

## Studies on systematic enumeration of cucurbit germplasm of Bihar

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### ABSTRACT

In the present paper the systematic enumeration of Cucurbit germplasm of Bihar State has been described. The three genera recorded from field were *Luffa*, *Momordica* and *Trichosanthes*. Three species of *Luffa*, five species of *Momordica* and three species of *Trichosanthes* were collected and described in detail.

**Key words:** Cucurbit, germplasm, Bihar.

### INTRODUCTION

Bihar is chiefly based on agriculture. A major portion of its population is dependent on agriculture. A major portion of the land is irrigated by the Ganga and its tributaries which help in increasing the fertility of land. About 29 lacs hectare of land is utilized for agriculture. The family Cucurbitaceae a tropical family containing 110 genera and 640 sps. In India, the family is represented by 37 genera and 97 species. The chief centre of distribution is in Eastern Himalayas. Gourd (*Luffa cylindrica* (L.) Roem), Bottle gourd (*Lagenaria sicer* (Mol.) standl.), Cucumber (*Cucumis sativus* L.), Red pumpkin (*Cucurbita maxima* Duchesne.) and Melon (*Cucumis melo* L.) are some common species in cultivation.

Cucurbits are succulent, trailing or decumbent annual or perennial herbs, usually climbing by means of tendrils. The tendrils are lateral, spirally coiled simple or variously branched structures. The morphological nature of the tendrils has been much disputed and they have been variously considered as roots, stems, leaves stipules, shoots, flower stalks or organs *sui generis*. May be they have a different origin in different

genera. The plants normally have a genetic diversity which is always changing because of intra and interspecific breeding in nature. Some of the genes are more desirable than the others. The species or varieties having desirable genes are significant for the improvement of cultivated plants. In Bihar Roy et al. (1972) studied the speciation in relation to the breeding system in the cucurbitaceae. Roy and Sharma (1988) studied the genetic basis of sex expression in Cucurbits of Bihar.

### Conservation of the Cucurbit germplasm

The conservation of the cultivated and wild varieties of the genera *Luffa*, *Momordica* and *Trichosanthes* of the family Cucurbitaceae is essential because of diversity in *L. acutangula*, *M. dioica*, *M. cochinchinensis*, *T. dioica* is so great that much remains to be collected and assessed. The rich diversity in these cultivated spp. specially in respect of their fruit shape, size, pulp, amino acid contents and protein profiles, disease resistance, summer and or rainy season varieties etc. is really impressive and, therefore, their collection & conservation would be a very valuable treasure for vegetable breeding and cultivation. Some species like *M. dioica*, can be termed as an endangered species in the sense that forests of the North Bihar,

hilly & literate regions where they grow in nature, are being devastatingly exploited by the tribal and aboriginal population of the areas not only for their fruit which is a delicious and fancy price-fetching vegetable but also for their tuberous roots which is an important medicine in the Ayurvedic & Unani systems. Soon after rains one can see hordes of tribals in these regions digging the root out of the ground for sale in the market. This has already resulted in considerable depredation of *M. dioica* in the natural habitat.

### Methodology

The procedures adopted for collection work were these of Chakravarty (1982). From the different floras of India especially that of Chakravarty (1959, 1982) which exclusively deals with Cucurbits, the explorable areas to be covered by field trips and excursions at different times of the growing seasons were noted. For this purpose several trips were arranged periodically. The spots for collection were randomly selected to cover different conditions of Bihar.

Some of the cultivated taxa are widely grown in the Diara area during the summer and are well adopted genotypes. Similarly quite a number of improved cultivars were collected from agricultural tracks near Rajgir where extensive cultivation of Cucurbits are done in the localized part of about 48 to 64 kms. Mature fruits, seeds or vines were brought to the experimental field of the department. The seeds were germinated and their percentage germination in the changed environment was studied. Similarly, seeds were obtained from the dry fruits and were grown in the growing season. Their growth habits and morphological features were noted as also their mode of flowering and types of flowers i.e. monoecious, dioecious or hermaphrodite. From the growing seedlings or tendrils of the established plants somatic complements of the concerned taxa was determined and compared with the previously related and investigated species. In a number of cases hybridisation involving cytotypes and between species were also attempted with a view to explore the possibilities of gene transfer from one to the other species and determine the species relationship. Pollinating mechanisms have been determined by scoring the germination of pollen *in*

*vivo* and *in vitro*, and through stigma squash after pollination. The time of anthesis, opening of the flower and receptivity of the stigma have been scored in suitable cases. These basic informations have provided useful data for successful hybridization. Thus, the germplasm has been augmented and an inventory of the accessions been made.

## DISCUSSION

### Systematic enumeration and morphology of the selected cucurbit germplasm

#### LUFFA

##### *Luffa acutangula* (L) Roxb.

Monoecious; extensive climber; petioles 8-12 cm. long scabrous, lamina 15-20 cm. long and as broad, palmately 5-7 angled or sublobate, apex-acute; tendrils sub-hispid, often trifid; flowers pale yellow, opening in the evening, slightly scented, male and female flowers in the same axil.

#### Male flowers

Peduncles usually 10-15 cm. long, 17-20 flowered at the apex; pedicels 1-4 cm. long probract 3-7 mm × 2-4 mm, fleshy green ovate with 3-10 glistening glands on the upper surface; petals 2.0 cm × 2.5 cm obcordate; stamens 3 (1-2 locular) pollen whitish yellow; filaments 3-4 mm long.

#### Female flowers

Single axillary, peduncles 5-10 cm long; ovary-elongate, ten-tangular, apex-constricted; fruit clavate oblong acutely 10 - angled, 15-30 cm long; seeds much compressed, margin not winged, ± 10 mm long, ± 7 mm broad and pitted.

#### *Luffa hermaphrodita*

It has the following distinguishing characters : Hermaphrodite, an extensive climber; stems sparsely pubescent 5 angled; tendrils 3-5 fid, glabrous; petioles 8-12 cm long; leaves smaller than the leaves of *L. acutangula*; lamina 6-12 cm long; reniform; both surfaces scabrous, 5 angular, probracts 3.5 mm × 2.5 mm; ovate with 3-5 glistening glands; flowers sulphur yellow, bisexual on peduncles of two types, one bearing a single flower or flowers in groups, 4-8 cm long, the other multiflowered, 6-15 cm long; pedicels 5-10 mm,

calyx-tube 6-7 mm x 4 mm triangular; petals 2 to 2.5 cm long; stamens 3, inserted on the calyx-tube, filaments longer than the style, highly scented, anthers sigmoid; ovary smooth, elongate, ovules many, horizontal, style short, stigmas 3, bilobed; fruits oblong ellipsoidal or cylindrical smooth (without angles) with ten obscurely ribbed and 5 to 8 cm long; seeds  $\pm 8$  mm long,  $\pm 5$  mm broad, smooth and shining black.

#### ***Luffa operculata***

Normal growth of vines, monoecious; stem elongate, glabrous; petioles 6-8 cm long, stout; leaves ovate or cordate in shape; lamina 8-12 cm x 9-12 cm, apex acute, margin minutely denticulate, both surfaces rough in touch; flowers light yellow. In male flowers the peduncles are 7-10 cm, 5-12 flowered; pedicels 5-7 cm long; petals 2 cm - 1.5 cm long and broad; stamens 3 (1 - 2 locular); pollen whitish yellow; female flowers single, axillary; ovary elongate and 10 angled, fruit obovoid and small in size in comparison to *L. acutangula* and *L. hermaphrodita*; but in case of *L. operculata* the fruits are 3-4 cm long acutely 10-angled. Seeds much compressed, with dot/spot like structure on the surface,  $\pm 7$  mm long,  $\pm 5$  mm broad.

#### ***Momordica***

In the genus *Momordica* collections were made on a wide scale from different parts of Bihar. Besides *M. dioica* *M. cochinchinensis* and *M. balsamina* were also collected. *M. charantia* is very widely cultivated and their fruit shape and size show a wide spectrum of variability.

The collection of germplasms of different taxa was done biannually from various places in Bihar and other states.

It is evident that collection of germplasms was made from different localities of Bihar. Collected germplasms of wild and cultivated species were grown in the experimental garden. During collection it has been observed that several species of plants are under endangered conditions. It is perhaps due to increasing human population and continuous deforestation. Hence, restricted collection of wild taxa, their conservation and proper evaluation are essential task for future workers.

*M. balsamina* and *M. cochinchinensis*, that were reported earlier from several places are not to be found there and in a sense have become race species.

#### **Morphological studies**

##### ***M. balsamina***

*M. balsamina* is an annual, wild and monoecious species growing in mesophytic condition. Its distribution is restricted to India.

Morphologically, it exhibits resemblance with *M. charantia*. Stem is subglabrous with profuse branching.

##### **Leaf**

Puberulous, lamina orbicular, lobed; lobes rhomboid and lamina deep green. Size of lamina is 2.9x3.5 cm. Tendril is simple, filiform and glabrous. Male flowers solitary, pedicel subfiliform, bracteate and 3.9 cm in length. Bracts denticulate, cordate, broader than long. Sepals ovate, acuminate and 0.22 cm in length. Corolla light yellow, size 1.3x0.8 cm. Female flowers bracteate or ebracteate. Ovary fusiform. Fruit broadly ovoid and fleshy, size of fruit 2.0x1.5 cm, seeds compressed, slightly verrucose.

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

*M. charantia* is an annual, monoecious and cultivated species, growing all over India. The fruits are used as vegetables. It is distributed sparsely in Assam and Meghalaya, whereas, widely in Bihar. North Bihar is the richest in its distribution. Two varieties of this species are found in Bihar. One has large green or white fruits called 'KARAILLA', while other has small green fruits commonly known as 'KARAILI'.

Stem is branched and tomentose. Petioles are subglabrous about 5.0 cm in length. Lamina is deep green, ovate with glabrous surface and 5-7 lobes. The size of lamina 5.6x8.4 cm. Tendril is simple and slender. Male flowers solitary, foliaceous, bracteate. Bracts reniform. Corolla is regular and yellow in colour, size of petal is 1.9x1.2 cm. Female flowers often bracteate at the base. Ovary fusiform. Fruits oblong, trivalved and dehiscent at apex. Size of fruit varies from 4.5 to 9.0 cm depending upon the variety of cultivars. Seeds are compressed, sculptured and creamish in colour.

***M. dioica* (diploid)**

*M. dioica* is a rhizomatous, perennial and distinctly dioecious, semi-cultivated species distributed in Central Africa and other countries of the world. In India, it has wide distribution from north eastern region to the plains and even to southern parts of the country. It has slender and glabrous stem; membranous, green leaves which are triangular to cordate in shape. Lamina is 5.6×5.9 cm in male and 6.2×6.0 cm in female and remotely denticulate. Tendril is filiform and simple.

Male flowers are solitary and bracteate; sepals green, lanceolate and petals yellow, oblong or obtuse. Female flowers have minute and rudimentary bracts at the base of the pedicel. Ovary ovoid, long and pubescent, placentation parietal. Fruits ovoid with echinate and spinous surface. Average size of fruit is 3.2×1.9 cm & seed is pale yellow and ovoid. The different populations of diploid plants exhibit variations in their morphological features.

***M. cochinchinensis***

It is a rhizomatous, perennial, dioecious and wild species. It is wild in distribution and restricted to some localities of Assam, Bengal and Andaman (Chakravarty, 1982). It is, however, widely distributed in China, Vietnam and other countries of the world. It is called *M. dioica* by the local people due to its rare presence. Germplasm of 23 years old female plant was also found from the same place. It is locally known as 'HATHI KARAILA'. The collection and detailed studies are being made for the first time.

It is a strong climber and reaches up to the height of 50 ft. Root is tuberous and up to about 30 kg in weight. Stem is robust, angular and up to 20 cm in width. Leaf petiole is glabrous and 8.2×0.3 cm of size in male while 5.05×0.37 cm in female: Lamina is deep green and broadly suborbicular in outline, divided into three lobes. Size of lamina as observed in male is 10.0×11.7 cm and that in female is 10.6×12.0 cm. The presence of 5-13 glands at the base of the lamina and petiole provides an interesting feature. Tendril is simple and glabrous.

Male flowers solitary, pedicel robust, bracteate and 9.7 cm in length. Bract is sessile, green and 2.3×3.3 cm in size. Calyx tube flat, sepals 5, blackish, narrow and 1.3×1.0 cm in size. Corolla whitish yellow, petals 5, ovate and 5.4×4.2 cm, stamen 1.3 cm in length, 3 (2 + 2 + 1) in number and syngenesious condition present. Glandular disc with two nectar pouches in closed by lid in anther.

Female flowers bracteate, size of bracts is 1.6×1.2 cm. The position of bract is at the middle of 10.3 cm long pedicel. The size of petal in female flower is 4.9×3.8 cm. Fruit is ovoid to spherical in shape and upper surface echinate in nature. The fruit is green when young but deep red at maturity. Size of fruit is 17×11.5 cm. Seeds numerous and ovate with both surfaces sculptured. It is ashy in colour, flattened and emarginate in outline.

***M. dioica* (Natural tetraploid)**

It is dioecious, rhizomatous and perennial. It differs from natural diploids.

It bears thicker stem and profuse branching. Leaves are larger and vary in size from 8.0×8.5 cm in male and 8.4×8.6 cm in female, and are denticulate, cordate, deep green and glabrous. Male flowers are bracteate and larger in size. Bracts are 2.4×4.0 cm and deep green. Sepals are green and larger than those of diploids. Petals are white, ornamental (with black spot at the base of petals). Female flowers are also bracteate but smaller in size. Bracts are smaller in size, i.e. 0.8×0.6 cm. Sepals are similar to those of the male flowers. The size of petals in male flowers are 5.3×4.4 cm and that in the female flowers are 5.2×4.2 cm.

The blooming period in tetraploid is 5 A.M. to 6 A.M. and flowers persist till the whole day. Flowering season is prolonged by one month as compared to the diploids. Pollen grains vary in size. Pollen fertility is lower than in diploids. Seeds are elliptical, compressed and emarginate, black to grey in colour. Fruits are bigger than diploids.

***Trichosanthes***

*Trichosanthes*, an Indo-Malayan genus, is the third largest genus of the family Cucurbitaceae.

India possesses 54% of these species of this genus (Chakravarty, 1959 & 1982). *T. cucumerina* L., a wild species, has fairly extensive range over India, while *T. dioica* and *T. anguina* are cultivated in Bihar, Uttar Pradesh, Punjab, West Bengal, Assam, Sikkim, Tamil Nadu, etc.

#### ***T. dioica***

Dioecious : extensive climbers; stems slender, branched, much scandent; petioles 1-3 mm long, slender, striate; lamina 7-10 cm × 4-8 cm, cordate or ovate oblong in shape, acute, rigid, sparsely scabrous, basal lobes narrow round, 1.5 - 2.0 cm deep; tendrils slender, short; flowers white in colour.

#### **Male flowers :**

Peduncles 2-3 cm long, paired both 1-flowered, one short, one long, usually in racemose; calyx-tube cylindrical, dilated above 5-lobed, linear; corolla 5 lobed, lobes oblong, fimbriate; stamens 3, free, subsessile, oblong, 3.5 mm×1.5 mm in length, one stamen 1-locular and two 2-locular, loculi conduplicate, connective narrow.

#### **Female flowers**

Peduncles 2-4 mm long, sometimes female flowers are 2,3 and 4 in number from an axil but usually solitary calyx and corolla as in the male, ovary inferior, ovoid or fusiform, 1-locular, placenta-3, parietal, ovules many, horizontal or semipendulous, style slender, stigma 3, entire or bifid; fruits 5-12×2-6 cm, oblong, glabrous, smooth; seeds 6.7×5.6 mm globose.

#### ***T. cucumerina***

*T. cucumerina*, a wild species, has fairly extensive range of growth all over India; extensive climber; monoecious; stems slender; petioles 2-7 cm long; lamina 7-10 cm×8-12 cm orbicular, reniform or broadly ovate, deeply 5-7 lobed; tendrils slender, 2-3 fid, flowers white in colour.

#### **Male flowers**

Peduncles in pairs, the earlier 1-flowered and the later ones in racemes, 8-15 flowered minutely bracteate; pedicels erect, 1-2 cm long, filiform; calyx-tube dilated at apex, 15-16 mm long,

apex 2.5 mm broad, lobes erect; staminal filaments 1.5 mm long, slender, glabrous, anther oblong 3×1.5 mm.

#### **Female flowers**

Peduncles 3-12 mm long, ovaryoblong, style 16-18 mm long filiform; fruits 5-6×3.5 - 4.0 cm ovoid, conical 8-10 seeded 11-12 mm× 6.0 - 6.5 mm and 4 mm thick, ovate-oblong, compressed, truncate or slightly emarginate, base attenuate.

#### ***T. anguina***

Monoecious; annual, extensive climber; stems slender, puberulous; petioles 12-15 cm long, stout; lamina 10-15 cm×12-18 cm orbicular, reniform, deeply 5 lobed; tendrils 2-3 fid.

#### **Male flowers**

Peduncles 10-25 cm long, robust; 8-15 flowered pedicels, 0.5 - 2.0 cm long, slender, minutely bracteate; calyx tube 2.5-3.0 cm long, sub-cylindrical, 2 mm long; petals 8-9 mm×3 mm oblong; stamens 3, staminal filaments slender, anthers ovoid, pistillode 15-17 mm long.

#### **Female flowers**

Peduncles 0.5-5.0 cm long; flowers solitary; ovary narrowly fusiform; fruits very long (upto 1.5 meter twisted, surface smooth, smooth, often 7-8 white stripes along the length, seeds 14-17 mm×7-9 mm and 3 - 5 mm thick, oblong, finely regulose, undulate, apex round or obscurely truncate, base attenuate.

Morphologically both *T. anguina* and *T. cucumerina* are similar but they differ mainly in fruit length, being 5 to 10 cm in *T. cucumerina* and 60 to 90 cm in *T. anguina*.

Thus, altogether 11 species belonging to 3 genera were collected from different parts of Bihar.

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