

Status, diversity and potential of indigenous and minor cucurbitaceous vegetables

The main goal of research on cucurbits in India is to double the productivity on sustainable basis. The breeding programmes have been shifted towards development of biotic stress and abiotic resistant varieties/hybrids coupled with quality attributes. Cucurbit breeding strategy and targets are dependent on consumer demand. Indigenous cucurbitaceous vegetables like cucumber, bitter gourd, pointed gourd, ash gourd, teasel gourd etc. have significant nutritional, medicinal and economic importance due to presence of several bioactive compounds responsible for therapeutic activities, usefulness for processing purpose and comparatively higher market price. Pointed gourd and teasel gourd are highly suitable for small and marginal farmers due to their high market value and minimal price fluctuation. In present time, there is a large Indian population residing in foreign countries especially in middle east Asia, south east Asia, Australia, USA, Canada etc. and there is huge demand of indigenous cucurbit vegetables i.e. pointed gourd, bitter gourd, ridge gourd, ivy gourd. Farmers may benefit from export of these vegetables.

CUCURBITS are vegetable crops belonging to family Cucurbitaceae, which primarily comprises 118 genera and 825 species. In India, 37 genera and about 100 species of cucurbits, including wild and cultivated, have been reported. About 60 cucurbit crops are grown in India and half of these are indigenous to India or Indian subcontinent. These indigenous crops are grown in summer and rainy season in northern and eastern part, while throughout the year in southern part of India. In India, cultivation of these crops is fitted in several commercial cropping systems and also as popular kitchen garden crops. Cucurbits are variously used as food, medicine, as well as utilitarian and ornamental items. Some cucurbits possess industrial importance too. These cucurbits are consumed in various forms i.e. salad (cucumber, gherkins, longmelon), sweet (ash gourd, pointed gourd), pickles (gherkins and cucumber) and others in culinary purpose. Cucurbits share ~5% of the total vegetable production in India which includes indigenous cucurbits. Being the largest group of vegetables, cucurbits provide better scope to enhance overall productivity and production of vegetable to meet the challenges. The important indigenous cucurbit crops grown in India are cucumber, bitter gourd, ridge gourd, sponge gourd, pointed gourd, ash gourd, snake gourd, ivy gourd, longmelon, roundmelon, snapmelon and spine gourd.

Role in diet diversification and medicinal importance

With the changing lifestyle and dietary pattern, the consumers in India are becoming more health conscious and also want more vegetable diversification and a continuous supply. In cucurbits, generally fruits are eaten but in case of longmelon, pointed gourd tender

leaves are also equally preferred. Cucurbit vegetables are purchased partly based on their nutritive values, appealing appearance and price. Product differentiation, including introduction of new types is still a key strategy for expanding sales in vegetable markets. For example, the introduction of new vegetables such as ivy gourd, longmelon, sweet gourd and hermaphrodite ridge gourd (satputia) in market has opened new opportunities for domestic producers. To exploit important virtues of cucurbits, it is important to continue research, disseminate information regarding the nutritional benefits of these vegetables, develop new improved cucurbit cultivars, processed products, evaluate the economic opportunities and the market scope of these new products, and identify marketing trends and alternatives. Providing customers with innovative combinations of products (pickles from cucumber, sweets and candy from ash gourd and pointed gourd, juice from ash gourd, chips and powder from bitter gourd) and services is the key to the processed vegetables.

The Cucurbitaceae family still retains a lot of medicinal properties, but in the medicine field they are not gaining popularity because the healing ability of these vegetables is not known to people. The research work was done over a few decades to find out the phytochemical significance of cucurbits. Cucumbers are known for their cooling and astringent properties. It is very useful in curing skin problems, hence, commonly used in formulation of cosmetics. The seed of cucumber has medicinal properties which are tonic and diuretic. The fruit of bitter gourd is having an anthelmintic, stomachic, antibilious and laxative properties and used as febrifuge, rheumatism, gout and disease of liver and spleen. Fruit juice of Bitter gourd has been used as traditional medicine for diabetes because it

is having insulin like polypeptides which is responsible for hypoglycemic properties. Leaves of ridge gourd are used as poultice in haemorrhoids, leprosy and splenitis; juice in conjunctivitis and jaundice; decoction for uraemia and amenorrhoea. Fruit are demulcent, diuretic and nutritive. Juice of sponge gourd leaves are used to cure conjunctivitis and jaundice. Roots have laxative effects and seeds are used for treatment of asthma, sinusitis and fever. Snake gourd's leaves and stems are used for the treatment of skin disease, whereas fruits are used as appetiser. The seeds of snake gourd have deworming properties. The leaves and stems of pointed gourd are hypocholesterolemic, hypoglyceridimic, hypoglycemic, hypophospholipemic and commonly prescribed for digestive complaints as tonic and febrifuge. Fruit extract helps in lowering cholesterol activity and blood sugar. The roots are diuretic and good medicine for ascites.

Fruits of ivy gourd are also used for the treatment of leprosy, fever, asthma, bronchitis and jaundice. Its leaves are used to control skin disease. The fruit of ash gourd is nutritive, diuretic, styptic and purgative and also has low calorific value. Its regular use relieves piles, dyspepsia, diabetes and inflammation in digestive system. The fruit juice is beneficial in treatment of peptic ulcer, haemoptysis, respiratory trouble and other internal haemorrhage discharges from stomach, lungs, kidneys, etc. It acts as a blood coagulant. The shelled seeds are also useful to expel out intestinal worms.

Origin and distribution

Cucumber

Cucumber (*Cucumis sativus* L.) is an indigenous vegetable to India. It is under cultivation over 3000 years. Burma could be regarded as a secondary centre of origin of this crop. The possible progenitor of cucumber is *Cucumis hardwickii* R. The cucumber seed was carried westward to Asia Minor, North America and Africa. It is grown throughout the world in sub-tropical and tropical climates. The sub genus cucumber X=7 consists of 3 Sino Himalayan species including *Cucumis sativus* (cucumber), *Cucumis hystris* (Syn. *muriculatus*) and *Cucumis hardwickii* R. *Cucumis hardwickii* R., a small bitter cucumber with sparse and stiff spines, has been found in wild in the foothills of Himalayas. Free hybridization with cultivated *Cucumis sativus* with no reduction of fertility in F_2 generation might be a feral form or more likely progenitor of the cultivated cucumber.

Bitter gourd

The origin of bitter gourd is India (Indo-Burma centre of origin). The region of eastern India and southern china are suggested as possible center of domestication. It is widely cultivated in India, Indonesia, Malaysia, Singapore, China, Japan, South-East Asia, tropical Africa and South America. Wild *Momordica charantia* var. *abbreviata*, a native of Asia, may be the progenitor of bitter gourd. The somatic chromosome number of bitter gourd is $2n=2x=22$. The related species of bitter gourd are *Momordica dioica* Roxb. ex Wild., *Momordica cochinchinensis* (Lour.) Spreng., *Momordica tuberosa* (Roxb.) Cogn. (syn. *Momordica cymbalaria*), *Momordica balsamina* L. and



Bitter gourd variety – Kashi Mayuri

Momordica cabriei. Among the above, first 2 species bear edible and cultivated. Wild species of genus *Momordica* are *M. subangulata* Bl., *M. denudata* and *M. macrophylla*.

Ridge gourd and sponge gourd

Both crops originated in India. They are found wild in the North-West of India. It is only genus of the subtribe *Luffinae* C. Jeffr., tribe *Benincaceae* Ser., sub family cucurbitoideae. The genus includes 7 species, 4 paleotropic and 3 neotropic in distribution. Two species are cultivated i.e. *Luffa acutangula* (L.) Roxb. ($2n=26$ ridge gourd, ribbed gourd, angled *Luffa*) and *Luffa cylindrica* M.J. Roem. ($2n=26$ sponge gourd, towel gourd, smooth loofah, vegetable sponge dish cloth gourd, syn. *L. aegyptiaca* Mill.). Other related species are *Luffa operculata* (L.) Cogn. (grown in tropical America), *Luffa graveolens*, *Luffa umbellata*, *Luffa peritadra*, *Luffa gigante*, *Luffa scabra* and *Luffa narylandica*.



Satputia variety – Kashi Khushi

Ash gourd

Ash gourd is believed to have originated in Indo-Malayan area of Southeast Asia and Japan. However. Indo-China area is the center of greatest diversity. It is widely cultivated in India, China, Malaysia, Indonesia, Philippines, Taiwan, Bangladesh and the Caribbean Islands. It is grown up to an altitude of 1500 m. *Benincasa* is monospecific genus, *B. hispida* (Thunb.) Cogn. (syn. *B. cerifera* Savi.) belonging to the tribe Beniscaseae Ser., subfamily Cucurbitoideae. In ash gourd four major cultivar groups are recognized i.e. (i) a late maturing winter melon group that have unridged seeds and cylindrical (50-100 cm long), dark green fruit, sparse wax, (ii) a ridged winter melon group that is similar except the seeds are ridged, (iii) a fuzzy gourd group with ridged seeds and narrow



Variety Kashi Surabhi



Waxless Ashgourd

cylindrical (20-25 cm long), green, hairy, sparsely waxed fruit, and (iv) the wax gourd group that also has ridged seeds, and oblong (10-60 cm in diameter), light green waxy and sometimes hairy fruit.

Pointed gourd

Trichosanthesis is a large genus of Indo-Malayan distribution, with about 44 species, of which 22 are found in India. The species of *Trichosanthes*, especially *T. dioica*, originated in the Old World, most probably in India. The name petola or patala, which signifies snake gourd (*Trichosanthes cucumerina*) in Malay Peninsula and Philippine islands, is of Sanskrit origin (patola), indicating that the genus *Trichosanthes* may be indigenous to India. Assam-Bengal region of India was the primary center of origin because this region, including Bangladesh, exhibits a rich species diversity of this crop. However, wild forms of *T. dioicadioca* are found throughout northern India.



Pointed gourd



Snake gourd

Snake gourd (*Trichosanthes cucumerina* L., syn. *Trichosanthes anguina* L.) occurs in the wild form in India, South-East Asia and tropical Australia. The Indian Archipelago is thought to be its place of origin.



Snake gourd

The genus includes about 40 species occurring in East, South Asia, tropical Australia, and Fiji. The species are distributed in South-East Asia, extending through Malaya to North Australia in one direction and China to Japan in another. Generally the genus is divided into 2 sections namely *Eutrichosanthes* and *Pseudotrichosanthes*, former containing 23 species and the latter 3 only. Two cultivated species under the genus are *Trichosanthes anguina* and *Trichosanthes dioica*.

Ivy gourd

Ivy gourd is believed to have its origin in India. It is distributed in Burma, Pakistan and whole South East Asia. It is grown in most part of India, tropical Africa, Central America, China, Malaysia and other tropical countries. It has 30 species in the old world, most are in Africa. Only one species *Coccinia indica* (syn. *Coccinia cordifolia*, *Ciphlandra indica*) is cultivated and occurring naturally throughout India and Tropical Africa.



Ivy gourd

Longmelon

Longmelon (*C. melo* var. *flexuous*) popularly known as *kakri* is valued for tender fruits which are eaten as salad. It is warm season crop grown mainly in tropical and sub-tropical regions, popular during summer months in most part of the country due to its cooling effect. In Middle Eastern countries where longmelon fruit is known as Armenian cucumber whose immature fruit used in salad as well as cooked. Longmelon grow well at day temperature between 25-35°C and also tolerates cool



Long melon

climate better than other melons. It cannot tolerate frost and strong winds. Low temperature and high relative humidity stimulate the development of female flowers. The pale green fruit are long and slender with a smooth longitudinally slightly ridged surface. Fruit length varies from 20 cm to 1 m and diameter from 4 to more than 10 cm.

Snapmelon

Snapmelon (*C. melo* var. *momordica* Duthie & Fullar), is commonly grown in North India during rainy season in mixed cropping, with its vines trained on maize or sorghum. Its production and popularity is largely limited to India, where it is locally called 'Phoot' which means 'to split.' The name Phoot/Snap is related with the cracking of fruit surface and its disintegration with advancing maturity. The fruits are oval or elliptic, with smooth skin, orange or light yellow in colour with weight about 900 g. The striped fruit has a light orange or white mealy flesh and sourish without sugar or aroma. The plants are monoecious. Immature fruits are cooked or pickled. After removing the coat, seeds are used in bakery products and the traditional drink 'thandai' and rich source of vitamin C, iron and calcium.

Roundmelon

Praecitrullus fistulosus is commonly known as Tinda and Indian round gourd in English with basic chromosome $n=12$. It is an annual, creeping or climbing herb with round fruits of the size of a small beet, pale or dark green in colour with black to brown seeds. Two type of fruits usually grown as a vegetable one with green fruits and the other with pale green fruits. *Praecitrullus fistulosus* is cultivated as a vegetable in India, Pakistan and Afghanistan. The origin is probably north-western India, where wild types may still be found and cultivated in Pakistan and Afghanistan. In India, Punjab, Western Uttar Pradesh, Mumbai and Rajasthan are major growing areas as well as important markets. It likes warm, sunny conditions of 25-30°C at daytime and 18°C or more during the night and performs less well in cooler and humid areas. In India, it is either grown in the dry season (February to end of April) or in the rainy season (mid-June to end of July).



Round melon

Teasle gourd

The teasle gourd (*Momordica subangulata* Blume ssp. *renigera*) is probably native to India. It is dioecious in nature and a perennial climber with tuberous roots mainly cultivated in Assam, West Bengal, Bihar, Odisha, North-eastern states, Maharashtra, Gujarat and Andaman Islands. This high quality minor crop could play an important role in food and nutritional security than many currently commercially produced crops, which are low in vitamins and minerals. Unavailability of improved varieties, difficulties in propagation by seed due to dormancy, low multiplication rate, and unpredictable sex ratio in seed-based populations are problems in increasing the yield potential of the teasle gourd. This crop has many problems, including poor natural pollination of female flowers and susceptibility to biotic stress.



Teasle gourd

Spine gourd

Spine gourd (*Mamordica dioica* Roxb) is an underutilized vegetable of high nutritional, medicinal and economic value. It is a native of tropical regions in Asia, Polynesia besides tropical Africa and south America. As many of the species of this genus have been found to grow wide in India, Bangladesh, Sri Lanka, Myanmar and Malaysia etc. which indicates that this region might be the origin



Spine gourd

of spine gourd. Spine gourd is mainly grown in Odisha, Bihar and West Bengal but occurs as wild in Punjab, Uttar Pradesh, Rajasthan, Madhya Pradesh, Kerala and Maharashtra. Spine gourd has a number of problems including low yield. Fruits become inedible at maturity owing to the presence of large number of hard seeds. Low rate of tuber production (10-20 tuberous pieces per year); germination of seeds is very low or impossible due to hard seed coat, non-availability of improved varieties, difficulties in propagation by seed due to dormancy, dormancy of tubers and unpredictable sex ratio in seedling progeny.

Plant genetic resources and registered unique germplasm

In India, ICAR institutes and State Agriculture

Universities are involved in collection, conservation and utilization of indigenous cucurbits (Table 1). Rich genetic diversity in wild and cultivated species of *Luffa*, *Momordica*, *Cucumis*, *Coccinia* and *Trichosanthes* has been augmented. There are several cucurbits, which have adaptability to a particular region of India i.e. *Momordica cochinchinensis* to Tripura, Assam and West Bengal, and *Trichosanthes dioica* to Eastern Uttar Pradesh, Bihar and West Bengal.

The Indian Institute of Vegetable Research is a National Active Germplasm Site for the systematic management and utilization of germplasm wealth of vegetable crops including indigenous cucurbits. The major activity includes collection, evaluation, maintenance and distribution of germplasm (Table 2).

Table 1. Institutes/SAUs involved in the research activity of indigenous cucurbits

Crop	ICAR institute/SAU/CAU
Cucumber	IIVR, Varanasi; IIHR, Bengaluru; IARI, New Delhi; HPKV, Palampur; MPKV, Rahuri; GBPUAT, Pantnagar
Bitter gourd	IIVR, Varanasi; IIHR, Bangalore; IARI, New Delhi; PAU, Ludhiana; KAU, Vellanikkara; TNAU, Coimbatore; CSUAT, Kanpur
Pointed gourd	IIVR, Varanasi; BAU, Sabour; HARP, Ranchi; Kalyani; NDUAT, Faizabad; IGKV, Raipur
Snake gourd	KAU, Vellanikkara; TNAU, Coimbatore
Ivy or scarlet gourd	IIVR, Varanasi; IGKV, Raipur; CHES, Bhubaneswar; TNAU, Coimbatore; BAU, Sabour
Longmelon	PAU, Ludhiana; IIVR, Varanasi; CIAH, Bikaner
Snadmelon	IIVR, Varanasi; IARI, New Delhi; CIAH, Bikaner
Roundmelon	HAU, Hisar; IIVR, Varanasi; IIHR, Bengaluru
Ash gourd	IIVR, Varanasi; IARI, New Delhi; KAU, Vellanikkara; TNAU, Coimbatore; ICAR Research Complex, Barapani
Ribbed or ridge gourd	IARI, New Delhi; IIHR, Bengaluru; IIVR, Varanasi; AAU, Anand
Sponge gourd	AAU, Anand; IIHR, Bengaluru; IIVR, Varanasi; HARP, Ranchi; RAU, Samastipur
Hermaphrodite ridge gourd	IIVR, Varanasi
Sweet gourd	IIVR, Varanasi; CHES, Bhubaneswar; ICAR Research Complex, Barapani

Table 2. Indigenous cucurbits germplasm maintained

Crop	Germplasm maintained	
	ICAR-IIVR, Varanasi	ICAR-NBPGR, New Delhi
Cucumber	115	625
Bitter gourd	120	487
Ridge gourd	53	46
Sponge gourd	173	411
Hermaphrodite ridge gourd (Satputia)	33	-
Ash gourd	94	281
Pointed gourd	145	01
Snake gourd	15	62
Ivy gourd	20	-
Longmelon	40	46
Round melon	20	49
Snadmelon	100	206
Spine gourd	20	05
Teasle gourd	55	66

ICAR-NBPGR, New Delhi has provided a mechanism for registering germplasm having unique trait under 'Registration of Plant Germplasm'. A total of 15 germplasm of 8 indigenous cucurbits have been registered, which could be utilized by breeder of different organization (Table 3).

Unique traits identified in different indigenous cucurbits

During evaluation of germplasm and segregating population, some unique traits i.e. aromatic sponge gourds, dwarf plant with erect fruit habit in longmelon, nematode resistant in bitter gourd, waxless in ash gourd

Table 3. Indigenous cucurbits germplasm registered for unique traits

Crop	Name of line	Natl. identity no.	Registered unique traits
Bitter gourd	GY-63	INGR-03037	Gynoecious line
	PreGy-1	INGR-12014	Predominately gynoecious habit
Cucumber	AHC-2	INGR-98017	High yield and long fruit
	AHC-13	INGR-98018	High yield, small fruit, drought and high temperature tolerance
	IC420405	INGR-18029	High carotenoid content and orange flesh colour
	IC257296	INGR-18030	Two female flowers per node, earliness, small fruit
Sponge gourd	VRSG-52-1	INGR-10159	Cluster bearing fruiting habit
	DSG-6	INGR-12013	Highly resistant to Tomato Leaf Curl New Delhi Virus
Roundmelon	HT-10	INGR-99038	Intermediate, semi-spreading vine, tolerant to downy mildew and root rot wilt
Snapmelon	AHS-10	INGR-98015	High yield and drought tolerance
	AHS-82	INGR-98016	High yield and drought tolerance
	B-159	INGR-7044	Downy mildew resistance
Pointed gourd	IIVR PG-105	INGR-03035	Seedless fruit, obligate parthenocarpic with long duration fruiting
Ivy Gourd	CHIG-15	INGR-9126	Fruit length (8.5-9 cm), uniform cylindrical shape
Kachari (<i>Cucumis melo</i> subsp. <i>agrestis</i>)	AHK-119	INGR-98013	High yield and drought tolerance

Crop	Name of the accession	Unique traits
Bitter gourd	IC-44428 and IC-44438	Nematode resistance
Longmelon	VRLM-172	Dwarf plant with erect fruit
Sponge gourd	VRSG-7-17	This genotype possess aroma like 'Basmati rice' in leaves, flowers, fruits, blossom end of fruits, plant vine and peel due to the presence of Hexenal, 1-octene3-ol and limonene
Pointed gourd	VRPG-103	Cluster bearing habit. The number of fruits per cluster varied from two to four. The double fruited cluster contributed maximum toward the number of fruit per plant
Ash gourd	VRAG-12-2	Wax less fruits



Erect fruited long melon



Cluster bearing pointed gourd

and cluster bearing in pointed gourd were identified. These germplasm/lines are in the process of registration and are being utilized in breeding program.

Breeding trends in indigenous cucurbits

Breeding of cucurbits has to address and satisfy the needs of both the consumer and the grower. The general objectives for growers are high yield, disease and pest resistance, uniformity, and tolerance to abiotic stresses. Objectives for consumers are quality, appearance, shelf life, taste, and nutritional value. Quality in vegetable crops, in contrast to field crops, is often more important than yield. Thus, colour, appearance, taste, and shape are usually more important than productivity. For example, in India, cucumber breeding programme is concentrated only on slicing cucumber with objective of high yield, quality and resistance. Breeding work on parthenocarpic cucumber (controlled by single dominant gene with many modifiers) with gynoecious sex expression is initiated at

GBPAUT, Pantnagar and IIVR, Varanasi for protected cultivation. The major colour segment in cucumber is light green, green, dark green and creamy skin. Several varieties and hybrids have been developed in slicing cucumber for commercial cultivation. In bitter gourd, fruit shape is main segment of variation. Four type of fruit shapes are found in bitter gourd i.e. a) large fusiform fruits pointed at both end dominated with triangular tubercles, b) small spindle shape; c) cone shaped, length 9-12 cm with dark green rind having prominent tubercles and d) Chinese long fruited (30-60 cm) with smooth ridge, light green skin colour. Gynoecious line (INGR 03037) has been developed and efforts are being made to utilize this line for development of better F_1 hybrids. Fruit fly and poty viruses are becoming limiting factors for bitter gourd production. This invites initiation of a breeding programme to develop few resistant varieties/hybrids.

Considering the importance of ash gourd in diet as good source of nutrition, medicinal properties and importance in petha industry, it is need of the hour to develop new varieties with better traits. For petha preparation, big size (10-15 kg) oval to cylindrical fruits are required, while for household consumption small cylindrical fruits (1-2 kg) without ash are in demand. Breeding for seedless, or fruits with less seeds may be the focus of present research as seedless fruits are easy for processing in petha industry. In ridge gourd and sponge gourd, major emphasis should be given to develop small cylindrical fruits having sequential fruiting habit (bearing on each node). The hermaphrodite ridge gourd may be utilized for developing ridge gourd and sponge gourd with sequential fruiting genotypes. These cultivars should be resistance to downey mildew, powdery mildew and viruses.

Genetic improvement to increase levels of specific micronutrients has been pursued in longmelon. The yield and nutritional content of longmelon has been increased significantly by exploiting intraspecific genetic variation of genetically diverse melons. Inbred long melon 'Punjab Long melon 1' (PLM1) was hybridized with 5 genetically

diverse inbred melons namely KP 7 (var. *momordica*), AM 72 (var. *acidulus*), Arya 1 (var. *chate*), 04-02 (var. *tibish*) and Punjab Wanga. The parents and hybrids were evaluated at three locations for 9 traits. Hybrids PLM1 × 04-02 and PLM1 × Punjab Wanga exhibited significant heterosis for the number of marketable fruits per plant, ascorbic acid and carotenoid content. Snapmelon is available in the Indian markets for about five months in the rainy season and are utilized by poor and middle-class consumers. Mineral and vitamin rich varieties would be important supplement to the nutritional needs of these consumers. Carotenoids in mature fruits of snapmelon accessions ranged from 34.7 to 308.2 mg/100 g. Ascorbic acid was more in the snapmelon landraces from northern India (up to 34.1 mg/100g) as compared to the accessions from eastern India (up to 19.4 mg/100g). The germplasm of ivy gourd, sweet gourd, snake gourd, roundmelon and pointed gourd should be characterized properly and promising accessions should be recommended for cultivation. The availability of quality planting material is very important for popularization of ivy gourd, pointed gourd and sweet gourd as they are vegetatively propagated.

Varietal development

The evaluation of indigenous and exotic germplasm introductions, and their hybridization resulted in the selection of superior varieties of different cucurbits. As a result of multi-location testing under All India Coordinated Vegetable Improvement Project, improved varieties in many indigenous cucurbits have been identified and recommended for cultivation and release for various agro-climatic regions of the country (Table 4). Many indigenous cucurbits are not included in multilocation testing of AICRP-VC. Hence, varieties of these crops have been recommended by states of the respective Institute/University.

Among the released and notified varieties, following are very popular among the farmers due to their high yield potential and specific traits. The adopted areas and salient features of important varieties are given in Table 5.

Table 4. List of the open pollinated varieties/hybrids released in India

Crop	National level	State /Institute level
Bitter gourd	Priya, RHRBG-4-1, KBG-16, PBIG-1	Coimbatore Long, Pusa Do Mausmi, Pusa Vishesh, Punjab-14, Kalyanpur Baramasi, CO-1, CO-2, Kashi Mayuri
Cucumber	Swarna Ageti (CHC-2), S. Sheetal (CH-20), Pant Khira-1 (PCUC-28)	Japanese Long Green, Straight-8, Pusa Uday, Himangi, Phule Subhangi, Swarna Poorna, Sheetal, CO-1, Pant Parthenocarpic Khira-1, Pant Parthenocarpic Khira-2
Ridge gourd	S. Manjari (CHRG-1), PRG-7, Arka sumeet (IIHR-7), Kashi Shivani	Swarna Uphar, Co-1, Co-2, PKM-1, Arka Sujat, Pusa Nasdar, Pusa Nutan, Punjab Sadabahar, Haritham, Hisar Kalitori, GJRGH-1, Gujrat Anand Ridge Gourd-1, Pant Torai-1, Arka Vikram (H)
Sponge gourd	Pusa Chikni, CHSG-1, JSGL, Kashi Divya, Kashi Shreya	Pusa Sneha, Pusa Supriya, PSG-9, Rajendra Nenua-1, Azad Torai-1, Azad Torai-2, Kashi Jyoti
Ash gourd	Kashi Ujwal, Kashi Surbhi, KAG-1, Pusa Ujjwal, PAG-72	Kashi Dhawal
Pointed gourd		'Swarna Alaukik', 'Swarna Rekha', 'Rajendra Parwal-I', 'Rajendra Parwal-II', 'Narendra Parwal-260', 'Narendra Parwal-307', 'Narendra Parwal-604, Kashi Divya, Kashi Suphal, Kashi Alankar, Kashi Amulya
Ivy gourd		Indira Kundru-05, Indira Kundru-35, Co-1, Kashi Bharpoor

Crop	National level	State /Institute level
Longmelon		Arka Sheetal, Karnal Selection, Punjab Longmelon-1, Pant Kakri-1
Roundmelon		Arka Tinda, Hisar Tinda (HT-10), Pusa Raunak
Snarmelon		Pusa Shandar
Hermaphrodite ridge gourd (Satputia)		Kashi Khushi
Snake gourd		CO-1, CO-2, PKM-1, Konkan Sweta, Baby, Manushree, Harithasree
Spine gourd		Arka Neelanchal Shanti
Teasel		Arka Neelanchal Gaurav
<i>Hybrids</i>		
Cucumber	Pant Sankar Khira-1, PCUCH-3, Hybrid No.1	Pusa Sanyog, AAUC-1, AAUC-2, Kashi Nutan
Bitter gourd	Pusa Hybrid-2, NBGH-167, Vivek	
Ridge gourd	Pallavi, HYRGH-5HB	
Sponge gourd	Kashi Rakshita	Kashi Saumya
Ash gourd	DAGH-14, DAGH-16	

Table 5. Salient features and adoption of important varieties/hybrids of indigenous cucurbits

Crop/Variety/hybrid	Adaptability	Salient features
Bitter gourd		
Kashi Mayuri	Uttar Pradesh	Green medium fruit with discontinuous ridges and medium tubercles, bears 14-16 fruits/plant, length 18-20 cm, weight 100-115 g, yield 190-200 q/ha.
Cucumber		
Kashi Nutan*	Uttar Pradesh	Fruit light green with mottle ting at peduncle side, length 21-24 cm, each plants bears 8-9 fruit having 200-225 g fruit weight, yield 150-175 q/ha.
Sponge gourd		
Kashi Divya	Uttar Pradesh, Delhi, Bihar, Madhya Pradesh, Chhattisgarh, Uttarakhand and West Bengal	Fruiting starts 48-50 days after sowing, single plant bears 10-12 light green fruits of 15-16 cm length, each of 80-85 g, suitable for rainy and summer season cultivation, yield 250-300 q/ha.
Kashi Shreya	Punjab, Uttar Pradesh, Bihar and Jharkhand	Fruit dark green, long straight (20-25 cm on flat bed, up to 32 cm on bower) and with 3-3.75 cm diameter. Fruits harvest at 50-55 days from sowing date, yield 150-200 q/ha.
Kashi Rakshita*	Punjab, Uttar Pradesh, Bihar and Jharkhand	Fruits dark green, long straight (20-25 cm on flat bed and up to 30 cm on bower) with 3-4 cm diameter. Fruits harvest starts from 48-52 days from sowing date, yield 200-250 q/ha.
Kashi Jyoti	Uttar Pradesh	Fruits light green, long straight (20-25 cm on flat bed and up to 30 cm on bower), width 2.5-3.0 cm. Fruit weight ranges from 100 to 140 g. Fruit harvest starts at 50-55 days of sowing, yield 140-160 q/ha.
Kashi Saumya*	Uttar Pradesh	Fruits green, long straight 20-25 cm and may increase on bower up to 32 cm with a diameter of 2.5-3.25 cm. Fruit weight ranges from 155 to 165 g. Fruit harvest starts at 45-50 days after sowing. The average yield 189.31 q/ha and potential yield 250 q/ha.
Ridge gourd		
Kashi Shivani	Punjab, Uttar Pradesh, Bihar and Jharkhand	Fruit green, long straight 20-30 cm and may increase on bower up to 40 cm with a diameter of 3-4 cm. Fruit weight ranges from 100 to 150 g. Fruit harvest starts at 50-60 days after sowing, yield 180-200 q/ha.
Hermaphrodite ridge gourd (Satputia)		
Kashi Khushi	Uttar Pradesh	Bearing hermaphrodite flowers on every node after 45-47 days of sowing. Fruit length 13-15 cm, weight 28-31 g, straight, with attractive light green, surface smooth with 10 dark green superficial and continuous longitudinal sutures, yield 128-144 q/ha in 8-10 pickings. Rainy season is most suitable period of cultivation.

Crop/Variety/hybrid	Adaptability	Salient features
Ash gourd		
Kashi Dhawal	Uttar Pradesh, Punjab, Bihar and Jharkhand	Fruits oblong, average weight 11-12 kg, fruit flesh thickness 8.5-8.7 cm, linear seed arrangements, crop duration 120 days, yield 550-600 q/ha, suitable for preparation of Petha sweets due to high flesh recovery.
Kashi Ujwal	Punjab, Bihar, Uttar Pradesh, Jharkhand, Karnataka, Tamil Nadu and Kerala	Less seeded fruits with average weight of 10-12 kg with globular in shape, yield 400-500 q/ha, suitable for preparation of Petha sweets due to high flesh recovery.
Kashi Surbhi	Punjab, Uttar Pradesh, Bihar and Jharkhand	Oblong shape fruit, medium in size (9.5-10 kg), flesh thickness 8.5-8.7 cm, 2.5-3.0, high flesh recovery, suitable for preparation of Petha sweets, yield 700-750 q/ha.
Pointed gourd		
Kashi Alankar	Uttar Pradesh and Jharkhand	Fruit colour green, spindle in shape and striped at distal end of the fruit, single plant bears 120-130 fruits of 6.7 cm length and each weighing 25-27 g, yield 180-200 q/ha.
Kashi Suphal	Uttar Pradesh	Fruit colour light green, fruit with mild stripe and slightly taper at the stem end and blossom end. Fruits are fleshier and contain soft seeds. Fruit length and diameter range from 6-7 cm and 2.5-3.0 cm respectively and yield 190-200 q/ha.
Kashi Amulya	Uttar Pradesh	Fruit colour light green, fruit with sparsely distributed white stripe. It is less seeded and contains only 5-8 seeds/fruit as compared to 20-28 seeds in seeded variety. Fruit length and diameter is 7-7.5 cm and 3.0 cm, respectively and yield 200-210 q/ha.
Snake gourd		
Harithasree	Kerala	This variety produces dark green fruits with white stripe and having high yield potential. Identified in 2013 for areas where green fruits are preferred.
Ivy gourd		
Arka Neelachal Sabuja	Odisha	Fruits are dark green in appearance with fractured stripe and conical in shape. It gives 70-80 harvest per season (10-11 months) and having a yield potential of 200-250 q/ha.
Round melon		
Pusa Raunak	Delhi NCR	First harvesting can be done 55-60 days after sowing. Young fruits at marketable stage are attractive green, shiny, uniform, flattish round in shape, 5 cm in diameter and single fruit weight is 60 g at marketable stage and yield is 75 q/ha.
Snap melon		
Pusa Shandar	Delhi NCR	Early maturing (46-48 days after sowing) tolerant to many diseases. Average fruit weight 700 g, having creamy white to light pink thick flesh and yield potential is 385 q/ha.
Spine gourd		
Arka Neelanchal Shanti	Odisha	It is developed through hybridization between spine gourd and teasel gourd. Fruit size medium (20 g) and yield potential is 15-16 kg/vine.
Teasel gourd		
Arka Neelanchal Gaurav	Odisha	Fruits are attractive, uniform lush green round-oval fruit with soft seed and high-quality edible portion for culinary purposes. Tolerant to downy mildew and anthracnose. Yield potential of this variety is 180-200 q/ha.

*Hybrid



Sponge gourd

Insect pest and diseases are the major problem for realizing maximum yield in indigenous cucurbits. Resistant variety for downy mildew and mosaic virus has been developed and recommended for cultivation (Table 6).

Varieties developed for processing purpose

The institute has initiated the research on identification of suitable variety for preparing the different product i.e. petha sweet, parwal sweet and, bitter gourd chips/powder,

Table 6. Response of varieties/hybrids to different biotic stresses

Crop	Disease	Variety/hybrid
Ash gourd	Tolerant to anthracnose	Kashi Dhawal
Sponge gourd	Resistant to sponge gourd mosaic virus	Kashi Shreya, Kasha Rakshita*, Kashi Jyoti and Kashi Saumya*
Ridge gourd	Tolerant to downy mildew	Kashi Shivani
Hermaphrodite ridge gourd (Satputia)	Tolerant to downy mildew	Kashi Khushi

* Hybrid

Table 7. Suitable varieties/hybrids for processing

Value added and processed product	Name of varieties
Petha sweet and preserved	Kashi Dhawal, Kashi Ujwal
Bari & Tilauri (Local product prepare using petha fruits)	Kashi Dhawal, Kashi Ujwal, Kashi Surbhi
Parwal sweet	Kashi Alankar
Bitter gourd chips/powder	Kashi Mayuri

through value addition and processing. The following varieties have been identified and notified for value addition and processing (Table 7).

Future challenges

- Most of the indigenous cucurbits except bitter gourd and cucumber are grown in specific location/pockets hence needs wide popularity.
- Lack of diversity in clonally propagated crops i.e. pointed gourd, ivy gourd, spine gourd and teasle gourd is a problem for further genetic improvement.
- Problem of fruit set, yellowing and dropping of immature fruits reported in pointed gourd due to improper pollination. The proper ratio of male and female plants (1:10) needs to be maintained in the field.

- Due to fluctuation in temperature and high vector population the dynamics of virus infestation are changing very fast and maximum percent of incidence recorded for begmovirus (93.33%) followed by poty virus (39.44) and tobamovirus (38.33%) in cucurbits and these viruses are causing considerable losses in total productivity.
- Occurrence of melon weevil damaging fruits and vines, becoming a serious pest of sponge and ridge gourds.

For further interaction, please write to:

Drs Sudhakar Pandey, Tribhuvan Chaubey, R. K. Dubey, P. Karmakar, Keshav K. Gautam, Vikas Singh, D.R. Bhardwaj and P M Singh, ICAR-Indian Institute of Vegetable Research, Varanasi 221 305. Email: sudhakariivr@gmail.com

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– Editor