

Diversity and conservation of indigenous and minor vegetables

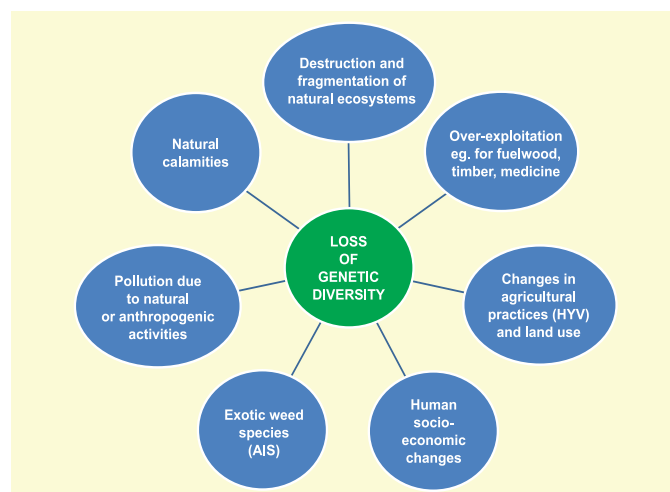
More than 100 indigenous and minor vegetables are widely grown all over the country throughout the year for their edible leaves, stems, flowers buds & open flowers, fruits, seeds, roots etc. Indigenous vegetables, viz. brinjal, bitter gourd, ridge gourd, sponge gourd, satputia, ashgourd, snakegourd, longmelon, snapmelon, round melon, cucumber, pointed gourd, ivy gourd, spine gourd, sweet gourd, basella, lotus, colocasia, cluster bean, Indian bean, water spinach, palak etc. are primary members for greater use of crop biodiversity as they are enjoyed locally and can be produced profitably with the minimal external inputs in both rural and urban environments. Today these indigenous and minor vegetables need greater attention of researchers, policymakers, and funding agencies to safeguard the extinction of biodiversity which is not only a source of well-being but also the foundation of their cultural and spiritual identities.

Extinction of Indigenous genetic diversity

There are several species which are becoming extinct day by day in changing scenario in cultivation especially monoculture, development of hybrids, urbanization, fragmentation of habitats, deforestation, overexploitation, rapid changes in the hydrological regime and land use patterns, soil degradation, air and water pollution, adverse impact of development and increase in the population (Table 1). Incidence of biotic and abiotic stress and many natural and biological factors, there is threat to the existing indigenous vegetable genetic wealth.

In situ conservation

In situ conservation is very 'Dynamic conservation' where mostly wild, landraces and locally adapted materials are maintain in the naturally adopted field condition where continuous evolution takes place. For majority of the situation, *in situ* conservation is ideal method of conserving wild plant genetic resources and perennial vegetables, which either do not set or set recalcitrant seed, or do not produce plants true to type or produce seeds having unequal male and female progenies. of greatest conservation concern is the fate of long-lived species like-pointed gourd, ivy gourd, spine gourd, curry leaf as



Loss of genetic diversity through different major factors

their replacement may take longer time. Some perennial vegetable crops are being maintained in different agro-ecological niches as National Active Germplasm Sites (NAGS) designated by ICAR-NBPGR, New Delhi or for promotion of research on locally adopted/dominating crops.



Diversity in long melon and bitter gourd

Table 1. Rare and endangered cucurbitaceous species in India

Cucurbitaceous species	Biogeographic zones
<i>Corallocarpus gracillipes</i>	Western ghat
<i>Gomphogyne macrocarpa</i>	East Himalayas
<i>Indogevillea khasiana</i>	North Eastern region
<i>Luffa umbellata</i>	Western ghat
<i>Melothria amplexicaulis</i>	Deccan Peninsula
<i>Momordica subangulata</i>	Deccan Peninsula , Western ghat
<i>Trichosanthes lepiniana</i>	Deccan Peninsula, Western ghat
<i>Trichosanthes perrottetiana</i>	Western ghat
<i>Trichosanthes villosula</i>	Deccan Peninsula, Western ghat

Ex situ Conservation

Ex situ conservation or “Static conservation” involves removal of plant propagules (seed, stem, root, meristem part, pollen, protoplast etc.) from its natural environment and storing them in gene bank under suitable conditions that maintain propagules viability and vitality for longer period. Basic strategy is to conserve accessions for longer period under controlled conditions without changing their original genetic integrity.

Seed banks

Seed conservation is quite easy, relatively safe and needs minimum space. Seeds are classified, on the basis of their storability into two major groups:

Orthodox: Seeds which can be dried to low moisture content and stored at low temperature without losing their viability for long periods of time is known as orthodox seeds. eg. *Canavalia*.

Recalcitrant: Seeds which show very drastic loss in viability with a decrease in moisture content below 12 to 13% are known as recalcitrant seeds.



Low energy gene bank at ICAR-IIVR, Varanasi

Ultra-dry seed storage by Zeolite beads

Ultra-dry storage, also called low moisture content storage, is a technique for decreasing seed moisture content to less than 5-6% using desiccants. Desiccant technology works by adsorbing moisture in the surrounding air; adsorption occurs when moisture is tightly held at a molecular level versus absorption where moisture is dissolved. The desiccant then adsorbs the moisture in the air, causing the seeds to continue losing moisture until the seed, relative humidity in the air and the

Table 2. Variability, distribution status and conservation priorities of Indigenous and minor vegetable crops

Crop	Genera	CS	DS	GVS	GES	GCP
Brinjal	<i>Solanum</i> species	C	W	W	M	H
Cluster bean	<i>Cyamopsis</i> species	C	R	M	M	M
Lablab bean	<i>Lablab</i> species	C	W	H	M	M
Climbing spinach	<i>Basella</i> species	C	W	M	M	M
Palak	<i>Beta</i> species	C	R	M	M	H
Bitter gourd	<i>Momordica</i> species	C	W	H	M	H
Snapmelon	<i>Cucumis</i> species	C	W	H	M	H
Pointed gourd	<i>Trichosanthes dioica</i>	C	L	H	H	M
Ridge gourd	<i>Luffa</i> species	C	W	H	H	H
Sponge gourd	<i>Luffa</i> species	C	W	H	M	H
Satputia	<i>Luffa</i> species	C	W	H	M	H
Tinda	<i>Praecitrullus fistulosus</i>	C	L	M	M	M
Ash gourd	<i>Benincasa hispida</i>	C	W	H	M	M
Snake gourd	<i>Trichosanthes anguina</i>	C	W	H	M	H

CS-Crop status (C-cultivated, W-Wild), **DS**-Distribution status (**W**-wide spread distribution, **R**-regional distribution, **L**- localized distribution), **GVS**-Germplasm variability status (H-high, M-medium, L-low), **GES**-Genetic erosion status (H-high, M-medium, L-low) and **GCP**-General crop priorities (H-high, M-medium).



Seed stored with Zeolite beads

desiccant have reached a moisture balance. Zeolite is a naturally occurring clay that has been effectively used as an absorbent for drying seeds endash a requirement for long term storage. Zeolite drying beads are desiccants that adsorb water and can be used indefinitely through “recharging” or heating to release moisture. The beads can absorb up to 25% of their weight in water.

Field or plant bank

Field or plant bank is an orchard or a field in which

Table 3. Designated centers for maintenance, multiplication and conservation of indigenous and minor vegetable crops

Vegetable crop	Designated sites of conservation
Brinjal	ICAR-IIVR, Varanasi (UP); ICAR-NBPGR, New Delhi & its centres; ICAR-IARI, New Delhi; ICAR-IIHR, Bengaluru (Karnataka); Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh); Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar)
Cucumber	ICAR-IIVR, Varanasi (UP); ICAR-NBPGR, New Delhi & its centres; ICAR-IARI, New Delhi; ICAR-IIHR, Bengaluru (Karnataka); Mahatma Phule Krishi Vidyapeeth Rahuri (Maharashtra); Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Ratnagiri (Maharashtra); G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand)
Bitter gourd	ICAR-IIVR, Varanasi (UP); ICAR-NBPGR, New Delhi & its centres; ICAR-IARI, New Delhi; ICAR-IIHR, Bengaluru (Karnataka); Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh); Kerala Agricultural University, Thrissur. Vellanikara (Kerala); Mahatma Phule Krishi Vidyapeeth Rahuri (Maharashtra); Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)
Ash gourd	ICAR-IIVR, Varanasi (UP); ICAR-IARI, New Delhi; Kerala Agricultural University, Thrissur Vellanikara (Kerala)
Ridge gourd	ICAR-IIVR, Varanasi (UP); Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra); ICAR-IIHR, Bengaluru (Karnataka)
Sponge gourd	ICAR-IIVR, Varanasi (UP); Mahatma Phule Krishi Vidyapeeth, Rahuri (Maharashtra); ICAR-IIHR, Bengaluru (Karnataka)
Satputia	ICAR-IIVR, Varanasi (UP); Mahatma Phule Krishi Vidyapeeth Rahuri (Maharashtra); ICAR-IIHR, Bengaluru (Karnataka)
Snake gourd	Tamil Nadu Agricultural University, Coimbatore (Tamil Nadu)
Long melon	ICAR-IIVR, Varanasi (UP); ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan)
Snapmelon	ICAR-IIVR, Varanasi (UP); ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan)
Round melon	ICAR-IIVR, Varanasi (UP); ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan)
Basella	ICAR-IIVR, Varanasi (UP)
Indian bean	ICAR-IIVR, Varanasi (UP); ICAR-IIHR, Bengaluru (Karnataka); ICAR-IARI, New Delhi; Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh); ICAR-ICAR Research Complex for NEH Region, Tripura Centre, Lembucherra
Cluster bean	ICAR-IIVR, Varanasi (UP); ICAR-Central Institute for Arid Horticulture, Bikaner (Rajasthan)
Palak	ICAR-IIVR, Varanasi (UP); ICAR-IARI, New Delhi
Lotus	ICAR-IIVR, Varanasi (UP)
Water spinach	ICAR-IIVR, Varanasi (UP)

Table 4. Germplasm conservation status of indigenous and minor vegetable crops at various research organizations

Vegetables	No. of collections	Source
Cucumber	2638	ICAR-IIVR, Varanasi (UP); ICAR-NBPGR, New Delhi & its centres; G.B. Pant University of Agriculture and Technology, Pantnagar (Uttarakhand); Kerala Agricultural University, Thrissur, Vellanikara (Kerala); NDU&T, Ayodhya (UP); ICAR-IARI, New Delhi; ICAR-IIHR, Bengaluru (Karnataka) ICAR-RCER Research Centre, Ranchi (Jharkhand); ICAR-CIAH, Bikaner (Rajasthan); PAU, Ludhiana (Punjab); Acharya N.G. Ranga Agricultural University, Rajendra Nagar (Telangana); Rajasthan Agricultural Research Institute (Sri Karan Narendra Agriculture University, Jobner) Durgapura, Jaipur (Rajasthan); Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh)
Bitter gourd	973	
Snap melon	697	
Kachri	648	
Snake gourd	289	
Pointed gourd	324	
Ivy gourd	154	
Spine gourd	80	
Sweet gourd	65	
Sponge gourd	1852	
Ridge gourd	1628	
Satputia	19	
Ash gourd	1139	
Round gourd	164	

Table 5. Conservation facility, condition and storage in field bank

Conservation facility	Condition of storage	Category of PGR	Form in which stored
Field gene bank (including clonal repository)	Ambient temperature and conditions of an open field or in screen house/net house/green house	Species which do not produce seeds, or if they do, produce few seeds (threatened, wild and/or endemic species); species which are propagated vegetatively or as clones; species that produce non-orthodox seeds (desiccation-sensitive); species that require a long life cycle to generate breeding and/or planting material	Whole plants

Table 6. Centre for maintenance, multiplication and conservation of indigenous perennial vegetable crops

Vegetable crop	Sites of conservation
Pointed gourd	ICAR-IIVR, Varanasi (UP); ICAR-RCER Research Centre, Ranchi (Jharkhand); Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar); Acharya Narendra Deva University of Agriculture & Technology, Ayodhya (U.P.); Bihar Agricultural University, Sabour, (Bihar); Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (West Bengal); Odisha University of Agriculture & Technology, Bhubaneswar (Odisha)
Ivy gourd	Regional Research Station, Kushinagar of ICAR-IIVR, Varanasi (U.P.); Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh); Kerala Agricultural University, Thrissur, Vellanikkara (Kerala)
Sweet gourd and spine gourd	Regional Research Station, Kushinagar of ICAR-IIVR, Varanasi (U.P.); ICAR-Research Complex-Barapani, (Meghalaya); Regional Research Station of ICAR-Research Complex-Tripura, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur (West Bengal); Odisha University of Agriculture & Technology, Bhubaneswar (Odisha); ICAR-CITH Regional Station, Mukteshwar-Kumaon, Nainital (Uttarakhand)
Curry leaf	University of Agricultural Sciences, Dharwad (Karnataka)
<i>Dioscorea</i> sp.	ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram (Kerala); ICAR-CTCRI, Regional Centres; NBPGRI Trissur and ICAR-NBPGRI, New Delhi



Ash gourd maintained at ICAR-IIVR, Varanasi

accessions of vegetatively propagated crops are grown and maintained. As per the guidelines of ICAR-NBPGRI, New Delhi, several vegetable crop base research institute maintaining field gene bank of mandated perennial and vegetatively propagated species in the field condition.

Shoot tip banks: Genetic stocks (basically vegetatively propagated crops like *Colocasia* (due to poor seed set)

is conserved as slow growth cultures of shoot-tips/meristem and node segments. *In vitro* slow/normal growth techniques offer short to medium term storage option avoiding risk of losses of indigenous genetic diversity in field gene bank due to insects, nematodes, disease attacks and natural disasters. In such gene banks, germplasm is conserved as slow growth cultures of shoot-tips and nodal segments. It is commonly used for vegetatively propagated species, non-orthodox seeded species and wild species which produce little or no seeds. Their regeneration consists of sub-culturing the cultures, which may be done every 6 months to 3 years. Regeneration of meristem is extremely easy. Each genotype can be conserved indefinitely free from virus or other harmful pathogens.

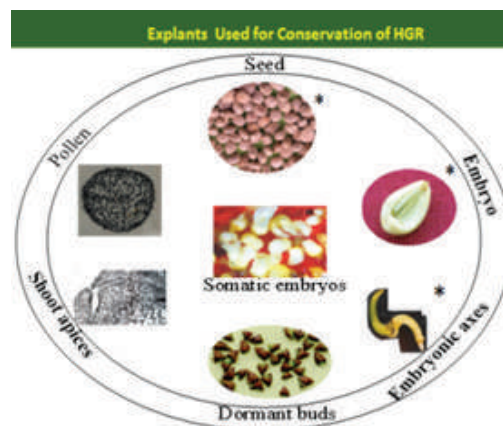
Cell and organ banks: A germplasm collection based on cryopreserved (at -196°C in liquid nitrogen) embryogenic cell cultures, somatic/ zygotic embryos can be called as cell and organ bank. Cell and organs are becoming very popular in conservation programme. Pollen grains are a rich source for diverse alleles in any gene pool, holding large genetic diversity

in small sample, size offering an effective propagule for germplasm conservation. Its inherent ability of hardiness and stability in harsh conditions enables its long-term cryogenic storage. The pollen of *Cucumis sativus* can be stored for longer period. In these banks, DNA segments from the genomes of germplasm accessions are maintained and conserved for longer period. For this slow freezing

(conventional method using programmable freezer) and fast freezing (desiccation, pre-growth, pre-growth-desiccation, encapsulation-dehydration, vitrification, encapsulation-vitrification and droplet freezing) can be used. Another approach is slow growth culture where a large number of samples can be stored. Under *in vitro* condition *Colocasia esculenta* can be stored successfully up to 7 months.

Regeneration protocols of indigenous perennial vegetable crops

Regeneration protocols in indigenous perennial vegetable crops have been standardized to maintain the genetic purity for longer period.



Explants used for conservation

Table 7. *In vitro* cryo gene bank storage

Types of conservation facility	Condition of storage	Category of PGR	Form in which stored
<i>In vitro</i> gene bank	Ambient temperatures, $25 \pm 2^{\circ}\text{C}$ (short-term storage) or low temperatures of $4\text{--}15^{\circ}\text{C}$ (medium-term storage)	Species which do not produce seeds, or if they do, produce few seeds (threatened, wild and/or endemic species); species which are propagated vegetatively or as clones; species that produce non-orthodox seeds (desiccation-sensitive); species that require a long life cycle to generate breeding and/or planting material	Tissue cultures (plantlets, shoot cultures, somatic embryos, root cultures, meristem cultures, embryogenic callus cultures, cell suspensions) which may be actively or slow growing.
Cryo-gene bank	Ultra-low temperatures, ranging from -130 to -196°C (using liquid nitrogen)	Species which do not produce seeds, or if they do, produce few seeds (threatened, wild and/or endemic species); species which are propagated vegetatively or as clones; species that produce non-orthodox seeds (desiccation-sensitive); species that require a long life cycle to generate breeding and/or planting material	Seeds, embryos, embryonic axes, buds, shoot tips, meristems, pollen, cell suspensions, DNA
DNA Bank	Low temperatures of 4°C (short-term storage for 1-2 years) and -20°C (medium-term storage for 3-5 years); Ultra-low temperatures, ranging from -70 to -196°C (long-term storage for > 5 years)	Any species, especially wherever genomic resources are being generated	Genomic, mitochondrial or chloroplast DNA; cloned genes, promoters fused with reporter genes; sub-genomic, cDNA, EST, repeat enriched libraries; cloning vectors, expression vectors, binary vectors, RFLP probes; BAC, YAC, PAC clones.

Table 8. Regeneration protocols in indigenous perennial vegetables

Vegetable Crop	Protocol	
Pointed gourd	Stem cutting comprising 1, 2, 3 and 4 nodes were treated with 0, 50, 100 and 150 ppm IBA and NAA, IBA at 100 ppm proved to be beneficial and it expressed the maximum percentage of sprouting, shoot growth and root performance. Increase in concentration beyond 100 ppm did not prove effective. IBA maintained its superiority over NAA with respect of all the vegetative and root attributes. The establishment per cent of 4 node cuttings in field condition was highest (73.56%) while among all the doses of Auxins, IBA at 100 ppm resulted in the maximum percentage of survival (61.13) of rooted cuttings.	 Pointed gourd-stem cutting

Vegetable Crop Protocol

Spine gourd Generally propagated through underground tubers (male and female separately) and getting sufficient quantity of tubers is difficult and also only one tuber can develop one plant. Therefore an experiment was conducted to multiply the crop through clonal propagation. An efficient protocol for rapid *in vitro* clonal propagation of genotype RSR/DR-15 (female) and DR/NKB-28 (male) was developed through enhanced axillary shoot proliferation from nodal segments. Maximum shoot proliferation of 6.2 shoots per explants with 100% shoot regeneration frequency was obtained from the female genotype on MS medium supplemented with 0.9 microMN6-BA and 200 mg/l casein CH. No polymorphism was detected revealing the genetic integrity of *in vitro* propagated plants. This micro propagation procedure could be useful for raising genetically uniform planting material.



Regeneration protocol in spine gourd

Spine gourd In spine gourd application of IBA 200 ppm concentration can be used in sprouting of shoot under moist soil condition. This technique helps in reducing the use of tuber for multiplication and storage.

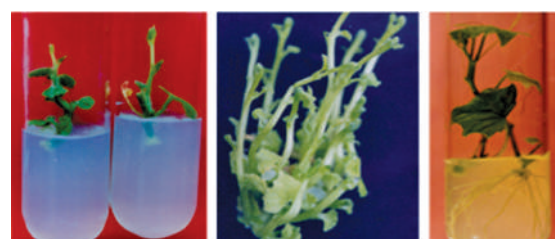


Sprouting of spine gourd with application of IBA 200 ppm

Ivy gourd Cuttings with 4 nodes sprouted earliest (8.8 days after planting) and enhanced the sprouting percent, length and diameter of vine, number of branches per shoot, number of leaves per cutting, length and diameter of root and regeneration percent than 1, 2 and 3 nodes/cutting. Cuttings treated with 75 ppm IBA took minimum days to sprout and improved sprouting percent, increased length and diameter of vine, number of branches per shoot, number of leaves per cuttings, length and diameter of root and regeneration percent than 75 ppm NAA and 25, 50, 100, 125 and 150 ppm IBA and NAA each.

Table 9. Minimum seed viability standards of Indigenous and minor vegetables for long term conservation

Botanical name	Minimum germination (%)	Minimum seed quantity (No.)
<i>Luffa echinata</i>	50	500
<i>L. pentandra</i>	50	500
<i>Momordica dioica</i>	60	500
<i>M. sahyadrica</i>	30	500
<i>M. subangulata</i> ssp. <i>renigera</i>	30	500
<i>M. tuberosa</i>	30	500
<i>Solanum</i> spp.	30	500
<i>Trichosanthes bracteata</i>	30	500
<i>T. cucurmerina</i>	30	500
<i>T. cuspidata</i>	30	500
<i>T. lobata</i>	30	500
<i>T. nervifolia</i>	30	500
<i>T. palmata</i>	30	500
<i>T. tricuspidata</i>	50	500



Shoot Initiation Shoot multiplication Root initiation



Conservation and propagation techniques through tissue culture

pushing some species into extinction. It is true that once they disappear; there is no alternative source for acquiring the unique qualities they provide. It is hence, important to develop sustainable harvesting and conservation regimes that do not undermine the capability of a plant species to survive in the wild. The scientists have shown great concern over the conservation and preservation of environment, biodiversity and ecosystem in a sustainable manner.

SUMMARY

The Indian gene centre has vast diversity of indigenous and minor vegetables in edible and wild/weedy form. Indiscriminate extraction of biological material from the wild threatens their survival, even to the extent of

For further interaction please write to:

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