Indian J. Pl. Genet. Resources 12(3): 410-416, 1999

Short Communication

AGRO-BIODIVERSITY AND CROP GENETIC RESOURCES IN NORTH-WESTERN HIMALAYAS

ARUN GUPTA, V. P. MANI, M. K. SINHA AND V. S. CHAUHAN, Vivekanand Parvatiya Krishi Anusandhan Sansthan, (ICAR), Almora 263 601 (Uttar Pradesh)

Western Himalaya contributed a great deal in conservation of crop genetic resources such as amaranths, chenopods, buckwheat, maize, wheat, fingermillet, *Echinochloa frumeritacea*, rice, lentil, *pyrus, prunus, sorbus, Rubus, Ribes, Hordecom, Allicum, Lepidium, Carum, Cicer, Cucumis* etc. Extent of variability in some of these crop has been depicted in this paper.

Key words : Agro-biodiversity, economic plants, NW Himalayas

The Himalayan ranges are about 2500 km long extending 73° to 93° East longitude and from 27°N to 37° North latitude, and covering an area of approximately 236000 sq. km. The entire region is endowed with a wide range of physiography, climate, soil and biological wealth. It has a large altitudinal range (300-8000 m), with a rich diversity of habitats providing varied micro climate and ecological niches not only for plants but also for humans. The western and the eastern flanks of the Himalayas are different. The Western Himalayan ranges are much wider and cooler with drier climate. In contrast, the eastern ranges are among the wettest regions of the world with high biodiversity (Khoshoo, 1992). The north western fringe include Kashmir, Himachal Pradesh and Uttarakhand (U.P.). The climate in north western himalaya ranges from sub tropical to arid shivaliks (subtropical); H.P., Uttarakhand (warm temperate, upper reaches approaches arctic); Kashmir Himalaya (dry temperate approaching arctic in Ladakh). Following Bagnolus and Gaussen (1957), the climate of the area is xerothermic and Sub Mediterranean. The precipitation however increase with increase in altitude upto certain point beyond which it decreases. Most of the precipitation at higher reaches is in form of snow which plays an important role in maintaining the moisture balance during the summer months when there is little rainfall. The western ranges have a vegetation, which is cold loving and drought resistant. There are large gregarious populations of conifers like the pines, deodar, fir and spruce. The native population rely on number of unconventional food plants such as *Vigna vexillata* (Sophlong), *Chenopodium* (Bathua), Buckwheat (Phaphar), Amaranth (Chaulai), Mushrooms etc because of small land holding and unaffordable optimum agricultural inputs. (Samant and Dhar 1997).

Centre of diversity of major crops in North Western Himalayas

India is one of the important centers of diversity of having contributed 167 species of plants whose origin and diversity is in this country. Within India there are eight sub-centres, of which three fall in the Himalayan belt. The Western

Himalaya has contributed species of the genera of *Pyrus, Prunus, Sorbus, Rubus, Ribes, Hordeum, Elymus, Eremopyrum, Avena, Aegilops, Allium, Lepidium, Carum, Linum, Cicer, Cucumis* (Arora and Nayar, 1984).

Genetic wealth of agri-horticultural crops in N.W. Himalayas

A total number of 162 species under 122 genera representing 53 families have been recorded by Negi and Pant (1994) from UP Himalaya as shown in Table 1. The dominant families of genetic wealth are Fabaceae (21), Cucurbitaceae (14), Brassicaceae (12), Poaceae (11), Rutaceae (8), Rosaceae (7), Solanaceae (7), Apiaceae (7) and Amaryllidaceae (4).

Table 1. Economic plant wealth of agri-horticultural crop groups in U.P. hills

S.N.	Crop Groups	Species No.
1.	Cereals	05
2.	Pseudocereals	06
3.	Minor millets	06
4.	Pulses	17
5.	Oil yielding crops	09
6.	Vegetables	27
7.	Salad	07
8.	Spices & condiments	17
9.	Fibres	07
10.	Semi domesticated	11
11.	Narcotics	02
12.	Washing detergents	01
13.	Bevarages	01
14.	Medicinal & Aromatic plants	12
15.	Horticultural & other fruit yielding plant material	34
Total		162

Wild relatives of cultivated plants

Among the wild relatives of cultivated plants, a rich diversity 125 species (Table 2) in the Western Himalaya (Arora and Nayar, 1984). Most of wild relatives provide a donor gene for wider adaptability, vigorous growth and resistance to major diseases and pest. Hence the native diversity can be utilized as a material for breeding and selection. To assess their existing economic value, ethnobotanical observations, quantitative data on the diversity and abundance of the species need to be intensified.

Table 2. Distribution of wild relatives of crop plants in the North-western Himalaya

Crop Group	Genera represented	Species represented (no.) Western Himalaya
Cereals & millets	15	29
Legumes	7	9
Vegetables	17	25
Fruits	25	37
Oilseeds	3	6
Fibers	6	4
Spices & condinents	8	10
Misc.	9	5
Total species diversity		125

Needs for collection of crop diversity

The significant changes in the land use pattern are predominantly influenced by the modern agriculture and habitat loss. The recently occurred landslides in Rudraprayag and Malpa are example of it. This had led to the loss of habitat consequently depleted the wide range of biological resources. Estimates of the rates of species extinction vary widely but the steady loss of biodiversity at every level is widely acknowledged. Survey conducted by Maikhuri *et al.*, in the Alaknanda catchment areas of North Western Himalaya revealed that the area under cultivation of traditional crops has declined at an alarming rate. In the last two decades area under *Hordeum* himalayans, *Secale cerale* and *Fagopyrum* spp. has

been reduced by 80-85 per cent. Similarly the horsegram, and barnyard millet declined by 60-75 per cent in the lower altitude of 560-1500 m amsl. Cultivation of *Perilla frutescens* and *Hordeum himalayans* has decreased rapidly and both these crops are at the verge of extinction in this area.

Similarly Atkinson 1885 described 48 varieties and stated thousand non descriptive varieties of rice occurs in U.P. hills but now its limited upto 10-12 type only. Thus the genetic base of rice is narrowing down.

Collecting crop genetic resources from N.W. Himalayas

Exploration were undertaken during 1978-85 by various teams of scientists and collections were made from eight districts of U.P. hills as shown in Fig 1. About 5000 accessions of various crops were collected from this region by VPKAS, Almora. The crop wise details of local landraces presently maintained at this institute are given in Fig. 2.

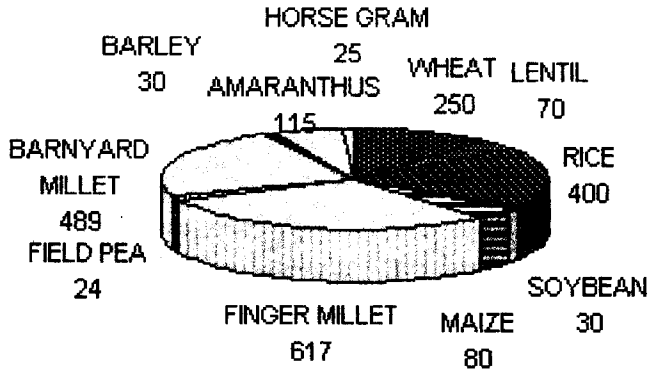

Fig. 2. Details of local collections of germplasm maintained at VPKAS, Almora

Besides this, the indigenous germplasm resources from other regions and the exotic germplasm were also received in form of National and International

1=Bhatwari	2=Uttarkashi
3=Dharanshu	4=Rishikesh
5=Narendra Nagar	6=Tehri
7=Ghanshyali	8=Tilwari
9=Ukhimath	10=Karanprayag
11=Pipalkoti	12=Joshimath
13=Badrinath	14=Mane
15=Duggada	16=Lansdowne
17=Satpuli	18=Pauri
19=Sri Nagar	20=Ram Nagar
21=Garjia	22=Sult
23=Dhum Koti	24=Liskote
25=Borokhal	26=Thallisain
27=Chamoli	28=Gairsain
29=Tharali	30=Baijnath
31=Chaukhutiya	32=Bhikiyasain
33=Dwarahat	34=Someshwar
35=Sama	36=Kapkot
37=Thal	38=Tawaghat
39=Dharchula	40=Pithoragarh
41=Jhulaghat	42=Lohaghat
43=Champavat	44=Tanakpur
45=Khatima	46=Sitarganj
47=Haldwani	48=Bhimtal
49=Mukteshwar	50=Almora
51=Bageshwar	

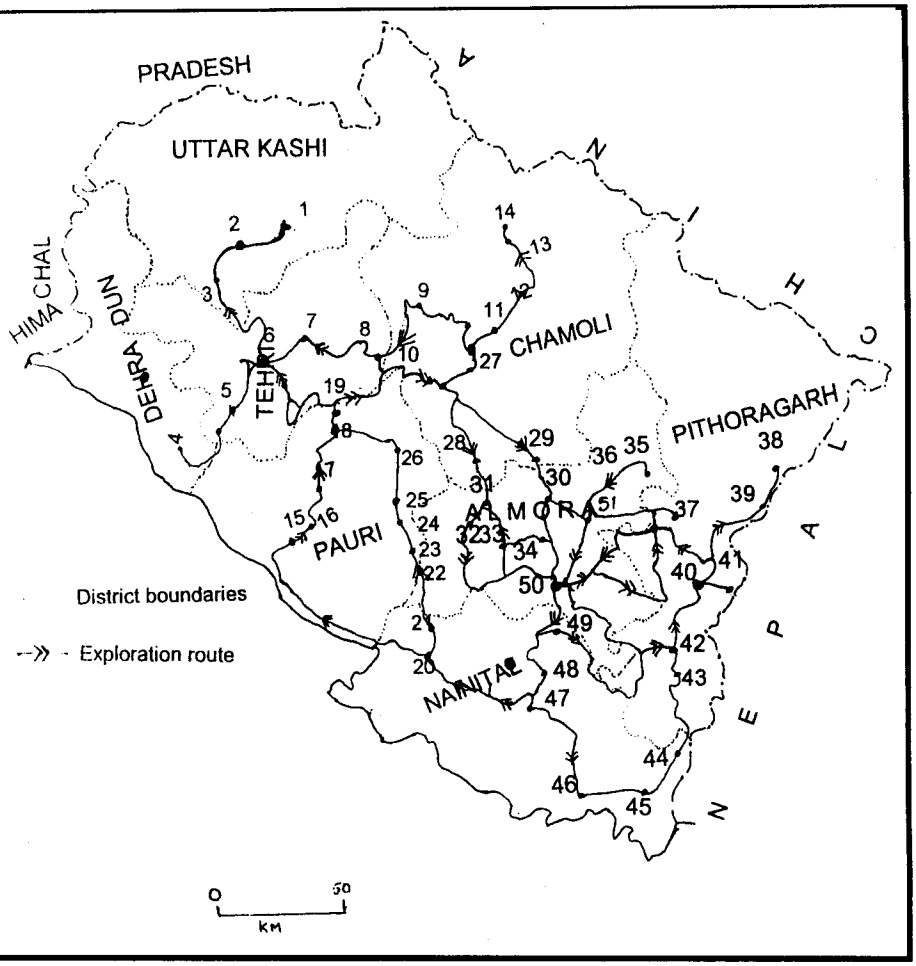

Fig. 1. Route map for the germplasm collection from U.P. hills

Nurseries and trials from AICRP/NBPGR.

Extent of variability in local collections

Maize

On the basis of variation in 75 per cent days to silk, 75 accessions were grouped into 4 distinct maturity classes namely late (64-67 days), medium (60-62 days), early (49-53) and very-early (40-42 days). (Mani, 1996) Most of the collections belonged to their early maturity (41%) or very early groups 26 per cent, whereas 26 per cent collections were medium in maturity and only 5 per cent were late maturity types. The range of variability in the maturity duration thus suggested that preference for shorter maturity groups in the U.P. hill. The range and mean of 75 genotypes for 10 characters under 4 maturity groups showed in Table 3.

Table 3. Mean and ranges for different characters under four maturity groups in maize

Sl. No.	Character	Late	Medium	Early	Very early
1.	Days to silk (75%)	65.0 (64-67)	60.9 (57-63)	51.2 (48-55)	43.3 (38-47)
2.	Plant height (cm)	233 (204-288)	237 (191-277)	205 (154- 237)	181 (152-232)
3.	Ear length (cm)	132 (99-207)	135 (77-181)	106 (74-136)	81 (45-128)
4.	Ear length (cm)	171.1 (15.4-18.4)	15.5 (13.2-17.0)	13.4 (11.2-14.8)	12.7 (9.0-15.2)
5.	Ear girth (cm)	13.6 (13.2-14.0)	13.0 (11.4-14.2)	12.4 (10.6-15.5)	12.1 (9.0-14.4)
6.	*H. turcicum** (1-5)	2.4 (2.0-2.5)	2.1 (1.5-2.8)	2.1 (1.5- 2.8)	2.0 (1.5-3.0)
7.	*H. maydis** (1-5)	2.1 (2.0-2.5)	2.0 (1.5-2.5)	2.1 (1.5- 2.8)	2.0 (1.5-3.0)
8.	Plant aspect** (1-5)	2.5 (2.5-2.8)	2.5 (2.3-3.0)	3.1 (2.0- 4.0)	3.1 (2.8-4.8)
9.	Ear aspect** (1-5)	2.5 (2.5-2.5)	2.5 (2.0-2.8)	2.3 (2.3- 2.5)	2.7 (2.7-3.5)
10.	Husk cover** (1-5)	2.3 (2.3-2.3)	2.4 (2.3-2.8)	2.6 (2.5- 3.0)	2.7 (2.5-3.3)

* 1 Resistant, 5 Highly susceptible; ** 1 best, 2 poor

Wheat

High variability for days to 50 per cent flowering (118-151), days to maturity (163-177) and plant height (100-150 cm) was recorded in 280 local collections of wheat from U.P. hills (VPKAS, 1980). All the cultures have been classified into different categories viz., intensity of coleoptile colour, awn, leaf auricle pigmentation, early growth habit, leaf length and width and grain colour, texture and size.

Madira (*Echinochloa frumentacea*)

Nine hundred fifty five accessions including local collections were evaluated for various agromorphological characters and disease and pest incidence (VPKAS, 1981). The data are summarized in Table 4.

Finger millet

Nine hundred eighty eight local collections of ragi were grouped into three categories on the basis of ear shape (open, semi compact and compact) and pigmentation at internode. A wide range of various for the various characters among these categories were recorded as shown in Table 5. Out of these IE 99-1 was found free from both neck and finger blast.

Table 4. Frequency distribution of cultures in various classes and range of expressions in Barnyrd millet (*Echinochloa frumentacea*)

Sl. No.	Plant height		Maturity		Ear length		Ear compactness		Ear nature		Ear colour		Smut disease		Stem borer	
	Class	Freq	Class	Freq	Class	Freq	Class	Freq	Clss	Freq	Class	Freq	Class	Freq	Class	Freq
1.	Below 110	206	Below 100	99	Below 10	15	Com pact	323	Erect	879	Purple	290	0	-	0	721
2.	111-130	132	101-105	248	11-15	356	Inter mediate	551	Droop y	76	Light purple	619	3	20	1	176
3.	131-150	86	106-110	345	16-20	386	Lax	81			Purple green	46	5	385	2	58
4.	151-170	395	111-115	222	21-25	152							7	316	3	-
5.	171 and above	136	116 and above	4	26 and above	41							9	234		
Range	60-230		98-119		7-28											

Table 5. Variability in local collected ragi (*Eleusine coracana*) germplasm

Group (ear shape)	Number	50% heading		Plant height		Number of effective tillers/plant		No. of fingers per ear		Finger length of the main ear (cm)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean
Open with pink internode	26	66-80	71.23	75-130	100.95	2-4	2.74	5-9	6.84	6-11	7.71
Open with greenish white internode	91	62-99	71.88	64.130	99.66	2-4	3.05	5-12	7.58	6-11	10.35
Semi compact with pink internode	83	57-92	70.89	60-135	97- 72	2-5	2.60	4-9	6.75	4-12	6.91
Semi compact with greenish white internode	127	58-109	74.94	65-130	94-40	1-4	2.67	4-11	6.94	5-16	7.35
Compact with pink internode	336	51-108	72.42	50-140	95.64	1-5	2.94	4-12	7.35	3-11	6.27
Compact with greenish internode	325	52-109	70.92	60-130	88.74	1-6	3.06	6-11	6.82	3-15	6.81
Range	988	51-109	71.75	50.140	96.1	1-6	2.89	4-12	7.85	3-18	7.88

Table 6. Details of varieties developed at VPKAS, Almora through direct utilization of germplasm collected from U.P. hills

Name of the crop	Name of the variety	Year of release	Area of adaptation
Rice	VL Dhan 206	1983	U.P. hills (spring sown)
Finger millet	VL Mandua 204	1987 UPSVRC	U.P. hills
	VL Mandua 124	1989 UPSVRC	U.P. hills
Barnyard millet	VL Madira 8*	1978 UPSVRC	U.P. hills
	VL Madira 21	1989 UPSVRC	U.P. hills & plains
	VL Madira 29	1986 CVRC	All India except Tamil Nadu & Andhra Pradesh
Lentil	VL Masoor 1	1981 UPSVRC	U.P. hills
	VL Masoor 4	1991 UPSVRC	U.P. hills
Soybean	VL Soya 2	1989 CVRC	N-W. hills
	VL Soya 21	1995 UPSVRC	U.P. hills
Horsegram	VL Gahat 1	1983 UPSVRC	U.P. hills
Rajmash	VL Rajmash 63	1978 UPSVRC	U.P. hills

*Denotified

Rice

Four hundred twelve accessions collected from U.P. hills were evaluated for 13 qualitative characters and 12 quantitative characters. The range of variation was as follows, leaf colour (green 350, light green 20, purple margin 41 and purple line 1); basal leaf sheath colour (light green 350, green 22, purple line 37, light purple 3); collar colour (light green 388, purple 24); awn (presence of awn 126 and absence of awn 286); and panicle exertion (fully exserted 320 and partially exserted 91). Among the quantitative characters following range was observed: days to 50% flowering, (73-108 days), number of tillers per plant (3-14) panicle per plant (2-10) plant height (73-135 cm), primary branches per panicle 95-11), secondary branches per panicle (3- 41), grains per panicle (15-64) paddy length (7.2-10.86 mm), paddy width (2.31-4.28 mm) and yield per plant (1.18-11.95).

Lentil

A wide range of variability was recorded in local collection of lentil viz., days to flower initiation (88-109 days), days to 50 per cent flowering (98-117), days to maturity (165-176 days), 100 seed weight (1.56-4.01 g), plant height (23.1-35.1 cm), height of lowest pod from the ground (7.1-12.1 cm), number of pods per plant (12-55) and yield per plant (5.7-2.13 g).

Apart from the above mentioned crops, the variability in characters such as plant height, inflorescence and grain colour in amaranth; seed shape size and colour in soybean and petiole colour in colocasia was also observed.

During the evaluation of local germplasm, the promising lines were identified and released for cultivation in U.P. hills or N.W. hills (J & K, H.P. and U.P. hills) by UPSVRC and CVRC. The details are given in Table 6. Beside this several of the landraces and traditional cultivars have been utilized in the varietal improvement programmes of V.P.K.A.S., Almora.

REFERENCES

Arora, R.K. and E.R. Nayar. 1984. Wild relatives of Crops Plants, NBPGR, Sci. Monograh 7. 97 p.

Atkinson, E.F. 1884. *Himalayan Gazetter* 1(2): 682-740 Pupl., N. Delhi.

Bagnolus, P. and H. Gaussen. 1957. Les climates bioloquiesn leu classification. *Ann. geor.* 355: 193-220.

Khoshoo, T.N., 1992 Plant diversity in the himalaya. Conservation and Utilization. G.B. Pant Memorial lecture II, G.B. Pant Institute of Himalayan Environment

and Development, Almora 129 p.

Maikhuri, R.K. 1997. Eroding traditional crop diversity imperils the sustainability of agricultural system in central himalaya. *Curr. Sci.* **73(9)**: 777-782.

Mani, V.P. and A. Gupta. 1996. Preliminary evaluation of local collected maize from U.P. hills. *Indian J. Pl. Genet. Resources* **9(2)**: 295-298.

Negi, S.K. and K.C. Pant. 1994. Genetic wealth of Agri. horticultural crops, their wild relatives, indigenous medicinal and aromatic plants of U.P. himalaya. *J. Econ. Taxon. Bot.* **18(1)**: 17-41.

Samant, S.S. and U. Dhar 1997. Diversity, endemism and economic potential of wild edible plants of Indian Himalaya. *Int. J. Sustain De. World Ecol.* **4**: 179-191.

VPKAS, 1978 to 1982. Annual Reports Vivekananda Parvatiya Krishi Anusandhan Santhan for the year 1978-1982. VPKAS, Almora.