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# Chapter 21

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## Indigenous Horticultural<sup>1</sup> Crops of the Indian Himalayas

B. D. Joshi

Horticulture, which includes vegetables as well as fruit species, covers a wide diversity of crops such as fruits, vegetables, root and tuber crops, spices and condiments, medicinal and aromatic plants, and ornamental plants. The relevance of these crops to the agricultural economy is becoming evident with strong shifts towards diversification of agriculture in favour of horticultural crops.

The Genetic Diversity of horticultural crops is well represented in India, which is a centre of diversity. Arora and Nayar (1984) have listed 66 genera in fruits, vegetables, and spices and condiments comprising 899 species, of which 190 species have economic importance (109 fruits, 54 vegetables, and 27 spices and condiments). The highest concentration of the wild relatives of fruits, vegetables, spices, and condiments is found in the northeastern region, followed by the western Himalayas.

In the northeastern Himalayas diversity is found in fruits such as citrus, mango, and banana (Arora and Nayar 1984, Ghosh 1984). *Citrus lemon*, *C. medica*, *C. jambhiri*, *C. ichengensis*, *C. latipes*, *C. macroptera*, *C. assamensis*, *C. indica* and *C. aurantium* are indigenous to this region. The Indian wild orange, *C. indica*, is native to the Naga Hills, the Garo Hills of Meghalaya, and the Kaziranga forests in Assam. The wild forms of *Mangifera indica* and its allied species, *M. sylvatica*, also occur in the forests of this region and there is a rich diversity in *Musa*, *Pyrus*, *Sorbus*, *Rubus*, *Ribes* and *Prunus* (Box 21.1). The Shillong plateau of the Khasi

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<sup>1</sup> Horticulture, as used here, does not refer to gardening — its correct definition in English. It rather refers to cultivation of vegetables, fruits, and others as cash crops.

**Box 21.1*****Popular HYVs of Vegetables in the Indian Himalayas***

<b>Vegetable</b>	<b>Varieties</b>
Egg plant	Pusa Purple Long, Pusa Purple Cluster
Cabbage	Pusa Drum Head, Golden Acre
Cauliflower	Pusa Snowball-1, Pusa Snowball K-1
Okra (lady finger)	Pusa Makhani, Perkin's Long Green
Spinach	Virginia Savoy, Australian Green
Capsicum	California Wonder, Yelowonder
French bean	Pusa Parvati, Contender
Onion	Brown Spanish
Tomato	Roma, Sioux, Best of All, Marglobe
Radish	Pusa Himani, Japanese White, Tipped
Turnip	Pusa Swarnima, Pusa Chandrima, Purple Top, White Globe
Pea	Early Giant, Lincoln
Palak	Pusa Harit
Carrot	Pusa Yamdagini
Garden beet	Crimson Globe, Detroit Dak Red

Hills in Meghalaya has many *Prunus*, *Sorbus*, *Pyrus*, and *Cydonia* species. There is a sizeable variability in vegetable and tuber crops such as *Alocasia*, *Abelmoschus*, *Amorphophallus*, *Colocasia*, *Dioscorea*, *Luffa*, *Cucumis*, and *Tricosanthus* in different parts of the region. *Alpinia speciosa*, *A. glauca*, *Amonum aromaticum*, *Curcuma zeodoaria*, *C. amada*, *Zingiber officinale*, *Piper longum*, and *P. peepuloides* are the main species of spices and condiments. The region is home to several species of medicinal plants, the most important being species of *Berberis*, *Cassia*, *Coptis*, *Gynocardia*, *Litsea*, *Paedesa*, and *Solanum*.

The northwestern Himalayas also have a rich diversity of fruits such as *Pyrus*, *Prunus*, *Sorbus*, *Malus*, *Rubus*, *Ribes*, *Hippophae*, *Holboellia*, *Juglans*, *Corylus*, *Myrica*, *Lonicera*, and *Viburnum* (Randhawa 1987, Joshi and Rana 1994, Negi and Gaur 1994). Other wild and semi-domesticated fruits found here include *Zizyphus*, *Citrus*, *Ficus*, *Morus*, *Aesandra*, and *Emblica*. Vegetable and tuber crops reported include diverse land races of pumpkin, bottle gourd, snake gourd, ridge gourd, bitter gourd, sweet gourd, peas, *Vicia*, and tomato, as well as different types of leafy vegetables such as *Brassicae*, spinach, and fenugreek. Amaranth, buckwheats, and chenopods are maintained by mountain farmers. Farmers also maintain a variety of land races of potato, *Colocasia*, ginger, *Dioscorea*, and turmeric. There is a range of diversity in medicinal plants such as *Aconitum*, *Podophyllum*, *Taxus*, *Gentiana*, *Swertia*, *Rheum*, *Saussurea*, *Inula*, *Nardostachys*, *Ephedra*, *Potentilla*, *Berberis*, *Artimissia*, *Onosma*, *Carum*, *Picrorhiza*, and *Mucuna*. Ornamental diversity is represented by *Rosa*, *Rhododendron*, *Gerbera*, *Bergenia*, *Hypericum*, *Anemon*, *Impatiens*, *Acer*, *Primula*, *Ilex*, *Woodfordia*, *Lonicera*, *Buddlia*, and *Gloriosa*.

## Fruit Diversity in the Himalayas

Overall the Himalayas are endowed with a wide range of diversity in fruit plants (Box 21.2). They include *Malus* (4), *M. baccata*, *M. sikkimensis*; *M. baccata* var. *himalaina*; *dirangensis*, *P. pashia* var. *kumaoni*, *P. communis*, *P. khasiana*, *P. pyrifolia*, *P. polycarpa*, *P. griffithii*, *P. thomsoni*, and *P. jacumontiana*; *Sorbus* (10) *S. insignis*, *S. foliolosa*, *S. microphylla*, *S. acuparia*, *S. cuspidata*, *S. ursina*, *S. verrucosa*, *S. granulosa*, *S. lantana*, and *S. rhamnoides*; *Prunus* (13), *P. cerasoides*, *P. armeniaca*, *P. persica*, *P. rufa*, *P. cornuta*, *P. salicina*, *P. nepaulensis*, *P. Jenkensisii*, *P. wallichii*, *P. jacumontiana*, *P. prostrata*, *P. tomentosa*, *P. sp.* (Behmi), and wild cherry; *Cotoneaster* (8), *C. bacillaris*, *C. multiflora*, *C. Microphylla*, *C. acuminate*, *C. frigida*, *C. rotundifolia*, *C. nummularia*, and *C. vulgaris*; *Crataegys* (2), *C. Crenulata* and *C. oxycantha*; *Ficus* (8), *F. carica*, *F. hispida*, *F. nemoralis*, *F. odorta*, *F. cunix*, *F.foeolata*, *F. palmata*, and *F. rumphii*; *Vitis* (5), *V. lanata*, *V. parviflora*, *V. himalayana*, *V. divaricata*, and *V. capreolata*; *Viburnum* (5), *V. corianum*, *V. corianum*, *V. cotnifolium*, *V. foetens*, *V. lanata*, and *V. stettulatum*; *Rubus* (19), *R. niveus*, *R. paniculata*, *R. biflorus*, *R. lasiocarpus*, *R. macilentus*, *R. calcinus*, *R. acuminate*, *R. hexagynus*, *R. hamiltoni*, *R. assamensis*, *R. insignis*, *R. ferox*, *R. moluccans*, *R. birmanicus*, *R. lucens*, *R. biflorus*, *R. opulifolius*, *R. lasiocarpus*, and *R. rosaeifolius*; *Ribes* (3), *R. glaciale*, *R. nigrum*, and *R. rubrum*; *Fragaria* (3), *F. indica*, *F. nilgerrensis*, and *F. vesca*; *Myrica* (3), *M. nagi*, *M. hookerina*, and *M. farquhariana*; *Docynia* (2), *D. indica* and *D. hookerina*; *Elaeagnus* (3), *E. conferta*, *E. latifolia*, and *E. umbellata*; *Hippophae* (2), *H. rhamnoides* and *H. salcifolia*; *Persea edulis*; *Corylus* (2), *C. ovellana* and *C. macrophylla*; *C. oblonga* and *C. mas*; *Zizyphus* (3), *Z. jujuba*, *Z. oxyphylla* and *Z. vulgaris*; *Actinidia* (2), *A. callosa* and *A. strigosa*; *Emblia* (2), *E. officinalis* and *E. urinaria*; and a number of accessions including elite material in pomegranate, walnut, *Prunus*, *Pyrus*, *Pinus gerardiana*, and *Rosa* (3), *R. macrophylla*, *R. sericea* and *R. moschata*.

Some pockets of the Himalayas maintain useful temperate fruits and their wild relatives. For example *Prunus prostrata* and *Prunus tomentosa* are restricted to Kinnaur in Himachal: *Prunus cornuta* occurs in the higher reaches of the Shimla hills, specifically at the two sites of Narkhanda and Khadralla. *Malus baccata* is also found in Kinnaur and in the Rohru area of Himachal Pradesh. It is known locally as *dhak* and in Kinnaur farmers use it as a root stock for apples cv. such as Royal. *Malus sikkimensis* occurs in the Lachun and Lachung areas of North Sikkim. *Pyrus communis* is planted widely by Western Himalayan farmers, mostly in Kashmir. *P. kumaoni* is localised in the Kinnaur (Kochli, Powari) hills, *Pyrus jacumontiana* is confined to the Shimla and Uttarakhand, and *P. pyrifolia*, *Pyrus khasiana*, and *Pyrus thomsoni* are confined to northeastern Himalayan regions. *Rubus* species also have a special distribution pattern; *R. fruticosus* is confined to the western Himalayas and *R. ineatus* to the northeastern Himalayan

## Box 21.2

*Plants of Minor Fruits in the Indian Himalayas*

S. N.	Botanical Name	Altitude	Places Collected
1	<i>Prunus undulata</i>	1000-1900	Khasi hills, Meghalaya
2	<i>Prunus jenkinsii</i>	< 900	Sibsagar, Assam
3	<i>Prunus acuminate</i>	700-1500	Khasi hills and Goalp
4	<i>Prunus punctata</i>	1200-1500	Khasi hills, Meghalaya
5	<i>Prunus rufa</i>	200-3500	Sikkim
6	<i>Prunus jacquimontii</i>	2000-3000	Kinnaur, Himachal
7	<i>Pyrus vestita</i>	1500-1600	Khasi and Jiantia hills
8	<i>Pyrus khasiana</i>	1300-1500	Khasi and Jiantia hills
9	<i>Pyrus granulosa</i>	1500-1800	Khasi hills
10	<i>Pyrus cuspidata</i>	1200-1400	Khasi and Jiantia hills
11	<i>Fragaria indica</i>	2500	Mashobra, Shimla
12	<i>Fragaria vesca</i>	2800	Pangi, Chamba
13	<i>Fragaria nilgerrensis</i>	1000-1500	Khasi hills
14	<i>Juglans regia</i>	2800	Pangi, Chamba
15	<i>Myrica nagi</i>	1500-200	Shimla
16	<i>Myrica farquhariana</i>	1200-1500	Khasi hills
17	<i>Myrica hookeriana</i>	1200-1500	Khasi hills
18	<i>Ribes glaciale</i>	2100-3500	Hatoo peak, Shimla
19	<i>Ribes nigrum</i>	2100-3500	Hatoo peak, Shimla
20	<i>Ribes rubrum</i>	2500-3500	Narkanda, Shimla
21	<i>Rubus niveus</i>	1800-3000	Shimla
22	<i>Rubus paniculatus</i>	900-2100	Glen, Shimla
23	<i>Rubus biflorus</i>	2100-2700	Shimla
24	<i>Rubus lasiocarpus</i>	2000-3000	Shimla
25	<i>Rubus macilentus</i>	600-2100	Mashobra, Shimla
26	<i>Rubus calcinus</i>	1300-1700	Cherrapunji, Sohrar
27	<i>Rubus accuminatus</i>	1300-1800	Khasi hills
28	<i>Rubus hexagynus</i>	up to 1300	Upper Assam and Garo hills
29	<i>Rubus hamiltoni</i>	1000-1500	Khasi hills
30	<i>Rubus assamensis</i>	1500-1800	Khasi hills
31	<i>Rubus insignis</i>	1100-1500	Assam and Khasi hills
32	<i>Rubus ferox</i>	1200-1500	Khasi hills
33	<i>Rubus moluccans</i>	< 1950	Assam
34	<i>Rubus birmanicus</i>	1500-2000	Khasi and Gari hills
35	<i>Rubus lucens</i>	900-1200	Khasi hills and N. Assam
36	<i>Rubus biflorus</i>	1600-1950	Khasi and Jiantia hills
37	<i>Rubus opulifolius</i>	1600-1950	Khasi hills
38	<i>Rubus lasiocarpus</i>	700-1950	Assam and Meghalaya
39	<i>Rubus rosæfolius</i>	900-1800	Upper Assam & Meghalaya
40	<i>Docynia indica</i>	1000-1500	Khasi hills
41	<i>Elæagnus conferta</i>	1400-1800	Jeori, Shimla

## Box 21.2

## Plants of Minor Fruits in the Indian Himalayas (Cont'd)

S. N.	Botanical Name	Altitude	Places Collected
42	<i>Elaeagnus umbellata</i>	1000-1200	Jeori, Shimla
43	<i>Elaeagnus latifolia</i>	3400-3800	Khasi hills
44	<i>Hippophae rhamnoides</i>	2800-3000	Chitkool, Kinnaur
45	<i>Hippophae salicifolia</i> / <i>Vitis lanata</i>	1400-1800	Sangala, Kinnaur
46	<i>Vitis parvifolia</i>	900-1800	Jeori, Shimla
47	<i>Vitis himalayana</i>	1800-3100	Hatkoti, Shimla
48	<i>Vitis divaricata</i>	1200-2100	Hatkoti, Shimla
49	<i>Vitis capreolata</i>	1200-2100	Mashobra, Shimla
50	<i>Cornus macrophylla</i>	1500-2000	Mashobra, Shimla
51	<i>Cornus oblonga</i>	1200-2400	Mashobra, Shimla
52	<i>Cornus capitata</i>	900-2100	Narkanda, Shimla
53	<i>Viburnum cotnifolium</i>	1800-3300	Hatoo, Shimla
54	<i>Viburnum coriaceum</i>	1200-3600	Raksham, Kinnaur
55	<i>Viburnum nervosum</i>	2500-3000	Summerhill, Shimla
56	<i>Viburnum mullaha</i>	2500-3000	Narkanda, Shimla
57	<i>Viburnum stellulatum</i>	1800-3300	Bahli, Shimla
58	<i>Viburnum foetens</i>	2800-3000	Mahasu, Shimla
59	<i>Sambucus nigra</i>	2300-2700	Narkanda, Shimla
60	<i>Zizyphus jujuba</i>	1400-2100	Nichar, Kinnaur
61	<i>Zizyphus oxyphylla</i>	300-2100	Shimla
62	<i>Pistacia integerimma</i>	600-2400	Shimla
63	<i>Flacourtia sapida</i>	900-1200	Shimla
64	<i>Flacourtia cataphracta</i>	1000-1500	Sunni, Shimla
65	<i>Olea cuspidata</i>	1200-1800	U. P. Hills
66	<i>Olea glandulifera</i>	1000-1500	Shimla
67	<i>Phyllanthus fraternus</i>	500-900	Basantpur, Shimla
68	<i>Phyllanthus urinaria</i>	500-1000	Sunni, Shimla
69	<i>Cotoneaster affinis</i>	1200-1500	Shimla
70	<i>Cotoneaster aitchisonii</i>	2700	Mashobra, Shimla
71	<i>Cotoneaster obtuse</i>	3000	Kilba, Lahaul
72	<i>Cotoneaster prostratus</i>	3200	Shimla
73	<i>Cotoneaster rosea</i>	2900	Kalpa, Kinnaur
74	<i>Cotoneaster simonsii</i>	1000-1600	Chini, Kinnaur
75	<i>Eriobotrya bengalensis</i>	1300-1650	Khasi hills
76	<i>Eriobotrya japonica</i>	1300-1500	Assam and Meghalaya
77	<i>Eriobotrya angustissima</i>	1300-1500	Assam and Meghalaya
78	<i>Sorbus insignis</i>	2150	Assam and Meghalaya
79	<i>Sorbus foliolosa</i>	3000-3800	Tiger hill, Darjeeling
80	<i>Sorbus microphylla</i>	3000-3800	Sandakpu, Darjeeling
81	<i>Sorbus ursina</i>	3000-3800	Sandakpu, Darjeeling
82	<i>Sorbus granulosa</i>	1500-2000	Sandakpu, Darjeeling

## Box 21.2

*Plants of Minor Fruits in the Indian Himalayas (Cont'd)*

S. N.	Botanical Name	Altitude	Places Collected
83	<i>Sorbus acuparia</i>	3000-4000	Cherrapunji
84	<i>Corylus avellana</i>	3500-4000	Koksar, H. P.
85	<i>Corylus columa</i>	3500-4000	Pangi and Satl???
86	<i>Berberis vulgaris</i>	2500-3500	Pangi and Satl???
87	<i>Berberis brachybotrys</i>	2800	Narkanda, Shimla
88	<i>Berberis aristata</i>	1800-2200	Shimla
89	<i>Berberis coriania</i>	2200-3100	Sarahan, Shimla
90	<i>Berberis hycium</i>	900-2800	Narkanda, Shimla
91	<i>Berberis chitria</i>	2500-3000	Shimla
92	<i>Berberis edgeworthiana</i>	2700	Kotgarh, Shimla
93	<i>Berberis jaeschkeana</i>	3000	Bagi
94	<i>Berberis kunawarensis</i>	2800-2900	Chitkool, Kinnaur
95	<i>Berberis lycium</i>	2500-3000	Kalpa, Kinnaur
96	<i>Berberis lycium var. fascicularis</i>	2800	Narkanda, Shimla
97	<i>Berberis pachyacantha</i>	2500	Jeori, Shimla
98	<i>Berberis umbellata</i>	3000	Matiana, Shimla
99	<i>Berberis zabeliana</i>	2900	Sangla, Kinnaur
100	<i>Schisandra grandiflora</i>	1500-300	Narkanda, Shimla
101	<i>Dillenia indica</i>	up to 1200	U. P. hills
102	<i>Milusa velutina</i>	up to 500	U. P. hills
103	<i>Holboellia latifolia</i>	1500-3000	U. P. hills
104	<i>Podophyllum hexandrum</i>	3000-4500	U. P. hills
105	<i>Capparis zeylanica</i>	????	U. P. hills
106	<i>Saussauria nepaulensis</i>	1500-2000	U. P. hills
107	<i>Shorea robusta</i>	up to 1200	U. P. hills
108	<i>Grewia optiva</i>	up to 1500	U. P. hills
109	<i>Glycosmis cochinchinensis</i>	1200	U. P. hills
110	<i>Zanthoxylum armatum</i>	up to 1500	U. P. hills
111	<i>Picrasma quassioides</i>	2000-3000	U. P. hills
112	<i>Garuga pinnata</i>	up to 1200	U. P. hills
113	<i>Oxalis nana</i>	up to 1500	U. P. hills
114	<i>Streblus asper</i>	up to 1200	U. P. hills
115	<i>Ficus auriculata</i>	up to 1500	U. P. hills
116	<i>Morus serrata</i>	1200-2000	U. P. hills
117	<i>Artocarpus lakoocha</i>	up to 1200	U. P. hills
118	<i>Corylus jacquimontii</i>	2500-3000	U. P. hills
119	<i>Castanopsis tribuloides</i>	900-2500	U. P. hills
120	<i>Pinus gerardiana</i>	2000-4500	Kinnaur, H. P.
121	<i>Ephedra gerardiana</i>	3500-4500	U. P. hills and H. P.
122	<i>Taxus wallichiana</i>	2000-3500	U. P. hills and H. P.
123	<i>Calamus tenuis</i>	up to 2000	U. P. hills

## Box 21.2

*Plants of Minor Fruits in the Indian Himalayas (Cont'd)*

S. N.	Botanical Name	Altitude	Places Collected
124	<i>Phoenix acaulis</i>	up to 2000	U. P. hills
125	<i>Celastrus paniculatus</i>	up to 2000	U. P. hills
126	<i>Sageretia thea</i>	up to 3000	U. P. hills
127	<i>Ampelocissus latifolia</i>	up to 1800	U. P. hills
128	<i>Leea crispa</i>	up to 1200	U. P. hills
129	<i>Schleichera oleosa</i>	up to 1000	U. P. hills
130	<i>Rhus javanica</i>	900-2800	U. P. hills
131	<i>Rhus parviflora</i>	500-1300	U. P. hills
132	<i>Spondias pinnata</i>	up to 1500	U. P. hills
133	<i>Coriaria nepaulensis</i>	1500-2500	U. P. hills
134	<i>Duchesnea indica</i>	600-1500	U. P. hills
135	<i>Fragaria rubicola</i>	2000-4000	U. P. hills
136	<i>Stranvaesia russia</i>	up to 1500	U. P. hills
137	<i>Ribes alpestre</i>	2000-3500	U. P. hills
138	<i>Careya arborea</i>	up to 1500	U. P. hills
139	<i>Melothrina heterophylla</i>	1500-2500	U. P. hills
140	<i>Mukia maderaspatana</i>	up to 1800	U. P. hills
141	<i>Angelia glauca</i>	2500-3500	U. P. hills
142	<i>Dendrobenthamia capitata</i>	1000-2500	U. P. hills
143	<i>Lonicera augustifolia</i>	2500-3500	U. P. hills
144	<i>Catunaregum spinosa</i>	up to 1500	U. P. hills
145	<i>Gardenia turgida</i>	up to 1200	U. P. hills
146	<i>Pavetta tomentosa</i>	up to 1200	U. P. hills
147	<i>Rubia manjith</i>	up to 3000	U. P. hills
148	<i>Gaultheria trichophylla</i>	1500-3000	U. P. hills
149	<i>Ardisia floribunda</i>	up to 1500	U. P. hills
150	<i>Maesa argenia</i>	600-2100	U. P. hills
151	<i>Aesandra butyracea</i>	300-1500	U. P. hills
152	<i>Diospyrus tomentosa</i>	utp 900	U. P. hills
153	<i>Carissa opaca</i>	up to 1800	U. P. hills
154	<i>Ehretia acuminata</i>	up to 200	U. P. hills
155	<i>Erycibe paniculata</i>	up to 1200	U. P. hills
156	<i>Physalis minima</i>	up to 2000	U. P. hills
157	<i>Withania somnifera</i>	up to 900	U. P. hills
158	<i>Callicarpa microphylla</i>	600-1500	U. P. hills
159	<i>Gmelina arborea</i>	up to 1200	U. P. hills
160	<i>Scumula cordifolia</i>	300-2000	U. P. hills
161	<i>Bridelia retusa</i>	up to 1200	U. P. hills
162	<i>Debregeasia longifolia</i>	600-2000	U. P. hills

region; whereas *R. lanatus*, *R. lasiocarpus*, *R. moluccans*, *R. niveus*, and *R. reticulatus* are widespread in the Himalayas. *Corylus* is restricted to North Sikkim and the Darjeeling district of West Bengal. Similarly, *Prunus rufa* seems to be endemic, but is confined to the Tonglu and Sandakpur areas of Darjeeling only. *Prunus prostrata*, *P. tomentosa*, *P. spp* (*Behmi*), and *Prunus jacumontiana* are endemic to cold dry zone areas in Kinnaur and Ladakh. *Sorbus microphylla*, *S. ursina*, *S. insignis*, and *S. foliolosa* are confined to the Darjeeling hills, *S. acuparia* to Koksar Vluve valley, and *S. lanata* to Khadralla, the Shimla hills, Pangi Valley and the Munshiyari area of Pithoragarh (Joshi and Rana 1994). *Sorbus verrucosa* and *S. granulosa* seem to be endemic in the Cherrapunji hills of Meghalaya. The wild germplasms of temperate fruits resistant to various diseases prevalent in the Himalayas are listed in (Table 21.1). The exotic germplasms introduced, evaluated, and conserved in the field gene bank in Shimla are listed in Table 21.2

The populations of wild relatives and land races of temperate fruits endemic in the Himalayas are potential resources of genes for resistance to drought, cold, frost, and hailstorms. These species do not have any patronage for protection in the forests and some of them can only be saved now through *ex situ* conservation.

**Table 21.1: Diversity through Introduction: Current Cultivars of Major Fruits in the Himalayas**

Fruit	Varieties	Remarks
Apples	Tydemans Worcester, Golden Delicious, Red Gold, Stark of Pippins, Early Shan Burry	Delicious, McIntosh, Rymer
Pears	Max Red Bartlett, Flemish Beauty, Kieffer, Hardy, Gola	
Peaches	Elberta, Red Top, Candor, Flordasun, Red Haren, Kanto-5	Supplement apples in farm economy
Plums	Greengage, Santa Rosa, Golden Drop, Starking Delicious	
Apricots	New Castle, Charmagz, Nugget, Royal, Sakarpara, Saffaidda, Shipley Early	Has a specific niche in the middle hills of the Himalayas
Cherries	Stella, Merton, Napoleon, Sun Burst, Bing, Star, Royal Ann, Compact Stella	Important crop in some pockets
Pomegranates	Bedana, Kandhari, Muskat White	
Grapes	Thompson Seedless, Kali Sahebi, Katta Anab-e-Shahi	
Kiwi Fruit	Allison, Bruno, Hayward, Monty, Abbott	
Strawberries	Gilbert, Gorella, Polka, Canoga, Belrubi, Arking	
Almonds	Non-Pareil, Drake, Ne-Plus-Ultra, California Paper Shell, Dhebar	Promising, but yet to become popular with farmers
Walnuts	Hartley, Lake English, Payne, Pedro	
Pacan	Mahan, Desirable, Nellis, and Stuart	Valuable crop for Kashmir farmers

**Table 21.2: Source of Disease Resistance in Some Wild Relatives of Temperate Fruit Germplasm**

Name of Species	Resistance to	Natural Habitat
<i>Malus baccata</i> var. <i>himalaica</i>	Collor rot (CR), root rot, and wooly aphid	Jahma, Lahaul Valley (3000 m) Himachal
<i>sikkimensis</i>	Powdery mildew and CR	Lachun, Sikkim (1970m)
<i>Pyrus jacumontiana</i>	Powdery mildew (PM)	Powari, Kinnaur (3500m) Himachal
<i>Pyrus polycarpa</i>	PM and fire blight	Sohriram, Meghalaya (1455 m)
<i>Prunus cerasoides</i>	PM	Shimla (1700m) Himachal
<i>Prunus salicina</i>	PM	Shimla (1700m) Himachal
<i>Prunus</i> spp. (Behmi)	PM	Kinnaur (3-70m) Himachal
<i>Prunus undulata</i>	PM	Upper Shillong (1524m) Meghalaya
<i>Prunus persica</i>	Taphrina deformis	U.P. Hills (1750m)

(Source: Ram and Randhawa 1979; Joshi and Pandey 1996)

### Vegetable Crop Diversity in the Himalayas

The western Himalayan region possesses a rich diversity in cucurbits, radishes, carrots, turnips, peas, cowpeas, chillies, brinjal (aubergine), okra (lady finger), spinach, fenugreek, amaranth, *Solanum khasianum*, *S. hirsutum*, *Schium edule*, and *Basella rubra*. In humid areas of the Himalayas in the states of Arunchal Pradesh, Nagaland, Manicure, Mizoram, Tripura, Meghalaya and Sikkim the rich diversity in vegetable crops is represented by cucurbits, radishes, peas, cowpeas, chillies, brinjal (aubergine), okra (lady finger), spinach, beet, amaranth, a number of *Solanum* spp, *Luffa echinata*, and *Schium edule*. The number of collections of different types of vegetable crops collected in the Himalayas and maintained in Shimla, Bhowali, Shillong (National Bureau of Plant Genetic Resources (NBPGR)), Kullu (Indian Agricultural Research Institute [IARI] and Solan (University of Horticulture and Forestry [UHF] are shown in Table 21.3).

### Wild Relatives of Vegetables and Related Crops in the Himalayas

The wild relatives of vegetables and related crops include 31 species of legumes, 54 species of vegetables, and 27 species of spices and condiments (Arora and Nayar 1984). They grow in the western and eastern Himalayas (Table 21.3). The important wild plants include *Cicer microphyllum*, *Trigonella emodi*, *Lathyrus apheca*, *Moghania vestita*, *Mucuna capitata*, *Vigna umbellata*, *Abelmoschus manihot*, *Cucumis hardweikii*, *C. trigonis*, *Luffa graveolens*, *Solanum incanum*, *Tricosanthus multiloba*, *T. himalensis*, *Alocasia macrorrhiza*, *Amorphophallus bulbifer*, *Colocasia esculenta*, *Cucumis hystrix*, *Dioscorea alata*, *Momordica cochinchinensis*, *M. microphylla*, *Allium rebellum*, *A. schvenoprasum*, *A. tuberosum*,

**Table 21.3: Vegetable Crop Diversity in the Himalayas Recorded Collections Maintained by NBPGR and Sister Institutions**

Name of Crop	Number of Collections	Name of Crop	Number of Collections
Allium	23	French bean	1500
Okra	129	Cowpea	15
Fenugreek	68	Amaranth	2800
Pumpkin	94	Buckwheat	500
Bottle gourd	128	Chenopod	94
Snake gourd	25	Brassica	300
Ridge gourd	14	Ginger	174
Sweet gourd	37	Colocasia	315
Bitter gourd	63	Turmeric	147
Potato	83	Garlic	25
Egg plant	87	Faba bean	15
Spinach	10	Dioscorea	229
Capsicum	35	Moghania	2
Pea	83		

*Carum bulbocastinu*, *Curcuma zeodoria*, *Phytolacca*, *Urtica*, *Asperagus racemosus*, *Fumeria*, *Amaranthus hybridus*, *A. tricolor*, *Fagopyrum cymosum*, and *Chenopodium album*.

Several mushroom species are found in the forests of the Indian Himalayas. Villagers living around forests collect these mushrooms during March-April and in the rainy season for home consumption and sale. *Morchela esculenta*, locally called *guchhi*, is the most precious and nutritious vegetable found in the forests. *Diplazium esculentum* is a fern collected from the forests and sold in the local markets.

### Conservation of Vegetable Genetic Resources

Over 28,000 germplasm accessions are held by the NBPGR, half of which are indigenous collections and include hill types. The variability collected and conserved includes french beans (4,500), cowpeas (34,000), peas (4,000), Dolichos beans (1,100), okra (4,000), egg plant (2,800), onions (1,300), cucurbits (1,100), Brassicae (800), faba beans (600), amaranth (2,800) (Joshi and Rana 1991), buckwheat (500) (Joshi and Paroda 1991), chenopods (103) (Partap and Joshi 1996), ginger (175), Colocasia (294), and turmeric (142).

### Medicinal and Aromatic Plants

The Himalayas support an enormously rich diversity of medicinal and aromatic plants (Gupta 1986). It is estimated that over a hundred medicinal plants of the

region are used in Ayurvedic, Unani, and allopathic medicines, as well as being used in home remedies. In fact, over two dozen medicinal species are collected by local people to earn cash income. Table 21.4 shows the most prominent medicinal plants collected from the Himalayas. The cold dry zone of the Indian Himalayas, covering areas of Ladakh, Pangri, Lahaul and Spiti, is an important gene pool area for valuable medicinal plants such as *Colchicum luteum*, *Onosma bracteatum*, *Carum bulbocastanum*, *Ephedra gerardiana*, *Ferula jeanchkina*, and *Artemisia maritima*. Some medicinal herbs have been declared endangered species. They include *Dioscorea deltoidea*, *Ephedra gerardiana*, *Saussurea lappa*, *Rauwolfia serpentina*, and *Aconitum violaceum*. These medicinal plants offer opportunities for farming, as for example *Saussurea* in the Ladakh valley. These plants can support the establishment of new agro enterprises and cash crop farming, thus diversifying the base for niche-based cash crops.

**Table 21.4: Medicinal and Aromatic Plants from the Indian Himalayas Conserved at Shimla and Bhowali (NBPGR), and Solan and Rallah (UHF)**

Name of Medicinal Plant	Distribution	Name of Medicinal Plant	Distribution
<i>Holarrhena antidysenterica</i>	Foothills	<i>Valeriana wallichii</i>	Mid and high hills
<i>Mallotus philippensis</i>	Foothills	<i>Thymus serpyllum</i>	Mid and high hills
<i>Acacia catechu</i>	Foothills	<i>Urgenia indica</i>	Mid and high hills
<i>Astonia scolaris</i>	Foothills	<i>Embalica officinalis</i>	Mid and high hills
<i>Rauwolfia serpentina</i>	Foothills	<i>Taxus baccata</i>	Mid and high hills
<i>Urgenia indica</i>	Foothills	<i>Aconitum heterophyllum</i>	Alpine region
<i>Adhatoda vasica</i>	Foothills	<i>Nardostachys jatamansi</i>	Alpine region
<i>Acorus calamus</i>	Foothills	<i>Inula racemosa</i>	Alpine region
<i>Mucuna pruriens</i>	Foothills	<i>Saussurea lappa</i>	Alpine region
<i>Gloriosa superba</i>	Foothills	<i>Orachis latifolia</i>	Alpine region
<i>Dioscorea deltoidea</i>	Mid and high hills	<i>Podophyllum emodi</i>	Alpine region
<i>Gentiana kurroa</i>	Mid and high hills	<i>Rhem emodi</i>	Alpine region
<i>Picrothiza kurroa</i>	Mid and high hills	<i>Carum bulbocastanum</i>	Alpine region
<i>Swertia chirata</i>	Mid and high hills	<i>Ephedra gerardiana</i>	Alpine region
<i>Berberis aristata</i>	Mid and high hills	<i>Artimissia maritima</i>	Alpine region
<i>Alpinia officinalis</i>	Mid and high hills	<i>Potentilla affine</i>	Alpine region
<i>Salvia moorecroftiana</i>	Mid and high hills	<i>Ferula jaeschkena</i>	Alpine region
<i>Coleus foakesolii</i>	Mid and high hills	<i>Colchicum luteum</i>	Alpine region
<i>Viola serpens</i>	Mid and high hills	<i>Onosma bracteatum</i>	Alpine region

### Himalayan Farmers as Custodians and Users of Native Genetic Resources

Marginal mountain farmers use products from some wild plants as staple foods as a part of their livelihood strategy (Box 21.3 and 21.4). A variety of such products is also sold in the local markets and consumed by urban populations. These include, for example, the fruits of *Myrica esculenta*, *Pyrus*, *Prunus*, *Rubus ellipticus*, *R. lasiocarpus*, *Persea edulis*, and *Pinus gerardiana*; a number of tuber

**Box 21.3*****Collection of Indigenous Horticultural Crops in the Indian Himalayas***

<b>Crops</b>	<b>Number of collections</b>
Fruits	635
Vegetables	893
Tubers	381
Species	75
Medicinal plants	150
Ornamentals	70

There are many wild vegetables and fruits that provide food security to tribal people and wildlife alike. There is a forest in Pithoragarh, in UP, that contain a unique gene pool of pears growing in the wild. It might be possible to domesticate this tree as the size and quality of the fruit is as good as those of commercial varieties. Domestication would make an important contribution to genetic variability in the pear gene pool. Local apples are still found in home gardens in Pangi district in the Shimla hills. There is a wide range of such examples, but little attention is paid in research to efforts to domesticate and promote market opportunities for local fruits. Improvements in the economy and quality of life of farming communities through farming of horticultural crops, particularly of apple and vegetable farmers in Himachal Pradesh, are widely recognised to be a success story of the hills. But more attention should be paid to the utilisation of local genetic resources to support this development. Some fruits have a special ecological niche, for example, and could be used to develop niche based cash crop farming, thereby conserving the pear gene pool through income-generating considerations.

**Box 21.4*****Do we know the potential value of biowealth: a few examples from the Indian Himalayas***

- *Podophyllum hexandrum* and *Taxus baccata* are found in the high mountain forests of the Indian Himalayas. They are anti-cancerous compounds and are being exploited by pharmaceutical and essential oil industries.
- *Cicer microphyllum* found in Lahaul and Spiti is cold and drought resistant and produces 6 to 8 grains per pod, thus it offers useful genes for biotechnological manipulations.
- *Cucumis hystris* from the North East Indian Himalayas is resistant to mildew and saved the musk melon industry in the USA.
- *Marcella esculenta*, locally called *guchhi*, is a precious mushroom found in the forests. Many poor families depend on its collection and sale for food security.

(Source: B.D. Joshi 1996)

and vegetable crops such as *Colocasia*, *Dioscorea*, *Phytolacca*, *Fumeria*, *Diplazium esculentum*, *Morchella esculenta* (mushroom), and *Bauhinia variegata* and spices such as *Carum bulbocastianum*, *Allium streachii*, and *Achillea millefolium*. Mountain farmers also collect a number of medicinal plants from the forest and sell them in the local markets; among these are *Embellica officinale*, *Inula racemosa*, *Saussaurea lappa*, *Aconitum ferox*, *Podophyllum emodi*, *Ephedra gerardiana*, *Viola biflora*, *Picrorhiza kurua*, *Terminalia balarica*, *T. chebula*, and *Swertia chirata* (Arora and Pandey 1996).

Indian Himalayan farming communities have a history of domestication, cultivation, and utilisation of fruit species. This is evident from the existence and cultivation of very old pome, stone, nut, and soft fruit trees. There are a number of fruit trees under cultivation locally resulting from direct utilisation of germplasm. As soon as a farmer identified an outstanding fruit tree it would be planted in the garden and multiplied by vegetative methods or seed and distributed to others. In the past, emphasis on the use of fruit germplasm was on the identification of trees with outstanding fruit characteristics and yield. Locally, much has been done to identify plants for precocity, dwarfedness, and resistance to pests, drought, cold, frost, and hail. There has been little emphasis on selecting wild species for use as root stocks to provide resistance to soil born diseases, but there are some examples of this type of practice. Many of the fruit growers in Kinnaur and Shimla districts use *Malus baccata*, locally known as dhak, as a root stock for royal and red varieties of apple. Similarly, *Prunus behmi* is used as a root stock for almonds in Kinnaur (Table 21.2).

Among the medicinal and aromatic plants of indigenous origin, *Rauwolfia serpentina*, *Podophyllum hexandrum*, *Picrorhiza kuroa*, *Inula racemosa*, and *Saussaurea lappa* are valuable for the pharmaceutical and essential oil industries. *Hyssopus officinalis*, which is found in Lahaul and Spiti, has industrial potential as a plant yielding essential oils. The principal components of the oil are pinocampore (38.4%) and pinocarone (11.7%) as a major compound and additional new compounds have been characterised. *Cymbopogon jawarancusa* from Spiti revealed 2.5 to 4.0 per cent oil yield on a dry weight basis. Thirty compounds were identified. Pipertone is the major compound (73.4%) of the 30 components identified, a much higher proportion than reported for Pakistani hyssop oil (64.4%). Thus, these two species also hold great promise for the essential oil industry.

Several initiatives related to genetic resources have absorbed the principal of paying special attention to community knowledge and considering it as a resource to be valued as much as the germplasm itself. The local architects of farming systems have tended to operate with survival-focussed farming strategies, rather than focussing on simple productivity or maximisation of profits. Thus, native

communities have gathered valuable knowledge related to the conservation and use of genetic resources. They also know the useful traits of the types of products that they have been growing or gathering from the wild.

Some of the unique ethnic communities in Chamba in Himachal Pradesh and in the Uttarakashi, Chamoli, and Pithoragarh districts of Uttarakhand move to high altitude areas with their sheep and cattle and remain there in the meadows for six to seven months from April to October. Their food comes from available plants such as *Allium*, *Dendrobenthamia*, *Eleagnus*, *Epilobium*, *Fagopyrum*, *Fragaria*, *Gautheria*, *Hippophae*, *Holboellia*, *Juglans*, *Corylus*, *Malus*, *Podophyllum*, *Prunus*, *Rheum*, *Rubus*, *Ribes*, *Sorbus*, and *Viburnum*. They know which leafy and tuberous wild plants can be used as vegetables and which are toxic, as well as how to use locally available medicinal plants to cure and relieve many illnesses and ailments. They recognise certain plants as having magical effects and use various plants in different rituals.

Many mountain farmers collect wild plants from the forest and plant them near their homes, along field boundaries, or near their village. Examples include fruit trees such as *Ficus palmata*, *F. racemosa*, *Morus serrata*, *Citrus* species, *Pomegranate*, *Bauhinia*, *Pyrus*, and *Prunus*. A few multipurpose plants such as *Morus*, *Sorbus*, *Aescendra butrycea*, and *Persea edulis* are grown for fruits, fodder, farm implements, and fuel.

The wild relatives of *Allium*, *Apium*, *Colocasia*, *Curcuma*, *Dioscorea*, *Fagopyrum*, *Phytolacca*, *Zingerber* and others are allowed to grow as weeds on farmlands to meet subsistence needs.

Table 21.5 shows various rare and endangered species of wild relatives of fruit crops found at different locations together with their *in situ* conservation sites in the northwestern and northeastern Himalayas. The species requiring immediate attention for *in situ* conservation are *Malus*, *Pyrus*, *Prunus*, *Sorbus*, *Cydonia*, *Diospyrus*, *Actinidea*, *Corylus*, *Pinus*, and *Crataegus*.

## Conservation

*Ex situ* conservation, in the form of field gene banks or *in vitro* conservation, should be a major conservation strategy. Table 21.6 shows the research centres in the Indian Himalayas involved at present in the conservation of fruit, vegetable, medicinal, and ornamental plant germplasm. Most of the wild endangered species of citrus in the Garo Hills of Meghalaya need *in situ* conservation on lime to back up *ex situ* conservation in their real home because of the specific ecological requirements of these species. Cryopreservation through pollen, meristem, budwood, and tissue could be explored. The germplasm collected and conserved

Table 21.5: Rare and Endangered Wild Relatives of Fruit Crops in the Indian Himalayas

Name of Species	Altitude (m)	<i>In situ</i> Conservation Site
<i>Malus baccata</i>	2100	Rohru, H.P.
<i>M. baccata</i> var. <i>himalaica</i>	3000	Jahlma, Lahaul
<i>M. sikkimensis</i>	1970	Lachen, N. Sikkim
<i>Pyrus serotina</i>	1980	Khasi hills
<i>P. jaquimontiana</i>	1530	Kochli, Powari, H.P.
<i>Prunus salicina</i>	1920	Shimla
<i>P. persica</i>	2000	Tehog, H. P., Shillong
<i>P. sp. (Behmi)</i>	3070	Kinnaur, H. P.
<i>P. wallichii</i>	2000	Darjeeling
<i>P. undulata</i>	1524	Shillong
<i>P. rufa</i>	3550	Passibhanjanj, Darjeeling
<i>P. prostrata</i>	3000	Giabung, Kinnaur
<i>Cotoneaster bacillaris</i>	2000	Mashobra, H. P.
<i>Cydonia</i>	1400	Kashmir
<i>Crataegus oxycantha</i>	2200	Matiyana, Shimla
<i>C. crenulata</i>	2000	Shimla
<i>Diospyros lotus</i>	1900	Shimla
<i>Sorbus microphylla</i>	3540	Yangthang
<i>S. ursina</i>	3540	Sandakphu, Darjeeling
<i>S. foliolosa</i>	3540	Sandakphu, Darjeeling
<i>S. verrucosa</i>	1690	Cherrapunji
<i>S. granulosa</i>	1690	Cherrapunji
<i>Actinidia callosa</i>	2100	Hiley, S. Sikkim
<i>A. strigosa</i>	2500	Bomdila, Arunachal
<i>Corylus jacquimontia</i>	3000	Joshimath, Chamoli
<i>Pinus gerardiana</i>	3040	Kinnaur, Pangi

in field gene banks at different locations needs to be documented in a centralized information system and the collections coordinated, so that germplasm can be used effectively.

Conservation strategies need to include protection of all the major and minor fruits, vegetables, medicinal and aromatic, and ornamental plants. There are a number of sites in the Himalayas that need surveying and protection. Pin valley in Spiti is a potentially exciting site for *in situ* conservation and protection of a number of wild *Rosa spp.*, a few medicinal plants, seabuckthorn, and *Cicer microphyllum*, as these species are all under great pressure from local inhabitants.

The state agricultural universities and state departments of agriculture and forestry may jointly establish a genetic reserve for *in situ* conservation of endangered wild species of fruits, vegetables, and medicinal plants.

**Table 21.6: Research Centres in the Indian Himalayas Involved in the Conservation of Fruit, Vegetable, Medicinal, and Ornamental Plant Germplasm**

- NBPGR, Regional Station, Phagli, Shimla - 1701004, Himachal Pradesh
- NBPGR, Regional Station, Niglat, Bhowali, Nainital, Uttar Pradesh
- NBPGR, Regional Station, Barapani, Shillong, Meghalaya
- IARI, Regional Station, Amartara Cottage, Shimla, HP
- Regional Fruit Research Station, Mashobra, Shimla, HP
- Regional Vegetable Research Station, Kandaghat, Solan, HP
- Regional Fruit Research Station, Bajaura, Kulu, HP
- University of Horticulture and Forestry, Nauni, Solan, HP
- IARI, Regional Station, Katrain, Kulu, HP
- VPKAS, Almora, UP
- G. B. Pant University of Agriculture and Technology, Hill Campus, Ranichauri, Tehri Garhwal
- ICAR, Research Complex, Gangtok, Sikkim
- National Research Centre for Orchids, Gangtok, Sikkim
- ICAR, Research Complex, Barapani, Shillong
- UP Pharmaceutical Laboratory, Tarikhet, Ranikhet, UP
- Horticultural Experiments and Training Centre, Chaubattia, Ranikhet
- Shere Kashmir Agricultural University, Srinagar, Jammu and Kashmir
- Central Institute for Temperate Fruits, Srinagar, J & K

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