

Unique germplasm of vegetable crops in India

Due to increasing global economic interdependence and trade in agricultural products and international conventions and treaties, it is desired to value and record the available diversity in crops of a region. Vegetables are an important part of the diet of millions of people around the world, more particularly in the tropics. Vegetables have quick plant growth to produce maximum quantity of food for the area planted and fetch more income in short time as compared to other food commodities. They provide variety and flavours to the diet, making meals more palatable and appetizing. The food value of vegetables, especially leafy types and fruits is low because of large amount of water, low fat and calories but they are rich sources of vitamins, minerals and fibre.

INTEREST towards vegetable production has increased rapidly in different parts of the world especially in the tropical regions due to increasing consciousness towards human health, food value and food security. In general, the consumption of fresh vegetables has increased substantially in the present time as compared to near past, thus making cultivation of vegetables more viable. The natural distribution pattern of cultivated vegetable species was largely influenced by the active transport across the regions and the continents along with human migration and trade. The minor vegetables (including wild types) and several other less known cultivated species are recognized only at local level and thus have potential for commercialization.

India has a rich diversity of plant genetic resources, including a wide range of unique germplasm of vegetables. Utilization of this unique germplasm in vegetable breeding programs can lead to the development of new and improved vegetable varieties that are well-suited to the diverse agro-climatic conditions found throughout the country. India is home to a diverse array of vegetable crops, many of which have unique germplasm that is not found anywhere else in the world. These unique varieties have been developed through centuries of traditional farming practices and have adapted to the specific growing conditions of different regions in India.

More than 20 different families including Cucurbitaceae (25 crops), Fabaceae (16), Brassicaceae (12 crop) and Solanaceae (6 crops) of higher plants are grown as vegetable crops in India. Despite being recognized for their nutritional value, the possible reasons of low utilization of this group of crop species is lack of supply and non-viable indigenous market when compared to major vegetables. Many under-utilized vegetables are rich source of vitamins, minerals and dietary fibre and have lot of potential for commercialization.

SOLANACEOUS VEGETABLES

The family Solanaceae, in addition to potato (*Solanum tuberosum*), provides several other vegetables (Table 1) like tomato, brinjal, chilli/ hot pepper and sweet pepper. Another example is the Indian eggplant, which is known for its unique shape and size. The Indian eggplant is small and round, and is typically used in curries and stews. It has a distinct, bitter flavour that sets it apart from other varieties of eggplant.

Contribution from ICAR-IIVR, Varanasi: Promising Solanaceous germplasm from ICAR-IIVR, Varanasi registered as unique germplasm at ICAR-NBPGR, New Delhi are provided in Table 2.

LEGUMENOUS VEGETABLES

Legume family, Fabaceae which includes pea, bean and cowpea provides highly nutritional vegetables rich in proteins, and amino acids neatly complementing to the cereals.

Contributions from ICAR-IIVR, Varanasi: Six promising genotypes have been registered by the institute, as given here.

Triple Podded Pea (VRP-500):

This is the first genetic stock of garden pea registered with NBPGR (INGR15009) bearing triple pod on every node. This line was developed through hybridization between VRP-5 (single pod at each node and early in maturity) and PC-531 (double pods at each node and medium in maturity) followed by selection. First flower appears on 13th node and it takes 52 days to 50%



Triple Podded Pea
(VRP-500)

Table 1. Promising genetic stocks of Solanaceous vegetables

Crop	National identity	INGR number	Novel/Unique feature
Brinjal	IC296759	99037	Intermediate, semi-spreading, medium tall, thornless, better ratooning, long fruit colour retention, less seed content, serves the purpose of long and round types
Brinjal	IC395333	3074	Resistance to bacterial wilt
Brinjal	IC526796	5025	Combined resistance to bacterial wilt
Brinjal	IC249349	9122	Resistance to bacterial wilt
Brinjal	IC090982	9123	Resistance to bacterial wilt
Brinjal	IC585684	12015	Highly resistant to bacterial wilt (<i>Ralstonia solanacearum</i>) disease. Fruit large, oblong and green. Good agronomic performance under Andaman Islands conditions.
Brinjal	IC635040	20034	Purple colour with green tinge at distal end of the fruit. Non-spiny nature. Cooking quality (CRISPY nature)
Brinjal	IC640704	21153	Resistant to bacterial wilt disease caused by <i>Ralstonia solanacearum</i> . Fruit is medium in size, oblong in shape and purple in colour; average no. of fruits/ plant is 7.0 with fruit weight of 76.25 g. Fruit yield of the variety is 16.0 t/ha during dry season of Rabi under Andaman Island conditions; suitable for growing in rain-fed conditions of tropical islands.
Chilli	IC395318 (IC395319)	3077	Cytoplasmic male sterility (CMS)
Chilli	IC399066	3092	High pungency
Chilli	IC296662 (IC296663)	4052	CGMS line with good general combining ability (GCA)
Chilli	IC296664 (IC296665)	4053	CGMS line with good GCA in different genetic background
Chilli	IC296667	4054	Fertility restorer line of MSI and MS 2
Chilli	IC296667	4055	Fertility restorer line
Chilli	IC526794	5024	Fertility restorer
Chilli	IC569194	9129	Erect cluster bearing de-stalking nature of fruits, low pungency and bright colour
Chilli	IC553284	7039	Resistant to leaf curl virus disease
Chilli	IC565015	8095	Resistant to thrips and mites
Chilli	IC505489	8097	Resistant to thrips and powdery mildew
Chilli	IC436231	14040	Purple phenotype as a morphological marker
Chilli	IC570408	14041	Immune to Anthracnose caused by <i>Colletotrichum capsici</i>
Chilli	IC553688;	13068	Unique material for high capsaicin adapted to the tropical humid climate
Chilli	IC615423	15057	Tallest in land/pot. Pungent-PPM-red 18300, green 17300. High yield
Chilli	IC631915	21154	Stalklessness or non-persistent calyx in red ripened fruit of chilli. Erect bearing habit. High yield.
Chilli	IC631916	21155	Stalklessness or non-persistent calyx in red ripened fruit of chilli. Pendent bearing habit. High yield and resistant to chilli leaf curl complex.
Chilli	IC642004	21219	Resistant to chilli veinal mottle virus disease. Good general combiner for yield and quality traits.
Chilli	IC646850	INGR22158	Heat Tolerance in chilli. The genotype can set fruits at maximum temperatures above 40°C and night temperatures above 25°C.
Chilli	IC646851	INGR22159	Heat tolerance. The genotype can set fruits at maximum temperatures above 40°C and night temperatures above 25°C.
Tomato	IC296468	3036	Resistant to root knot nematodes (<i>Meloidogyne javanica</i> and <i>M. incognita</i>)
Tomato	IC395328	3075	Resistant to tomato leaf curl virus (TLCV) and bacterial wilt
Tomato	IC395457	3076	Resistant to TLCV and bacterial wilt in different genetic background

Table 1. (Concluded)

Crop	National identity	INGR number	Novel/Unique feature
Tomato	IC528034	6036	High carotene
Tomato	IC526807	6037	High lycopene (7.86 mg/100 g) and carotenoides
Tomato	IC565013	8094	Source of resistance to root knot nematodes (<i>Meloidogyne javanica</i>)
Tomato	IC565014	8096	Resistant to root knot nematodes (<i>Meloidogyne javanica</i>)
Tomato	IC564448	9065	High TSS (6.00B)
Tomato	IC637249	21150	Broad spectrum resistance to Tomato leaf curl virus (ToLCV). <i>Ty-3</i> gene carrying tomato elite line with green fruit shoulder. It has greater combining ability
Tomato	IC637252	21151	Broad spectrum resistance to Tomato leaf curl virus (ToLCV). <i>Ty-2</i> and <i>Ty-3</i> gene pyramided line. Uniform ripening fruits.
Tomato	IC640703	21152	Dwarf plant
Tomato	IC637253	21216	Broad spectrum resistance to Tomato leaf curl virus (ToL CV). <i>Ty-2</i> and <i>Ty-3</i> gene pyramided line. Plum shaped fruits with distinctive thick green shoulder.
Tomato	IC644011	22049	Root Knot Nematode resistance. <i>Alternaria solani</i> resistance. ToLCV resistance and heat tolerance

Table 2. Promising genetic stocks of Solanaceous vegetables registered from ICAR-IIVR, Varanasi

National Id.	Crop/Botanical Name	Potentially valuable features
F-6050- (INGR No.-06036)	Tomato <i>Solanum lycopersicum</i>	Registered as a 'Jointless' peduncle mutant line of tomato. Can be used as a morphological marker. Plant bears round fruits (fruit size index-1.007) with an average weight of 60 g and plant height of 47.6 cm.
F-7028- (INGR06037)	Tomato <i>Solanum lycopersicum</i>	Registered as a source of 'high lycopene' content in tomato. Fruits of this line are slightly flattish round (fruit size index - 0.98); fruit weight ranges from 50-60 g with 4-5 locules on plants of 62-70 cm height. Can be used in breeding programme for developing varieties/hybrids with higher level of lycopene content in tomato.
IC640702 INGR21149	Tomato <i>Solanum lycopersicum</i>	Broad spectrum resistance to Tomato leaf curl virus (ToLCV). <i>Ty-3</i> gene carrying line with uniform ripening fruits. It has greater combining ability
IC637249 INGR21150	Tomato / <i>Solanum lycopersicum</i>	Broad spectrum resistance to Tomato leaf curl virus (ToLCV). <i>Ty-3</i> gene carrying tomato elite line with green fruit shoulder. It has greater combining ability
IC637252 INGR21151	Tomato / <i>Solanum lycopersicum</i>	Broad spectrum resistance to Tomato leaf curl virus (ToLCV). <i>Ty-2</i> and <i>Ty-3</i> gene pyramided line. Uniform ripening fruits.
IC637253 INGR21216	Tomato / <i>Solanum lycopersicum</i>	Broad spectrum resistance to Tomato leaf curl virus (ToL CV). <i>Ty-2</i> and <i>Ty-3</i> gene pyramided line. Plum shaped fruits with distinctive thick green shoulder.
IC644011 INGR22049	Tomato / <i>Solanum lycopersicum</i>	Root Knot Nematode resistance. <i>Alternaria solani</i> resistance. ToLCV resistance and Heat tolerance.
BS-35- INGR07039	A natural Interspecific hybrid of <i>Capsicum chinense</i> and <i>C. frutescens</i>	Registered as source of Pepper leaf curl virus disease in chillies. Highly pungent small fruited bird eye chilli.



F-6050- (INGR No.-06036)

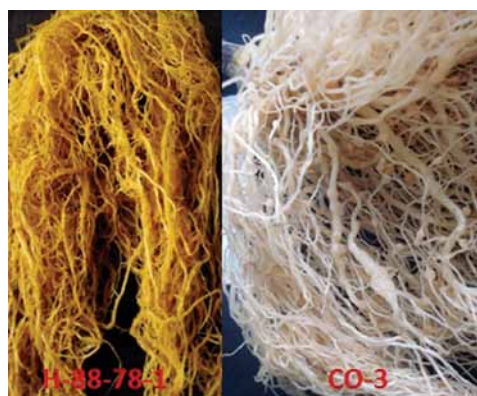


F-7028- (INGR06037)



BS-35- INGR07039





H-88-78-1 (IC644011; INGR22049)



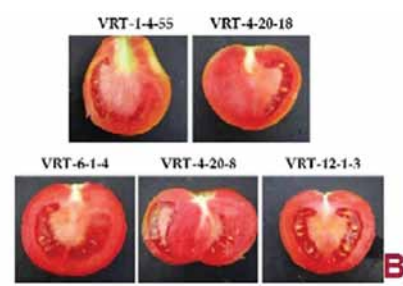
VRT-2-3-1 (IC637249; INGR21150)



VRT4-55-20 (IC637253; INGR21216)



VRT-6-1-4 (IC637252; INGR21151)



VRT-12-1-3-2 (IC640702; INGR21149)



done 70-75 days after sowing. Pods are 8-9 cm in length, green in colour and slightly curved having 8-9 seeds/pod. Average yield/plant is 176-190 g and shelling per cent is 48-49. This genetic stock can be used for future breeding programme for higher number of pods and yield.

Multiple Disease Resistant Pea (VRP-147): VRP-147 is a late maturing genotype registered with NBPGR (INGR15028) for powdery mildew, downy mildew and rust resistance. First flower appears on 16-17th node and 50% flowering occurs in 65-66 days after sowing. Average pod length and width is 5.5 cm and 1.42 cm, respectively. Pods are green in colour and slightly curved. Average number of pods/plant is 24.5 and 10 pod weight is 44 g. Each pod has 6.2 seed. Yield/plant is 98 g and shelling per cent is around 47.2. The total sugar is 3.80%.

flowering. The plant height of VRP-500 varies from 130-137 cm with an average of 134.7 cm. First picking can be

Table 3. Promising genetic stocks of Leguminous vegetables

Crop	National identity	INGR number	Novel/Unique feature
Fenugreek	IC296791	1012	Light green narrow leaves, downy mildew resistant, quick germination, fast initial growth, long pod, bold seed with green tan seed coat colour
Fenugreek	IC296792	1013	Tall, erect plant type with multi-branched habit, whitish green stems, dark green narrow leaves, powdery mildew resistant and downy mildew tolerant
Pea	IC610501	15009	For triple podded at every node
Pea	IC598281	15028	Resistant to downy mildew and rust
Pea	IC598280	15029	Resistant to powdery mildew
Pea	IC630592	19077	Capable to produce 3-5 pods/peduncle at multiple flowering nodes (Multi-podded genotype).
Pea	IC637586	21059	Fasciation plant type. Synchronized flowering and pod formation. Putative mutant synthesized from Azad P-1.
Pea	IC642003	21221	Resistant to powdery mildew disease
Pea	IC642307	22087	Extra early genotype of vegetable pea (<i>Pisum sativum</i> var. <i>hortense</i>). Synchronous maturity, thus suitable for single picking or Mechanical harvesting and Multiple cropping.



Multiple Disease Resistant Pea (VRP-147)

Multiple Disease Resistant Pea (VRP-343): VRP-343 is also late maturing genotype having multiple resistance for powdery mildew, downy mildew and rust (Registration No. INGR15029). First flower can be seen after 13 to 14th node and plants takes 59-60 days for 50% flowering. Average pod length is 6.10 cm while, width of pod is around 1.36 cm. Pods are green in colour and slightly curved. Average number of pods/plant is 26.4 and each pods is having 6.5 seed. The weight of 10 pods is 42 g. Yield/plant is 110 g and shelling per cent is around 46.5. The total sugar is 3.15%.



Multiple Disease Resistant Pea (VRP-343)

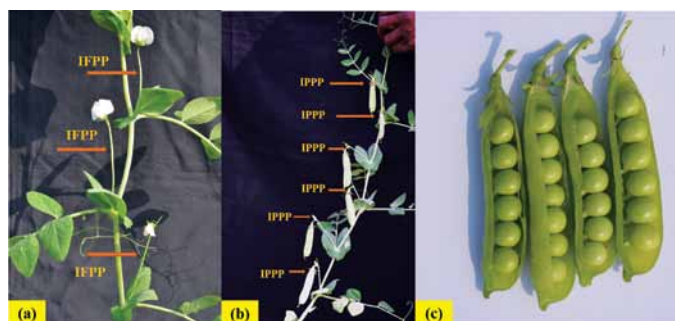
VRPM-901-5 (INGR19077): The newly bred 'VRPM-901-5' is a mid-season pea genotype capable of producing 3-5 flowers/pods at multiple flowering nodes. This genotype was developed by using single plant selection approach from a cross 'VL-8 × PC-'. The first multi-flowering node appears on average 21st node. This genotype is characterized with higher number of primary branches/plant (2 to 7) and high reproductive nodes/plant (on average 18.9). Pods are 7.5-9 cm in length and light green in colour. VRPM-901-5, appeared most promising for pod yield per plant (208 g). This genotype had showed yield potential up to 290 g/plant, almost 2.5 times the existing cultivars. This genotype is very promising for high pod yield and can also be used as parents for any breeding program aimed at incorporating multi-flowering trait in garden-pea.

VRPSel-17 (INGR21139): VRPSel-17 is unique in the fact that it bears only one flower (white) on all its flowering nodes and is not affected by external growing conditions including the environment. Over the years,



Field performance of VRPM-901-5, (a) appearance of five flowered raceme; (b) plant bearing five pods and four pods on single peduncle at multiple reproductive nodes, and (c) multi-flowering racemes at seed maturity.

the genotype exhibited consistent flowering behaviour of single FPP on all the reproductive nodes. The genotype is also resistant to powdery mildew and rust under natural field conditions. Despite its low pod yield (60-70 g/plant), this genotype can be used in a variety of genetic studies, including inheritance of flower numbers, flowering time, peduncle traits, seed and pod characters, disease studies, and so on.



VRPSel-17 (INGR21139)

VRPE-29 (INGR22087): VRPE-29 is an extra early vegetable pea genotype (Days to flower ≤32 days) in which pods are ready for picking in 60-65 days with average pod yield of 70 g/plant. The plants are determinate, with shorter internodal length, 1st flower appeared on 8th to 9th node onward. The pods are very attractive and slightly curved in shape, having on average 8 seeds/pod. Plant bears 10-12 dark green pods of 8-8.5 cm long, having pod width of 1.5 cm, average pod weight of 8-9.5 g, 100-green seed weight of 54 g, shelling percentage of 50% and pod yield potential of 90-100 q/ha. It has additional advantage of synchronous maturity (single picking) and can be easily fit for multiple cropping and high intensity cropping systems. Additionally, it could be a potential parent for breeding early maturing cultivars in peas.



(a) Pod bearing and (b) seed filling in VRPE-29 (IC0642307) under normal field conditions

Table 4. Promising genetic stocks of Cucurbitaceous vegetables

Crop	National identity	INGR number	Novel/Unique feature
Cucumber	IC296700	98018	High yielding, small fruit, drought hardy and high temperature insensitive
Cucumber	IC645771	22085	High carotenoid content (54.8 $\mu\text{g/g}$ in mature fruits; 8.12 $\mu\text{g/g}$ in tender fruits). Orange flesh colour.
Watermelon	IC296694	98012	High yielding, drought hardy, sweet, juicy with longer shelf life
Watermelon	IC296816	1037	Yellow colour flesh
Watermelon	IC296817	1038	Simple unlobed leaf
Watermelon	IC584139	10158	Bushy plant type
Watermelon	IC627526	19079	Stable andromonoecious sex form.
Watermelon	IC631247	20033	BIL-53 is an advanced Pre breeding line derived from the cross <i>C.lanatus</i> var. <i>citroides</i> $\times$ <i>Arka manik</i> possessing resistance to WBNV disease.
Watermelon	IC523059	20036	Possess resistance to <i>Fusarium oxysporum</i> f. sp. <i>niveum</i> race 1 and race 2 performed good as a rootstock with respect to different yield and quality traits of a susceptible scion grafted onto it
Watermelon	IC633085	20117	Saffron coloured flesh with high carotenoid content. Non-lobed (entire) leaves.
Kachri	IC296695	98013	High yielding drought hardy with large fruits, suited for salad
Kachri	IC299696	98014	High yielding drought hardy with large fruits, suited for salad
Snapmelon	IC296697	98015	High yielding and drought hardy with different genetic background
Snapmelon	IC296698	98016	High yielding and drought hardy with different genetic background
Snapmelon	IC553288	7044	Downy mildew resistance
Bottle gourd	IC296733	99009	Andromonoecious sex
Bottle gourd	IC296744	99022	Segmented leaf type
Bottle gourd	IC571819	10064	Spindle shaped fruit with hard durable rind
Bottle gourd	IC635410	21145	Resistant to gummy stem blight. Short cylindrical fruit
Bottle gourd	IC635411	21146	Resistant to gummy stem blight medium cylindrical fruit.
Bottle gourd	IC635413	21147	Resistant to powdery mildew, elongated straight.
Bottle gourd	IC635412	21148	Resistant to gummy stem blight, round shaped fruit
Bottle gourd	IC635414	21215	Resistant to powdery mildew elongated straight with stripes
Round melon	IC296758	99036	Intermediate, semi-spreading vine, green foliage, round bright fruits, tender and sparsely pubescent, tolerant to downy mildew and root rot wilt complex
Bitter gourd	IC591254	12014	Predominantly gynoeocious habit
Bitter Gourd	IC642345	22161	Resistant to powdery mildew (<i>Podosphaera xanthii</i> U. Braun and Shishkoff) Dark green, deeply lobed leaves. Fruit is small, dark green, discontinuous ridges
Bitter gourd	IC296539	3037	Gynoeocious line with high yield and attractive fruits
Pointed gourd	IC296492	3035	Seedless fruit, obligate parthenocarpic with long duration fruiting
Pumpkin	IC526803	5027	High carotenoid content
Ivy gourd	IC553244	9126	Fruit length (8.5-9 cm), uniform cylindrical shape
Meetha Karela	IC415397	6020	Spineless large fruit (Dia 2.56 cm)
Muskmelon	IC557426	8043	Fruit wall round, light brown
Muskmelon	IC557706	8044	Source of resistance to Cucumber Green Mottle Mosaic Virus (CGMMV) & Downy mildew
Muskmelon	IC599709	14043	Monoecious sex form
Sponge gourd	IC584054	10159	Cluster bearing habit of fruiting
Sponge gourd	IC588956	12013	Highly resistant to Tomato Leaf Curl New Delhi Virus
Sponge Gourd	IC588957	21058	Highly resistant to Tomato Leaf Curl New Delhi Virus. Good combiner and gives higher heterosis for yield and other desirable traits. Resistance is governed by single dominant gene, hence can be utilized for resistant hybrid development

CUCURBITACEOUS CROPS

Cucurbitaceae is among the important families providing large number of vegetables such as gourds, melons, pumpkin/squash and cucumbers. Among major crops, the cucurbits are important for the Indian region, including 38 endemic species. One example of unique germplasm in vegetable crops in India is the bitter gourd. The Indian variety of bitter gourd is known for its high tolerance to extreme weather conditions and its ability to produce fruits even in drought-like conditions. This makes it an important crop for farmers in arid regions of the country. Similarly, the Indian Bottle gourd is also a unique vegetable crop in India. It has a distinctive shape, and is typically used in curries and stews. It is a popular vegetable in southern India and is often used in sambar and other traditional dishes.

Contributions from ICAR-IIVR, Varanasi: Given here.

Cluster bearing sponge gourd “VRSG-52-1” INGR-10159: This is the first report in which cluster bearing cultivars and hybrids in sponge gourd are being used.

SA-90: A high carotenoid content pumpkin (*Cucurbita moschata*) genotype (IGNR No. – 05027): The genotype SA-90 has 14.85 mg (100 g edible portion) carotenoid and was considered as a promising line for carotenoid followed by Pumpkin-111 (14.19 mg), BP-14 (13.61 mg) and IVPK-226 (13.08 mg). SA-90 is vigorous in vine growth. The single plant bears 1.6 fruits, having the fruit weight 4.0-5.15 kg. The flesh colour of the fruit is dark yellow and 3.5 cm thick. The shape of the fruit is oblong round having the 3-5 month storage capacity at ambient room temperature.

B-159: Downy mildew resistance genotype of snapmelon (*Cucumis melo* var. *momordica*): (IGNR No. 07044): Genotype was evaluated under epiphytic field conditions during summer and B-184 and B-159 were observed to be highly resistant and again planted in the glass house with susceptible lines and inoculated with spores at seedling stage. The coefficient of infection value was 0 and 1.2 for B-159 and B-184 is easily crossable with muskmelon, and can be utilized for development of resistant hybrid and variety. The fruit of B-159 are long (35-40 cm) with dark green colour and having 7.5-8 cm diameter. The average weight varied from 0.8-1 kg at mature stage and bear 3-4 fruit/plant.

Gynoecious bitter gourd: Gy 63 (IC296539; INGR No. 03037): It is a first gynoecious genetic stock in bitter gourd. Gynoecious sex expression is stable. Its plants are very vigorous and bear light green leaves of medium to big size. The flowering starts from 7th node within 45 to 48 days of seeding and fruits attain edible maturity in 64 days (8-10 days after fruit set). Fruits are attractive green in colour and attain a length up to 15 cm and a diameter of 3.55 cm. Average individual fruit weight is 75-100 g. An average of 30 fruits per plant can be harvested. It possesses good keeping quality with more flesh.

Seedless pointed gourd IIVRPG-105 (IC296492; INGR No. 03035): It is an obligate parthenocarpic long duration fruiting genetic stock with seedless fruits. Fruits of the selected line were found free from seeds not only at edible stage but also at mature stage. Morphologically,



Seedless pointed gourd

this line has medium sized orbicular and un-lobed light green leaves having 10-15 cm length with rough surface. Plants attain a height of more than 3.0 m. Fruiting starts at 7th node and continues up to full plant growth stage. Fruits are medium in size, light green, striped, elliptical in shape and pointed. The flesh of fruit is light whitish. Length of fruit ranges 5.21 cm. Shelf life of fruits is up to 10 days. Close planting is recommended on trellis/bower system for growth and better management.

VRSG-7-17 (*Luffa cylindrica* L. Roem. Syn. *Luffa aegyptica* Mill.): An aromatic genotype of sponge gourd has been identified at ICAR-Indian Institute of Vegetable Research (IIVR), Varanasi. The genotype VRSG-7-17 is unique material of sponge gourd with characteristic aroma which resembles with the typical aroma of ‘Basmati rice’ in its various plant parts, viz. fruits, peel, and leaves. The SPME-GC/MS analysis of the volatile compounds of the fruits suggested that the compounds responsible for Basmati rice-like aroma were mainly hexanal, 1-octen-3-ol, 3-octanone and limonene. The fruits of this novel sponge gourd genotype (VRSG-7-17) also retained its special aroma even after cooking and/or boiling at high temperatures and did not lose fragrance traits at high temperatures. Interestingly, all the duo volatiles were either absent or found in very low concentration in the control sample Kashi Shreya (VRSG-194). The fruits of the genotype (VRSG- 7-17) are light green in colour with average fruit length 27.46 cm, fruit diameter 3.35 cm and fruit weight 156.5 g. Fruits mature at 52-60 days after sowing with an average fruit yield of 1.13 kg per plant.

MALVACEOUS CROP

The Indian okra, also known as lady’s finger, is another unique vegetable crop in India. The Indian okra has a tough, fibrous stem that makes it particularly suitable for use in stews and curries. It is a popular vegetable in southern India and is often used in sambar and other traditional dishes. The promising unique germplasm registered in okra are given in Table 5.

COLE CROPS

The mustard family, Brassicaceae, includes many important vegetables. Single species *Brassica oleracea*

Table 5. Promising genetic stocks of okra

Crop	National identity	INGR number	Novel/Unique feature
Okra	IC526802	5026	New plant type (Dwarf, bushy with short inter-nodal length)
Okra	IC565533	9125	Thin (0.9 cm) and long fruited (26 cm)
Okra	IC523737	10156	GMS line
Okra	IC189926	10157	Completely ridge less fruit, long stalk easy to snap, shorter inter-node length, suitable for both fresh market and processing

Table 6. Promising genetic stocks of Cole vegetables crops

Crop	National identity	INGR number	Novel/Unique feature
Cauliflower	IC614417	16015	Cytoplasmic male sterile line (CMS); good seed yield; cream coloured flower.
Cauliflower	IC614418	16016	Maintainer line of Ogu 3A.
Cauliflower	IC614419	16017	Cytoplasmic male sterile line (CMS); good seed yield; cream coloured flower.
Cauliflower	IC614420	16018	Maintainer line of Ogu 33A.
Cauliflower	IC632605	19078	Downy mildew resistance genotype of cauliflower and resistance is governed by single dominant <i>PPa3</i> gene. The resistance locus <i>Ppa3</i> is mapped with molecular markers. A genotype of medium maturity group cauliflower.
Cauliflower	IC 6 3 2 6 0 3 IC632604	& 20030	Ogura based cytoplasmic male sterile line of early maturity group (25-30°C) of Indian cauliflower. CMS line with dwarf plant type. Good combiner for earliness and curd yield in early maturity group of Indian cauliflower.
Cauliflower	IC 6 3 2 6 0 1 IC632602	& 20031	Cytoplasmic male sterile line of early maturity group (25-30°C) of Indian cauliflower. Carry Ogura sterile cytoplasm. Good combiner for earliness and curd yield.
Collard green	IC632940	20035	A tropical type-first of its kind in the world that bolts, flowers and sets seeds during spring season at Varanasi, Uttar Pradesh. It does not require vernalization to stimulate/induce bolting and flowering. Fast growing and high leaf yield potential, i.e. 45-50 t/ha.
Cauliflower	IC 6 3 7 0 2 6 IC637027	& 20092	Cytoplasmic male sterile line. Compact creamy white curd. Strongly waxy. Bluish green broad leaves.
Cauliflower	IC637585	21057	It is resistant to black rot disease (<i>Xanthomonas campestris</i> pv. <i>campestris</i> race 1). Carry a novel single dominant gene <i>Xca1bo</i> for black rot resistance. <i>Xca1bo</i> gene is located on chromosome 3 and flanked by DNA markers
Cabbage	IC638877	21105	Self-Incompatible (SI) line. Flat compact head. Shorter stalk length.
Cabbage	IC638878	21106	Self-Incompatible (SI) line. Round and very compact head. Smaller plant spread and height with minimum number of non-wrapper leaves
Broccoli	IC632628	21214	Purple heading early tropical type broccoli which produce seeds in Northern plains during winter season. In head, buds are fine to medium fine and buds and their stalk are intense purple therefore rich in anthocyanin (30.0 mg/100 g fw). Average marketable head weight ranges from 650-810 g and marketable yield is 27.0 t/ha.
Cauliflower	IC642000	21217	It is resistant to black rot disease (<i>Xanthomonas campestris</i> pv. <i>campestris</i> race 1). Carries single dominant resistant gene
Cauliflower	IC642001	21218	PC-1 is a new genotype of Purple Sicilian type (an intermediate type of cauliflower and broccoli) which produce attractive purple curds with light green stalks. The purple curding phenotype is governed by a single locus <i>Pr</i> with incomplete dominance but different from purple cauliflower. 'PC-1' curds are rich in anthocyanin (40.6±2.74 mg/100 g FW) and mature in December month and produce seed profusely in sub-tropical condition.
Cauliflower	IC643987	22047	Highly resistant to downy mildew disease (c.o. <i>Hyaloperonospora parasitica</i>). Carry single dominant gene <i>Ppa207</i> for downy mildew resistance. The resistant gene <i>Ppa 207</i> was mapped in 4.8 cM linkage interval on linkage group 2 (C02) of cauliflower, flanked by the markers BoGMS0486 and BoGMS0900 at 3.6 and 1.2 cM, respectively.

includes the 'cole crops' such as cabbage, cauliflower, knol-khol, brussels sprouts, broccoli and kale (Table 6).

Contributions from ICAR-IIVR, Varanasi: Given here.

Kashi Kale-1 (INGR20035, tropical genotype of Kale):
A unique tropical genotype of kale- first of its kind in the world was developed at ICAR-IIVR, Varanasi, Uttar

Pradesh, It doesn't require vernalization; and bolts, flowers and sets seeds in spring season of Varanasi, UP having 11-24°C temperature, 54-91% RH and 5.5 h day light during January-February i.e. 60 days before flowering. Registered as Unique Germplasm by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi on 29th September 2020.



Flowering in Kashi Kale-1

LEAFY VEGETABLES

Around 700 species (521 species used as leafy vegetables and 145 species as roots/tubers and 101 species as flower/ buds) out of over 1,200 species of higher plants are used as vegetable from wild plants growing in India overlap with about 200 species of less-known types. The northern plains/Gangetic plains including tarai region is considered to exhibit variability in leafy and other aquatic leafy vegetables. The north western/Indus plain region is rich in diversity particularly in amaranth, chenopods and ipomoea. Among the common leafy vegetables popular in India, species of brassica, amaranths and chenopodium are eaten in different parts of the country. Though all species of *Amaranthus* have edible leaves; leaves of grain types are hard as compared to the ones exclusively used as leafy vegetables. Some minor leafy vegetable crops mainly used for garnishing belong to family Apiaceae. Dill (*Anethum graveolens*), Indian dill (*A. sowa*), coriander (*Coriandrum sativum*), fennel (*Foeniculum vulgare*) and anise (*Pimpinella anisum*) are normally cultivated as potherbs, salad, flavouring soups, vegetable curries or for garnishing. Their cultivation is confined to marginal land and on small scale. They are sold in local market for consumption. Some of the promising genetic stocks in leafy vegetables registered by ICAR-IIVR include:

VRPLK-2 (INGR22086, Heat tolerant genotype of Spinach beet or Palak): Leaves are attractive, smooth, succulent, lush-green with entire margin. It is suitable for round the year cultivation (winter, spring, summer, rainy and autumn seasons) because of tolerance to heat conditions (up to maximum temperature of 40-45°C), delayed bolting and wide adaptability. Marketable yield is 500-900 q/ha (August to November sowing), 120-170 q/ha (December to February sowing) and 180-235 q/ha (March to July sowing). Dry matter is about 15-16% and good source of vitamin C, i.e. 65-75 mg/100 FW. Registered as Unique Germplasm by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi on 8th July 2022.

UNDERGROUND VEGETABLES

Tuberous/root vegetables, rank next to cereals as rich source of carbohydrate but are poor in proteins and fats. The minor vegetables, despite their tremendous potential for commercial use have remained localized for cultivation and consumption. Among spices, onion and garlic are important vegetables (Table 7).



VRPLK-2 during April, January and June, respectively

Contributions from ICAR-IIVR, Varanasi: Given here. **"CMS" A-line and B-line in tropical carrot (IC570071, fertile CR-27F); INGR-10110:** This is the first report in tropical carrot, which is very useful in development of hybrids.

VRCAR-214 (INGR22160, Male sterile line of Red carrot): It is a petalod-CMS line of red carrot with better heterotic potential for root yield, lycopene content and uniformity. The economic traits of VRCAR-214 are as root length of 22.1 cm, root weight of 118.7 g, shoulder diameter of 3.65 cm, lycopene content of 7.45 mg/100 g FW, beta-carotene content of 3.41 mg/100 g FW, TSS of 7.45 °Brix, and root yield potential of 325 q/ha. VRCAR-214 and its maintainer are ideally synchronous in flowering/pollination activities. Registered as Unique Germplasm by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi on 8th December 2022.

VRCAR-252 (INGR22088, Male sterile line of Black carrot): It is a petalod-CMS line of black carrot with better heterotic potential for root yield and uniformity. The roots are excellent source of plant derived anthocyanins (278 mg/100 g FW) and phenolics (323 mg GAE/100 g FW); having better anthocyanin yield potential (67 kg/ha); and greater anti-oxidative ability (FRAP value of 47 µmol TE/g FW), i.e. 28-times higher than red/orange/yellow carrots. VRCAR-252 and its maintainer are ideally synchronous in flowering/pollination activities. Registered as Unique Germplasm by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi on 8th July 2022.

Table 7. Promising genetic stocks of underground vegetables

Crop	National identity	INGR number	Novel/Unique feature
Garlic	IC296711	98030	Compact bulbs with silvery white skin, cream coloured flesh and big cloves
Garlic	IC296712	98031	Compact bulbs, creamy white skin with cream coloured flesh
Garlic	IC0596521	14009	For earliness, suitable for cultivation in <i>Kharif</i> season, ready for harvest within 72-77 days, in <i>Rabi</i> mature in only 85-95 days.
Garlic	IC598236	16035	Bolder size of bulbs, bears umbels with micro-cloves, suitable for cultivation in frost prone hills.
Malabar tamarind/ Gummi-gutta	IC244100-2	4061	Early bearing (6 years after transplant) with superior yield traits
Carrot	IC057007 and IC570261	10110	Petaloid type stable male sterile line of Asiatic carrot, suitable for development of hybrid
Onion	IC645764	22082	Waterlogging tolerance.
Onion	IC645763	22083	Drought tolerance.
Onion	IC645760 and IC645761	22084	Long day/intermediate day length onion line with Cytoplasmic male sterility (CMS)
Onion	IC598327	14057	Very early in maturity (harvested within 90 days after transplanting during <i>rabi</i>). 100% uniform neck-fall. Unique genotype for earliness and uniform neck-fall.
Onion	IC616539	16006	Unique early multiplier; suitable for both <i>rabi</i> and <i>kharif</i> seasons; early maturing with six uniform bulblets per bulb.
Carrot	IC623130 and IC642961	22088	VRCAR-252 is a petalod-CMS line of black carrot with better heterotic potential for root yield and uniformity. The roots of VRCAR-252 are excellent source of plant derived anthocyanins (278 mg/100 g FW) and phenolics (323 mg GAE/100 g FW); having better anthocyanin yield potential (67 kg/ha); and greater antioxidative ability (FRAP value of 47 μ mol TE/g FW) i.e. 28-times higher than red/ orange/ yellow carrots. VRCAR-252 and its maintainer are ideally synchronous in flowering/pollination activities which facilitate proper pollination and maximum seed set in CMS line.
Carrot	IC623137 and IC642958	22160	VRCAR-214 is a petaloid-CMS line of red carrot with better heterotic potential for root yield, uniformity and lycopene content; valuable for development of potential F1 hybrids; and cost-effective multiplication of hybrid seeds. The CMS line (VRCAR-214) and its maintainer (Kashi Arun) are ideally synchronous in flowering/ pollination activities which facilitate proper pollination and maximum seed set in CMS line. The roots of VRCAR-214 are good source of lycopene (7.3-7.5 mg/100 g FW) and beta-carotene (3.25-3.50 mg/100 g FW).
Carrot	IC635036 and IC635037	20115	Dark purple (black) colour main season tropical carrot CMS line developed indigenously. It has 'petaloid' type sterility and stable and easy to distinguish. Its roots are of acceptable size and of self core. It is suitable for main season sowing, i.e mid-September onwards in north Indian plains.
Carrot	IC598343 and IC637028	20116	First red colour main season tropical carrot CMS line developed indigenously. Roots are of acceptable size and suitable for main season sowing, i.e. from mid-September onward in North Indian plains.
Carrot	IC635034 and IC635035	21056	IPC HT2A is first red colour heat tolerant tropical carrot CMS line developed indigenously. Roots are of acceptable size, red colour and self-core. It is only CMS line which is suitable for early season sowing due to its Pusa Vrishti (IPC HT2) genotype background
Carrot	IC635038 and IC635039	21090	PC 11A Orange is the first orange colour main season tropical carrot CMS line developed indigenously. Roots are of acceptable size and suitable for main season sowing, i.e. from mid September onward in north Indian plains. It has petaloid type sterility and stable and easy to distinguish.
Radish	IC642005 and IC642006	21220	Cytoplasmic Male Sterile (CMS) line having lyrate leaf shape and blunt root (almost cylindrical root shape). Good combiner and higher heterosis for yield (12.5-33.6%), root length (6.5-32.4%) and root weight (17.2-30.0%) during winter season. ICAR-IIVR, Varanasi, UP is first to develop CMS line of radish among Public Sector Organizations in India, and will be available on public domain after its registration.
Radish	IC643967	22048	High tolerance to irrigation water salinity (EC _{iw} 8-10 dS/m) and soil sodicity (pH 8.5)
Radish	IC625064 and IC625065	20032	Cytoplasmic Male Sterile (CMS) line. First CMS line of radish from Public sector in India developed at ICAR-IIVR, Varanasi, UP. Good combiner and high heterosis for yield, root length and root weight.



Male sterile and male fertile umbellate and flowers of VRCAR-214 and its maintainer



Male sterile and male fertile umbellate and flowers of VRCAR-252 and its maintainer

VRRAD-12 (INGR21220, Male sterile line of Radish):

Second Ogura-CMS line of radish from Public Sector in India developed at ICAR-IIVR, Varanasi, Uttar Pradesh; robust CMS system with better combining ability and heterosis; lyrate type of leaf shape i.e. leaf morphology (leaf division incision); and develop white and non-tapering (almost blunt) roots during winter season. VRRAD-12 and its maintainer are ideally synchronous in flowering/pollination activities. Registered as Unique Germplasm by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi on 24th December 2021.



CMS line (VRRAD-12) and its maintainer

VRRAD-201 (INGR20032, Male sterile line of Radish): First Ogura-CMS line from Public Sector in India; having robust CMS system with better combining ability and heterosis; sinuate type of leaf shape, i.e. leaf

morphology (leaf division incision); and develops white and tapering roots during winter, spring and summer seasons. VRRAD-201 and its maintainer are ideally synchronous in flowering/pollination activities. Registered as Unique Germplasm by Plant Germplasm Registration Committee (PGRC), ICAR-NBPGR, New Delhi on 29th September 2020.



In addition to these unique vegetable crops, India is also home to a variety of unique fruits and spices that are an important part of the country's traditional cuisine, which are known for its taste, flavour, nutrition and response in biotic and abiotic stresses. One way in which such unique germplasm is utilized in vegetable breeding programs in India is through the use of landraces, or traditional varieties of vegetables that have been developed and maintained by farmers over generations. These landraces often possess unique characteristics, such as tolerance to specific diseases or abiotic stresses, which can be exploited in breeding programs. Additionally, unique germplasm may be used as a source of genetic variation for traits such as yield, fruit quality, and pest resistance. Another way that unique germplasm is utilized in vegetable breeding programs in India is through the use of wild relatives of cultivated vegetables. These wild relatives often possess valuable traits, such as disease resistance, that can be introgressed into cultivated varieties. This is done by crossing the wild relatives with the cultivated varieties to transfer the desired trait.

SUMMARY

The utilization of unique germplasm in vegetable breeding programs in India can lead to the development of new and improved vegetable varieties that are well-suited to the diverse agro-climatic conditions found throughout the country. This can be done by using landraces and wild relatives of cultivated vegetables as a source of genetic variation for desired traits. India is home to a wide variety of unique vegetable crops that have adapted to the specific growing conditions of different regions in the country. These unique varieties have been developed through centuries of traditional farming practices and are an important part of India's traditional cuisine. These unique germplasm hold a great importance in the field of agriculture and food security.

For further interaction, please write to:

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