

OCCURRENCE, DISTRIBUTION AND DIVERSITY OF SOFT FRUITS IN N-W AND W-HIMALAYA AND PROSPECTS OF THEIR CONSERVATION AND UTILIZATION

B.D. Sharma¹ and K.P.S. Chandel²

¹NBPGR, Regional Station,
Shimla, 171 004 (Himachal Pradesh)

²NBPGR, Pusa Campus,
New Delhi 110 012

Soft fruits, constituting genera of *Rubus*, *Ribes* and *Fragaria* have rich species diversity in the N-W and W- Himalaya due to the high ecological diversity. There occur 32 species and 4 varieties of *Rubus*, seven species of *Ribes* and four species of *Fragaria*. Some of these have good horticultural potential. Prospects of their commercial cultivation, conservation and utilization have been discussed.

Key words : Soft fruits, *Rubus*, *Ribes*, *Fragaria*, Himalaya, species diversity.

India is a country of very rich diversity in edible plants. The under-utilization or even non-utilization of the plant genetic resources in many instances not matching the ever increasing demand of food and nutrition has been causal to its placement in the group of developing countries. Soft fruits present an excellent case of non-utilization of the existing resources. The soft fruits or small fruits is a category of highly perishable fruits which include genera of *Rubus*, *Ribes* and *Fragaria*. The present paper is an attempt to throw light on the existing resources, distribution, diversity and prospects of their conservation and utilization.

Ecological Diversity

The North Western and Western Himalaya comprises of the states of Jammu & Kashmir, Himachal Pradesh and the Uttarakhand (Uttar Pradesh). The N-W and W-Himalayan ranges have the widest flank and have colder and drier climate. The vegetation is in general drought resistant and cold loving. This part of the Himalaya is constituted of Siwaliks or outer hills,

central (Greater) Himalaya and the trans-Himalaya. Its ecological zones include; (i) warm tropical (below 800m), (ii) warm subtropical (800 to 1200m), (iii) cool temperate (1200 to 2400m), (iv) cold temperate (2400 to 3600m), and (v) arctic or arid temperate (above 3600m). This part of the Himalaya usually receives low rainfall in monsoon but gets heavy snow or rain in winters. The region has contributed a number of species of the genera of *Rubus*, *Ribes*, *Prunus*, *Pyrus*, *Sorbus*, *Hordeum*, *Avena*, *Cicer*, *Aegilops*, *Allium*, *Cucumis*, *Linus*, *Carum*, *Elymis*, *Eremopyrum*, *Lepidium* and *Viburnum*. Since the climate ranges from tropical through temperate to the tundra type (near snow line), there occurs unique vegetation consisting of extensive stands of pines, deodars, beaches, birches, rhododendrons and sea buckthorn. The soils are also extremely varied. The foot hills and plain valleys have deposits of gravel and coarse sand, alluvial and red loams. On mountains the forest soils are clayey and gravely porous sandy loam rich in humus. Marshy low lying areas comprise peaty soils. The coniferous covered hill slopes have acidic podzols and oak covered areas have brown soils. Leaching of nutrients and soil erosion are the main features of soils on slopy lands. The trans-Himalaya have sandy soils, very low winter temperatures and very scanty rainfall.

The Specific Diversity

The north-western and western Himalaya is a suitable habitat and hence is also a rich resources of soft fruit plant species.

1. *Rubus* species : *Rubus* is the most variable and complex genus, widely and predominantly distributed in temperate and warm temperate regions of the northern hemisphere. Focke has described 429 or more species the world over, of which 57 species occur in the Indian subcontinent. The north-western and western Himalayan region contain 32 species and four varieties (taxonomic), which is about 63 per cent of total diversity (Table 1).

The distribution of *Rubus* species shows a wide altitudinal and ecological variation (Table 1). The warm tropical and subtropical climate comprised of deep valleys, low and medium hills with 500 to 2000 m altitude contain eight species and two varieties under *Rubus ellipticus* Linn. Seven species and two varieties of *R. niveus* have distribution in cool temperate mid hills with altitude ranging from 2000m to 2500m above m.s.l. The highest specific number of species (12) however occur in high hills (altitude 2500 to 3000m) with cold climate. In temperate arid climatic conditions of very high hills 3000 m above m.s.l. only five spp. have been found distributed. The two species *R. ellipticus* and *R. niveus* exhibited wide variation for foliar and fruit characteristics.

Table 1. Distribution and diversity of *Rubus* spp. in different ecological zones of N-W and W Himalaya

S.No.	Ecological zone	Altitude range (m)	<i>Rubus</i> spp. diversity and distribution
1.	Warm tropical & subtropical (valleys & low hills)	500 to 2000 m	<i>Rubus ellipticus</i> , <i>R. paniculatus</i> , <i>R. almorensis</i> , <i>R. acuminatus</i> , <i>R. ellipticus</i> , <i>Var. hirtus</i> , <i>R. antennifer</i> , <i>R. fasciculatus</i> , <i>R. ellipticus var. denulata</i> , <i>R. noluccanus</i> , <i>R. fruticosus</i> .
2.	Cool temperate (Mid hills)	2000 to 2500 m	<i>R. foliosus</i> , <i>R. ulnifolius</i> , <i>R. reticulatus</i> , <i>R. alpestris</i> , <i>R. niveus var. pauciflorus</i> , <i>R. niveus var. membranaceus</i> , <i>R. hoffneistriani</i> , <i>R. purpureus</i> , <i>R. clarkei</i> .
3.	Cold temperate (High hills)	2500 to 3000 m	<i>R. biflorus</i> , <i>R. nacilentus</i> , <i>R. pedunculatus</i> , <i>R. barbatus</i> , <i>R. lanatus</i> , <i>R. calycinus</i> , <i>R. nepalensis</i> , <i>R. nutans</i> , <i>R. flavus</i> , <i>R. rosaefolius</i> , <i>R. chambica</i> , <i>R. pungens</i> .
4.	Temperate arid (cold desert)	Above 3000 m	<i>R. irritatus</i> , <i>R. niveus</i> , <i>R. saxatilis</i> , <i>R. hypagyris</i> , <i>R. concolor</i> .

2. *Ribes* species : About 150 species of *Ribes* occur in temperate and cold regions of the world. In India eight species have been recorded, seven of these are found in the N-W and W Himalayan region (Table 2). In general

Table 2. Distribution and diversity of *Ribes* species in the N-W and W Himalaya

S.No.	Name of Species	Distribution
1.	<i>Ribes alpestre</i> Wallich ex Decne = <i>R. grossularia</i> auct. (non L.) Wall.	Alpine Western Himalaya (2400-3600): Chamba, Kinnaur, Lahaul & Spiti; Ladakh, Kashmir valley
2.	<i>Ribes emodense</i> Decne. = <i>R. rubrum</i> auct. (non L.) H.F. & T. = <i>R. himalense</i> Decne.	Chamba, Kinnaur, Kullu, Lahaul & Spiti, Shimla (Narkanda); Gulmarg (J&K).
3.	<i>Ribes glaciale</i> Wall. = <i>R. acuminatum</i> Wallich.	Chamba, Kinnaur, Kullu, Lahaul & Spiti, Shimla (Chur peak alt. 3600m)
4.	<i>Ribes nigrum</i> Linn.	Lahaul & Spiti, Kinnaur, Gulmarg (J&K); Garhwal and Kumaon.
5.	<i>Ribes orientale</i> Desf.	Chamba, Kinnaur, Lahaul & Spiti, Ladakh (J&K), alt. 2100 to 4400 m.
6.	<i>Ribes takare</i> D. Don.	Kumaon and Garhwal (2200 to 3300 m).
7.	<i>Ribes rubrum</i> Linn.	Shimla, Narkanda (Himachal Pradesh, Kumaon and Garhwal (U.P.), Kashmir, alt. 2400 to 3600 m.

their most favourable habitat is altitudes above 200 m m.s.l. and cool climatic conditions of Kinnaur, Lahaul & Spiti, Chamba in Himachal Pradesh; Jammu & Kashmir (Ladakh, Gulmarg) and Uttarakhand (Kumaon and Garhwal) of Uttar Pradesh, the species such as *R. alpestre* and *R. orientale* are adapted to low temperature and moisture stress areas. The *R. rubrum* could grow very well in moist and dry localities whereas *R. emodense* grows only in moist situations.

3. *Fragaria* species : The species of *Fragaria* are low growing perennial herbs confined to the north temperate zone and in the high tropical regions of the western Hemisphere. Probably 20 to 25 species occur all over the world. In India five species have been recorded and four of these are found distributed in the N-W and W Himalayan region (Table 3). *Fragaria indica* Andr. grows in moist and shady situations in lower hills and valleys while *F. vesca* is well adapted to high altitudes (2700-2800 m) and dry soil conditions. *F. nubicola* Lindley ex. Lacaïta. has a wide range of altitudinal variation (1800 to 3800 m) and is found distributed in Uttarakhand (Nainital, Dewali) of Uttar Pradesh. The Kali valley (2000-3600 m) is a favourable habitat for *F. daltoniana* Gay.

Table 3. Diversity and distribution of *Fragaria* species in the N and W-Himalaya

S.No.	Species	Distribution
1.	<i>Fragaria vesca</i> Linn.	Kinnaur (Chini alt. 2775 m), Chamba (Pangi, alt. 2800)
2.	<i>Fragaria nubicloa</i> Lindley ex Lacaïta	Kumaon (Nainital, Dewali, alt. 1800 to 3800 m)
3.	<i>Fragaria daltoniana</i> Gay.	Uttarkhand (Kali valley, alt 2000 to 3600 m).
4.	<i>Fragaria indica</i> Andr.	H.P. (Bilaspur, Kangra, Hamirpur, Shimla, Mandi); Lower hills and valleys of J&K; Uttarakhand (U.P.).

Adaptability Gene Complex

All the species of *Rubus*, *Ribes* and *Fragaria* show considerable variation with respect to their adaptation to different soil conditions (continuous moist rich in organic matter to dry rocky and humus poor sandy soils on hill slopes), low to high precipitation areas, low hills of high mountains, and subtropical temperatures to freezing arctic temperatures. The *Rubus* spp. can be successfully grown on a wide range of soil types. Some species like *R. niveus* have been found to grow even on alkaline soils in the United States.

Biotic and abiotic stress

Generally no serious diseases and insect pests are observed on the naturally occurring soft fruit species. Among the *Rubus* species, *R. biflorus* Buchham. and *R. ellipticus* Sm. could be used as parental lines in breeding for incorporation of disease resistance. *Ribes alpestre* Wall ex Decne. is considered to have moderate resistance to white pine blister caused by *Cronartium ribicola* Fisher., and *R. glaciale* Wall. and *R. orientale* Desf. are said to be immune to white pine blister (Wealth of India).

Table 4. Classification of *Rubus* spp. on the basis of time of flowering, fruiting and fruit colour

Flowering Time	Jan-March	<i>R. ellipticus</i> , <i>R. fasciculatus</i> , <i>R. calycinus</i> , <i>R. nepalensis</i> , <i>R. biflorus</i> , <i>R. chambica</i> , <i>R. foliolus</i> , <i>R. nacilentus</i> , <i>R. niveus</i> , <i>R. paniculatus</i> , <i>R. ulnifolius</i> , <i>R. rosaefolius</i> , <i>R. pedunculatus</i> .
	April-June	<i>R. narbatus</i> , <i>R. acuminatus</i> , <i>R. reticulatus</i> , <i>R. hypagyryus</i> , <i>R. ellipticus</i> var. <i>hirtus</i> , <i>R. niveus</i> var. <i>pauciflorus</i> & var. <i>nembranaceous</i> , <i>R. hoffmeisterianus</i> .
	July-Sept.	<i>R. irritanus</i> , <i>R. saxatilis</i> , <i>R. antennifer</i> .
Fruiting Time	April-May	<i>R. ellipticus</i> , <i>R. calycinus</i> .
	June-July	<i>R. rosaefolius</i> , <i>R. pedunculatus</i> , <i>R. fasciculatus</i> , <i>R. nepalensis</i> .
	August-Sept.	<i>R. biflorus</i> , <i>R. chambica</i> , <i>R. foliolus</i> , <i>R. irritanus</i> , <i>R. nacilentus</i> , <i>R. niveus</i> , <i>R. paniculatus</i> , <i>R. saxatilis</i> , <i>R. ulnifolius</i> , <i>R. lanatus</i> , <i>R. acuminatus</i> , <i>R. reticulatus</i> , <i>R. alpestris</i> , <i>R. concolor</i> , <i>R. hypagyryus</i> .
Fruit colour	Orange	<i>R. biflorus</i> , <i>R. ellipticus</i> , <i>R. irritanus</i> , <i>R. rosaefolius</i> , <i>R. ellipticus</i> var. <i>hitrus</i> .
	Red	<i>R. saxatilis</i> , <i>R. barbatus</i> , <i>R. lanatus</i> , <i>R. acuminatus</i> , <i>R. reticulatus</i> , <i>R. hypagyryus</i> , <i>R. noluccanus</i> , <i>R. calycinus</i> , <i>R. nepalensis</i> , <i>R. hoffmeisterianus</i> ,
	Pink	<i>R. pedunculatus</i> , <i>R. nutans</i> .
	Black	<i>R. niveus</i> , <i>R. paniculatus</i> , <i>R. ulnifolius</i> , <i>R. fasciculatus</i> , <i>R. foliolus</i> .

Attributes of horticultural value

Considerable variability exist for fruit size, shape, colour and juiciness as well as the nutritional contents (Table 4 & 6). *Rubus* species have fruits of

black, red, pink, scarlet and orange colour. The genes for improving the fruit quality could be found in *R. biflorus*, *R. ellipticus*, *R. almorensis* and *R. pedunculatus*. The fruit quality in *F. vesca* is as good as the European types. In *F. daltoniana*, fruits are large about 2.5 cm long and have attractive pink colour and were pleasantly flavoured. Similarly the fruits of the indigenous wild spp. of *Ribes* are large and palatable like cultivated European types. The flowering in *Rubus* begins in January and goes upto the end of September while the fruit maturity spreads over six months starting from April to September. The *Fragaria* spp. bear fruits from April to June. The availability of fruits in *Ribes* is mostly in September (Table 4).

Status of Soft fruits in the Indian Horticulture

Except strawberry (*Fragaria* cultivars) meagre efforts have been made to grow or to improve genetically either the *Rubus* or the *Ribes* species. The fruits of these are collected from their wild habitats and are consumed fresh by the hill people. Information on their nutritive value is rather scanty. Fruit processing is negligible.

Prospects of Soft fruits

The advanced countries such as U.S.A. have achieved good success in the build up of genetic resources, genetic improvement and fruit processing. The small or soft fruits sometimes classified as high value speciality crops have gained industrial prominence in USA. The germplasm collection at the National Clonal Germplasm Repository (NCCGR) at Corvallis include *Rubus* (1229 accessions), *Ribes* (717 accessions) and *Fragaria* (976 accessions) whereas in India no efforts have been made to collect even the indigenous diversity existing in these fruit plant species.

By judicious use of the wild germplasm, appreciable work on the genetic improvement aimed at high fruit yield or better fruit quality have been done in the United States and the European countries. Till 1989 in USA there were 49 cultivars of *Rubus* (black berry), 47 cultivars of *Ribes* (currant), 42 cultivars of *Ribes* (gooseberry), 86 cultivars of *Rubus* (raspberry), and 130 cultivars of *Fragaria* (strawberry). Some of the important cultivars among them are given below:

Raspberry	Black Hawk, Brandy wine, Cumberland, Bristol, Heritage, Lotham, Royalty.
Black berry	Black Satin, Thornless Boysenberry, Darrow, Himalaya Blackberry, Tay berry, Thornfree.
Currant	Alpine currant, Cherry, Consort, Red Lake, Wilder.

Gooseberry	Pixwell, Poorman, Welcome, Captivator, Oregon Champion.
Strawberry	All Star, Earlilglow, Guardian, Red Chief, Sure Crop, Sparkle, Tristar, Ozark Beauty.

The annual estimates for the Oregon state of USA for the earnings from the processed fruit products during 1987 were straw berries (\$55 million), black berries (\$ 18 million), rasp berries (\$ 19 million). It is also evident that a single US state (Oregon) has expanded the small fruit cultivation remarkably as is evident from the following table :

Table 5. Statistics on area, yield/acre, production and total income of small fruits in the Oregon State of USA.

Commodity	Area harvested (Acres)	Yield/acre	Production (,000 units)	Total income
Strawberries	7,740	12,600 lbs	98,106	28,233\$
Red raspberry	3,650	4,330 lbs	15,809	8,027\$
Black raspberries	1,700	2,610 lbs	10,207	7,707\$
Other berries	1,268	-	-	2,714\$
Total	14,358	-	124,122	47,283\$

The above account clearly describes as to how the soft fruit genetic resources have been exploited in the countries like USA. As pointed out earlier, the rich resources of the N-W and W Himalaya offers ample scope for growing soft fruits. The berries not only provide remunerative source for improving the economic conditions of the mountain people, but these have also high nutritional value (Table 5). The fruits of *Rubus* and *Ribes* are rich in minerals Ca, P, K, Fe and vitamins A&C. These could be grown on marginal fertility lands on hill slopes with low inputs. The fruits are either consumed fresh or could be preserved as jellies, fruit sauces, chutney, canned and frozen.

They may be used flavoring to ice cream, pudding, biscuits, toffees. Therefore the soft fruits may provide new opportunities to start cottage or small scale industries in the hills. Ideal conditions exist for the cultivation and commercial exploitation of the fruit plant species *Rubus*, *Ribes* and *Fragaria* in the hills. This could be possible by introduction of superior improved varieties and simultaneously initiating research on all aspects for the development of these fruit crops. The quality of Wild Himalayan black current fruits is comparable to cultivated European types.

A guide to their cultivation is that raspberries fit apple climates while black raspberries and black berries prefer subtropical (peach climate) conditions. The strawberries suit almost any soil or any temperate climate.

Ethnobotanical/ Medicinal and Ornamental Uses

1. *Rubus ellipticus* Linn. : Juice of young tops is given to cure tonsillitis in children. Ripe fruits are rich in minerals like K, Fe, P and Na (Singh, 1995) hence can be used to treat deficiency symptoms.

2. *Rubus fruticosus* Linn. : Decoction of root is useful for relaxing bowels and dysentery and against whooping cough in its spasmodic stage. Infusion of leaves is beneficial to control diarrhoea and bleeding. Leaves contain lactic, succinic, malic and oxalic acids. Wild fruits contain cyanidin- monoglucoside (W.I.).

3. *R. moluccanus* Linn. : Leaves are astringent, emmenagogue and abortifacient. Fruits (ripe) are useful remedy for nocturnal micturition in children (Chopra, Nayar, Chopra 1986). Ripe fruits are also considered beneficial for liver ailments in children. Young shoots effectively cure pneumonia (Dutta, 1985). Paste of roots is applied on cuts for checking bleeding and to prevent swelling (Maikhuri & Gangwar, 1993).

4. *Ribes nigrum* Linn. : A decoction of leaves and top shoots is considered to be a home cure for coughs. Leaves are also said to have diuretic properties. Fruits are very rich in vitamin C K(372 mg/100g), and minerals Mg (17 mg/100g), and Ca (60mg/100g). They are also a good source of flavonoids (Kaempferol, quercetin & myricetin).

5. *Ribes orientale* Desf.: Fruits are said to have good purgative properties (Wealth of India).

Besides, *Rubus* and *Ribes* have value as ornamentals. The *Rubus* also serve as a good fence for preventing the entry of animals. The species, which have value as ornamental, are *R. ellipticus*, *R. barbatus*, *R. paniculatus*, *R. rosaefolius*.

Research Needs

The soft fruit (small fruit) crops except strawberry have received little attention in the Indian subcontinent where they offer good scope for exploitation. There is urgent need to undertake intensive research for developing technologies to suit different agro-ecological zones of the hills. The research thrusts must be laid on the following :

- (1) Genetic improvement to evolve superior varieties to the local agro-climates.

- (2) Collection, evaluation, documentation and conservation of germplasm of *Rubus*, *Ribes* and *Fragaria* species from India and abroad.
- (3) Introduction of elite cultivars from the USA and European countries either for direct use or using as parental lines.
- (4) Standardization of agro-techniques for the soft fruit crops.
- (5) Research on pathological and entomological problems.

Table 6. Nutritional value of soft fruits

Name of Berry	Edible portion (%)	Water (g)	Protein (g)	Fat (g)	Minerals (g)	Fibre (g)	Carbohydrates (g)	Ca (mg)	P (mg)	Fe (mg)	Vit. A (mg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)
Black berry (<i>R. fruticosus</i>)	100	87.2	1.3	0.5	0.5	3.8	6.7	30	20	4.3	7.0	-	-	20
Black currant (<i>Ribes nigrum</i>)	98	18.4	2.7	0.5	2.2	1.0	75.2	130	110	8.5	21.0	0.03	0.14	0.40
Rasp berry (<i>R. ellipticus</i>)	-	84.8	1.0	2.1	1.8	0.1	10.6	40	110	2.3	1248	-	-	0.80
Straw berry (<i>Fragaria vesca</i>)	96	87.80	0.7	0.2	0.4	1.1	9.8	30	30	1.8	18	0.03	0.02	0.20

Source: Nutritive value of Indian foods, NIN, Hyderabad.

- (6) To explore possibilities of their diversification to apple belts.

REFERENCES

- Atkinson E.R. 1980. The Economic Botany of the Himalayas. Cosmo Publications, New Delhi.
- Bailey L.H. 1947. The Standard Cyclopedia of Horticulture. Vol. III. The MacMillan Co. New York.
- Collett H. 1971. Flora Simlensis. M/S Bishen Singh Mahendra Pal Singh, Dehradun.
- Dutta A.C. 1985. Dictionary of Economic and Medicinal Plants. Khelmati, Jorhat, Assam.
- Gopalan C., B.V. Rama Sastri and S.C. Balasubramaniam. 1978. Nutritive Value of Indian Foods. National Institute of Nutrition, ICMR, Hyderabad.
- Gupta R.K. 1968. Flora of Nainitalensis. Navyug traders Publication, New Delhi.
- Kachroo P., B.L. Sapru and U. Dhar. 1977. Flora of Ldakh-an ecological and taxonomic appraisal. Bishen Singh Mahendra Pal Singh, Dehradun.
- Maikhauri R.K. and P.S. Ramakrishnan. 1992. Ethnobiology of some tribal societies of Arunachal Pradesh in N-E India. J. Econ. Tax. Bot. Addl. Ser. 10: 67-71.
- Nair N.C. 1977. Flora of Bushar Himalayas. International Bioscience Publishers, Hissar.
- Polunin O. and Adam Stainton. 1986. Flowers of the Himalaya. Oxford Univ. Press, New Delhi.

- Raizada M.B. and H.O. Saxena. 1978. Flora of Mussorie. Vol. I. Bishen Singh Mahendra Pal Singh, Dehradun.
- Singh G. and P. Kachroo. 1976. Forest Flora of Srinagar and Plants of Neighbourhood. Periodical Expert Book Agency, Delhi.
- Singh V. 1995. Lesser known wild edibles of Sikkim Himalaya. J. Econ. Tax. Bot., 19 2385-390.
- Stewart R.R. 1971. The Flora of Ladakh, Western Tibet. Bulletin of the Torrey Botanical Club Rep. by M/S Bishen Singh Mahendra Pal Singh, Dehradun.
- Strachey R. and J.F. Duthie. 1974. Catalogue of Plants of Kumaon and the Adjacent Portions of Garhwal and Tibet. M/S Bishen Singh Mahendra Pal Singh, Dehradun.
- Wealth of India. 1972. Vol. IX. pp. 85-90. CSIR, New Delhi.