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MANAGEMENT OF VEGETABLE CROPS GERMPLASM - CURRENT STATUS

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National Bureau of Plant Genetic Resources (NBPGR), New Delhi is the mandatory National Active Germplasm Collection Site for vegetable crops in the Indian National Plant Genetic Resources System (IN-PGRS). NBPGR is responsible for maintaining base collection/working collections of many vegetable crops such as Solanaceous (eggplant, tomato, chillies), Leguminous (cowpea, pea, beans), Cucurbitaceous (pumpkin, gourds, melons and cucumber etc.), Leafy (spinach, Chinese cabbage, methi etc.), Bulbous (garlic and onion), Root crops (radish and carrot) and okra. Considering the importance of distribution of diversity in Indian Gene Centre, IBPGR has also assigned crop responsibility for 5 vegetable crops viz., okra, eggplant and lablab bean (global), chillies and radish (Asian). Comprehensive collections have been made through exploration in the sub-continent and sizeable number introduced from abroad. More than 15500 collections in different vegetables have been made since 1986 to 1994-95 and about 18000 lines imported from several countries during the same duration. Characterization and preliminary evaluation is carried mainly at Issapur Farm, New Delhi and several centres of NBPGR. The current holdings of vegetable crops (over 24000) and tuber vegetables except potato (about 2,000) is under evaluation at different centres. Several promising lines have been identified. Some 5,735 samples of vegetable crops have been kept in long-term storage (–20°C). The working collection are maintained in medium-term storage (+40°C). Besides several vegetables are conserved *in-vitro* through tissue culture. Documentation of information, related to plant genetic resources provides basis for utilization of potential germplasm in crop improvement. Based on the characterization and preliminary evaluation, germplasm accessions are catalogued to facilitate breeders in selecting the material of their interest. So far, 14 catalogues have been published on various vegetable crops like french bean, tomato, okra, chillies, winged bean and cowpea. NBPGR has strong linkages with several Institutes/Universities in India in respect of vegetable crops. Seeds of promising lines are supplied directly to identors which include farmers and seed growers also.

Key words : Vegetable crops, germplasm, management

Vegetables, comprising of solanaceous, cucurbitaceous, leguminous, leafy, cole, root, rhizomatous and bulbous crops, constitute one of the biggest group of cultivated plants. These represent a wide array of taxa and groups depicting diverse edapho-climatic adaptability, plant types and usage based upon consumption of different plant parts for food. Vegetables provide vitamins, minerals

and protein and remain indispensable component of human diet for vegetarians and non-vegetarians alike. The Indian sub-continent, which represents one of the 8 Vavilonian centres of origin and diversity of crop plants, exhibits preponderance of variable forms of different vegetable crops viz., landraces, primitive types, old and osolete cultivars etc. Unconsicious selection at farmers fields, isolated nitches in diverse agroclimatic zones and tribal pockets, and traditional knowledge of various ethnobotanical uses of individual types are among the several factors leading to the accumulation of variability. The presence of few large-area based monocultures in vegetable crops, in contrast with cereals, render increased chances for collection of additional variability as well as new genes. National Bureau of Plant Genetic Resources (NBPGR), New Delhi is the nodal agency for the Indian National Plant Genetic Resources System (IN-PGRS) and also the mandatory National Active Germplasm Site (NAC) for the vegetable crops under this system (Rana, 1991). In addition, NBPGR holds the IBPGRI assigned crop responsibility for okra, eggplant and lablab bean (Global); and regional responsibility for chillies and radish (Asian). The present paper deals with the status of plant genetic resources activities of vegetable crops at the Bureau, particularly solanaceous crops (eggplant, tomato and chillies), leguminous crops (cowpea, pea and beans), cucurbitaceous crops (pumpkin, gourds, melons and cucumbers), bulbours crops (garlic and onion), root crops (radish and carrot) and okra.

GERMPLASM EXPLORATION AND COLLECTION

About 16,000 germplasm accessions of different vegetables, tuber, spices and condiments crops were collected through several crop- specific and multicrop expeditions conducted by NBPGR alone or in collaboration with other Institutes, during the period 1986 to 1994-95 (Table 1). The yearwise split up showed a systematic reinvigorated effort with collection of maximum accessions in the year 1989-90 (3974 accessions). These intensive efforts were continued in the subsequent years also as is evident in the Table-1. These collections showed substantial variation in terms of taxa, agronomical and quantitative morphological traits. Some notable collections for the related wild species include *Albemoschus tetraphyllus, A. tuberculatus* and *A. ficulneus* in okra, *Solanum surattense, S. torvum, S. indicum, S. incanum* and *S. insanum* in solanaceous vegetables and *Vigna unguiculata* ssp. *sesquipedalis* and *V. unguiculata* ssp. *angularis* in legume vegetables etc. In ridge gourd, several morphotypes of 'Satputia' were collected which bear fruits in clusters. Similarly, *Nenua* and *Ghiwra*, having white seeded long fruits consitituted prominent collections with adequate commercial potential. Among the states/regions showing interesting variability for specific crops were Madhya Pradesh, particularly Bastar belt and Sarguja hilly tracts for bottle gourd and North-eastern region, Maharashtra and Uttar Pradesh for cultivated brinjal and related wild species. Brinjal

accessions viz., **Kachabachia, Ramnagar** and **Balfawa Baigan** from eastern Uttar Pradesh, showed potentials for cultivation in the off-season. Variability in cowpea included types with extra-long snake like pods from north-eastern region and very small seeds/pod types from arid western zone. Enormous variability has been collected in chillies, onion, parwal, beans, cucurbits among vegetables, *Diascorea* and cassava among tuber crops and *Piper, Curcuma* and *Zingiber* among spices and condiments (Rana *et al.*, 1993).

Table 1. Exploration and collection of indigenous germplasm of vegetable crops (1986 to 1994-95)

Year	No. of Exp. undertaken	Diversity Collected (No. of samples)			
		Vegetable	Tuber	Spices	Total
1986	28	1615	201	118	1934
1987	29	673	216	207	1096
1088	32	1220	33	400	1653
1989-90	48	3111	260	603	3974
1990-91	29	2799	-	-	2799
1991-92	22	1600	20	144	1764
1992-93	10	1559	-	-	1559
1993-94	7	350	-	-	359
1994-95	7	455	-	-	455
TOTAL	212	13382	730	1472	15584

INTRODUCTION OF EXOTIC GERMPLASM

Table 2 shows the number of germplasm accessions imported from other countries through introductior and exchange for the years 1986 to 1994-95. In all, over 18,000 accessions were introduced from 16 countries which covered 19 crop species in vegetables, 4 in tuber crops and 10 in spices and condiments. Some of the promising exotic introduced germplasm, ex. USA and Isreal, may be enlisted in tomato for disease, pest and nematode resistance (EC-173859, EC-179883, EC-182761 to EC-182874, EC-196588 to EC-196597, EC-198416, EC-200769 to EC-200776 and EC-204194 to EC-204198). Some of these lines possessed additional desirable characters like resistance to biotic and abiotic stress and

heat tolerant. Cultivar Montecarlo (Ex USA EC-179189) was preferred for its deep red, globe shaped fruits. Germplasm accessions EC-248282 to EC-248311 ex. taiwan were the promising processing types. In onion, F1 hybrids having yellow coloured bulbs, and good storage quality (EC-177284, EC-177285, and EC-187221 to EC-187225) were imported from the Netherland and Germany.

Table 2. Introduction of exotic germplasm of vegetable crops (1986 to 1994-95)

Year	Number of accessions introduced			
	Vegetables	Tuber crops	Spices	TOTAL
1986	1957	73	7	1937
1987	783	720	4	1507
1988	2257	168	38	2463
1989-90	802	145	26	973
1990-91	1321	155	13	1489
1991-92	1176	148	51	1375
1992-93	2296	42	-	2338
1993-94	5208	-	-	5208
1994-95	1104	-	-	1104
TOTAL	16904	1451	139	18394

In cole crops, lines with multiple disease resistance (EC-175800 to EC-175806, ex USA, and EC-187228 to 187230, ex Canada, and better curd quality (EC-243384, ex Taiwan) were promising. Similarly, germplasm accessions with desirable characters were also observed in carrot (EC-274883 to EC-274886, ex Netherlands, EC-178385, ex Italy and EC-187207, ex USA), bell pepper (EC-280642, ex Netherlands), cucumber (EC-178495 and EC-329300, ex USA) and several other vegetable crops (Rana *et al.*, 1993).

Quarantine and phytosanitary inspection of the introduced germplasm is mandatory. NBPGR performs this National responsibility through the single window entry system for research materials/propagules. The post entry quarantine inspection includes physical inspection of seed, seed pathology and field screening. Efforts are also made to salvage the contaminated infested or infected seed or plant materials using appropriate techniques. Some important pathogens and pests intercepted on exotic vegetable crops alongwith the source country of the important germplasm is reported by Rana *et al.* (1993).

Table 3. Active germplasm holdings of vegetables crops at NBPGR

Crop/ Station	Delhi	Shi-mla	Bho-wali	Shill-ong	Jodh-pur	Akola	Amra-vati	Thri-ssur	Total
Vegetables									
Okra	2082	-	-	-	62	1147	-	263	3554
Brinjal/ eggplant	2321	-	-	-	-	-	-	-	2321
Onion	780	-	13	-	-	-	553	-	1346
Garlic	899	-	82	-	-	-	-	-	981
Tomato	2822	-	-	-	-	-	-	-	2822
Cucurbits	937	-	-	-	-	-	-	165	1102
Allium spp.	-	-	20	-	-	-	-	-	20
Chillies	-	-	-	-	-	-	388	365	753
Total	9841	-	115	-	62	1147	941	793	12899
Leguminous vegetables									
Frenchbean	132	2751	1291	-	-	-	-	-	4174
Cowpea	2461	-	13	-	345	-	-	498	3317
Peas	1738	120	95	-	-	-	-	-	1953
Sword bean	210	-	-	-	-	-	-	-	210
Lab-Lab bean	718	-	-	-	-	-	449	-	1167
Yam bean	-	-	-	-	-	-	33	-	33
Mucuna	198	-	-	-	-	-	-	-	198
Total	5457	2871	1399	-	345	-	482	498	11052
Tuber crops, species etc.									
Greater yam	-	-	-	-	-	-	-	181	181
Lesser yam	-	-	-	-	-	-	-	51	51
Elephant foot yam	-	-	-	-	-	-	-	121	121
Chinese potato	-	-	-	-	-	-	-	57	57
Cassava	-	-	-	-	-	-	-	154	154
Taro	-	-	-	112	-	-	-	130	242
Ginger	-	-	-	61	-	-	-	80	141
Coco yam	-	-	-	-	-	-	-	828	828
Sweet potato	-	-	-	-	-	278	-	-	278
Total	-	-	-	173	-	278	-	1602	2053
Grand Total	15298	2871	1514	173	407	1425	1423	2893	26004

Active germplasm holdings

The current holdings of different vegetable and tuber crops exceeds 26,000 accessions which are maintained at NBPGR Headquarters and its various regional stations (Table 3). These stations are located in diverse agroclimatic zones of the country ranging from as near to the equator as 10° 50′ N at 50m above m.s.l. at Thrissur in Kerala State to 31° N latitude at 2076 m above n.s.l. at Shimla located in the Shivalik range of the Himalayas. The longitudinal range varies from 73°E at Jodhpur (224 m above a.s.l.) in the arid zones of Rajasthan to 91° 80′ E at Shillong (1496 m above n.s.l.) in Meghalaya State. This agroclimatic diversity influences the choice of crops allocated to individual stations. Tuber crops and spices etc. are predominantly maintained as live collections at Trichur centre. However, taro and Ginger are equally distributed at Shillong centre, in addition to Thrissur. Onion, cucurbits, frenchbean and cowpea etc. are maintained at more than one locations as per crop responsibilities to centres (Table 3) whereas a few accessions of some other crops are also maintained as active collections at multiple locations as a folllow up of collected germplasm from their respective zones.

Evaluation and Documentation

These germplasm are grown for 2 years for characterization and preliminary evaluation as per workable descriptors and their descriptor states finalized by NBPGR taking into consideration the IPGRI's list of descriptors for respective crops, if available. Promising germplasm lines are reported in the NBPGR Newsletter and Annual Reports for the active reference of users. Field days are held for spot selection of desirable types by the geneticists, breeders and industry. Catalogues are also published (Table 4) covering the entire range of descriptors and ready-to-use queries. Further three more catalogues on okra and one on *Diascorea alata* L. have also been published during the years 1990-1993. The exhaustive lists of promising types of various vegetable crops identified at different NBPGR stations are provided by Gupta *et al.* (1993), Rana *et al.* (1993) and Rai (1993). Some of the improved varieties originated as direct selections from germplasm in these crops include Pusa Harbhajan in pea, La Bonita in tomato, Sel-2 in Okra, Rituraj in Cowpea, Sharad Bahar in Guar, Ratnar Sel. in Onion and AKWB-1 in winged bean etc.

Table 4. List of Catalogues published by NBPGR on vegetable crops

Sr. No.	Crop	Year	Number of Accessions	Number of Descriptions
1	Cowpea	1981	707	34
2	Cowpea	1982	683	24
3	Frenchbean	1981	1773	16
4	Oliferous brassicae	1986	555	7
5	Tomato	1982	80	21
6	Winged bean	1983	1439	31
7	Cowpea	-	259	23
8	Chillies	-	102	9
9	Turmeric	-	113	22
10	Yam	-	110	34
11	Okra	1990	361	-
12	Okra	1991	219	38
13	Okra	1993	107	36
14	Discorea	1991	175	33

Germplasm Conservation

Above 7,600 germplasm accessions of 14 vegetable crops were conserved *ex situ* in long term repository of National Gene Bank upto March 31, 1995 (Table 5). These included highest number in cowpea (*Vigna unguiculata*; 1475 accessions) followed by clusterbean (*Cymopsis tetragonoloba*; 1395 accessions), Okra (*Abelmoschus esculentus*; 1382 accessions), Lablab bean (*Lablab purpureus*; 901 accessions) and Onion (*Allium cepa*; 704 accessions). Substantial diversity is conserved in cases of solanaceous vegetables also, viz., potato (494 accessions), tomato (450 accessions), and brinjal (331 accessions). The difficulties in attaining proper seed sample with complete physiological maturity, proper seed moisture, high germination percentage and sample size are some of the factors which are duly taken care of during evaluation and multiplication before supply to genebank.

Table 5. *Ex situ* conservation of vegetable germplasm at long term repository of National Gene Bank (upto March 31, 1995)

Crop	Botanical Name	Number of accessions
Brinjal	*Solanum* spp.	331
Tomato	*Lycopersicon esculentum*	450
Potato	*Solanum tuberosum*	494
Chillies	*Capsicum annum*	143
Onion	*Allium cepa*	704
Bitter gourd	*Momordica charantia*	51
Cabbage	*Brassica oleracea var. capitata*	47
Cluster bean	*Cyamopsis tetragonoloba*	1395
Cowpea	*Vigna unguiculata*	1475
Faba bean	*Vicia faba*	31
Frenchbean	*Phasoolus vulgaris*	110
Lablab bean	*Lablab purpureus*	901
Okra	*Abelmoschus esculentus*	1382
Fenugreek	*Trigonella* spp.	140
TOTAL		7654

CONCLUSIONS

Above 3,300 germplasm accessions of different vegetable crops were supplid all over the country to different indentors for use in the fundamental and applied research (Gupta *et al.*, 1993). This clearly illustrates that the PGR programme on vegetables at NBPGR is effectively oriented towards germplasm utilization. Efforts are also made to have a two-way interaction with the user Institutes/Agencies which would help in formulation of further collection strategy of individual crops besides multiplication/regenration of the preferred elites.

The Indian National Plant Genetic Resources System is fluid and viable. Although NBPGR is the key National Active Germplasm Site for vegetable crops under this system, three more NAGS are essentially integrated to this programme due to their involvement and allocation for potato; tuber and rhizomatous crops; and plantation and spices. These are CPRI, Shimla for potato; CPCRI, Kasaragod for plantation crops and CTCRI, Sreekarayam (Thiruvananthapuram) for tuber crops. An outstanding feature of the IN-PGRS is the conservation and management of PGRs related to their effective use by collaboration between the NBPGR and user agencies through workshops,

symposia, trainings, bilateral programmes and workplans under MoUs (Rana *et al.*, 1993). The ultimate objective, nevertheless remains safe conservation of the vegetable crops genetic resources for posterity and their sustainable utilization for the viability of crop improvement programmes.

REFERENCES

Gupta, P.N., M. Rai, U. Chandra, S. Kochhar, B. Singh, Kamla, V. and P. Brahmi. 1993. Building up of genetic resources of vegetable crops - their characterization, evaluation and maintenance. Presented at All India Coordinated Group Workers Meeting on Vegetable crops. JNKVV, Jabalpur, December 15-18. 11p

NBPGR 1986 to 1994-95. Annual Reports. National Bureau of Plant Genetic Resources for the years 1986 to 1994-95. NBPGR, New Delhi

Rai, M. 1993. Characterization and Evaluation of Vegetable Crops. *In* Exploration, Evaluation & Conservation of Plant genetic Resources. R.S. Rana *et al.* (eds.), NBPGR, New Delhi p 106-117

Rana, R.S. 1991. Indian National Plant Genetic Resources System. *In* : Plant Genetic Resources - Documentation and Information Management. R.S. Rana *et al.* (eds.), NBPGR, New Delhi p 1-16

Rana, R. S., P.N. Gupta and M. Rai. 1993 Genetic resources programme of Horticultural Crops : AN Indian Perspective. Presented at Golden Jubilee Symp. on Horticultural Research-Changing Scenario. IIH R Bangalore, May 24-28. 20p