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Short Communication

COLLECTION, EVALUATION AND CONSERVATION OF HORTICULTURAL CROPS IN UTTAR PRADESH HILLS

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The Himalayas represents a rich repository of diverse flora with different ecosystem. Central Himalayas of Uttar Pradesh hills is the seat of a large number of minor fruit crops both tropical and temperate species. Since inception of NBPGR Regional Station in 1986, systematic approach was made to collect germplasm of different agri-horticultural crops from UP hills. A total number of 1018 accessions of horticultural germplasm viz., strawberry (81), *Citrus* (50), *Malus* (26), other fruits (81), vegetables (623) and ornamentals (157), were collected/assembled and evaluated for various qualitative and quantitative characters. The fruit germplasm has been conserved in field gene bank and vegetables and annual ornamentals under medium teri at this Station and promising accessions identified. IC 219062 (*Diospyros kaki*), IC - 219058 in Jogiya Hisalu (*Rubus* sp.), EC - 362602 in strawberry, Haward and Allison in kiwi fruit were found to be quite promising, details of which are highlighted in this paper.

Key words : PGR, collection, evaluation, conservation, fruits, ornamentals

In India, the endemic species are generally distributed in two distinct areas, approximately 4200 species in Himalayas and 2600 species in peninsular region. Although indigenous fruit plant species occurring in India is meagre, several wild relatives are said to be originated in this region (Zevan and Zhukovsky 1975; Arora and Nayar 1984). Some of the fruit species, where rich diversity occurs in India, included banana and plantain (*Musa* sp.), jackfruit (*Artocarpus* sp.), mango (*Mangifera* sp.), anola (*Emblica officicinalis*), Karonda (*Carissa* sp.) etc. A number of wild species of some of the important and commercial fruits are said to be originated in this region viz. grapes (*Vitis lanata* Roxb., *V. oblecta* Wall., *V. polystachya* Wall. and *V. pyenantha* Coll. & Hems; Citrus (*Citrus ichangensis* Swingle, *C. letipes* tanaka, *C. macroptera* Mont;, *C. assamensis, C. aurantium L., C. jambhiri* Lush, *C. limonia* Osbeck and *C. karna* Kaf.). date palm (*Phoenix* spp.), apple (*Malus sikkimensis*), cherry (*Prunus nepaulensis*), pear (*Pyrus khasiana*) etc. (Arora, 1985; Bhattacharya and Dutta, 1951, 1956; Dutta, 1958; Krishnamurthy and Seshadri, 1958; Mukherjee, 1949; Patil, 1993 and Singh, 1967).

The Himalaya represents a rich repository of diverse flora with different ecosystem. UP hills play host to a large number of minor fruits crops from tropical to temperate species because of great altitudinal differences in the region coupled with varied physiography which contributes to great climatic variations viz. from tropical forest to sub tropical, temperature, sub alpine, alpine and cold arid zone vegetation. Most of the fruits grow wild. Endowed with medicinal, therapeutic or commercial value, the fruits are also attractive,

congenial in taste and quality. Even then the fruit wealth of these areas is gradually becoming extinct and this is the time to collect the traditional and wild fruit plant (Paroda *et al.* 1988).

Horticultural crops in UP hills

The hilly region of Uttar Pradesh constitutes mainly Garhwal and Kumaon hill region of North-western and Central Himalayas and spread over an area of 51125 sq. km. with total population of 58.74 lakhs, as per 1991 census. Agriculture is one of the major occupation of the natives residing in the region. Two types of agricultural systems are followed by local people and tribals; mixed cropping in mountainous region and intensive cropping pattern in valley areas. Due to inadequate irrigation facilities, most of the areas are totally dependent on the seasonal rains/monsoon. Rich variability in fruits were reported in *Pyrus, Prunus, Sorbus, Malus, Rubus, Ribes, Hippophae, Juglans, Colrylus* and *Myrica* (Joshi and Rana, 1994). The other wild and semi domesticated fruits *Ziziphus, Citrus, Ficus, Morus, Aesendra* and *Emblica* are well distributed. In vegetables and tuber crops, good variability occurs in pumpkin, bottle gourd, snake gourd, ridge gourd, bitter gourd, peas, tomato, in leafy vegetables viz., spinach, fenugreek, amarnath and chnopods. Among tuber crops, variability was observed in potato, *Colocasia*, ginger, *Dioscorea* and turmeric. In medicinal plants, diversity is represented by *Aconitum, Taxus, Swertia, Rheum, Potentilla, Carum* and *Berberis* and in ornamentals, tremendous variability has been observed in *Gladiolus, Rosa, Gerbera, Rhododendron* and *Gloriosa.*

1. Explorations and collections

Numerous plant explorers surveyed this part of UP Hills since 1796. Some of them were Thomas Hardwickee, Strachey and Winter Bottom (1846-49), Osmaston (1927), Sonythe (1932), and M.B. Raizada (1938). Several fruit crops were brought to India from other regions by travellers, invaders like Parsians, Turks, Moghals, Portuguese, Dutch, French and British. The introductions made in the past were maintained in various institutes throughout the country and also at Chaubattia in UP Hills (Chadha and Pareek, 1993; Paroda *et al.*, 1986). Since its inception, National Bureau of Plant Genetic Resources, Regional Station, Bhowali, Nainital, (Uttar Pradesh) in 1986 which is actively engaged in collection of agrihorticultural crops from UP hills and also in evaluation, characterisation, multiplication, maintenance, diseases screening, cataloguing and enrichment of germplasm by introducing exotic plant material. Out of crop specific explorations specially for *Citrus, Fragaria* and other minor fruits were also collected. Consequently 1018 collections of horticultural germplasm have been made (Table 1).

2. Horticultural germplasm and their evaluation

(i) Fruit crops

A total of 238 accessions of fruits were collected/acquired from exotic resources (Table 1). They include *Fragaria* sp. (81), *Actinidia* sp. (7), *Citrus* sp. (50), *Malus* sp. (26), *Sorbus* sp. (1), *Prunus* sp. (6), *Pyrus* sp. (9), *Castanea* sp. (1), *Physalis* sp. (1), *Ziziphus* sp. (3), *Morus* sp. (2), *Rubus* sp. (15), *Vitis* sp. (4), *Juglans* sp. (1), *Ficus* sp. (7), *Myrica* sp. (1) *Diospyros* sp. (1), and *Carissa* sp. (1), *Elaeagnus* sp. (1), *Syzygium* sp. (1), *Cordia* sp. (1) and other minor fruits (18). Elite material in Kaku (*Diospyrus kaki*) was collected from Kashyalekh area of Nainital district having very good aroma and taste with attractive eye appealing colour. A few collections like *Hippophae* sp. need specific ecological requirements for conservation. *Rubus* spp. exhibited special distribution pattern. *Rubus ellipticus* and *R. nivens* showed widespread distribution in Kumaon hills whereas *Jogiya hisalu* (*Rubus* sp.) is confined to some pocket like Mukteshwar and China peak of Nainital.

Table 1. Horticultural germplasm collected/ maintained at NBPGR Regional Station, Bhowali, Nainital, UP

S. No.	Crop group/ crops germplasm	Total	Promising accessions
Fruit crops			
1.	Strawberry	81	NIC-14837, NIC-18074, NIC-18075, NIC-18080, NIC-18123, NIC-20966 & EC-362602
2.	Kiwi	07	Hayward and Allison
3.	Citrus	50	-do-
4.	Apple	26	-do-
5.	Other fruits	74	-do-
		238	
Vegetable crops			
6.	Chillies	600	EC-362899-C, EC-362901, EC-362903, EC-362918, IC-119699, IC-119703, P-2072
7.	CHow-chow	10	-
8.	Others	13	-
		623	
Ornamental crops			
9.	*Gladiolus*	31	NIC-14888, NIC-14893, NIC-14895, NIC-14899, NIC-14901, NIC-14903, NIC-14909
10.	*Tagetes*	32	-
11.	*Dahlia*	18	-
12.	Others	76	-
		157	

(a) *Fragaria* sp. : A total 81 accessions were evaluated for 32 descriptors. NIC-14837, 18074, 18075, 18080, 18083, 18089, 18123, 20966 were found promising and EC-362602 showed large fruit size with improved keeping quality. Other top ranking accessions with their respective characters have shown in Table 2.

(b) *Actinidia chinenesis* : EC-367653 was established and multiplied for onward supply on Hayward root stock. Other varieties Hayward, Bruno, Allison, Monty and Abbot fruited well. Acidity, TSS and other physico-chemical traits were analysed (Table 3) in all accessions at Department of Horticulture, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, UP.

Table 2. Strawberry evaluation in UP Hills

Variable	Min.	Max.	S.D	To ranking accessions
Plant height (cm)	7.10	34.00	5.91	NIC-18134, NIC-18110, NIC-18113, NIC-18114, NIC-18112
Number of runners/plant	0.00	5.00	0.95	NIC-18119, NIC-18090, NIC-18119, NIC-18108
Length of runner (from main plant to node) (cm)	0.00	25.30	4.36	NIC-18126, NIC-18112
Days to 50% flowering	41.00	124.00	17.26	NIC-18076, NIC-14837
Fruit length (cm)	1.00	5.60	0.63	NIC-18074, NIC-18090
Fruit width (cm)	1.21	2.47	0.24	NIC-18074, NIC-18075, NIC-18123.
	2.10	12.30	1.79	NIC-18074, NIC-18075, NIC-18076.
	2.00	37.50	5.05	NIC-18074, NIC-18075, NIC-18076, NIC-18081
	2.00	30.40	4.43	NIC-18123, NIC-14837.

(c) *Citrus sp.* : Forty five collections *Citrus sp.* from Kumaon region with its related genera, *Poncirus trifoliata* were maintained which includes *Citrus sinensis, C. medica, C. jambhiri, C. aurantifolia, C. reticulata, C. decumana* and *Citrus mitis.*

Table 3. 3 Kiwi Evaluation for fruit characteristics

Variable	ABBOT	ALLISON	BRUNO	HAYWARD	MONTY	S.E.
Fruit length (cm)	5.39	5.77	5.44	5.47	5.21	0.08
Fruit width (cm)	3.71	3.27	3.63	3.42	3.56	0.05
FSI.	1.45	1.76	1.50	1.59	1.46	0.03
Fruit weight (g)	45.23	34.18	45.20	38.70	40.50	1.93
Fruit volume (ml)	45.06	33.97	43.70	39.70	39.25	2.04
SPG.	1.01	1.00	1.03	0.98	1.03	0.01
Peel weight (g)	7.20	5.53	6.80	6.81	6.02	0.31
TSS (%)	11.86	12.95	13.56	14.98	12.51	0.30
Acidity (%)	1.90	2.23	1.76	1.66	2.22	0.09
TAR.	6.27	5.84	7.95	9.06	6.55	0.33
ASA. (mg/100g)	10.34	10.34	6.89	5.17	9.21	1.33
Flesh(%)	83.77	67.37	86.85	82.43	84.89	2.94
Peel (%)	16.22	17.62	15.79	17.57	14.61	1.07
PPR.	5.60	5.56	5.62	5.05	6.36	0.39

FSI. - Fruit shape index., SPG. - Specific gravity., TAR.- Tss acid ratio. ASA. -Ascorbic acid., PPR. - Pulp peel ratio

(ii) Vegetable crops

(a) *Capsicum* sp.: A total of 289 accessions were evaluated for 30 descriptors. Variability was recorded for fruit colour (green, purple, black, yellow, orange and red) and fruit shape (elongate, oblate, round, conical and bell or blocky type). EC-362899-C, EC-362901, EC-362903, EC-362918, EC-362922, EC-362925, EC-362930, EC-362938, EC-339047, IC-092123, IC-119200, IC-119203, IC-119216, IC-119235, IC-119241, IC-119280, IC-119305, IC-119381, IC-119203, IC-119216, IC-119235, IC-119241, IC-119280, IC-119305, IC-119381, IC-119387, IC-119408, IC-119557, IC-119629, IC-119669, IC-119699, IC119703, IC-119703, IC-119706, IC-1199709, IC-119718, IC-119743, IC-119746, IC- 119747, IC-119773, IC-119787, NIC-19943, NIC-19944, NIC-19949, NIC-19988, NIC-23393, NIC-23394, NIC-23396, NIC-23398, NIC-23399, P-1893, P-2072, SKV-433 and SKV-434 were found promising. Exotic accessions mainly *Capsicum annum, C. baccatum and C. chinense* were attractive and ornamental plants. (Table 4).

Table 4. Chillies evaluation in UP hills

Variable	Minimum	Maximum	Mean	Sum	S.Error
G	82.00	117.00	95.37	27562.00	0.47
PH	7.50	96.50	45.30	13092.45	0.73
PC	10.60	2610.50	938.23	271149.79	26.79
LL	4.40	17.30	9.36	2706.50	0.11
LW	1.60	6.00	2.78	806.10	0.03
DFL	160.00	220.00	168.09	48580.00	0.37
DFR	178.00	250.00	195.26	56432.00	0.41
FRNO	1.00	95.00	16.29	4710.30	0.67
FL	1.50	11.80	5.24	1515.45	0.08
FW	0.12	3.25	0.95	275.90	0.02
FG	1.50	65.50	21.70	2673.30	0.64
FDG	0.20	12.50	5.43	1569.50	0.15

G - Days to 50% germination; LL = Leaf length (cm); LW - Leaf width (cm); PH - Plant height (cm); PC - Plant canopy (sq. cm); DFL - Days to 50% flowering; DFR - Days to 50% fruiting; FRNO - Fruit number/plant; FL - Fruit length (cm); FW - Fruit width (cm); FG - Fruit green weight (g); FDG - Fruit dry weight (g);

(b) *Sechium edule* : A total 10 accessions were maintained in the field gene bank. Yield and fruit weight per plant varied from 3-51 fruits per plant 180-556g per fruit.

3. Horticultural germplasm conservation

There is an assortment of legislation in UP hills relating to the indigeneous/endemic flora and fauna. Wild life sanctuaries e g. Corbett National Park(52082 ha. in Pauri), Govind Wild Life Sancturies (95312 ha. in Uttarkashi), Kedarnath Wild Life Sancturies (96.726 ha. in Chamoli), Motichur Wild Life Sancturies (in Dehradun), Nanda Devi National Park (63033 ha. in Chamoli), Rajaji National Park (in Dehradun), Valley of flowers (8750 ha. in Chamoli), have been established to oversee conservation and preservation of Himalayan heritage.

Ex-situ conservation, either in field gene bank (*in vivo*) or *in vitro* conditions also serves as base collection is maintained in case of fruit crops like *Citrus*, strawberry and rosaceous fruits and also in case of bulbous ornamentals. This station has also given responsibility of secondary centre of chillies evaluation. Presently 289 accessions were evaluated for 2 consecutive years and total 600 accessions are under evaluation. Other accessions of Chow chow (10) and 10 *Cucumis* sp. are under evaluation and multiplication for seed increase for long term conservation at NBPGR, Pusa campus, New Delhi. In case of ornamentals tubers/rhizomes of *Iris* sp. (4), *Rosa* sp. (14), *Hydrangea* sp. (1), *Pelargonium crispum* (5), *Buddeleia* sp. (1), *Jasminum* sp. (1), *Chrysenthemum* sp. (1), *Juniperus* (1) and *Polienthes tuberosa* (1), were maintained in the fields. 39 accessions of different flowering annuals are maintained. *Gladiolus* (31), *Tagetes* (32), *Dahalia* (18), accessions are under evaluation for different traits.

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