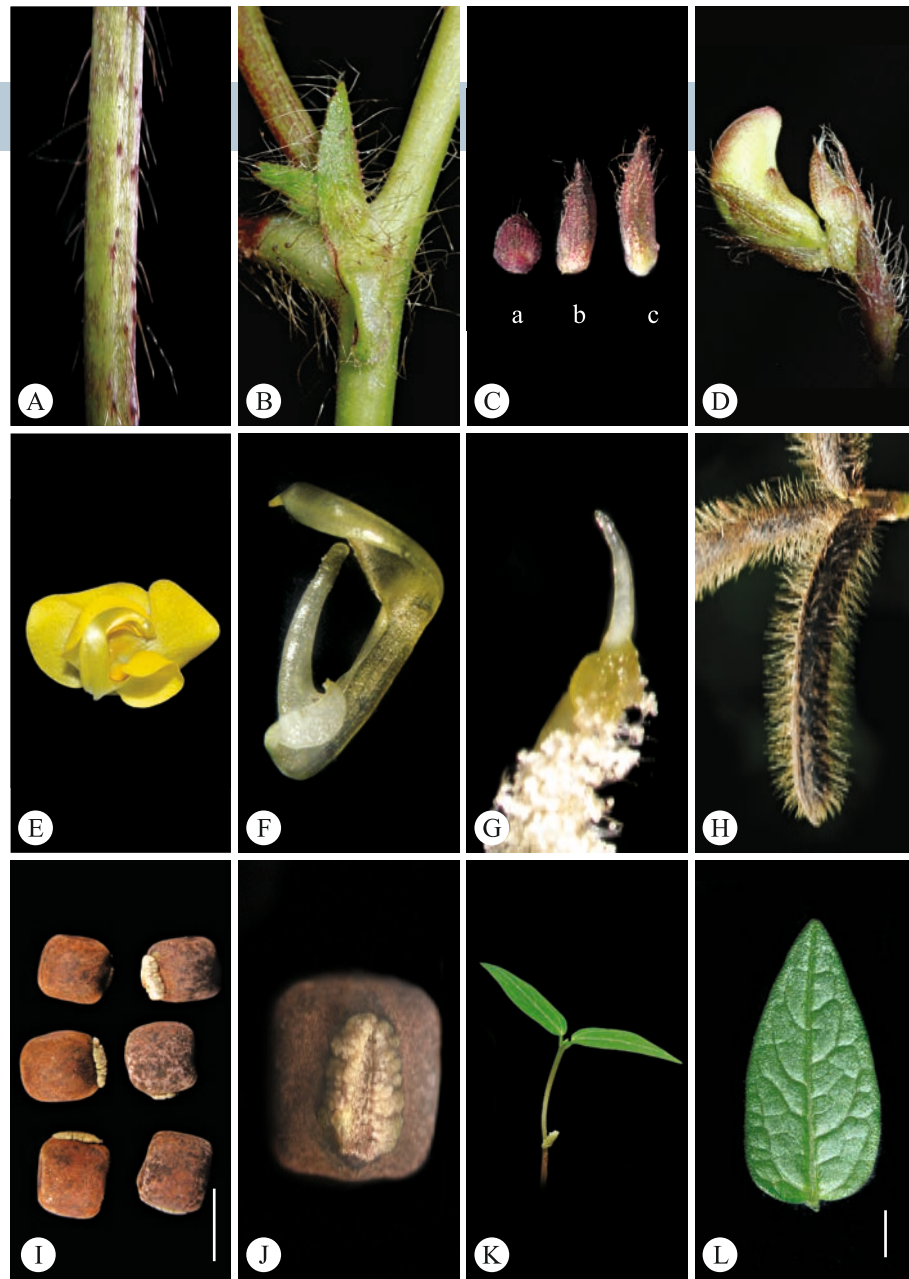
Flowering and fruiting: August to November.

Distribution: India: Northern Western Ghats (Maharashtra).

Field notes: It is similar to *V. silvestris* but differ in 6- 6.5 cm long 10-15 seeded, 7-12 mature pods per inflorescence.

Chromosome number: 2n = 22.





Vigna silvestris (Lukoki *et al.*) Aitawade *et al.* A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. silvestris (Lukoki, Maréchal & Otoul) Aitawade, K. V. Bhat & S. R. Yadav

Twinning herb. Stem 120 - 150 cm long, densely covered with 2.5 mm long yellowish brown hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to narrowly ovate, lateral leaflets obliquely ovate. Stipule elliptic or rather falcate, medifixed, 8-12 x 5-6 mm. Inflorescence 4-8 flowered; flowers golden yellow, 18-19 mm in diam. Pods linear, cylindrical and densely hairy, 3.7-4.5 x 0.4-0.6 cm, brown to black when mature. Seeds rounded, 6-8 per pod, rough, brown to maroon, 3.2 x 3.1 x 3 mm, aril well developed.

Flowering and fruiting: September to October

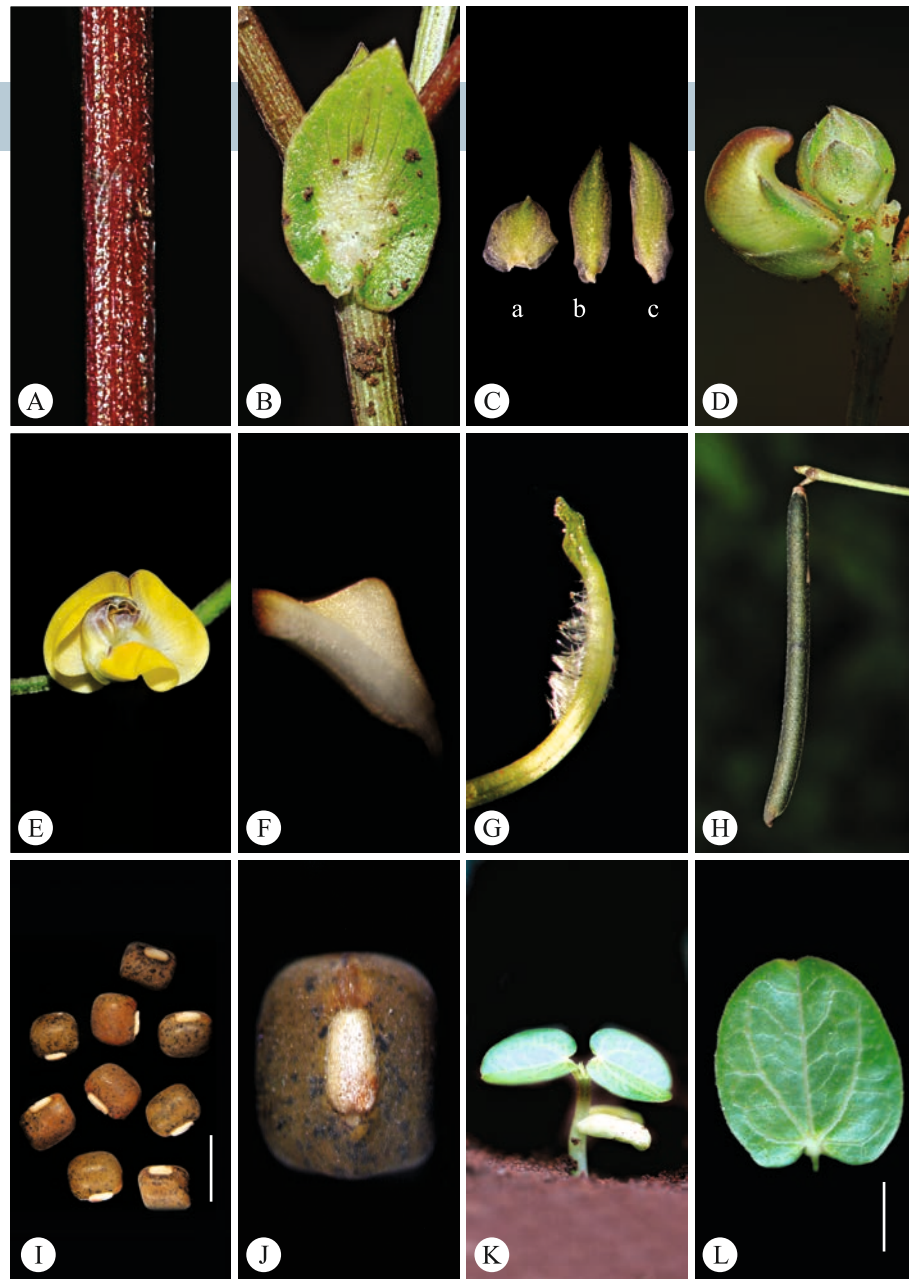
Distribution: India, Myanmar, Thailand.

India: Goa, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Rajasthan and Tamil Nadu.

Field notes: It is a common species growing in hedges, among bushes in forest areas.

Chromosome number: 2n = 22.





Vigna stipulacea Kuntze A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. stipulacea Kuntze

A trailing or twinning herb. Stem 30-120 cm long, sparsely covered with 1 mm long white hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to rhomboidal, 1-3 lobed or entire, lateral leaflets obliquely ovate, 1-2 lobed or entire. Stipule conspicuously large ovate, medifixed, 8-22 x 1-1.4 mm. Inflorescence 4-12 flowered; flowers shiny yellow, 10-11 mm in diam. Pods linear, cylindrical and sparsely to densely hairy, 4-5 x 0.2-0.3 cm, blackish brown when mature. Seeds elliptic, 10-14 seed per pod, rough fine, brown with small black mottled, 3 x 2 x 1.5 mm, aril slightly developed.

Flowering and fruiting: September to November

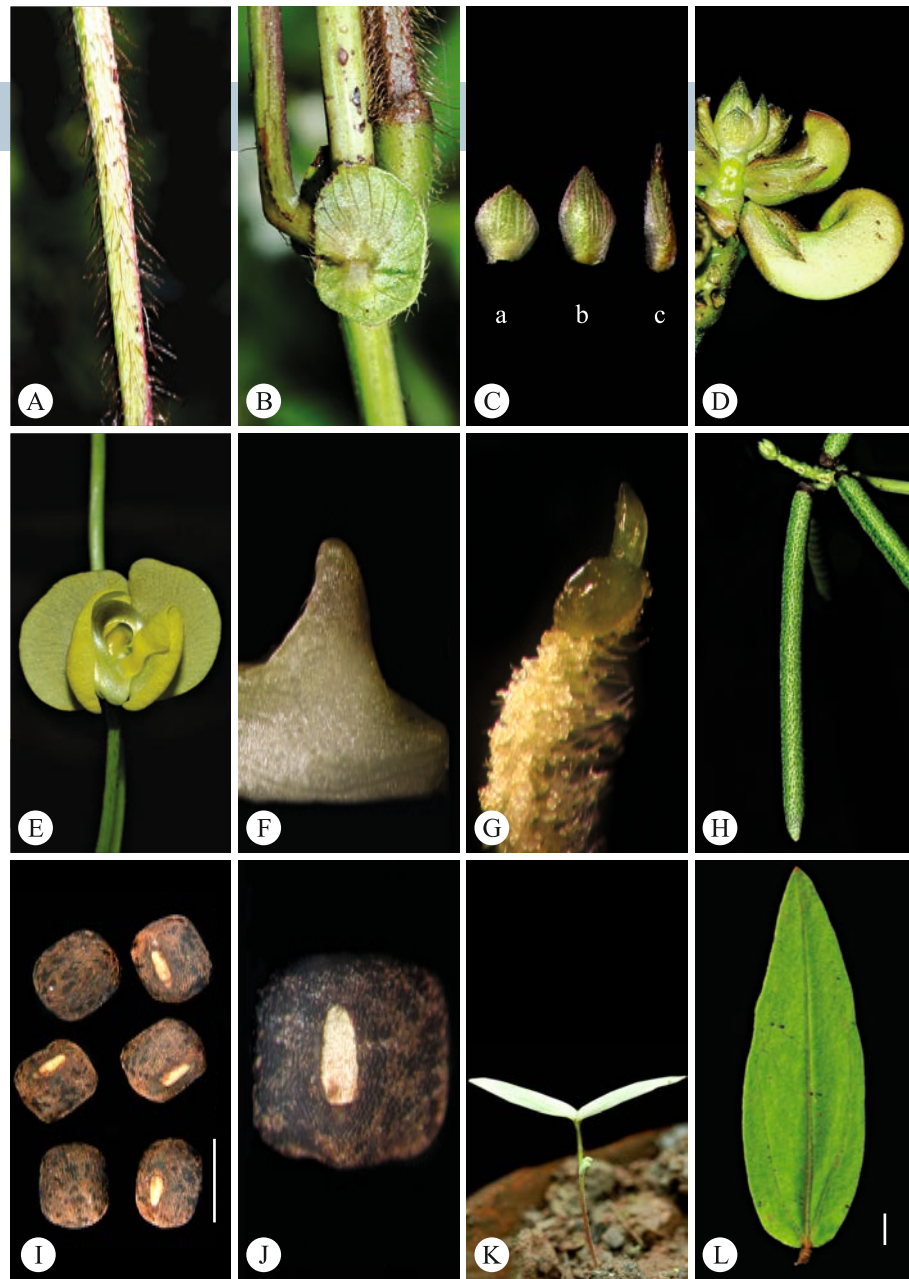
Distribution: Bangladesh, India, Indonesia, Madagascar, Myanmar, Sri Lanka, Vietnam and Yemen.

India: Chhattisgarh, Maharashtra, Madhya Pradesh, Orissa, Rajasthan and Tamil Nadu.

Field notes: Found in open or partially shady habitats, particularly at the edge of paddy as well as in cultivated fields.

Chromosome number: $2n = 22$.





Vigna sublobata (Roxb.) Babu & S. K. Sharma A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. sublobata* (Roxb.) Babu & S. K. Sharma**

A trailing or twining herb. Stem 100-120 cm long, densely covered with 2.5 mm long brown hairs. Leaflets 3-foliolate, terminal leaflet rhomboidal, broadly ovate, lateral leaflets obliquely ovate. Stipules ovate, medifixed, 10-12 x 5-6 mm. Inflorescence 10-12 flowered; flowers greenish yellow with grey keel, 18-19 mm in diam. Pods linear, cylindrical and ferruginously hairy, 6-6.5 x 0.4-0.5 cm, dark brown to blackish when mature. Seeds rectangular, 10-14 per pod, rough, dark brown to maroon, 3 x 2.7 x 2.5 mm, aril not developed.

Flowering and fruiting: September to November

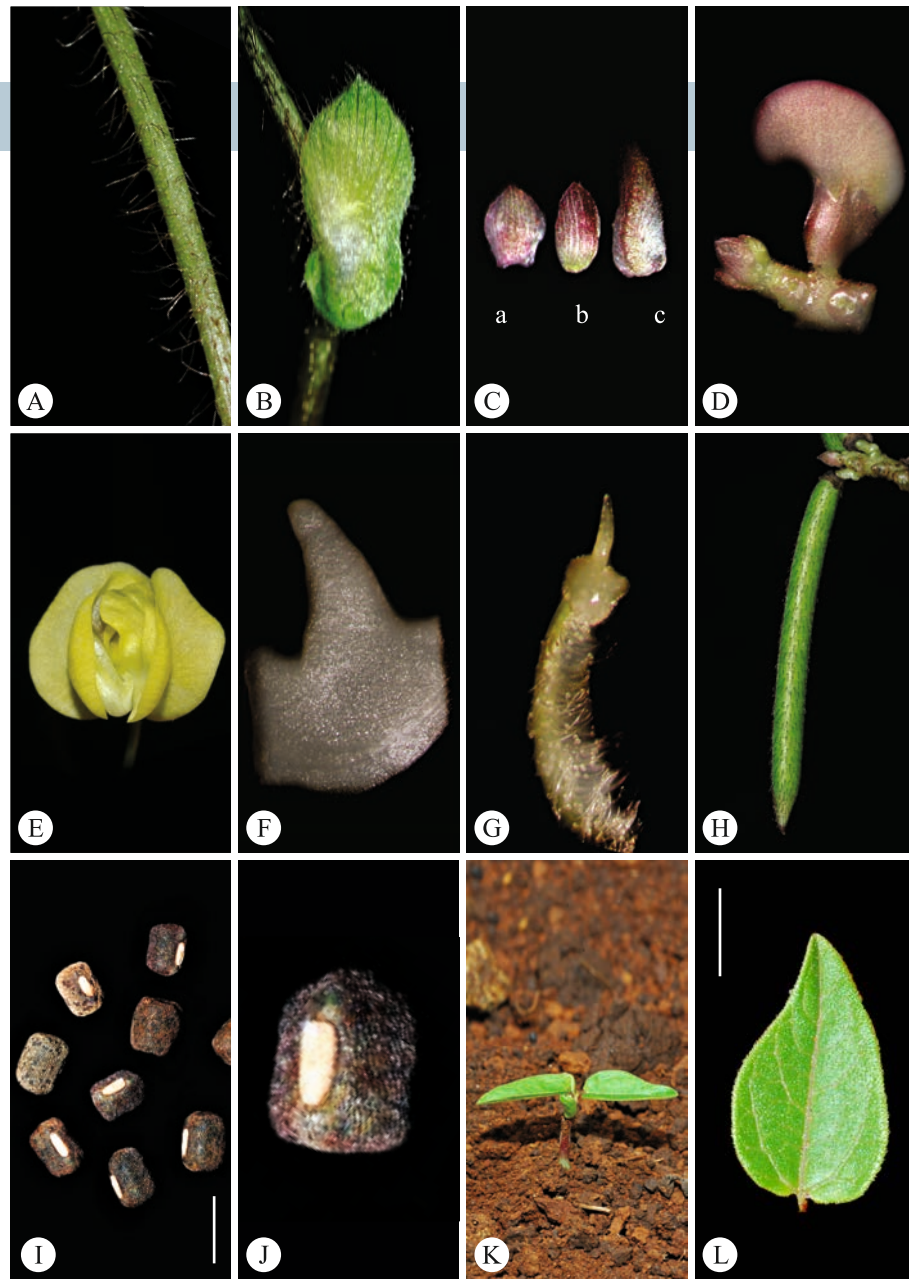
Distribution: India, Malaysia, Throughout Tropics.

India: Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, West Bengal and Tamil Nadu.

Field notes: A species of forest margin and grassland. It is probable progenitor of *V. mungo*.

Chromosome number: 2n = 22.





Vigna subramaniana (Babu ex Raizada) M. Sharma A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. subramaniana (Babu ex Raizada) M. Sharma

A twining herb. Stem 100 - 150 cm long, densely covered with 2.5 mm long brown hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to rhomboidal, lateral leaflets obliquely ovate. Stipules broadly ovate, medifixed, 6-7 x 3.5-4 mm. Inflorescence 6-8 flowered; flowers pale yellow, 13-14 mm in diam. Pods linear, cylindrical and densely pubescent, 4-4.5 x 0.3-0.35 cm, blackish when mature. Seeds rectangular, 10-12 per pod, rough, black, 2.5 x 1.8 x 2 mm, aril not developed.

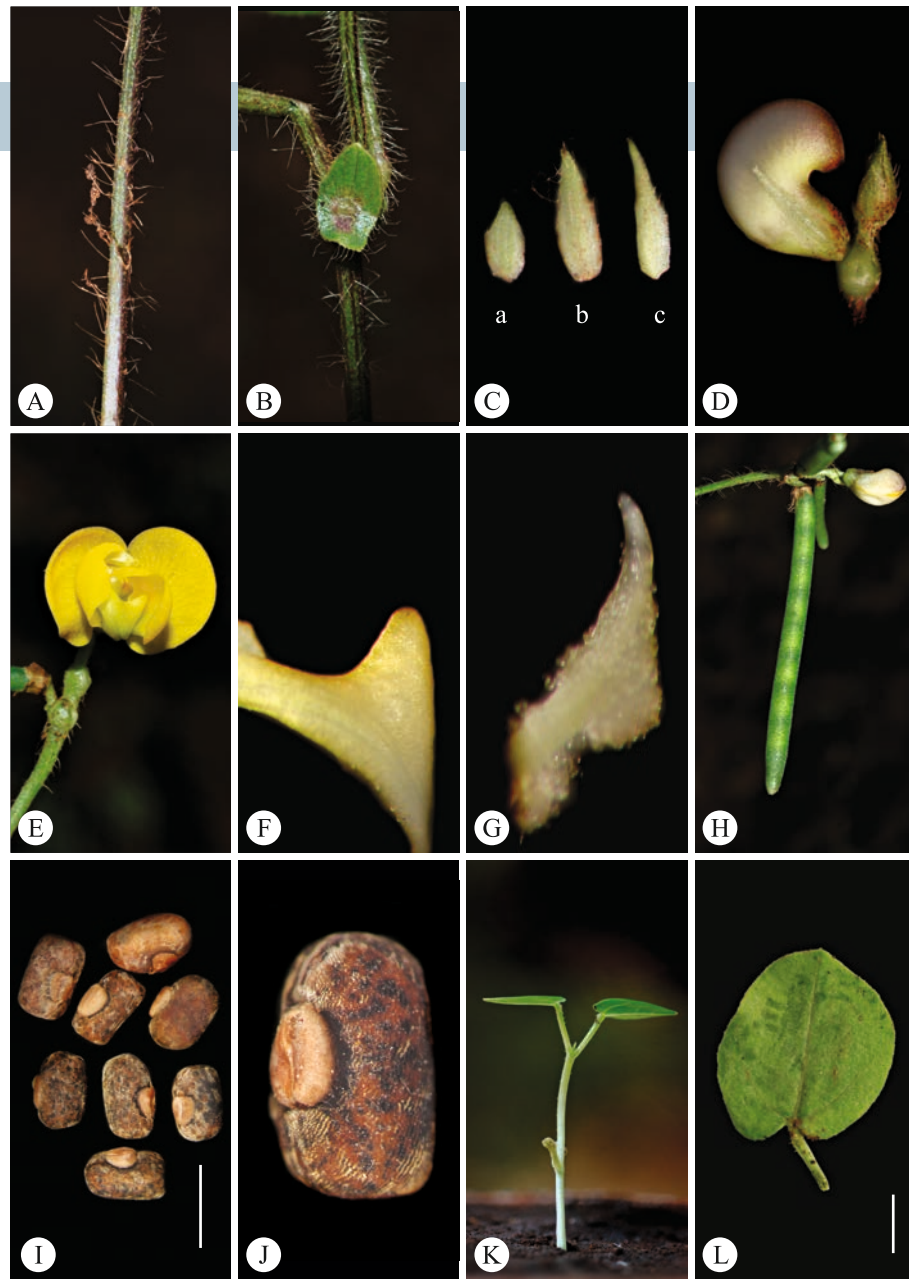
Flowering and fruiting: September to December

Distribution: India: Himachal Pradesh and Kerala.

Field notes: It grows along forest margin and road sides.

Chromosome number: 2n = 22.





Vigna trilobata (L.) Verdcourt A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. trilobata* (L.) Verdcourt**

A trailing or twinning, straggling annual-perennial herb. Stem 60-80 cm long, densely covered with 1-1.5 mm long white hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate, 3 lobed, lateral leaflets obliquely ovate, 3 lobed. Stipules orbicular to ovate, medifixed, 4-4.2 x 2.2-2.4 mm. Inflorescence 2-6 flowered; flowers golden yellow, 8-10 mm in diam. Pods linear, cylindrical and glabrous or minutely hairy, 2.8-3.2 x 0.18-0.2 cm, buff or pale brown when mature. Seeds rounded or elliptic, 6-10 per pod, rough, orange or brown, 3 x 2 x 2 mm, aril well developed.

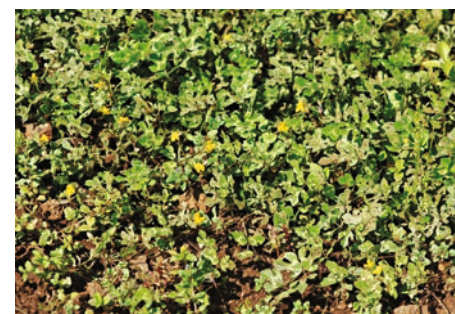
Flowering and fruiting: September to February

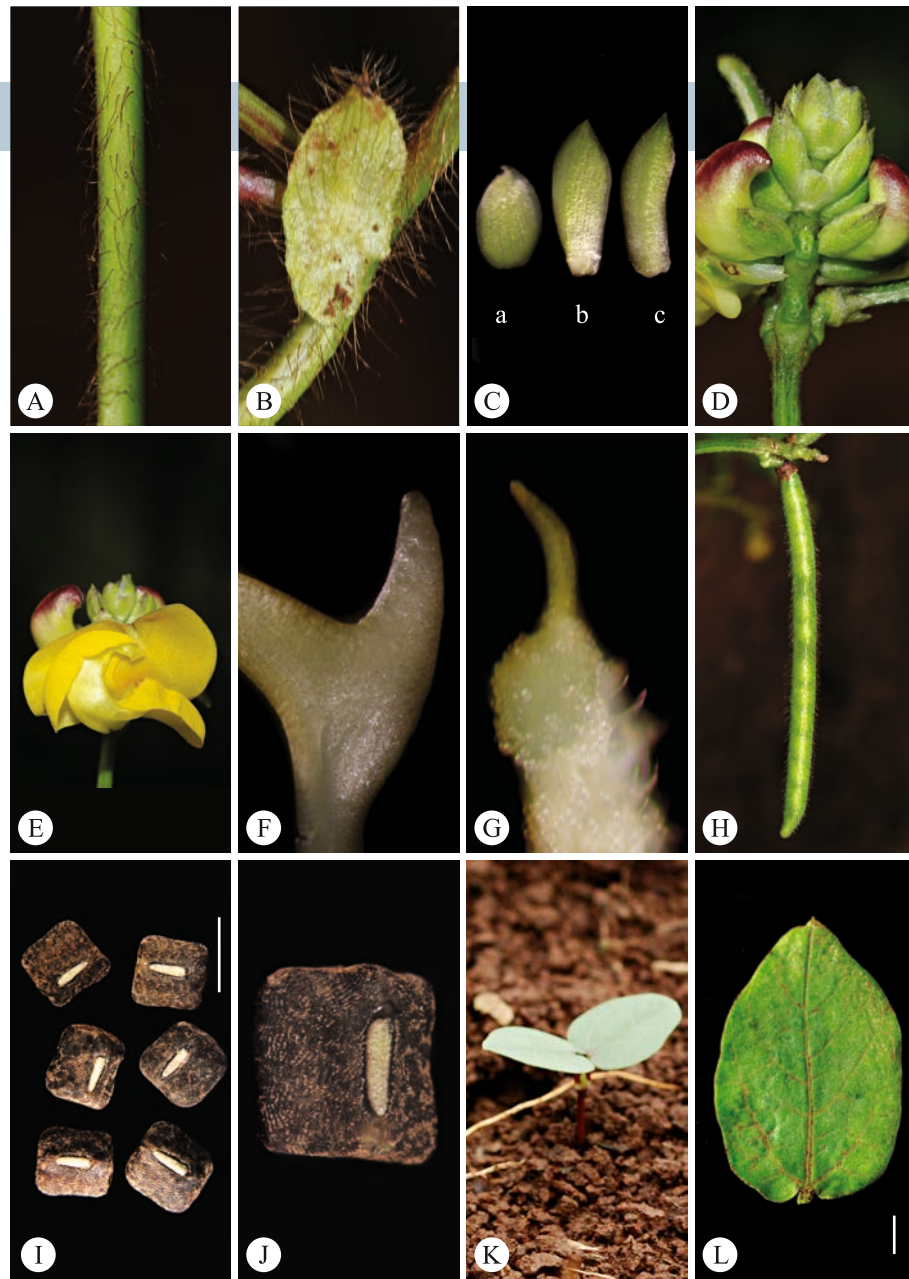
Distribution: India and Sri Lanka.

India: Andhra Pradesh, Karnataka, Kerala and Tamil Nadu.

Field notes: Grows in sandy soil and along costal line.

Chromosome number: 2n = 22.





Vigna trinervia var. *trinervia* (Heyne ex Wall.) Tateishi and Maxted A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. trinervia* var. *trinervia* (Heyne ex Wall.) Tateishi & Maxted**

A twinning herb. Stem 120 - 150 cm long, densely covered with 1-2 mm long brown hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to rhomboidal, lateral leaflets obliquely ovate. Stipule long elliptic, medifixed, 1.3-1.4 x 0.5-0.6 mm. Inflorescence 4-14 flowered; flowers golden yellow, 17-17.5 mm in diam. Pods linear, cylindrical and densely hairy, 4.5-5 x 0.3-0.4 cm, dark brown to blackish when mature. Seeds rectangular, 10-14 per pod, rough, maroon to brown, 3 x 2.5 x 3 mm, aril not developed.

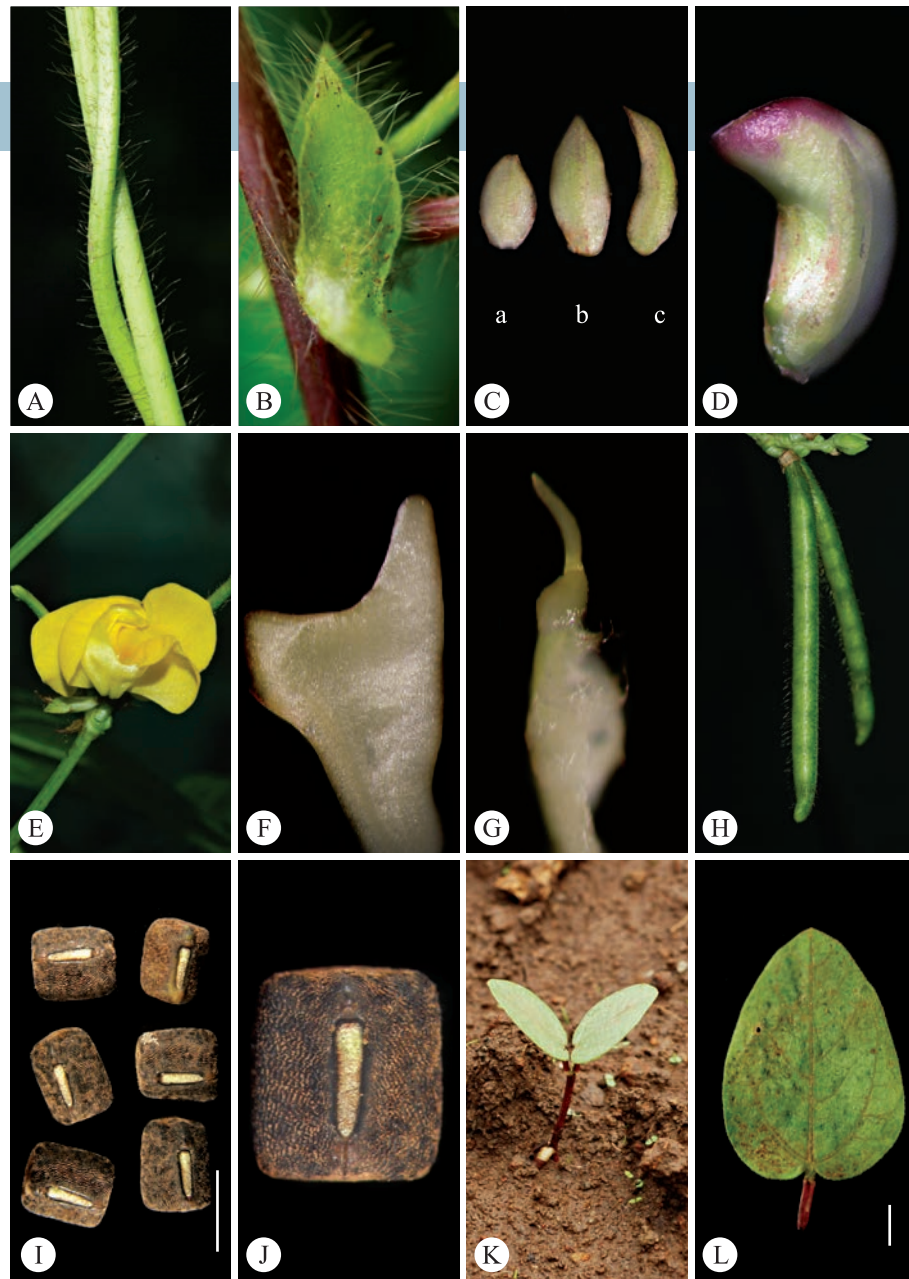
Flowering and fruiting: September to December

Distribution: India, Indonesia, Madagascar, Myanmar, Philippines, Sri Lanka, Tanzania, Thailand and The Comorous islands.

Field notes: Very robust species found in wet places among grasses and hedges. Leaflets sometimes marked with white blotch on upper surface.

Chromosome number: $2n = 22$.





Vigna trinervia var. *bourneae* (Gamble) Tateishi and Maxted A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. trinervia* var. *bourneae* (Gamble) Tateishi & Maxted**

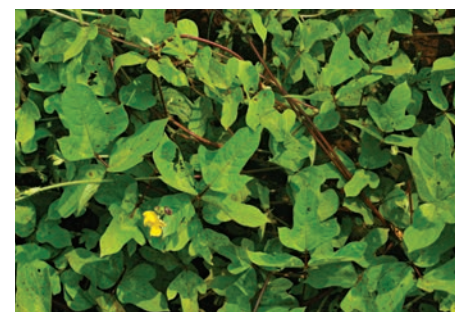
A twinning herb. Stem 120 - 150 cm long, densely covered with 2- 2.5 mm long yellowish brown hairs. Leaves 3-foliolate, with white blotch, terminal leaflet narrowly ovate to rhomboidal, lateral leaflets obliquely ovate. Stipule long elliptic, medifixed, 12-14 x 4-5 mm. Inflorescence 6-10 flowered, flowers golden yellow; 20-21 mm in diam. Pods linear, cylindrical and densely hairy, 3.5-4 x 0.3-0.4 cm, dark brown to blackish when mature. Seeds rectangular, 10-14 per pod with rough reticulate surface, maroon to brown, 3 x 3 x 2.5 mm, aril not developed.

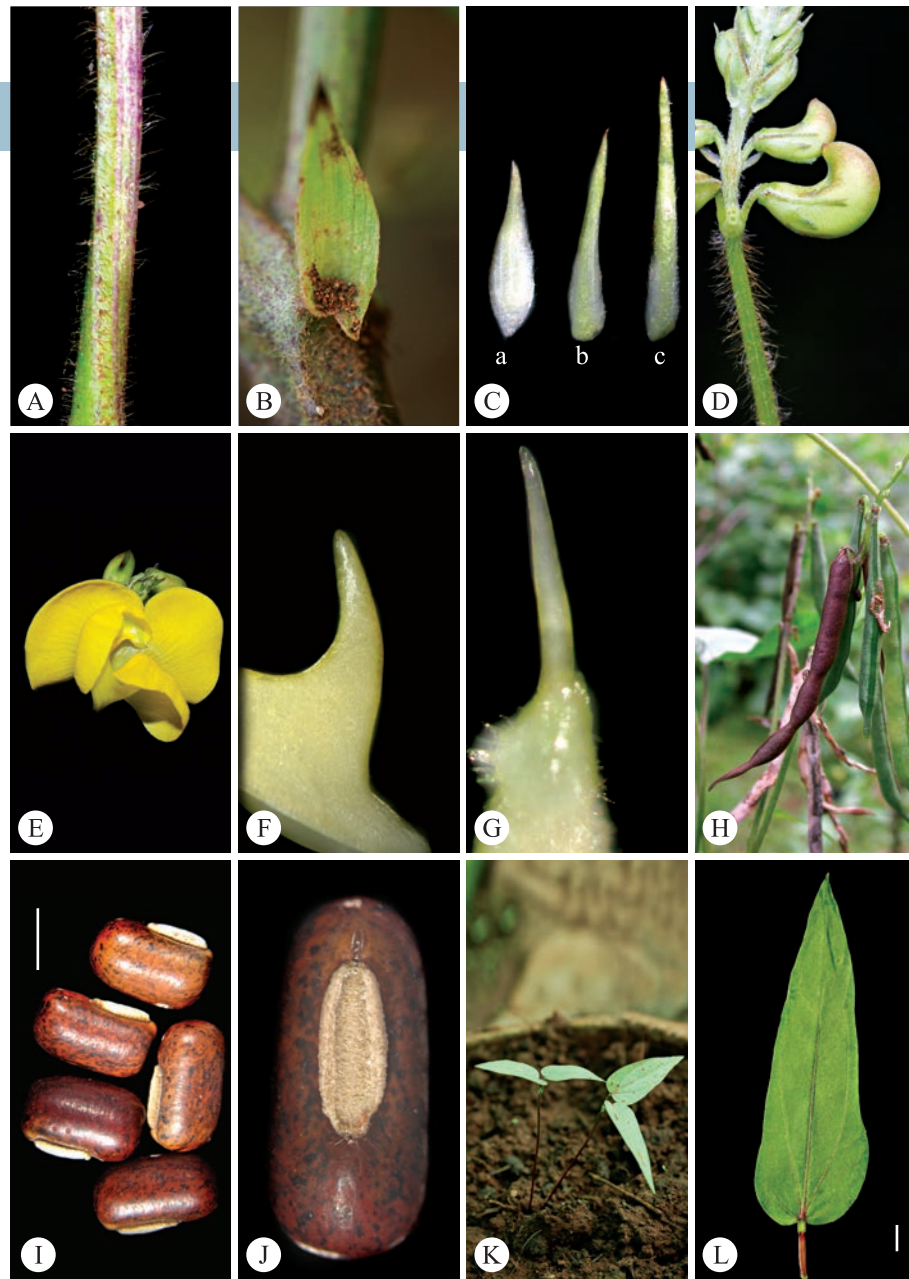
Flowering and fruiting: September to December

Distribution: India: Goa, Karnataka and Tamil Nadu.

Field notes: Very robust species found along roadside and in Ghats. Leaflets marked with white blotch on upper surface.

Chromosome number: 2n = 22.





Vigna umbellata (Thumb.) Ohwi & Ohashi (Cultivated) A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. umbellata* (Thumb.) Ohwi & Ohashi (Cultivated)**

Twinning or sub erect herb. Stem 120-150 cm long, densely covered with 1-1.2 mm long greyish white hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to rhomboidal, lateral leaflets obliquely ovate. Stipule narrowly elliptic to falcate, medifixed, 10-12 x 3-4 mm. Inflorescence 20-30 flowered; flowers large golden yellow, 22-25 mm in diam. Pods linear, pendulous, compressed and very sparsely covered with white hairs or glabrous, 11-12 x 0.4-0.45 cm, buff to brown colored when mature. Seeds elliptic, 10-12 per pod, smooth, shiny, pale yellow or pale brown, 7.5 x 4 x 2.5 mm, aril well developed.

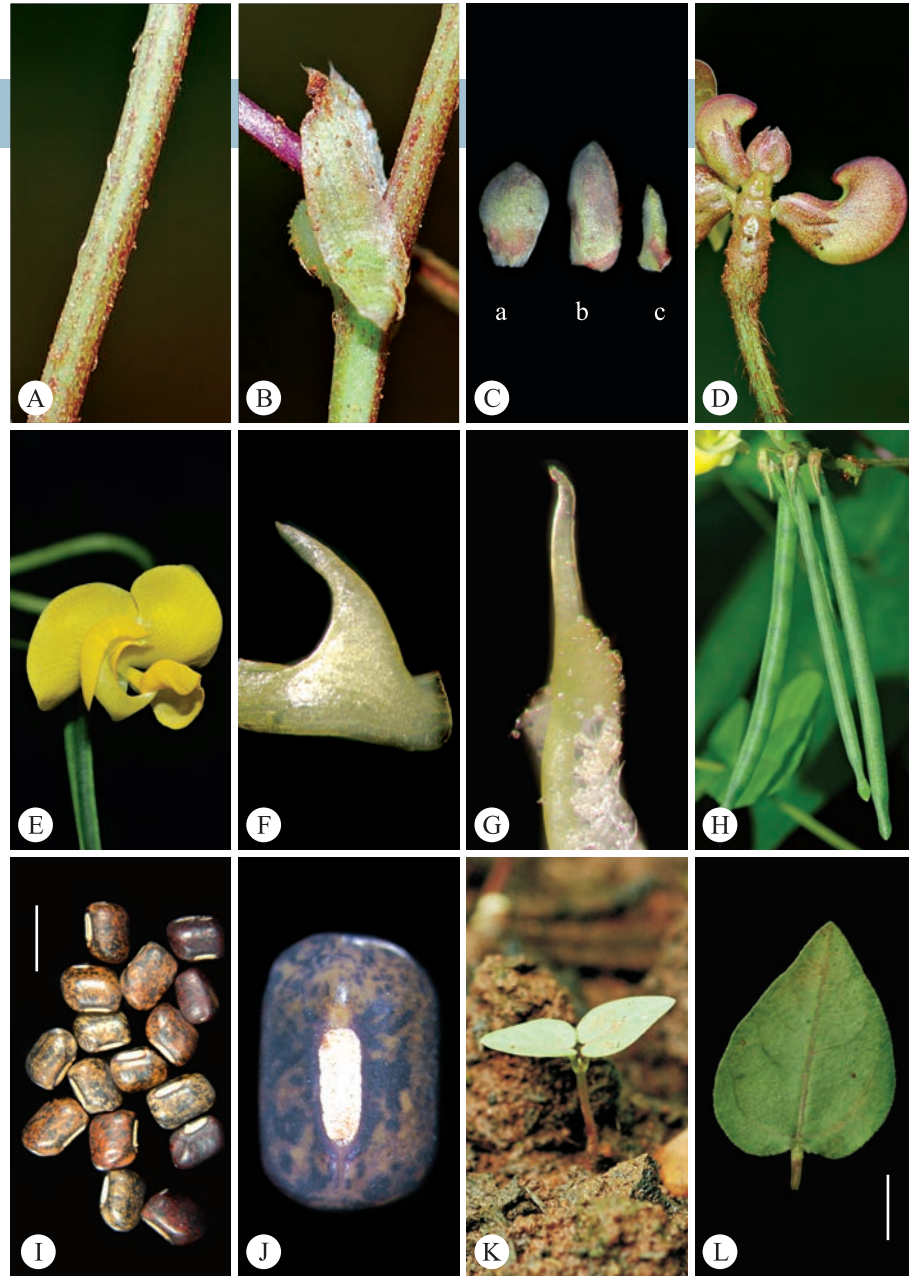
Flowering and fruiting: August to November

Distribution: India, also cultivated in Tropics.

Field notes: Cultivated form has many flowered inflorescence bearing golden yellow flowers.

Chromosome number: $2n = 22$.





. *Vigna umbellata* (Thumb.) Ohwi & Ohashi (Wild) A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. umbellata (Thunb.) Ohwi & Ohashi (Wild)

A twining herb. Stem 120-150 cm long, sparsely to densely covered with 0.7 mm long white hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to rhomboidal, lateral leaflets obliquely ovate. Stipule narrowly elliptic to rather falcate, medifixed, 7.5-8 x 2.2-2.5 mm. Inflorescence 10-20 flowered; flowers golden or lemon yellow, 10.5-11 in diam. Pods linear, pendulous sparsely covered with minute hairs, 5-6 x 0.25-0.3 cm, grayish black when mature. Seeds elliptic, 10-14 seeds per pod, smooth, shiny, blackish brown, 3 x 2.5 x 2 mm, aril poorly developed.

Flowering and fruiting: September to November

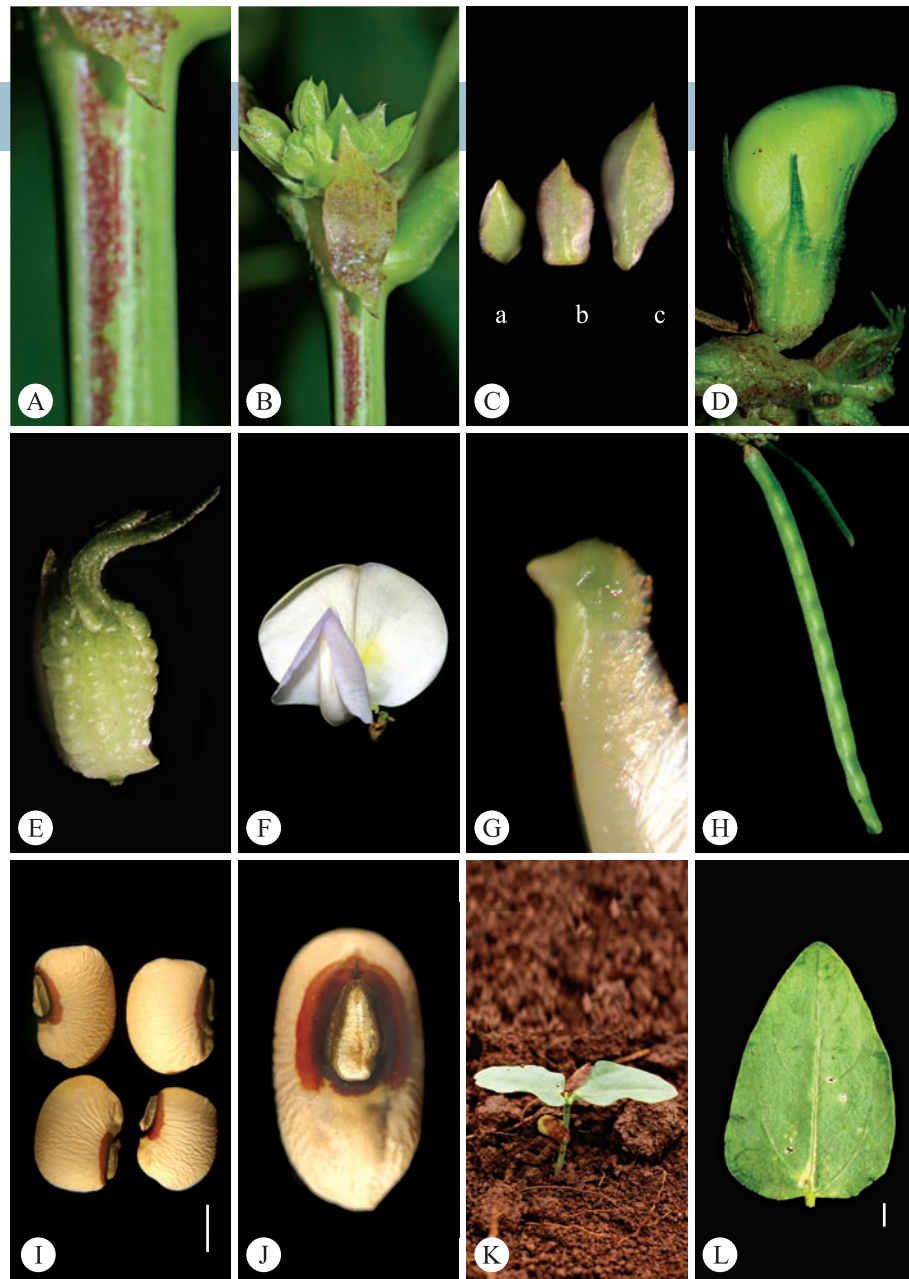
Distribution: India, Myanmar and Thailand.

India: Karnataka, Mizoram and Orissa.

Field notes: Grows in disturbed habitat such as road side, beside paddy field and near streams.

Chromosome number: $2n = 22$.





Vigna unguiculata (L.) Walp. A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Calyx, F. Flower, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

V. unguiculata (L.) Walp.

Erect or scandent or straggling or trailing or twining herb. Stem 120-150 cm long glabrous or sometimes sparsely to densely covered with 0.8-1 mm long white hairs. Leaves 3-foliolate, terminal leaflet ovate, lateral leaflets obliquely ovate. Stipule ovate to lanceolate, medifixed, 15-18 x 4-5 mm. Inflorescence 8-10 flowered; flowers bluish white or pale white or pink, 2.5-2.7 mm in diam., calyx tuberculate. Pods subterete, subcompressed and glabrous or puberulent, 16-18 x 0.9-1 cm, pale yellow when mature. Seeds rounded, 10-16 per pod, smooth, pale yellow, 10 x 5 x 7 mm, aril slightly developed.

Flowering and fruiting: September to March.

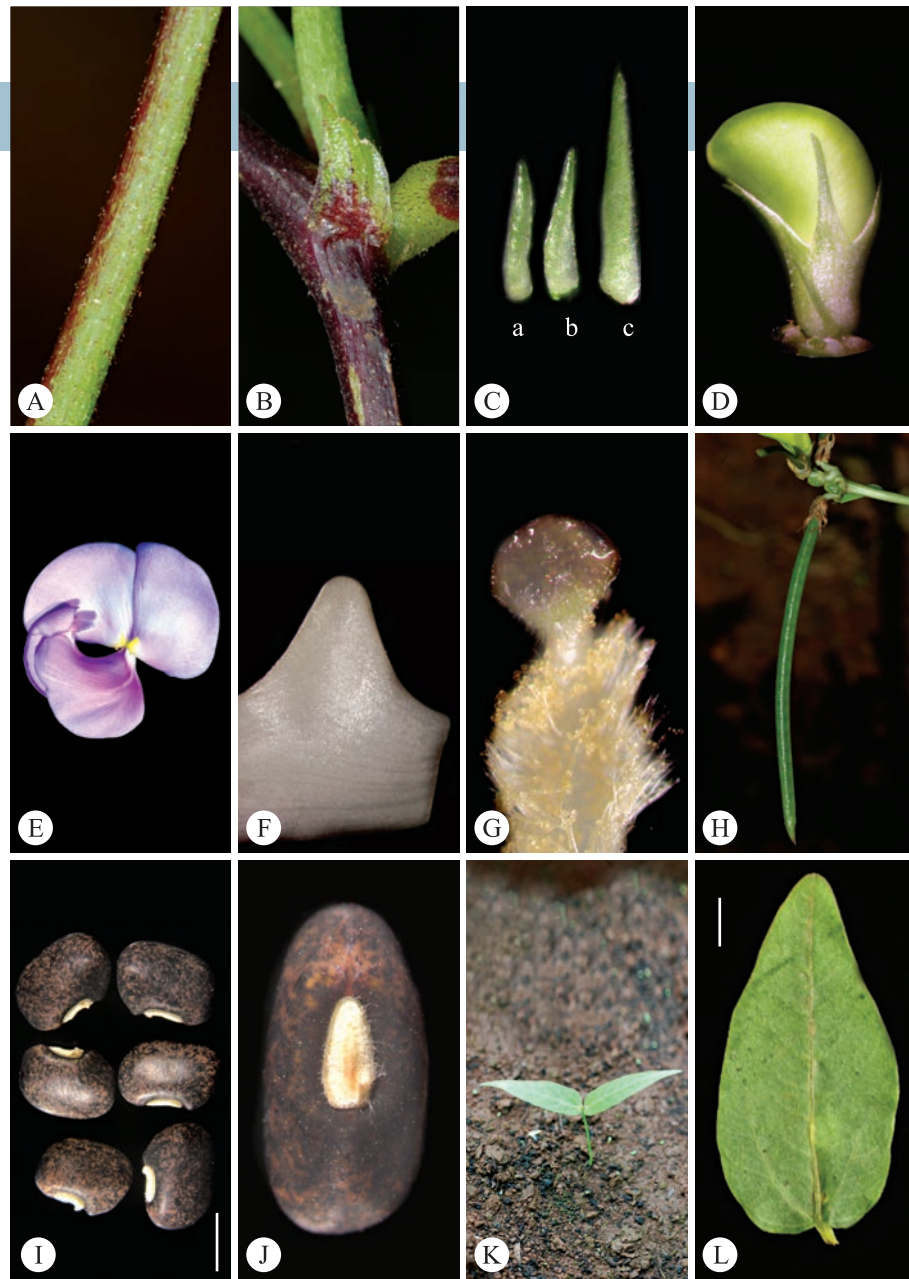
Distribution: India, widely grown in Tropics.

India: Kerala, Maharashtra, Orissa, Tripura, Uttaranchal and West Bengal.

Field notes: Cultivated species can be distinguished by its long pods and bluish white or pale white or pink flowers.

Chromosome number: $2n = 22$.





Vigna vexillata (L.) A. Rich. A. Stem, B. Stipule, C. Primary bract (a); Secondary bract (b); Bracteole (c), D. Bud, E. Flower, F. Keel pocket, G. Beak, H. Pod, I & J. Seed, K. Seedling and L. First leaf. Scale bar 3 mm

***V. vexillata* (L.) A. Rich.**

Twinning or straggling, perennial herb with tuberous root stalk. Stem 150-200 cm long, glabrescent or sparsely covered with 0.2-0.6 mm long yellowish brown hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to ovate, lateral leaflets obliquely ovate. Stipule ovate to triangular, basifixed, 7-8 x 2-2.2 mm. Inflorescence few flowered (2-4), flowers light purple, 3.5-3.7 cm in diam. Pods linear, cylindrical and glabrescent, 11-13 x 0.4-0.5 cm, grayish black when mature. Seeds rounded, 10-15 per pod, smooth, shiny, black, 4.5 x 3 x 3.2 mm, aril developed.

Flowering and fruiting: August to December

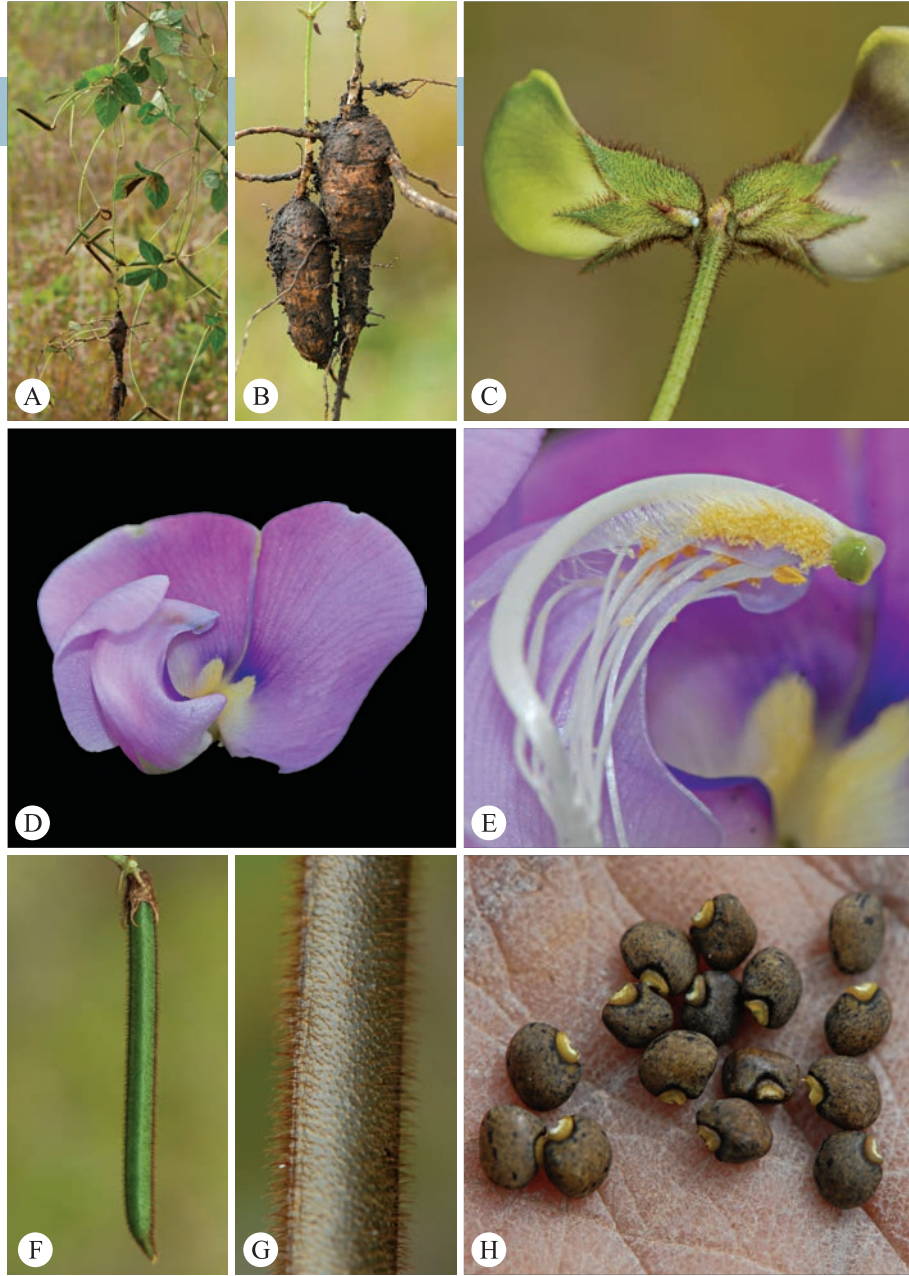
Distribution: India, Cosmopolitan in tropics, Australia.

India: Goa, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Punjab, Rajasthan, Shillong, Tamil Nadu and Uttaranchal.

Field notes: Highly variable with respect to hairiness, shape and size of leaflets.

Chromosome number: $2n = 22$.





V. vexillata var. *stocksii* Benth. ex Baker A. Habit, B. Root, C. Bud, D. Flower, E. Staminal tube, F & G. Pod and H. Seeds.

***V. vexillata* var. *stocksii* Benth. ex Baker**

Scandent or trailing herbs with tuberous root stalk. Stem 120-180 cm long, glabrescent or sparsely covered with 0.8-1 mm long ferrugineous hairs. Leaves 3-foliolate, terminal leaflet narrowly ovate to ovate, lateral leaflets obliquely ovate. Stipule ovate lanceolate, basifixed, 4-4.5 x 2-2.5 mm. Inflorescence few flowered (2-5), flowers light purple, 3.4-3.6 cm in diam. Pods linear, cylindrical and glabrescent, 6.5-7 x 0.3-0.4 cm, grayish black when mature. Seeds rounded 10-12 per pod, smooth, shiny, black, 4.2 x 2.8 x 3mm, aril developed.

Flowering and fruiting: August to December

Distribution: India. **India:** Hilly tracts of Peninsular and Eastern India, Karnataka, Kerala, Maharashtra, Tamil Nadu, Madhya Pradesh, Bihar and Orissa.

Field notes: This variety is densely covered with 1-2 mm long brown hairs.

Chromosome number: 2n = 22.

Key to the varieties of *Vigna vexillata*

- 1a. Leaf narrowly lanceolate, 2-2.5 cm broad.....var. *angustifolia*
- 1b. Leaflets ovate-deltoid, more than 3 cm broad..... 2
- 2a. Leaflets membranous, glabrescent. Stems, petioles and peduncles sparsely covered with short, brown hairs..... var. *sepiaria*
- 2b. Leaflets coriaceous, pubescent with rusty-brown hairs. Stems, petioles and peduncles densely covered with long, rusty brown hairs..... 3
- 3a. Calyx densely villous with short, rusty-brown hairs. Leaflets subobtusate, mucronate var. *wightii*
- 3b. Calyx hirsute with long, rusty-brown hairs. leaflets acuminate 4
- 4a. Leaflets 4-15 cm long. Flowers 2.5 cm long. Calyx lobes up to 2 cm long. var. *vexillata*
- 4b. Leaflets less than 6 cm long. Flowers 2 cm long. Calyx lobes up to 1 cm long. var. *stocksii*



Flowers of Indian *Vigna*



Seeds of Indian *Vigna*



Genus *Cucumis* L. in India

an illustrated guide for species identification



Cucumis L. sensu lato

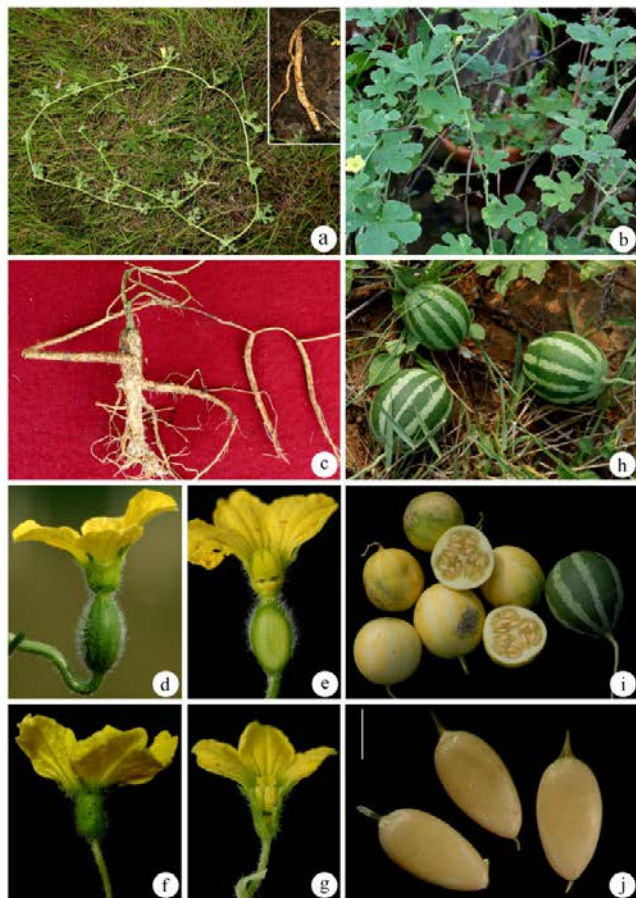
On the basis of molecular studies, Ghebretinsae *et al.* (2007) merged five genera viz. *Dicaelospermum* C. B. Clarke, *Cucumella* Chiovanda, *Mukia* Arnott, *Myrmecosicyos* C. Jeffrey and *Oreosyce* Hook.f. into *Cucumis*. With this enlarged circumscription, the genus consists of 52 species of which 13 occur in India.

The genus is of great economic importance. Two species of *Cucumis*, *C. sativus* (Cucumber) and *C. melo* (Melon) are economically important, highly nutritious crops widely cultivated throughout the world and India. Cucumber and melons are the third most widely cultivated vegetable crops after the tomatoes and onions in the world. According to the United Nations's Food and Agriculture Organization (FAO) cucumber and melon are the most popular cucurbit after the watermelon. China, Iran, Turkey and USA are the leading countries in the production of cucurbits. In 1994, from these four leading countries *ca* ten lakhs hector area was harvested for cucumber and melon and *ca* two crore tonnes yield had been harvested. In India, 71,000 hector area was under the cultivation of these two cucurbits and 12,00,000 tonnes yield was harvested in 2010-11. This gross production is *ca* 1 % against the total vegetable production in India. These cucurbits and their wild relatives are medicinally important, in addition to their great nutritional value.

The wild relatives of cultivated species form an essential gene pool for vigorous growth, productivity, resistance to biotic and abiotic factors and nutritional quality. Recent molecular studies have revealed that cucumber and melon are of Asian origin (India and China) and have numerous wild relatives. Systematic studies of these species in their centre of origin and diversity is very important from agricultural and plant breeding point of view. This booklet is based on such systematic studies and aims at easy identification in field and understanding the species of *Cucumis* and its wild relatives in India.

Taxonomic key for Cucumis species

1. Male and female flowers present in same axil; seed 3-chambered *C. ritchiei*
1. Male and female flowers present in different axils; seed 1-chambered 2
2. Female flowers in cluster 3
2. Female flower solitary 4
3. Fruit globose 5
3. Fruit ellipsoid *C. javanicus*
4. Ovary and fruits aculeate 6
4. Ovary and fruits not aculeate 7
5. Hypanthium teeth reflexed; seed smooth *C. leiospermus*
5. Hypanthium teeth not reflexed, straight; seed scorbiculate *C. maderaspatanus*
6. Young fruit stripped *C. prophetarum*
6. Immature fruit non-stripped 8
7. Ovary and fruit fusiform 9
7. Ovary and fruit oblong, cylindric 10
8. Fruit beaked 11
8. Fruit not beaked *C. dipsaceus*
9. Retrorse hairs on ovary and fruit; fruit dehiscent *C. silenvalleyi*
9. Antrorse hairs on ovary and fruit; fruit indehiscent *C. indicus*
10. Leaves angular 12
10. Leaves lobed 13
11. Fruit sparsely tuberculate *C. hystrix*
11. Fruit densely echinate-muriculate *C. muriculatus*
12. Ovary and fruit setose hairy; fruit 2-2.8 x 1.5-1.8 cm *C. setosus*
12. Ovary and fruit hispidulous; fruit 4.5-30 x 3-15 cm *C. sativus*
13. Perennial, stem repent; leaves deeply lobed *C. callosus*
13. Annual, stem not repent; leaves shallowly lobed *C. melo*



Cucumis callosus (Rottl.) Cogn. a. Habit, inset shows woody root stock; b. Leaves; c. Woody root stock with repent stem; d. Female flower; e. L. S. of female flower; f. Male flower; g. L. S. of male flower; h-i. Fruits; j. Seeds. Scale bar 2 mm

Cucumis callosus (Rottl.) Cogn.

Cucumis callosus (Rottl.) Cogn., Pflanzenz. (Engler) IV. 275. II: 129. 1924; *Bryonia callosa* Rottl., Neue Schrift. Ges. Nat. Freunde zu Berlin IV: 210. 1803. *Cucumis trigonus* Roxb. Hort. Beng. 70. 1814.

Diagnostic features : Perennial creeping herb, with woody rootstock. Stem repent. Leaves deeply 5-7 lobed. Male flower *ca* 1.5 x 1.6 cm, in fascicle of 4-6 per axils. Female flower *ca* 2.5 x 1.8 cm, solitary, ovary densely soft hairy; hairs antrorse. Fruit 3-4 x 2.5-3 cm, indehiscent, ovate to globose, green with ten yellowish green to white continuous longitudinal stripes, turns yellow and glabrous at maturity, bitter. Seed 0.6 x 0.3 x 0.5 cm, ovate to lance-ovate, beaked, funiculus persistent, grey-white.

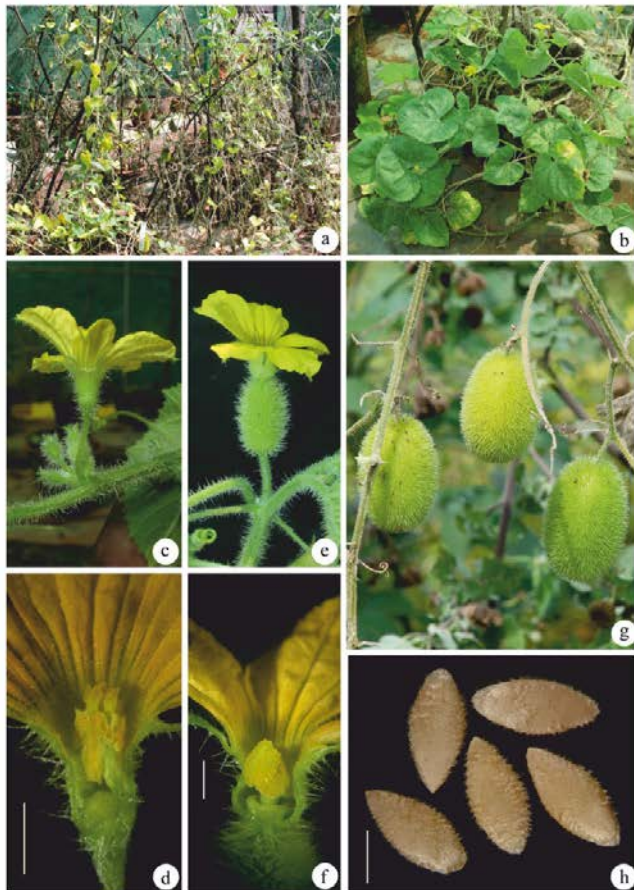
Flowering and fruiting : August to December.

Distribution : South East Asia, Africa, Australia, **India :** Andhra Pradesh, Gujarat, Haryana, Madhya Pradesh, Uttar Pradesh, Maharashtra, Orissa, Rajasthan, Tamil Nadu and West Bengal.

Field notes : The species is adapted to semi-arid-arid regions. It is found in open grass lands and along the borders of cultivated fields. Fruits are inedible.

Vernacular names : Indrayan, Bislumbha (Hindi); Karit (Marathi); Kaattuthumatti (Tamil).

Chromosome number : 2n = 24.



Cucumis dipsaceus Ehrenb. ex Spach a-b. Habit; c. Male flower; d. L. S. of male flower; e. Female flower; f. L. S. of female flower; g. Fruits; h. Seeds. Scale bar 2 mm

Cucumis dipsaceus Ehrenb. ex Spach

Cucumis dipsaceus Ehrenb. ex Spach, Hist. Nat. Vég. (Spach) 6: 211. 1838.

Diagnostic features : Annual climbing herb. Leaves cordate-orbicular. Male flower *ca* 1.3 x 2.5 cm, in fascicle of 3-5 per axils. Female flower *ca* 2.5 x 2.2 cm, solitary, ovary densely aculeate. Fruit 5-7 x 3.5-4 cm, indehiscent, oblong, green when young pale yellow at maturity, densely aculeate, bitter; aculei 0.5-0.7 cm long. Seed 0.5 x 0.2 x 0.1 cm, both ends acute, ovate to lance-ovate, funiculus caducous, non beaked, grey-white.

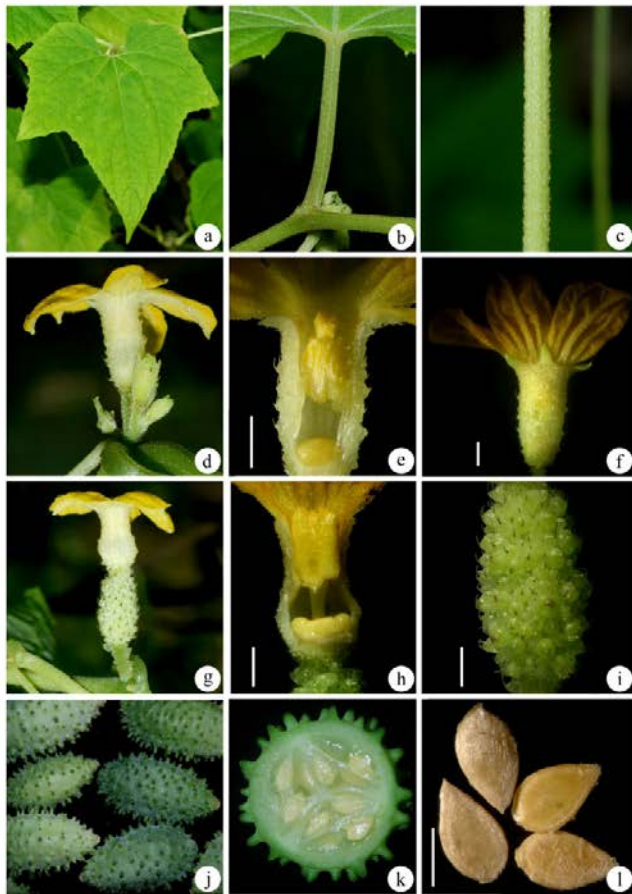
Flowering and fruiting : July to January.

Distribution : West Indies, Africa, North and South America, Saudi Arabia, **India:** Tamil Nadu and Karnataka.

Field notes : Native of Saudi Arabia. It was introduced under breeding program and now naturalizing in some parts of south India. Found growing widely along the road sides in waste lands. It is also cultivated as ornamental. Inedible.

Vernacular names : Hedgehog gourd (English).

Chromosome number : 2n = 24.



Cucumis hystrix var. nov., a. Leaf lamina; b-c. retrorse hairs on petiole; d. Male flower; e. L. S. of male flower; f. Hypanthium and calyx lobes; g. Female flower; h. L. S. of female flower; i. Ovary; j. Fruit; k. T. S. of fruits, l. Seeds. Scale bar 2mm

Cucumis hystrix Chakrav.

Cucumis hystrix Chakrav., J. Bombay Nat. Hist. Soc. 50 (4): 896. 1952.

Diagnostic features : Annual climbing herb. Hairs antrorse. Leaves pentangular, middle lobe distinctly elevated and shallow incised at base. Male flower *ca* 1.5 x 1.5 cm, in fascicle of 4-6 per axils. Female flower *ca* 2.5 x 1.8 cm, solitary, ovary densely aculeate, aculi antrorsly hairy. Calyx lobes 0.1 cm, straight. Fruit 4-5 x 1.7-2 cm, indehiscent, ovate, tapering at both ends, beaked, aculeate; aculi obtuse, 0.15-0.2 cm long, green. Seed 0.4 x 0.2 x 0.5 cm, apex rounded, base acute, ovate to lance-ovate, funiculus caducous, non beaked, grey-white.

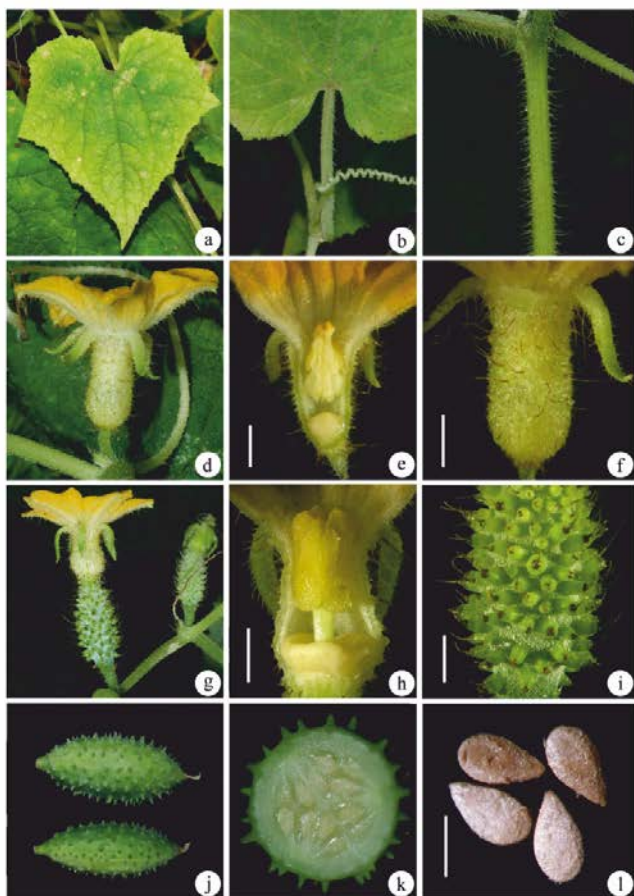
Flowering and fruiting : July to December.

Distribution : India : Mizoram.

Field notes : Rare. Found along the road sides, trailing on bushes in forests. Edible.

Vernacular names : Arphagma (Mizoram)

Chromosome number : 2n = 24.



Cucumis hystrix Chakrav. var. nov. a. Leaf lamina; b-c. antrorse hairs; d. Male flower; e. L. S. of male flower; f. Calyx lobes; g. Female flower; h. L. S. of female flower; i. Ovary; j. Fruit; k. T. S. of fruit, l. Seed. Scale bar: 2mm

Cucumis hystrix Chakrav. var. nov.

Cucumis hystrix Chakrav. var. nov.

Diagnostic features : Annual climbing herb. Hairs retrorse to perpendicular to surface. Leaves pentangular. Male flower *ca* 1.5 x 1.5 cm, in fascicle of 4-6 per axils. Female flower *ca* 2.5 x 2 cm, solitary, ovary sparsely aculeate; aculi antrorsly hairy. Calyx lobes 0.2-0.3 cm, turn downward. Fruit 4-5 x 1.7-2 cm, indehiscent, ovate, tapering at both ends, beaked, aculeate; aculi acute, 0.15-0.2 cm long, green. Seed 0.4 x 0.2 x 0.5 cm, apex rounded, base acute, ovate to lance-ovate, funiculus caducous, non beaked, grey-white.

Flowering and fruiting : August to December.

Distribution : China, Myanmar, Thailand, **India**: Arunachal Pradesh, Meghalaya, Mizoram and Nagaland.

Field notes : Rare, grows along roadsides in forest areas. Edible.

Chromosome number : $2n = 24$



Cucumis indicus Ghebretinsae & Thulin a-b. Habit; c. Female flower; d. Stigma; e. T. S. of ovary; f. Male flower; g. L. S. of male flower; h. Flowering twig; i-j. Fruits, k. Seeds. Scale bar 2 mm

Cucumis indicus Ghebretinsae & Thulin

Cucumis indicus Ghebretinsae & Thulin, Novon, 17 (2): 177. 2007. *Melothria ritchei* Chakrav., J. Bombay Nat. Hist. Soc. 50 (4): 898. 1952. *Cucumella ritchei* (Chakrav.) C. Jeffrey, Kew. Bull. xix. 215. 1965.

Diagnostic features : Annual climber. Leaves angular. Male flower *ca* 2.5 x 2 cm, in fascicle of 4-7 per axils. Female flower *ca* 3 x 2 cm, solitary, ovary elongate, fusiform, sparsely antrorse hairy. Fruit 3-5.5 x 1-1.5, indehiscent, elongated, fusiform, rostrate, pale green with 10 dark green longitudinal stripes, turn pale green to white at maturity, glabrous. Seed 0.4 x 0.2 x 0.02 mm, apex rounded, base acute, ovate to lance-ovate, funiculus caducous, non beaked, grey-white.

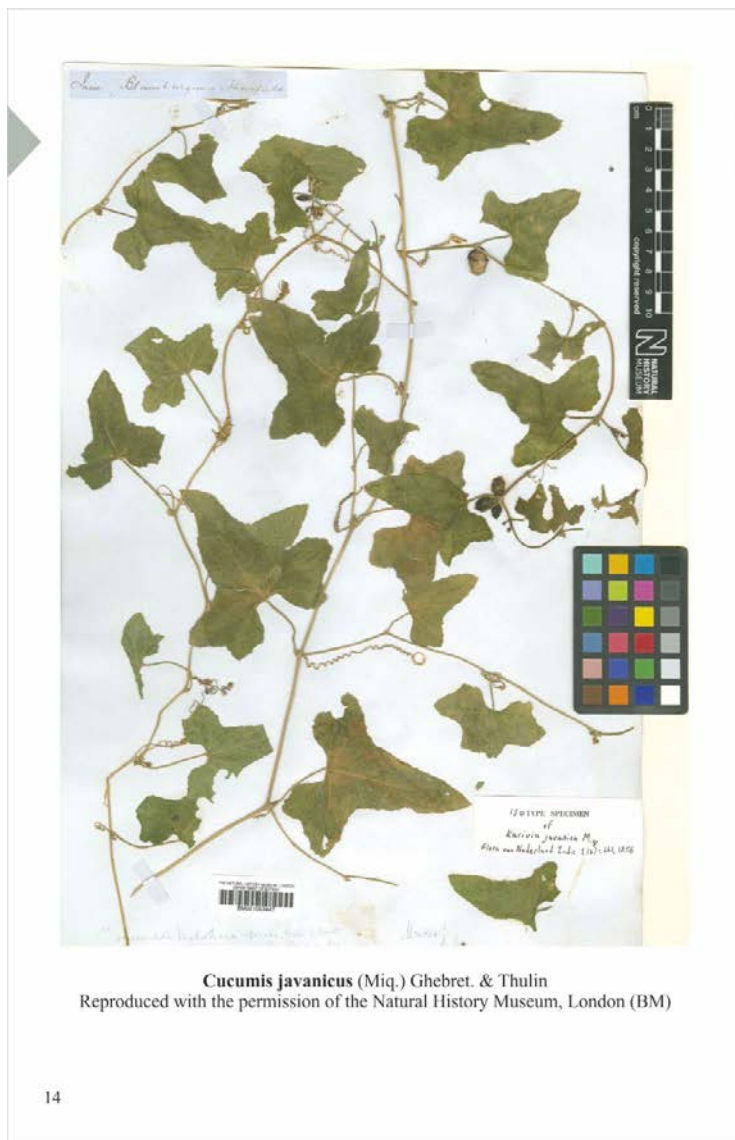
Flowering and fruiting : August to November.

Distribution : Endemic to Northern-Western Ghats.

Field notes : Plants grow along slopes amidst grasses and shrubs, in Ghats region along road sides at an altitude between 500 to 950 m. Edible.

Vernacular names : Meti, Tausal (Marathi).

Chromosome number : $2n = 20$.



Cucumis javanicus (Miq.) Ghebret. & Thulin
 Reproduced with the permission of the Natural History Museum, London (BM)

Cucumis javanicus (Miq.) Ghebret. & Thulin

Cucumis javanicus (Miq.) Ghebret. & Thulin, *Novon* 17(2): 177. 2007. *Karivia javanica* Miq, *Fl. Ned. Ind.* 1(1): 661. 1856. *Melothria javanica* (Miq.) Cogn. *Monogr. Phan.* 3: 625. 1881. *Mukia javanica* (Miq.) C. Jeffrey Hooker's *Icon. Pl.* 37(3): 3-4, t. 3661. 1969. *Melothria assamica* Chakrav. *J. Bombay Nat. Hist. Soc.* 50: 899. 1952. *Melothria assamica* var. *scabra* Chakrav. *J. Bombay Nat. Hist. Soc.* 50: 899. 1952.

Diagnostic features : Annual climbing herb. Leaves pentangular. Male flower *ca* 1.5 x 2.1 cm, in fascicle of 3-6 per axils. Female flower *ca* 1.6 x 2.5 cm. Fruit 1-1.5 x 0.6-0.8 cm, ellipsoid, pale green, turning dark red at maturity, 8-18 seeded. Seed *ca* 3.5-0.5 x 0.1-1.5 cm, elliptic to obovate, apex rounded, beaked, margined, smooth, grey-white.

Flowering and fruiting : August to November.

Distribution : China, Malesia, **India**: Assam.

Note : This specimen has not been collected so far from India. The present description is based on the type specimens deposited at BM and relevant literatures.



Cucumis leiospermus (Wight & Arnott) Ghebretinsae & Thulin a. Habit; b-c. Female flower; d. L. S. of female flower; e-f. Male flower; g. L. S. of male flower; h-j. Fruits; k. Seeds. Scale bar 2 mm

Cucumis leiospermus (Wight & Arnott) Ghebretinsae & Thulin

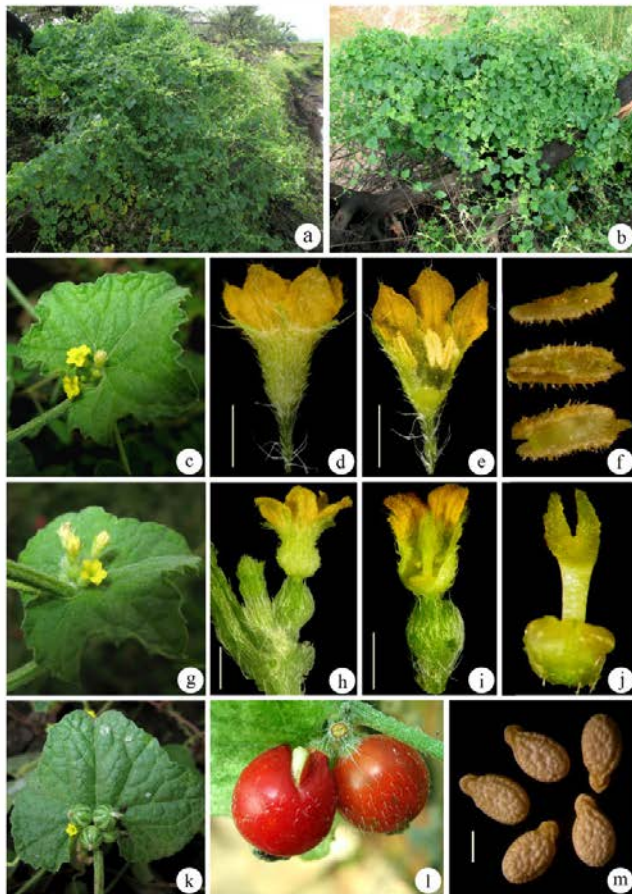
Cucumis leiospermus (Wight & Arnott) Ghebretinsae & Thulin, Novon, 17 (2): 177. 2007. *Bryonia leiosperma* Wight & Arn., Prodr. Fl. Indiae Orient. 1: 345. 1834. *Mukia leiosperma* (Wight & Arn.) Wight, Ann. Mag. Nat. Hist, ser. 1, 8: 268. 1842. *Melothria leiosperma* (Wight & Arn.) Cogn. In A.D.C. & C.D.C., Monogr. Phan. 3: 622. 1881.

Diagnostic features : Annual climbing herb. Leaves pentangular. Male flower *ca* 0.9 x 0.5 cm, in fascicle of 5-8 per axils. Female flower *ca* 1.5 x 0.8 cm, in fascicle of 2-3 per axils, ovary densely hairy. Fruit 1.3-1.4 x 1 cm, oval-globose, indehiscent, pale green with 10 dark green longitudinal stripes, turning dark red at maturity, 16-17 seeded. Seed 0.5 x 0.3 x 0.2 cm, ovate to lance-ovate, funiculus caducous, apex rounded, short beaked, marginated, smooth, grey-white.

Flowering and fruiting : August to December.

Distribution : Sri Lanka, **India:** Tamil Nadu, Kerala.

Field notes : Plants grow along slopes amidst grasses and shrubs in Ghats region along road sides at an altitude between 300 to 1200 m.



Cucumis maderaspatanus L. a-b. Habit; c. Male inflorescence; d. Male flower; e. L. S. of male flower; f. Stamen; g. Female inflorescence; h. Female flower; i. L. S. of female flower; j. Stigma, k-l. Fruits; m. seeds. Scale bar 2 mm

Cucumis maderaspatanus L.

Cucumis maderaspatanus L., Sp. Pl., 1: 1012.1753. *Mukia maderaspatana* (L.) M. Roem. Fam. Nat. Syn. Monogr. 2: 47. 1846. *Melothria maderaspatana* (L.) Cogn., Monogr. Phan. [A.DC. & C.DC.] 3: 623. 1881.

Diagnostic features : Annual climbing herb. Leaves pentangular. Male flower *ca* 0.8 x 0.5 cm, in fascicle of 5-15 per axils. Female flower *ca* 0.8 x 0.5 cm. Fruit 1-1.2 x 1-1.2 cm, circular, pale green with 7-10 dark green longitudinal stripes, turning dark red at maturity, 3-20 seeded. Seed *ca* 0.52 x 0.3 x 0.2 cm, elliptic to obovate, apex rounded, beaked, marginated, smooth when fresh, scorbiculate when dry, grey-white.

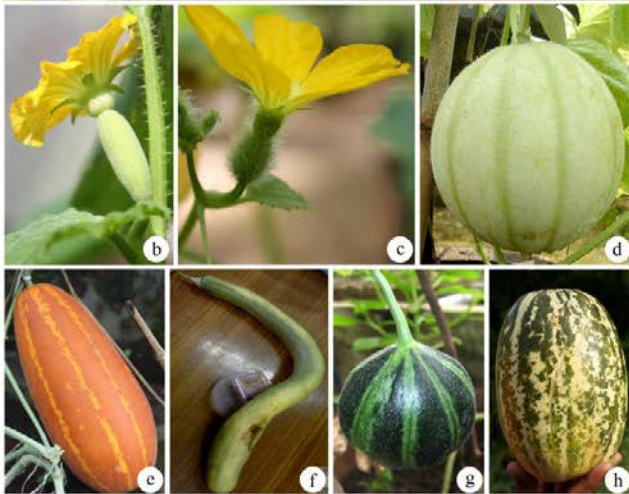
Flowering and fruiting : August to November.

Distribution : Widespread. Africa, SW and SE Asia, Australia. **India**: In all the states.

Field notes : Plants grow along slopes amidst grasses and shrubs, in Ghats regions, hedges along road sides and cultivated fields. Edible.

Vernacular names : Chirati (Marathi); Mukkapira (Malayalam)

Chromosome number : $2n = 24$.



Cucumis melo L. a. Fruits of melons; b. Female flower of *C. melo* var. *Conomon*; c. Female flower of *C. melo* var. *melo*; d. *C. melo* var. *Cantalupensis*; e. *C. melo* var. *Conomon*; f. *C. melo* var. *flexuosus*; g. *C. melo* var. *melo*; h. *C. melo* var. *momordica*.

Cucumis melo L.

Taxonomic key to the subspecies of *Cucumis melo*

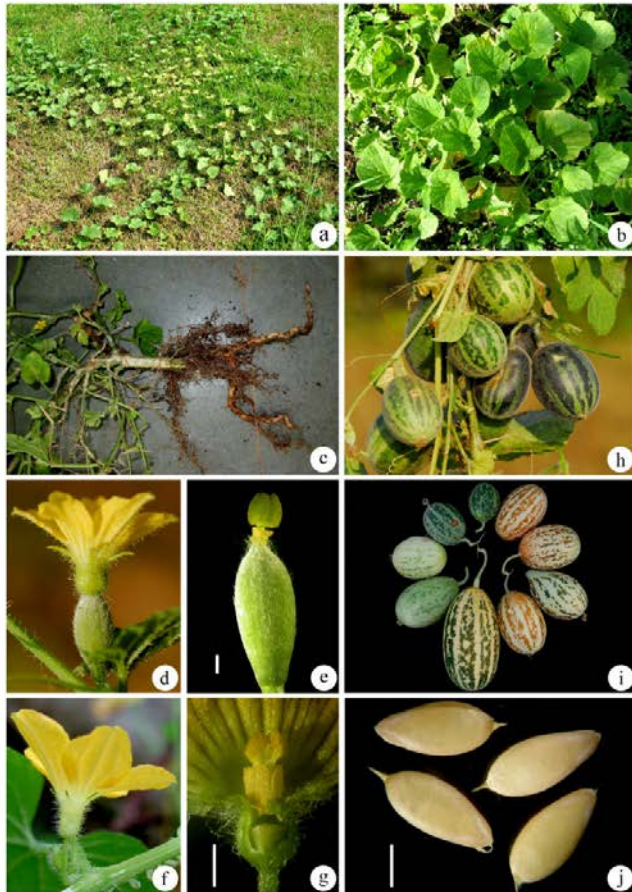
1. Ovary pilose to villose, long hairy subsp. *melo*
1. Ovary with retrorse or antrorse appressed short hairy subsp. *agrestis*

Taxonomic key to the varieties of *Cucumis melo* subsp. *melo*

1. Fruit elongated, 76 – 90 cm long var. *flexuosus*
1. Fruit globose, 15 – 20 cm long 2
2. Fruit globose, scaly or netted rind, monocolour var. *cantalupensis*
2. Fruit globose, not scaly or netted, bicolour var. *melo*

Key to the varieties of *Cucumis melo* subsp. *agrestis*

1. Wild, bitter, inedible var. *agrestis*
1. Cultivated, sweet, edible 2
2. Fruit 30 – 65 x 7 – 16 cm, cylindrical-oval, developing cracks at maturity var. *momordica*
2. Fruit 15 – 20 x 10 – 12 cm, oblong to oval, not developing cracks ... var. *conomon*



Cucumis melo var. *agrestis* Naud. a. Habit; b. Leaves; c. Root stock; d. Female flower; e. Ovary and Stigma; f. Male flower; g. L. S. of male flower; h-i. Fruits; j. Seeds. Scale bar 2 mm

Cucumis melo var. *agrestis* Naud.

Cucumis melo var. *agrestis* Naud., Ann. Sci. Nat., Bot. series 4 11 (2): 73. 1859.

Diagnostic features : Annual prostrate, herb. Leaves shallowly 3-5 lobed. Male flower *ca* 4.5 x 2 cm, in fascicle of 4-6 per axils. Female flower *ca* 3.5 x 2.5 cm, solitary, ovary densely antrorsly hairy. Fruit 4-4.5 x 2.5-3 cm, indehiscent, ovate-oblong, mottled dark green with 10 pale green continuous longitudinal stripes, turns pale yellow at maturity, mostly bitter, rarely not bitter. Seed 0.6 x 0.3 x 0.05 cm, ovate to lance-ovate, beaked, funiculus persistent, grey-white.

Flowering and fruiting : June to December.

Distribution : World wide. **India:** All states.

Field notes : It is widely spread species. Habitat ranges from evergreen forest to semi dry to dry forest. It grows along road side, in grass land and cultivated fields. Inedible, some forms are edible after maturity.

Vernacular names : Kachoori, Takmak, Shinde (Marathi); Simmatikkai (Tamil).

Chromosome number : 2n = 24.



Cucumis muriculatus Chakrav.

Cucumis muriculatus Chakrav., J. Bombay Nat. Hist. Soc. 50 (4): 896. 1952.

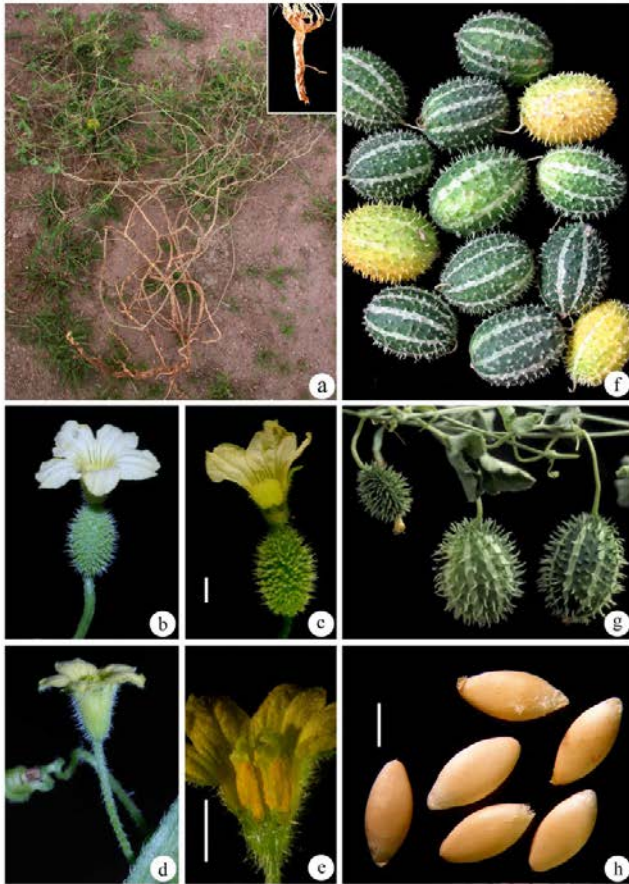
Diagnostic features : Annual climbing herb, Hairy. Leaves pentangular. Male flower *ca* 1.1 x 1.3 cm, solitary or fascicle, Female flower *ca* 2 x 1.9 cm, solitary, ovary densely hairy. Fruit 2-2.5 x 1.5-2 cm, indehiscent, oblong-round, tapering at both ends, beaked, densely echinate-muriculate, green. Seed 0.4 x 0.2 x 0.5 cm, apex rounded, base acute, ovate to lance-ovate, funiculus caducous, non beaked, grey-white.

Distribution : Burma

Notes : Chakravarty (1952) described two species of *Cucumis* viz., *C. hystrix* from India and *C. muriculatus* from Burma. However, *C. muriculatus* has been considered as a synonym of *C. hystrix* by many workers. After critical analysis of literature, illustration and the type specimens of *C. muriculatus* and *C. hystrix* it seems that both species are distinct entities. The fruits of *C. hystrix* are sparsely tuberculate while the fruits of *C. muriculatus* are densely echinate-muriculate. This prominent feature is raising *C. muriculatus* at the level of distinct taxa. There is a need of critical survey and study of this entity from its type locality to widening the wild gene pool for cultivars.



Fruit



Cucumis prophetarum L. a. Habit, inset shows woody root stock; b. Female flower; c. L. S. of female flower; d. Male flower; e. L. S. of male flower; f-g. Fruits; h. Seeds. Scale bar 2mm

Cucumis prophetarum L.

Cucumis prophetarum L., Cent. Pl. I. 1: 32. 1755.

Diagnostic features : Perennial creeping herb, with woody rootstock. Leaves deeply 3-5 lobed. Male flower *ca* 1 x 1.1 cm, solitary or in fascicle of 4-6. Female flower *ca* 2.5 x 1.8-2 cm long, solitary, ovary aculeate, hairy. Fruit 3-5 x 2-4 cm, oval to globose, green with ten white continuous longitudinal stripes, green when young turns yellow at maturity, bitter, aculeate. Seed 0.4-0.5 x 0.2 cm, both ends acute, ovate to lance-ovate, funiculus caducous, non beaked, grey-white.

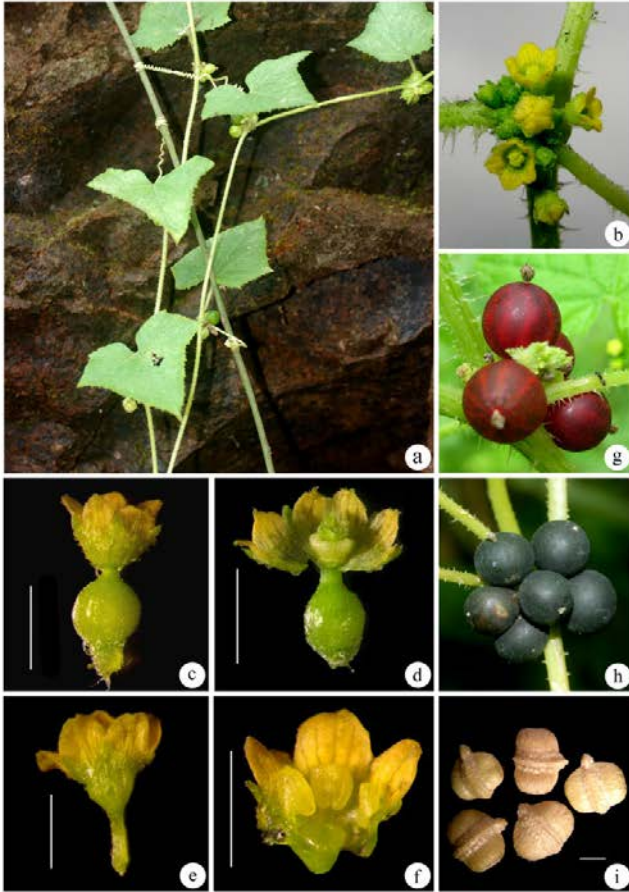
Flowering and fruiting : August to January.

Distribution : Ethiopia, Kenya, Somalia, Egypt, Uganda. Middle East, Pakistan, **India**: Gujarat, Karnataka, Kerala, Maharashtra, Rajasthan and Tamil Nadu.

Field Notes : Plants growing in dry arid zones in open waste lands. Inedible.

Vernacular names : Khat-Kachario (Rajasthan).

Chromosome number : $2n = 24$.



Dicaelospermum ritchiei C. B. Clarke, a. Habit; b. Inflorescence; c. Female flower; d. L. S. of female flower; e. Male flower; f. L. S. of male flower; g-h. Fruit; i. Seed. Scale bar 2 mm

Cucumis ritchiei (C. B. Clarke) Ghebretinsae & Thulin

Cucumis ritchiei (C. B. Clarke) Ghebretinsae & Thulin, Novon, 17 (2): 178. 2007. *Dicaelospermum ritchiei* C. B. Clarke in Fl. Brit. India (J. D. Hooker) 2: 630. 1879. *Mukia ritchiei* (C. B. Clarke) W. J. de Wilde & Duyfjes, Thai Forest Bull., Bot. 34: 45. 2006.

Diagnostic features : Annual climbing herb. Leaves pentangular. Male and female flowers in fascicle in same leaf axil. Male flower *ca* 0.5 x 0.3 cm, stamen without appendage. Female flower *ca* 0.4 x 0.3 cm, sessile. Fruit *ca* 1.5 x 1 cm, globular, indehiscent, green with ten white longitudinal stripes, turns red or black at maturity, glabrous. Seed *ca* 0.6 x 0.55 cm, widely ovate to rectangular, beaked, base rounded with raised part of margin, turgid, funiculus caducous, grey-white, margin distinct, three chambered; two lateral chambers are empty, middle with cotyledons.

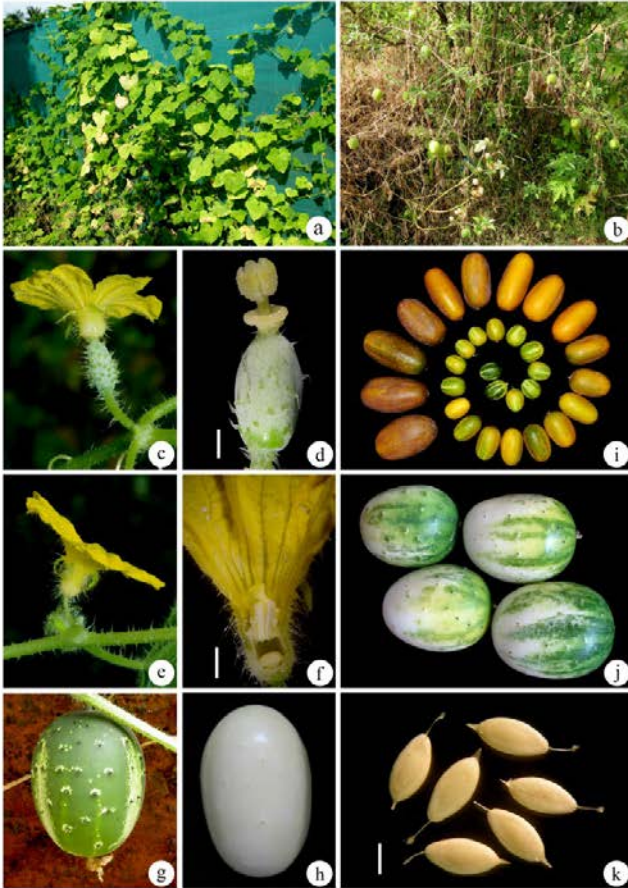
Flowering and fruiting : August to November.

Distribution : **India:** Gujarat, Maharashtra, Karnataka. Endemic to Northern-Western Ghats.

Field notes : Plants grow along slopes amidst grasses and shrubs, along the road sides at an altitude between 500 to 950 m in Ghats region.

Vernacular name : Ghugarya (Marathi).

Chromosome number : $2n = 24$



Cucumis sativus forma *hardwickii* (Royle) W.J. de Wilde & Duyfjes a-b. Habit; c. female flower; d. Ovary and stigma; e. Male flower; f. L. S. of male flower; g-j. Fruits; k. Seeds. Scale bar 2 mm

Cucumis sativus forma *hardwickii*

(Royle) W.J. de Wilde & Duyfjes

Cucumis sativus forma *hardwickii* (Royle) W.J. de Wilde & Duyfjes, Sandakania 17: 58. 2008. *Cucumis hardwickii* Royle III. Bot. Himal. Mts. 1: 220, t.47, f. 38. 1839. *Cucumis sativus* var. *hardwickii* (Royle) Gabaev, Ogurtsy, 47: 1932.

Diagnostic features : Annual climbing, herb. Leaves pentangular. Male flower *ca* 2 x 3 cm, in cluster of *ca* 7-9. Female flower *ca* 3.5 x 2-2.5 cm, solitary, ovary trigonus, oblong, hispidulous hairy. Fruit 4.5-17 x 3-10 cm, indehiscent, oblong to rounded, green with ten longitudinal stripes, rarely white, green when young turns pale yellow to brown at maturity, bitter. Seed 1.5 x 0.4 x 0.3, ovate to lance-ovate, beaked, funiculus persistent, grey-white.

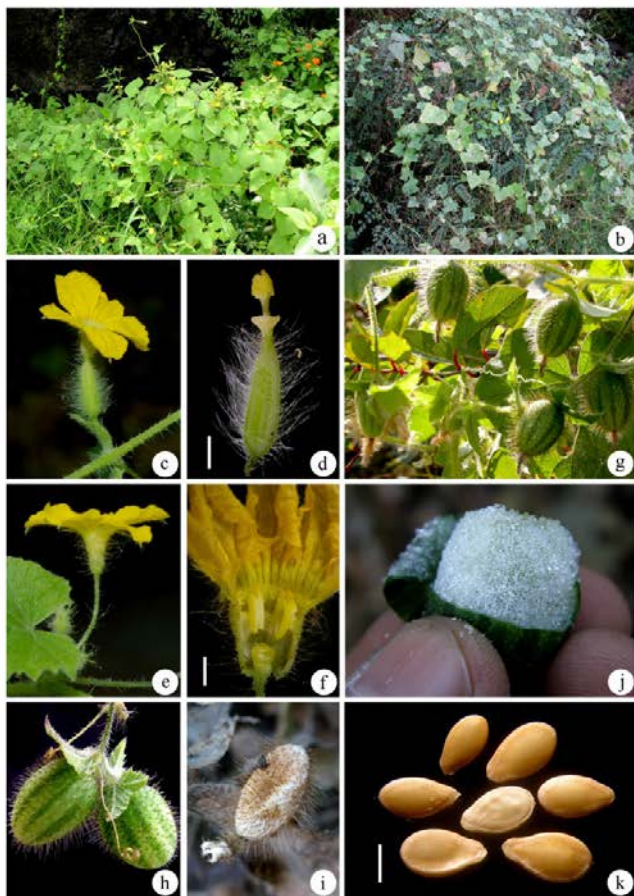
Flowering and fruiting : June to December.

Distribution : Worldwide. **India:** In all states.

Field notes : This species is common throughout India and grows in hedges along roadsides and in agricultural fields. Inedible.

Vernacular names : Jangali Kakadi (Marathi), Wild cucumber (English)

Chromosome number: 2n = 14.



Cucumis setosus Cogn. a-b. Habit; c. female flower; d. L. S. of female flower; e. Male flower; f. L. S. of male flower; g-i. Fruit; j. Cut open fruit with granular pulp; k. Seeds. Scale bar 2 mm

Cucumis setosus Cogn.

Cucumis setosus Cogn., Monogr. Phan. [A.DC. & C.DC.] 3: 491. 1881.

Diagnostic features : Annual herb. Leaves pentangular. Male flower *ca* 1.6 x 2 cm, in fascicle of 4-6. Female flower *ca* 2 x 2.3 cm, solitary, ovary oblong, densely setose hairy. Fruit 2-2.8 x 1.5-1.8 cm, indehiscent, pulp granular, oblong, yellowish green with ten dark green longitudinal stripes, turns pale green to whitish at maturity setose hairy. Seed 5 x 2.5 x 2 mm, ovate to lance-ovate, apex rounded, base acute, non beaked, funiculus caducous, grey-white.

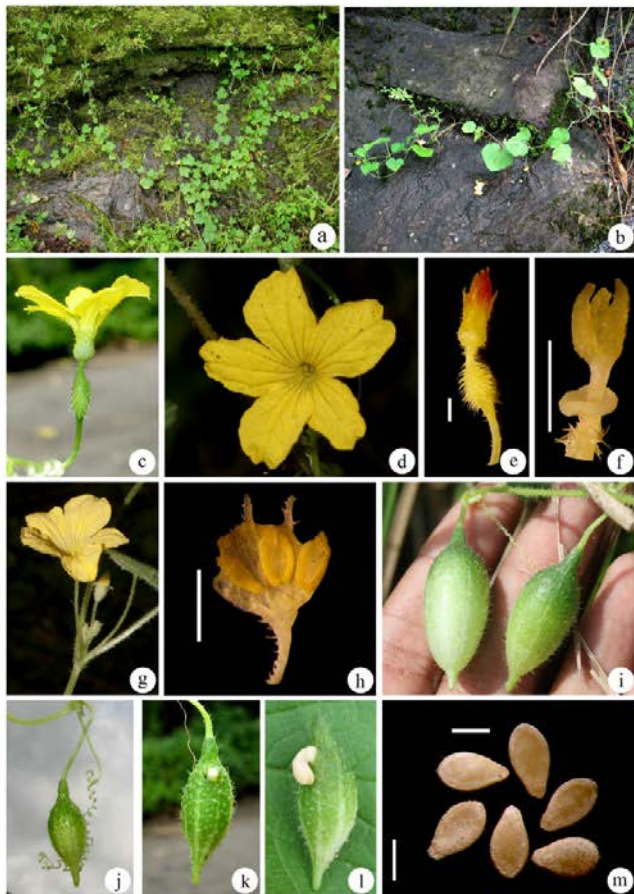
Flowering and fruiting : July to December.

Distribution : India: Endemic to Northern-Western Ghats. Edible.

Field notes : It grows at 600-800 m elevation and is often found along roadsides in Ghat regions.

Vernacular names : Meki, Mehaki, Mekunya (Marathi).

Chromosome number : 2n = 24.



Cucumis silentvalleyi (Manilal, T. Sabu & P. J. Mathew) Ghebretinsae & Thulin a-b. Habit; c-e. Female flower; f. Stigma; g. Female flower; h. L. S. of male flower; i-j. Fruit; k-l. Dehiscent fruit; m. Seeds. Scale bar 2 mm

Cucumis silentvalleyi (Manilal, T. Sabu & P. J. Mathew) Ghebretinsae & Thulin

Cucumis silentvalleyi (Manilal, T. Sabu & P. J. Mathew) Ghebretinsae & Thulin, Novon, 17 (2): 178. 2007. *Cucumella silentvalleyi* Manilal, T. Sabu & P. Mathew, Acta Bot. Indica 13 (2): 283. 1985.

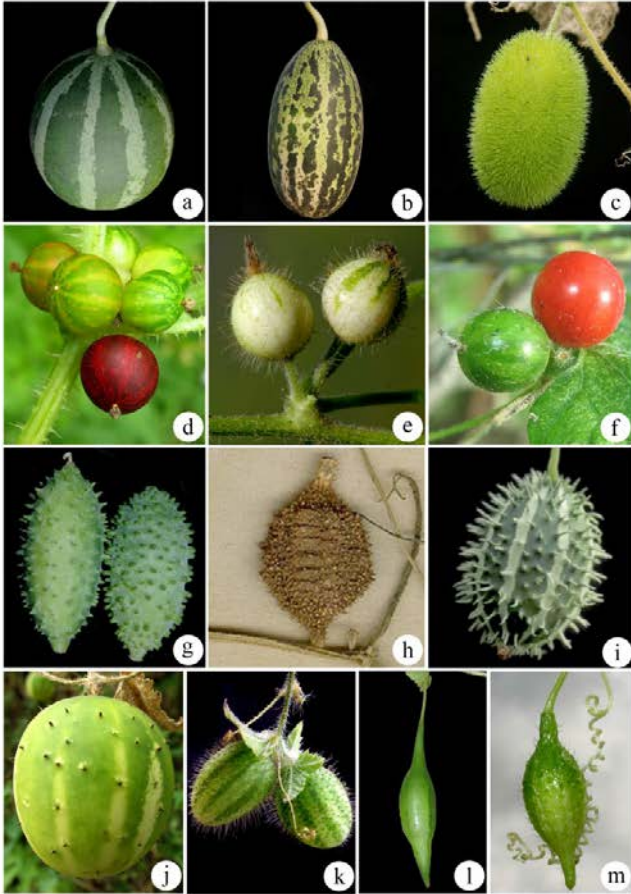
Diagnostic features : Annual climber. Leaves angular. Male flowers ca 1.5 x 2 cm, in fascicle of 3-6. Female flower solitary, ca 2 x 2 cm, ovary elongate, fusiform, dense retrorse hairy. Fruit 2.5-3 x 2-2.2 cm, dehiscent, oblong, fusiform, rostrate, green to pale green in colour with whitish spotted ten longitudinal stripes, turn pale green to white at maturity, retrorse hairy; hairs bulbous based. Seed 0.4 x 0.2 x 0.02 cm, ovate to lance-ovate, apex rounded, base acute, non beaked, funiculus caducous, grey-white.

Flowering and fruiting : August to November.

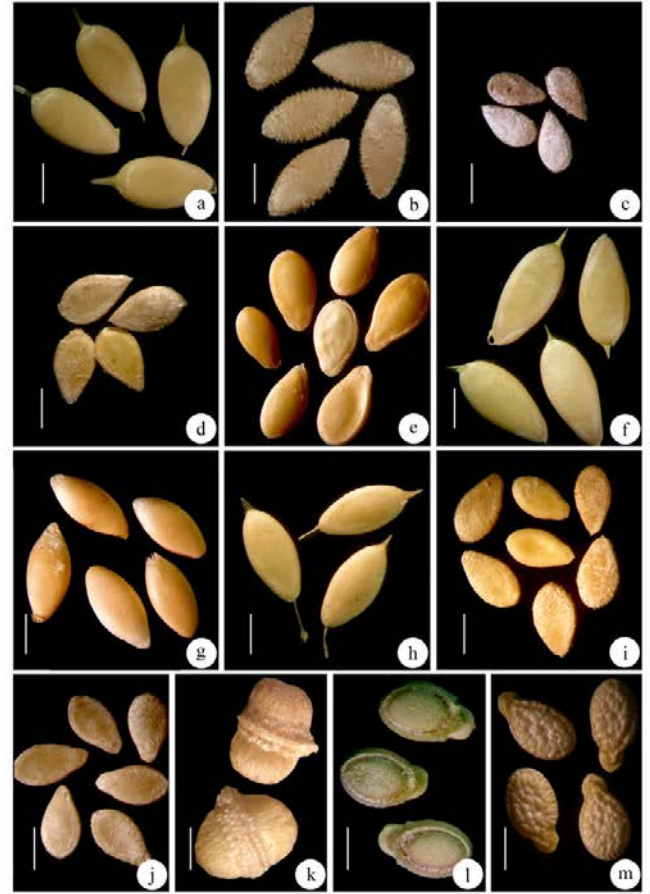
Distribution : India : Kerala and Tamil Nadu. Endemic to Southern-Western Ghats.

Field notes : Plants grow along slopes amidst grasses and shrubs, in Ghats region along open places and wet dripping rocks at an altitude between 500 to 950 m. Edible.

Chromosome number : 2n = 24.



Fruit : a. *Cucumis callosus*; b. *C. melo* var. *agrestis*; c. *C. dipsaceus*; d. *C. ritchiei*; e. *C. leiospermus*; f. *C. maderaspatanus*; g. *C. hystrix*; h. *C. muriculatus*; i. *C. prophetarum*; j. *C. sativus* f. *hardwickii*; k. *C. setosus*; l. *C. indicus*; m. *C. silentvalleyi*.



Seed : a. *Cucumis callosus*; b. *C. dipsaceus*; c. *C. hystrix* var. *hystrix*; d. *C. hystrix* var. *nov.*; e. *C. setosus*; f. *C. melo* var. *agrestis*; g. *C. prophetarum*; h. *C. sativus* f. *hardwickii*; i. *C. indicus*; j. *C. silentvalleyi*; k. *C. ritchiei*; l. *C. leiospermus*; m. *C. maderaspatanus*. Scale bar 2 mm

Genus Abelmoschus Medik. in India

an illustrated guide for species identification



Introduction

The word *Abelmoschus* probably originated from Arabian *abul-l-musk* meaning "father of musk, source of musk" referring to the seeds of the genus. Genus *Abelmoschus* is well known because of its economically important cultivated species, viz. *A. esculentus* (okra) and *A. caillei*. They are grown in many parts of the world, especially in tropical and subtropical countries. Due to wide morphological diversity of *Abelmoschus* in Indian continent, it has been considered centre of diversity of the genus. A number of wild and semi-wild *Abelmoschus* species are found in dense forests, open waste lands as well as homestead and backyard gardens. In India, species of *Abelmoschus* are widely distributed in different phytogeographical regions from Himalaya to Southern peninsular parts of India.

Among the species, *A. esculentus* is economically very important and highly nutritious crop which is widely cultivated throughout world. Another cultivated species *A. caillei* has an occurrence limited to West and Central Africa. *Abelmoschus moschatus* is grown for aromatic seeds as well as an ornamental plant, although sometimes found as an escape in the wild habitats. The rest of species namely, *A. angulosus*, *A. crinitus*, *A. enbepeegearensis*, *A. ficulneus*, *A. manihot*, *A. palianus*, *A. rhodopetalus*, *A. rugosus* and *A. tuberculatus* are truly wild species. Due to high protein contents in *A. esculentus* seeds, this crop has been considered as an alternative to soybean and therefore could be used as a supplement to cereal based diets. Along with the seeds, leaf and fruit parts can be effectively used in the treatment of renal tubular-interstitial diseases, reduce proteinuria and also improve renal function.

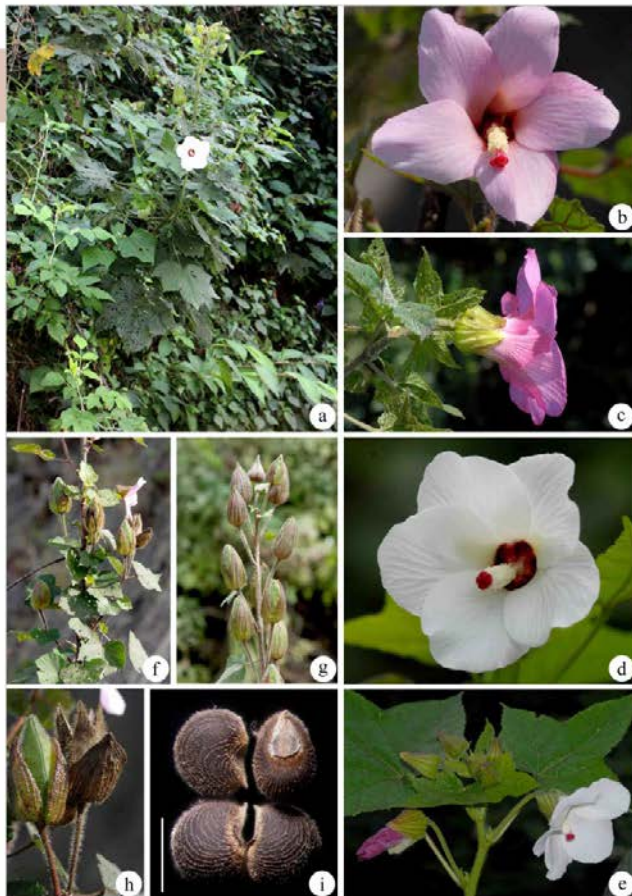
The wild relatives of *Abelmoschus* have been identified as potential source of desirable gene for agronomic traits such as biotic and abiotic stresses which can be useful in okra breeding programme. However, the prolonged controversies surrounding the release of GM crops make it difficult to develop new resistant varieties by advanced genetic engineering approaches. Therefore, a traditional breeding approach is the only way to transfer the desire gene from wild relatives to present cultivar. Hence, okra breeders have the prime need of taxonomical correct identity of wild relatives of okra and their characterization for the improvement of cultivated okra.

This booklet is the outcome on the exploratory survey conducted in various eco-geographic regions of India and aims to provide a taxonomic key for the easy and undoubted identification of the species of *Abelmoschus*.

Key to the species of *Abelmoschus*

- 1. Epicalyx deltoid, coherent, enclosing fruits *A. angulosus*
 - i. Flower 10 – 12 cm in diameter, pink without an eye spot at the corolla throat..... var. *purpureus*
 - i. Flower 5 – 7 cm in diameter, white, pink or yellow with crimson eye at centre ii
 - ii. Flower yellow iii
 - ii. Flower white or pink var. *angulosus*
 - iii. Leaves palmately lobed var. *grandiflorus*
 - iii. Leaves palmately divided to parted var. *tetraphyllus*
- 1. Epicalyx lobes linear, lanceolate, ovate to narrowly ovate, free, not enclosing fruits 2
- 2. Flower red, white or pink 3
- 2. Flower pale yellow to yellow..... 4
- 3. Flower red, corolla patent, young fruit densely hirsute, seed glabrous, warty *A. rhodopetalus*
- 3. Flower white, turn pink; corolla campanulate, young fruits capitate hairy, seed hairy *A. ficulneus*
- 4. Epicalyx lanceolate, ovate to narrowly ovate 5
- 4. Epicalyx linear 6
- 5. Epicalyx persistent in fruit 7
- 5. Epicalyx caducous in fruit 8
- 6. Fruit broadly elliptic, without rostrum, epicalyx longer than half the length of fruit *A. crinitus*
- 6. Fruit elliptic-lanceolate, with prominent rostrum, epicalyx smaller than half length of fruit 9
- 7. Plant sparsely scabrous, seed minute puberulent *A. palianus*
- 7. Plant densely hispid, seed glabrous, warty *A. sp. nov.*
- 8. Fruit tomentulose, dehiscence lateral, seed glabrous *A. caillei*
- 8. Fruit hirsute, dehiscence apical, seed hairy..... *A. manihot*
- 9. Fruit tuberculate *A. tuberculatus*
 - i. Leaves palmilobed to palmatisect, seed glabrous..... var. *tuberculatus*
 - ii. Leaves deltoideform, seed densely villous var. *deltoidefolius*

- 9. Fruit tomentulose, villous or soft strigulose 10
- 10. Plant with tuberous tap root, fruit villous hairy, dehiscence apically, epicalyx persistent 11
- 10. Plant without tuberous tap root, fruit tomentulose or soft strigulose, dehiscence laterally, epicalyx caducous 12
- 11. Plant 1 – 1.5 feet in height *A. rugosus*
- 11. Plant 5 – 8 feet in height *A. enbeepegearense*
- 12. Fruit lanceolate, acuminate, tomentulose, seed subglobose, grayish *A. esculentus*
- 12. Fruit lance-ovate, acute, soft strigulose, seed reniform, laterally compressed, brown *A. moschatus*



Abelmoschus angulosus var. *angulosus* Wall. ex Wight & Arn. a. Habit; b-d. Flower; e. Flowering twig; f-h. Fruits; i. Seeds. Scale bar 2 mm

***Abelmoschus angulosus* var.
*angulosus*** Wall. ex Wight & Arn.

Abelmoschus angulosus var. *angulosus* Wall. ex Wight & Arn., Prodr. Fl. Pen. Ind. Or. 1: 53. 1834.

Diagnostic characters: Perennial, hirsute subshrub up to 4 m tall. Leaves palmatifid, 3-5 lobed. Flower 5-6 x 7-9 cm, solitary, drooping, white or pink with crimson eye at centre. Epicalyx 4, persistent, deltoid, coherent, enclosing young fruits; epicalyx segment 2.5-3 x 1.3-1.5 cm, prominently 5-7 nerved, hairy. Capsule 3-4 x 1.5-2 cm, ovate, densely hispid, dehiscent apically; rostrum ca 2 mm long. Seed 0.3 x 0.3 cm, subglobose, concave at hilum, dark brown, puberulent; hairs in concentric rings. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: August to February.

Distribution: Sri Lanka, **India:** Kerala and Tamil Nadu.

Field notes: This species is found in grassy hill slopes, forest fringes and along the road sides in Ghat regions at an altitude 1100–2000 m.

Chromosome number: $2n = 56, 66, 130$



Abelmoschus angulosus var. *grandiflorus* Thwaites a. Habit; b. Flowering twig; c-d. Fruits; e-f. Flower; g. Seeds. Scale bar 2 mm

Abelmoschus angulosus var. *grandiflorus* Thwaites

Abelmoschus angulosus var. *grandiflorus* Thwaites, Enum. Pl. Zeyl. 26. 1858.

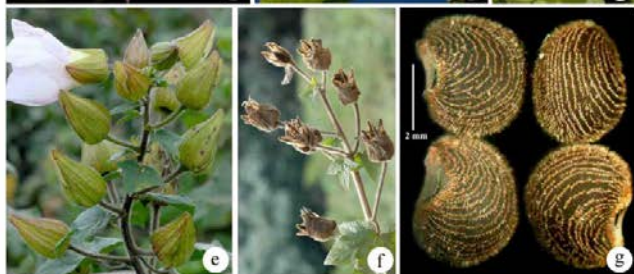
Diagnostic characters: Annual, hirsute subshrub up to 2 m tall. Leaves 3-5 angular or palmatifid. Flower 5-7 x 5-8 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 4, persistent, deltoid, coherent, encloses young fruits; epicalyx segment 2-2.5 x 1.3-1.5 cm, prominently 5-7 nerved, hairy. Capsule 3-4 x 1.3-1.5 cm, ovate, densely hispid, dehiscent apically; rostrum *ca* 2 mm long. Seed 0.3 x 0.3 cm, subglobose, concave at hilum, dark brown, puberulent; hairs on seeds in concentric rings. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: August to January.

Distribution: Malesia, Sri Lanka, **India:** Goa, Karnataka, Kerala, Maharashtra and Tamil Nadu.

Field notes: It is found occasionally in lower Western Ghats, in partial opening, along the hill slope in semi-deciduous and evergreen forests.

Chromosome number: $2n = 66$



Abemoschus angulosus var. *purpureus* Thwaites a. Habit; b-c. Flower; d. L. S. of flower; e. Flowering twig; f. Fruits; g. Seeds. Scale bar 2 mm

Abemoschus angulosus var. *purpureus* Thwaites

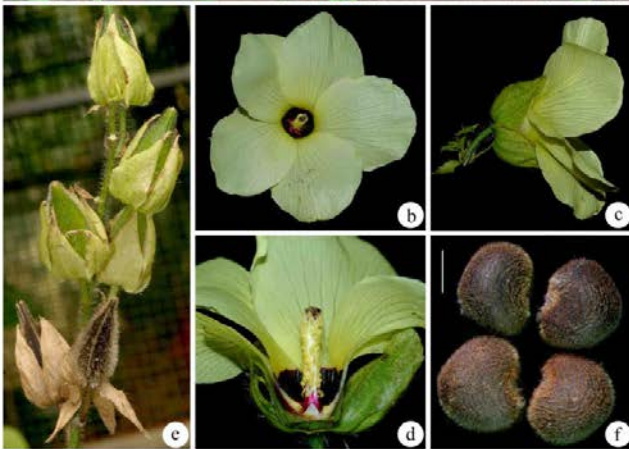
Abemoschus angulosus var. *purpureus* Thwaites, Enum. Pl. Zeyl. 26. 1858.

Diagnostic characters: Perennial, hirsute small tree, 4-5 m tall. Leaves 3-7 angular or palmatifid. Flower 10-12 x 9-11 cm, solitary, drooping, purple to light pink with creamy yellow eye at centre. Epicalyx 4, persistent, deltoid, coherent, encloses young fruits; epicalyx segment 2-2.5 x 1.3-1.5 cm, prominently 5-7 nerved, hairy. Capsule 3-4 x 1.3-1.5 cm, ovate, densely hispid, dehiscent apically; rostrum *ca* 2 mm long. Seed 0.4 x 0.4 cm, subglobose, concave at hilum, dark brown, puberulent; hairs on seeds in concentric rings. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: October to January.

Distribution: Malesia, Sri Lanka, **India:** Karnataka, Kerala and Tamil Nadu.

Field notes: It is found along forest margins and grassy hill slopes, under the shades and mostly along the water streams at an altitude 1200 to 1700 m.



Abemoschus tetraphyllus (Roxb. ex Hornem.) R. Graham a. Habit; b-c. Flower; d. L. S. of flower; e. Fruits; f. Seeds. Scale bar 2 mm

Abemoschus tetraphyllus (Roxb. ex Hornem.) R. Graham

Abemoschus tetraphyllus (Roxb. ex Hornem.) R. Graham, Cat. Bomb. 14. 1839. *Hibiscus tetraphyllus* Roxb. ex Hornem., Hort. Hafn. 661. 1815. *Abemoschus manihot* subsp. *tetraphyllus* (Roxb. ex Hornem.) Borss., Blumea 14: 97. 1966. *Hibiscus pungens* Roxb., Fl. Ind. Ed. Carey 3: 213. 1832. *Abemoschus manihot* subsp. *tetraphyllus* var. *pungens* (Roxb. ex Hornem.) Borss., Blumea 14: 97. 1966.

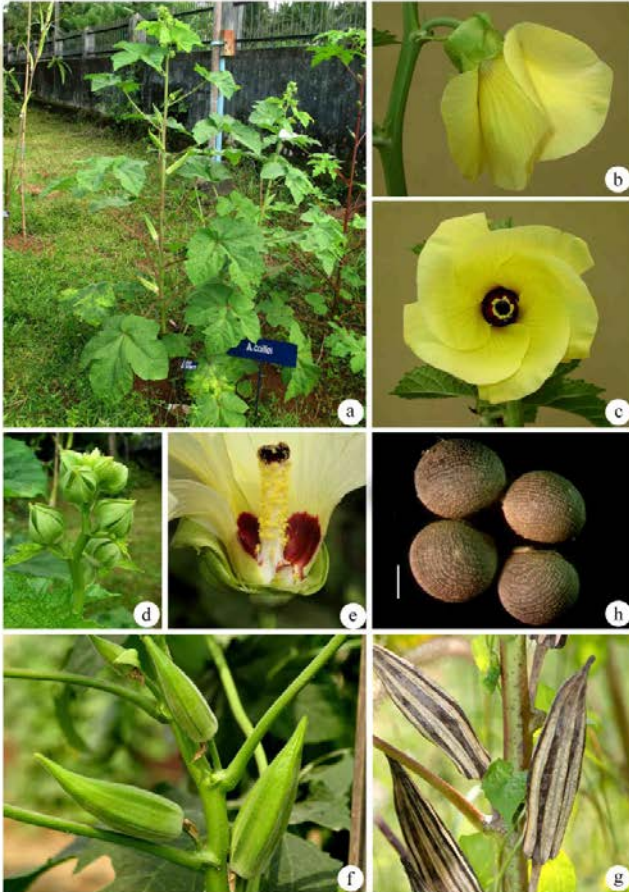
Diagnostic characters: Annual, hirsute subshrub, 3-4 m tall. Leaves 3-7 palmatisect. Flowers 8-9 x 8-10 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 4, persistent, accrescent, deltoid, coherent, encloses young fruits; epicalyx segment 2.5-3 x 1.3-1.5 cm, prominently 4-5 nerved, hairy. Capsule 4-5 x 1.5-2 cm, ovate, hirsute, dehiscent apically; rostrum ca 5 mm long. Seed 4 x 3 mm, subglobose, brownish, puberulent in concentric rings. Hilum 2 x 1 mm, ovate.

Flowering and Fruiting: July to January.

Distribution: Burma, China, Indonesia, Japan, Malesia, Pakistan, Philippines, Thailand, **India:** In all states.

Field notes: It is found wildly along roadsides, railway tracks and wastelands.

Vernacular name: Ran bhendi (Marathi)



Abelmoschus caillei (A. Chev.) J. M. C. Stevels a. Habit; b-c. Flower; d. Flower buds; e. L. S. of flower; f-g. Fruits; g. Seeds, Scale bar 2 mm

Abelmoschus caillei (A. Chev.) J. M. C. Stevels

Abelmoschus caillei (A. Chev.) J. M. C. Stevels, Bull. Mus. Natl. Hist. Nat., B, Adansonia Sér. 4, 10(2): 138. 1988.

Diagnostic characters: Annual or biannual, glabrous herb, 1-2.5 m tall. Leaves 3-7 angular or palmatifid. Flower 6-10 x 7-8, solitary, drooping, yellow with crimson eye at centre. Epicalyx 7-9, free, ovate-deltoid, caducous; epicalyx segment 1-3.5 x 0.4-1.5 cm, hairy. Capsule 6-18 x 2-4 cm, lanceolate to lance-ovate, tomentulose, dehiscent laterally; rostrum ca 1-2 cm long. Seed 0.5-0.7 x 0.6-0.7 cm, subglobose, concave at hilum, greyish, glabrous, minutely warty in concentric rows. Hilum 0.3 x 0.2 cm, widely ovate.

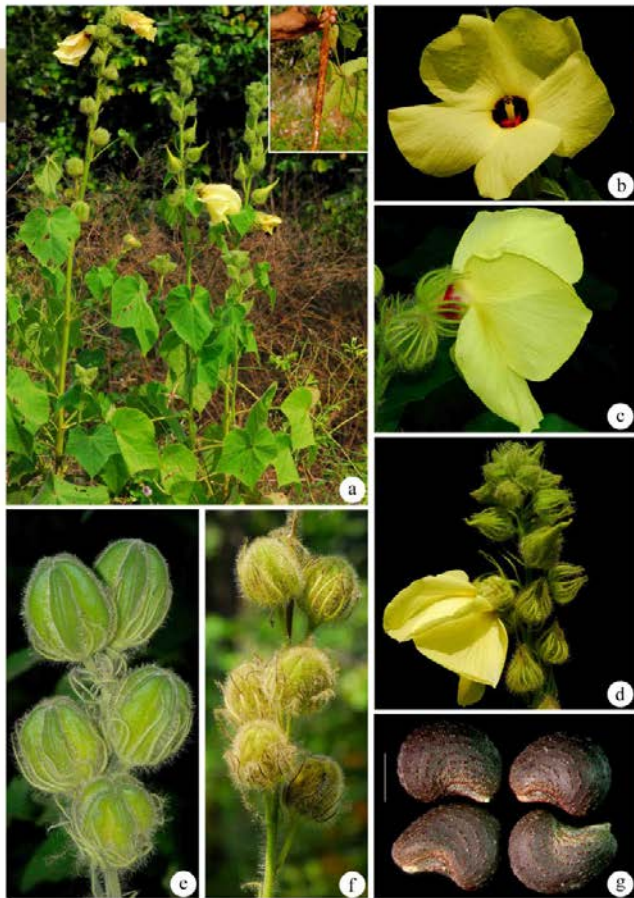
Flowering and Fruiting: Throughout the year.

Distribution: West and Central Africa, **India:** Introduced as a crop in Kerala, Karnataka, Goa, Tamil Nadu and North-East India.

Field notes: This species is widely cultivated for its tender fruits

Vernacular name: West African Okra (English)

Chromosome number: $2n=166, 194, 185-199, 184-200$



Abemoschus crinitus Wall. a. Habit, inset shows tuber like tap root; b-c. Flower; d. Flowering twig; e-f. Fruits; g. Seeds. Scale bar 2 mm

Abemoschus crinitus Wall.

Abemoschus crinitus Wall., Pl. Asiat. Rar. 1 (2): 39, t. 44. 1830.

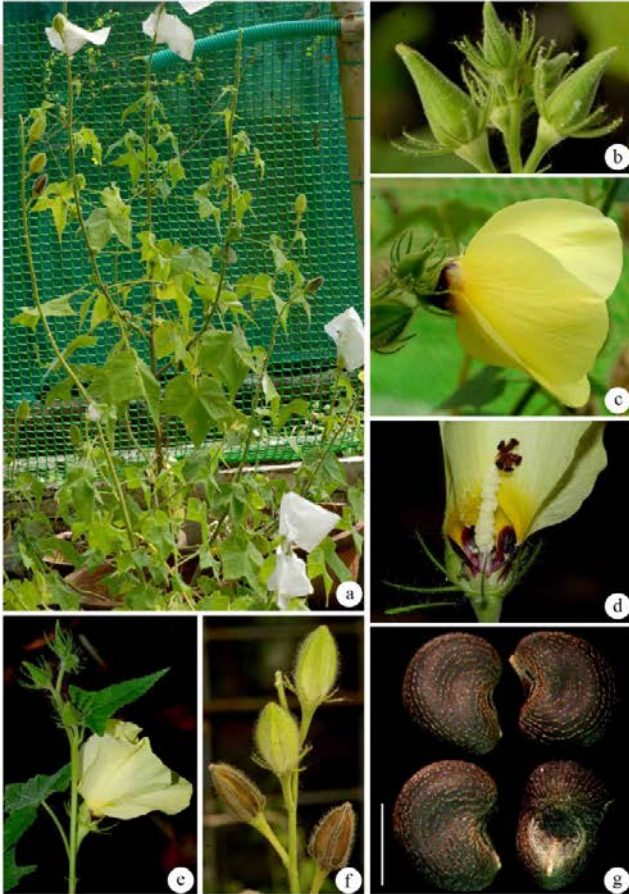
Diagnostic characters: Perennial herb with fusiform tuber like tap root, pilose, 1-2 m tall. Leaves 3-7 angular or palmatifid. Flower 6-9 x 6-8 cm, solitary, drooping, yellow with a crimson eye at centre. Epicalyx 10-16, linear, free, persistent; epicalyx segment 2-2.5 x 1 cm, hairy. Capsule 3-5 x 2.5-3 cm, widely elliptic, hirsute, dehiscent apically, non beaked. Seeds 0.3-0.4 x 0.2 cm, reniform, dark brown, glabrous, minutely warty in concentric rows. Hilum 0.3 x 0.2 cm, ovate.

Flowering and Fruiting: July to January. **Distribution:** Myanmar, China, Malesia, Pakistan, Philippines, **India:** In all states.

Field notes: Occur in drier parts along waysides, wastelands and occasionally as undergrowth in deciduous forests.

Vernacular name: Ran bhendi (Marathi)

Chromosome number: $2n = 138$



Abelmoschus enbeepeegearense J. John *et al.* a. Habit with tuber like tap root; b. Flower buds; c. Flower; d. Staminal column; e. Flowering twig; f. Fruits; g. Seeds. Scale bar 2 mm

Abelmoschus enbeepeegearense

J. John, Scariah, Nissar, K. V. Bhat & S. R. Yadav.

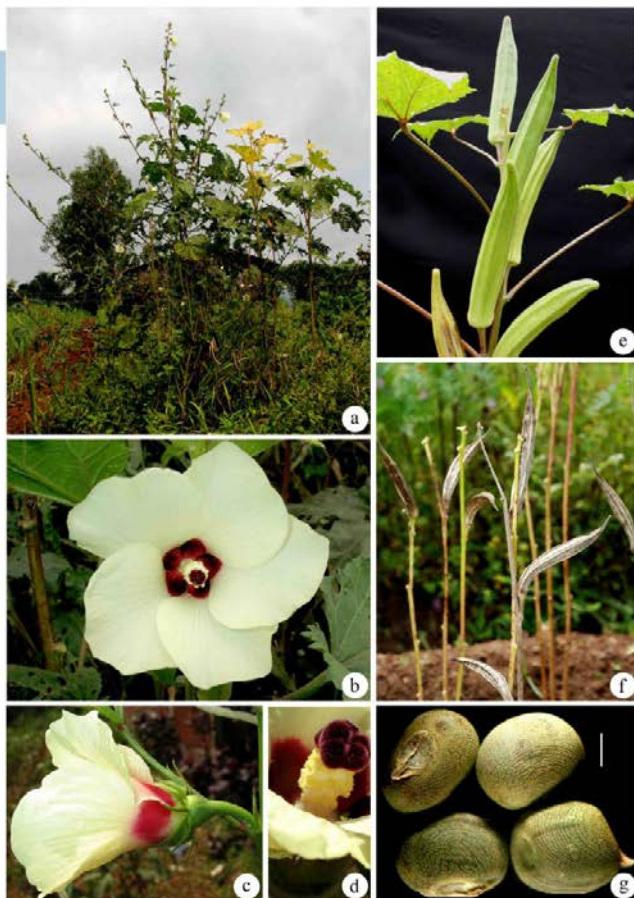
Abelmoschus enbeepeegearense J. John, Scariah, Nissar, K. V. Bhat & S. R. Yadav. Nord. J. Bot. 31 (2): 170-175. 2013.

Diagnostic characters: Perennial, pilose herb with fusiform tuber like tap root, 1-2 m tall. Leaves 3-5 angular or palmatifid. Flowers 8-10 x 8-9 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 10-11, free, linear, persistent; epicalyx segment 2-2.6 x 0.1-0.2 cm, hairy. Capsule 4.5-5 x 2.5-3.2 cm, ovate, soft strigulose, dehiscent apically; rostrum short, *ca* 1 mm long. Seeds 0.5 x 0.4 cm, reniform, brownish, glabrous, minutely warty in concentric rows. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: July to November.

Distribution: India: Kerala, Tamil Nadu.

Field notes: It is found along hill slopes, road sides in forest areas.



Abelmoschus esculentus Moench a. Habit; b-c. Flower; d. Staminal column; e-f. Fruits; g. Seeds. Scale bar 2 mm

Abelmoschus esculentus Moench

Abelmoschus esculentus Moench, Methodus 617. 1794. *Hibiscus esculentus* L., Sp. Pl. 696. 1753.

Diagnostic characters: Annual, sparsely scabrous herb, 1-1.5 m tall. Leaves 3-4 palmatifid or palmatisect. Flower 6-7 x 7-8 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 6-10, free, linear to lanceolate, caducous; epicalyx segment 2.1-2.4 x 0.5-0.6 cm, hairy. Capsule 7-30 x 2-3 cm, lanceolate, tomentulose, dehiscent laterally; rostrum *ca* 3-5 cm long. Seed 0.5-0.7 x 0.6-0.7 cm, subglobose, concave at hilum, greyish, glabrous, sometimes pubescent near hilum, minutely warty in concentric rows. Hilum 0.3-0.4 x 0.2-0.3 cm, ovate.

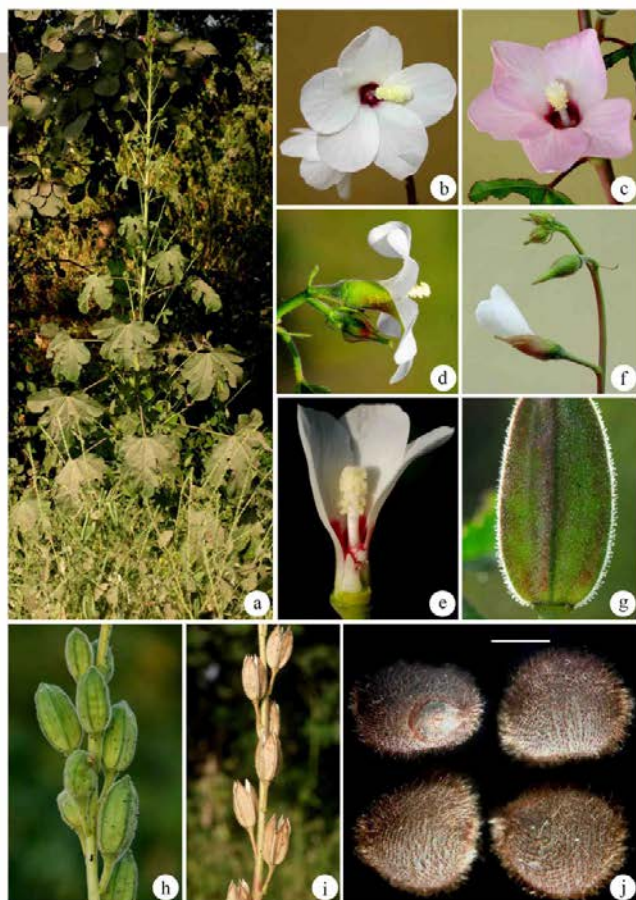
Flowering and Fruiting: Throughout the year.

Distribution: Worldwide. **India:** In all states.

Field notes: This species is widely cultivated for its delicious tender fruits

Vernacular name: Dehras (Bengal); Okra (English); Binda (Gujarati); Bhindi (Hindi); Bhendi (Marathi); Vendai (Tamil); Bendi (Telugu).

Chromosome number: 2n = 66, 72, 108, 118, 120, 122, 124, 126-134



Abemoschus ficulneus (L.) Wight & Arn. a. Habit; b-d. Flower; e. L. S. of flower; f. Flowering twig; g. pilate-glandular hairs of fruits; h-i. Fruits; j. Seeds. Scale bar 2 mm

Abemoschus ficulneus (L.) Wight & Arn.

Abemoschus ficulneus (L.) Wight & Arn. Cat. Ind. Pl. 14. 1833. *Hibiscus ficulneus* L., Sp. Pl. 695. 1753.

Diagnostic characters: Annual, glabrous undershrub, 0.5-1.5 m tall. Leaves 3-5 palmatifid. Flower 4-5 x 5-6 cm, solitary, drooping, white turn to pale pink, with crimson eye at centre. Epicalyx 5-6, free, lanceolate to narrowly ovate, caducous before anthesis; epicalyx segment 0.5-1.1 x 0.1-0.3 cm, hairy. Capsule 3-4 x 1.5-2.5 cm, ovate, capitate hairy, dehiscent apically; rostrum ca 1 mm long. Seeds 0.3 x 0.3 cm, subglobose, brownish, pilose hairy in concentric rows. Hilum 0.2 x 0.1 cm, ovate.

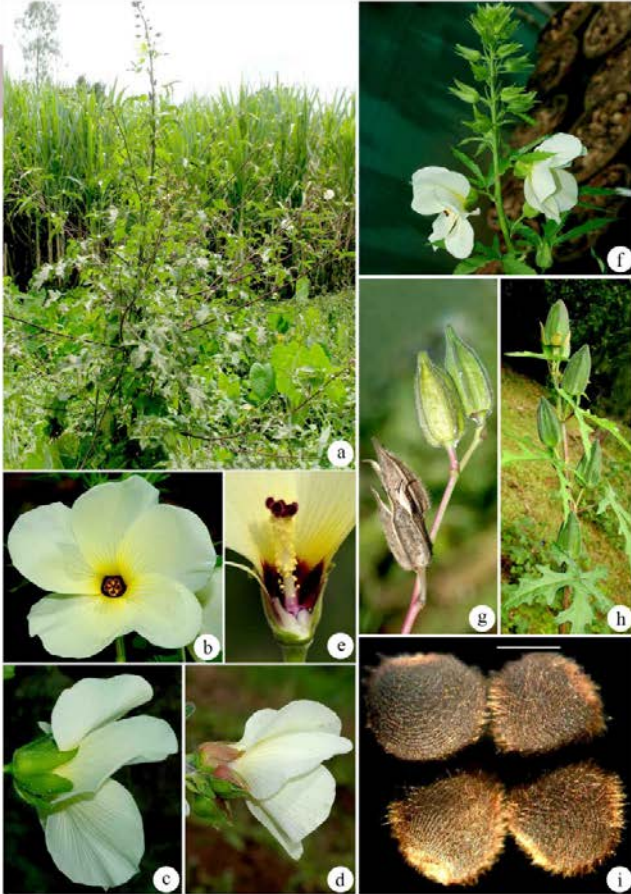
Flowering and Fruiting: September to March.

Distribution: Pakistan, Sri Lanka, East Africa, North Australia, Malasia, **India:** Andhra Pradesh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Field notes: It is found along roadsides and wastelands.

Vernacular name: Ban-dheras, Jangali Bhindi (Bengali); Ran bhendi (Hindi, Marathi); Deola dula, Kapasiya (Punjabi); Kattuvendai (Tamil); Nelabenda, Parupubenda (Telugu).

Chromosome number: $2n=72$



Abemoschus manihot (L.) Medik. a. Habit; b-d. Flower; e. L. S. of flower; f. Flowering twig; g-h. Fruits; i. Seeds. Scale bar 2 mm

Abemoschus manihot (L.) Medik.

Abemoschus manihot (L.) Medik., Malvenfam. 46. 1787. *Hibiscus manihot* L., Sp. Pl. 696. 1753.

Diagnostic characters: Annual, sparsely scabrous subshrub, 4-5 m tall. Leaves 3-7 palmatifid or palmatisect. Flowers 5-6 x 6-7 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 4-7, free, broadly lanceolate to ovate, caducous; epicalyx segment 0.8-1 x 0.4-0.5 cm, hairy. Capsule 5-6 x 1.5-2 cm, ovate to lance-ovate, hirsute, dehiscent apically; rostrum *ca* 0.5 cm long. Seed 0.4 x 0.3 cm, subglobose, brownish, pilose hairy in concentric rows. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: July to January.

Distribution: Pakistan, Indo-Chinese Peninsula, south China, Malesia, North Australia, **India:** In all states.

Field notes: It is found wildly along roadsides, railway tracks and wastelands. In some part their tender fruits are used as a vegetables.

Vernacular name: Kate bhendi, Ran Bhendi (Marathi)

Chromosome number: $2n = 60, 66, 68, 120, 130, 132, 138, 196$



Abemoschus moschatus Medik. a. Habit; b-c. Flower; d. L. S. of flower; e-f. Fruits; g. Seeds. Scale bar 2 mm

Abemoschus moschatus Medik.

Abemoschus moschatus Medik., Malvenfam. 46. 1787. *Hibiscus abemoschus* L., Sp. Pl. 696. 1753.

Diagnostic characters: Annual, pilose undershrub, 1-3 m tall. Leaves 3-7 palmatifid or palmatisect. Flowers 7-9 x 8-9 cm, solitary, yellow with crimson eye at centre. Epicalyx 7-8, free, linear, caducous; each epicalyx segment 0.8-0.9 x 0.1 cm, hairy. Capsule 5-6 x 2-2.5 cm, lance-ovate, soft strigulose, dehiscent laterally; rostrum ca 1 cm long. Seeds 0.3 x 0.3 cm, reniform, brownish, glabrous, minutely warty in concentric rows. Hilum 0.2 x 0.1 cm, ovate.

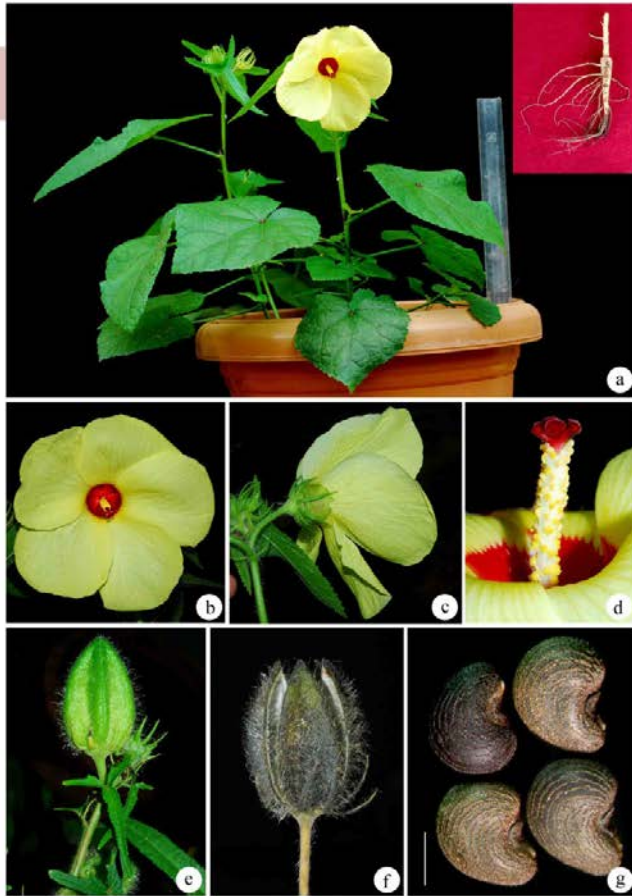
Flowering and Fruiting: July to January.

Distribution: Bangladesh, China, Indo-Chinese Peninsula, Indonesia, Malesia, Thailand, **India:** In all states.

Field notes: This species is cultivated for its seeds to obtain aromatic oil and mostly it is grown in gardens for its ornamental value. Sometimes it is also found as an escape in waste lands, along the road sides and railway tracks.

Vernacular name: Musk dana (Hindi, Bengal, Gujarati); Gorukhia-korai (Assam); Kasturibende (Kannad); Kasturibhendi (Marathi), Kattukasthuri (Malayalam); Vartilai kasthuri, Katukasthuri (Tamil).

Chromosome number: $2n = 72, 130$



Abelmoschus rugosus Wight & Arn. a. Habit, inset shows tuber like tap root; b-c. Flower; d. Staminal column; e-f. Fruits; g. Seeds. Scale bar 2 mm

Abelmoschus rugosus Wight & Arn.

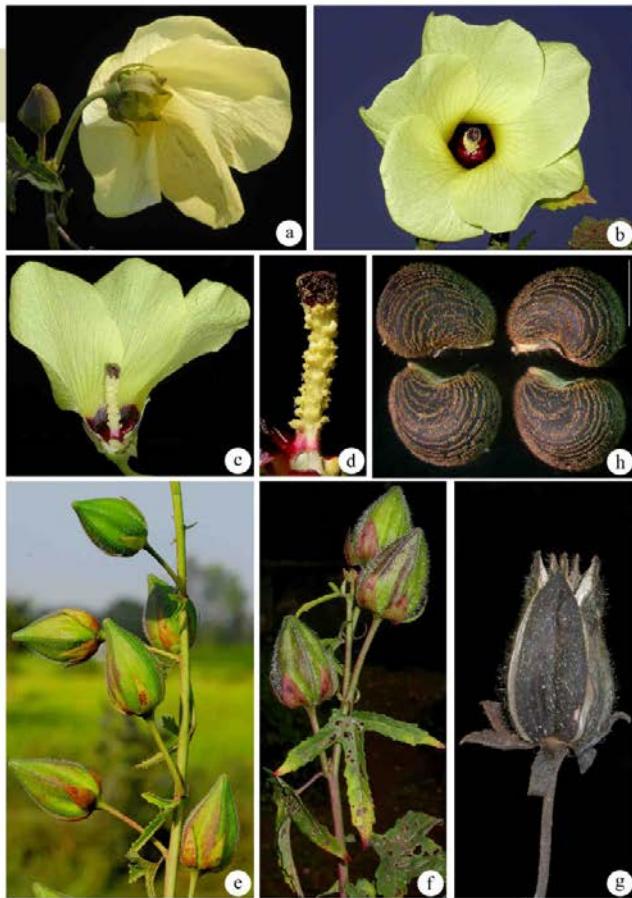
Abelmoschus rugosus Wight & Arn., Prodr. Fl. Ind. Orient. 1: 53. 1834. *Bamia rugosa* Wall., Cat. n. 1923. 1829. *Abelmoschus moschatus* ssp. *tuberosus* (Span.) Borss. Waalk., Blumea 14 (1): 93–95. 1966.

Diagnostic characters: Perennial, pilose herb with fusiform tuber like tap root, 1-2 m tall. Leaves 3-5 angular or palmatifid. Flowers 8-10 x 8-9 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 10-11, free, linear, persistent; epicalyx segment 2-2.6 x 0.1-0.2 cm, hairy. Capsule 4.5-5 x 2.5-3.2 cm, ovate, soft strigulose, dehiscent apically; rostrum *ca* 1 mm long. Seeds 0.5 x 0.4 mm, reniform, brownish, glabrous, minutely warty in concentric rows. Hilum 0.2 x 0.1 mm, ovate.

Flowering and Fruiting: July to November.

Distribution: Hainan, Indo-Chinese Peninsula, Malesia, Northern and Western Australia, **India:** Kerala, Tamil Nadu, Maharashtra.

Field notes: It is found along hill slopes, under semi-shade in semi-deciduous forests.



Abelmoschus palianus Sutar, K. V. Bhat & S. R. Yadav a-b. Flower; c. L. S. of flower; d. Staminal column; e-g. Fruits; h. Seeds. Scale bar 2 mm

Abelmoschus palianus Sutar, K. V. Bhat & S. R. Yadav

Abelmoschus palianus Sutar, K. V. Bhat & S. R. Yadav, Genet. Resour. Crop Ev. 60 (7): 1953-1958. 2013.

Diagnostic characters: Annual, sparsely scabrous herb, 2-3 m tall. Leaves 3-5 palmatifid or palmatisect. Flowers 7-8 x 8-9 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 5-7, free, ovate to narrowly ovate, persistent; epicalyx segment 1.8-2 x 0.3-0.5 cm, hairy. Capsule 3.5-4 x 2.5-2.7 cm, broadly ovate, densely hirsute, dehiscent apically; rostrum *ca* 2 mm long. Seeds 4 x 3 mm, reniform, brownish, puberulent in concentric rings. Hilum 2 x 1 mm, ovate.

Flowering and Fruiting: June to February.

Distribution: India: Chhattisgarh.

Field notes: The species grows along the waste land and on the bunds of cultivated fields.



Abemoschus rhodopetalus F. Muell. a. Habit, inset shows tuber like tap root; b-d. Flower; e. Staminal column; f. Epicalyx; g-h. Fruits; i. Seeds. Scale bar 2 mm

Abemoschus rhodopetalus F. Muell.

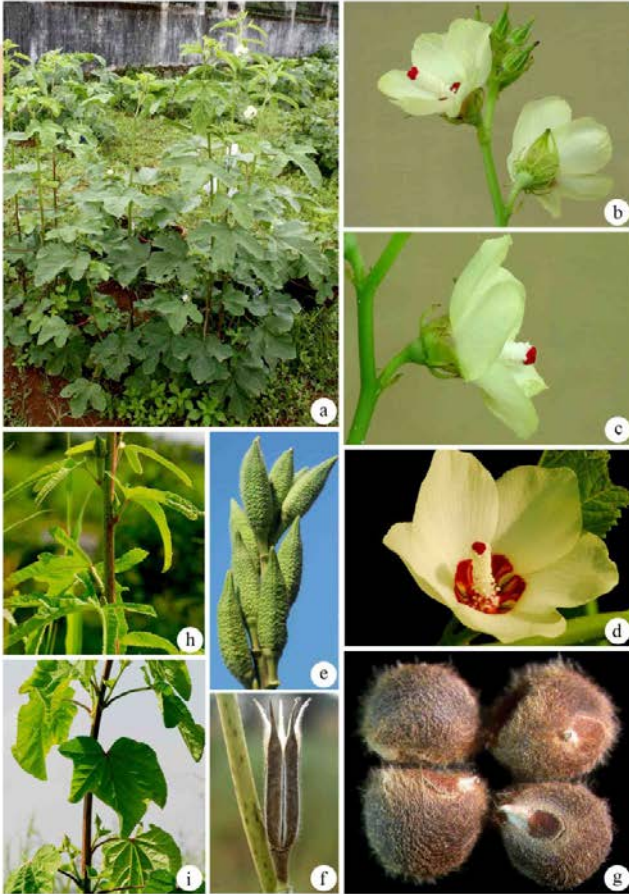
Abemoschus rhodopetalus F. Muell., Fragm. 2: 113. 1861.

Diagnostic characters: Perennial, pilose herb with fusiform tuber like tap root, 0.5-0.8 m tall. Leaves 3-5 palmatifid or palmatisect. Flowers 3-4 x 7-8 cm, solitary, facing upward, corolla patent, crimson-red with creamy-white at centre. Epicalyx 7-8, free, ovate to narrowly ovate, caducous; epicalyx segment 0.8-1.1 x 0.2 cm, hairy. Capsule 2.5-3 x 1.5-1.7 cm, ovate, densely hirsute, dehiscent apically; rostrum *ca* 2 mm long. Seeds 0.3 x 0.2 cm, reniform, brownish, glabrous, minutely warty in concentric rows. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: August to February.

Distribution: Australia, **India:** In all states.

Field notes: This species is widely cultivated as an ornamental for its dwarf height and showy bright red flowers.



Abelmoschus tuberculatus Pal & Singh

Abelmoschus tuberculatus Pal & Singh, Bot. Gaz. 113. 458. 1952.

Diagnostic characters: Annual, sparsely scabrous undershrub, 1-2 m tall. Leaves 3-5 palmatifid or palmatisect. Flowers 3-4 x 4-5 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 10-14, free, linear, caducous; epicalyx segment 0.5-0.9 x 0.1-0.15 cm, hairy. Capsule 4-5 x 2-2.5 cm, elliptic-lanceolate, tuberculate hairy, dehiscent apically; rostrum *ca* 2 cm long. Seeds 0.4 x 0.4 cm, brownish, villous hairy; hairs on seed in concentric rows. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: October to February.

Distribution: India: Rajasthan, Gujarat, Maharashtra, Madhya Pradesh and Uttar Pradesh.

Field notes: This species is found in deciduous forests and open grass lands and around cultivated fields.

Chromosome number: $2n = 58$



Abemoschus sp. nov. a. Habit, inset shows hirsute stem; b-c. Flower; d-e. Fruits; f. Seeds Scale bar 2 mm

Abemoschus sp. nov

Diagnostic characters: Perennial, densely hirsute subshrub, 3-4 m tall. Leaves 3-5 palmatisect. Flowers 7-8 x 8-9 cm, solitary, drooping, yellow with crimson eye at centre. Epicalyx 4-5, free, lanceolate, persistent; epicalyx segment 2.3-2.5 x 1-1.3 cm, hairy. Capsule 3.5-5 x 2.5-3 cm, ovate, densely hirsute, dehiscent apically; rostrum *ca* 3 mm long. Seeds 0.4 x 0.3 cm, reniform, brownish, glabrous, minutely warty in concentric rows. Hilum 0.2 x 0.1 cm, ovate.

Flowering and Fruiting: August to January.

Distribution: India: Uttarakhand.

Field notes: This species is cultivated as an ornamental for its showy flowers.



Top view of flowers: a. *Abelmoschus angulosus* var. *angulosus*; b. *A. angulosus* var. *grandiflorus*; c. *A. angulosus* var. *purpureus*; d. *A. angulosus* var. *tetraphyllus*; e. *A. palianus*; f. *Abelmoschus* sp. nov.; g. *A. manihot*; h. *A. ficulneus*; i. *A. caillei*; j. *A. esculentus*; k. *A. crinitus*; l. *A. moschatus*; m. *A. rugosus*; n. *A. rhodopetalus*; o. *A. tuberculatus*.



Top view of flowers: a. *Abelmoschus angulosus* var. *angulosus*; b. *A. angulosus* var. *grandiflorus*; c. *A. angulosus* var. *purpureus*; d. *A. angulosus* var. *tetraphyllus*; e. *A. palianus*; f. *Abelmoschus* sp. nov.; g. *A. manihot*; h. *A. ficulneus*; i. *A. caillei*; j. *A. esculentus*; k. *A. crinitus*; l. *A. moschatus*; m. *A. rugosus*; n. *A. rhodopetalus*; o. *A. tuberculatus*.



Young fruits: a. *Abelmoschus angulosus* var. *angulosus*; b. *A. angulosus* var. *grandiflorus*; c. *A. angulosus* var. *purpureus*; d. *A. angulosus* var. *tetraphyllus*; e. *A. palianus*; f. *Abelmoschus* sp. nov.; g. *A. manihot*; h. *A. ficulneus*; i. *A. caillei*; j. *A. esculentus*; k. *A. crinitus*; l. *A. moschatus*; m. *A. enbeepeegearensis*; n. *A. rugosus*; o. *A. rhodopetalus*; p. *A. tuberculatus*.



Mature fruits: a. *Abelmoschus angulosus* var. *angulosus*; b. *A. angulosus* var. *grandiflorus*; c. *A. angulosus* var. *purpureus*; d. *A. angulosus* var. *tetraphyllus*; e. *A. palianus*; f. *Abelmoschus* sp. nov.; g. *A. manihot*; h. *A. ficulneus*; i. *A. caillei*; j. *A. esculentus*; k. *A. crinitus*; l. *A. moschatus*; m. *A. enbeepeegearensis*; n. *A. rugosus*; o. *A. rhodopetalus*; p. *A. tuberculatus*.



Seeds: a. *Abolmoschus angulosus* var. *angulosus*; b. *A. angulosus* var. *grandiflorus*; c. *A. angulosus* var. *purpureus*; d. *A. angulosus* var. *tetraphyllus*; e. *A. paltianus*; f. *Abolmoschus* sp. nov.; g. *A. manihot*; h. *A. ficulneus*; i. *A. caillei*; j. *A. esculentus*; k. *A. crinitus*; l. *A. moschatus*; m. *A. enbeepeegearensis*; n. *A. rugosus*; o. *A. rhodopetalus*; p. *A. tuberculatus*. Scale bar = 2 mm.

GLOSSARY

(Simpson 2005)

Caducous: dropping off very early.

Deltoid: Length: width ratio approximately 1.

Elliptic: Widest at the midpoint, length:width ratio 2:1 and 3:2.

Hirsute: With long, rather stiff trichomes.

Hispid: With very long, stiff trichomes, often capable of penetrating skin.

Lanceolate: Length: width ratio between 6:1 and 3:1.

Lance-ovate: Widest near base, length:width ratio between 3:1 and 2:1.

Linear: Length: width ratio between 12:1 and 6:1.

Ovate: Length: width ratio 2:1 to 3:2.

Palmitifid: Palmately lobed to divided.

Palmitisect: Palmately divided, almost into discrete leaflets but confluent at the lobe base.

Patent: Horizontal.

Pilose: With soft, straight to slightly shaggy trichomes at right angles to the surface.

Puberulent: Minutely pubescent.

Reniform: Kidney shaped.

Strigulose: Minutely strigose.

Tomentulose: Minutely tomentose.

Tuberculate: Papillate.

An Illustrated Guide for the Identification of *Vigna Savi*, *Cucumis L.* and *Abelmoschus Medik.* Species in India

Authors: SR Yadav, KV Bhat, M Latha, JK John, SK Malik, M Aitwade, SR Rao, S Scariah, M Nissar, S Umdale, P Patil, G Krishnan, R Khedsana



Establishing taxonomic identity is basic to scientific management of plant genetic resources. Taxonomy is the study and description of the variation of organisms, the investigation of the causes and consequences of this variation, and the analyses of the data to produce a system of classification. The realization of the value of biodiversity in ecology, medicine and other fields of biology has resulted in renewed interest in biodiversity. The plant breeders had long known the importance of wild relatives of crop plants as the source of 'New Genes' in crop improvement in order to overcome the 'bottleneck effects' in crop domestication. Wild related species were often used in wide hybridizations as donors of useful genes in several crops including wheat, rice, tomato and the pulses such as greengram and blackgram. However, lesser importance was given to describing correct identity of the donor species which lead to confusions about the source material used. The recent phenomenon of digitization of biodiversity data has lead to the widespread application of taxon names that are superfluous, ambiguous or incorrect. This has resulted in the existence of numerous synonyms and homonyms thereby leading to non-scientific genetic resources classification and management. This publication is an attempt to resolve taxonomic identity problems in three of the important native genera, namely, *Vigna*, *Cucumis* and *Abelmoschus*. India has rich diversity for these cultivated species and their wild relatives. However, study and analyses of this diversity had not been exhaustive so far and this is an attempt at developing an efficient and effective system for germplasm classification so as to enhance the utilization of the genetic resources in crop improvement programmes.

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