

Towards collection of wild relatives of crop plants in India

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Abstract A total of 373 species of wild relatives of crop plants representing 120 genera and 48 families were collected from different phytogeographical regions of India during a mission mode sub-project on Sustainable Management of Plant Biodiversity under National Agricultural Technology Project during 1999–2005. Significant diversity representing endemic/rare/endangered species has been discussed in this paper. The information on phytogeographical distribution, life form, economic types and assessment of threat has also been included. Thrust areas for future target collections and conservation have been discussed to serve as reference for management of genetic resources.

Keywords Conservation priority · Germplasm collection · India · Phytogeographical regions · Potential traits · Wild relatives of crop plants

Introduction

Wild relatives of crop plants constitute a part of crop gene pool, which possess genes that have great potential for their utilization in crop improvement

programmes. Wild gene pools especially those occurring in biotically disturbed habitats are under threat of genetic erosion and require immediate collection to make use of their wider adaptability, tolerance/resistance to disease, insect-pests, yield, quality attributes and other biotic and abiotic traits.

The Indian gene centre harbours about 166 species of native cultivated plants (Vavilov 1949–1950; Zeven and de Wet 1982) and over 320 wild relatives (Arora and Nayar 1984; Arora 1991, 2000). The wild relatives of crop plants by and large, occur as components of disturbed habitats within the major vegetation types with distribution in the warm humid tropical, sub-tropical regions and in the Western Himalaya with low representation in the drier parts of north-western region (Arora and Nayar 1984; Arora and Pandey 1996; Arora 2000). Over 100 wild relatives and related taxa and endemic/rare/endangered species occur predominantly in the hot-spots/microcentres of India (Nayar 1996; Pandey and Arora 2004; Pandey et al. 2005).

Wild relatives identified for their potential value include some important taxa: *Oryza nivara* Sharma et Shastry, wild annual rice and a wild relative of cultivated *Oryza* (paddy), having resistance to grassy stunt virus and the only source of resistance to rice tungro virus from eastern Uttar Pradesh; *Porteresia coarctata* (Roxb.) Tateoka, a weedy relative with hardiness traits for saline/marshy habitats from Sunderban delta region in West Bengal; *Eleusine compressa* (Forssk.) Aschers. et Schweinf. ex

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C. Christenson, a wild relative of *E. coracana* (L.) Gaertn. (finger millet) from north-western arid tracts, having traits for hardiness and drought tolerance; *Vigna mungo* var. *silvestris* Lukoki, Marechal et Otoul and *Vigna radiata* var. *sublobata* (Roxb.) Verdc., wild relatives of cultivated *V. mungo* (L.) Hepper (black gram, urd) and *V. radiata* (L.) Wilczek (green gram, mung), respectively from Ghats and adjacent areas, exhibiting tolerance to yellow mosaic virus; *Cicer microphyllum* Royle (wild chickpea), a wild relative of *Cicer arietinum* L. (chickpea) having cold hardiness and more seeds/ pod from high altitude regions of Himalaya; *Sesamum laciniatum* Klein ex Willd. from coastal Andhra Pradesh and Tamil Nadu, a wild relative of cultivated *Sesamum indicum* L. (sesame) having resistance to leaf phyllody disease; *Linum perenne* ssp. *perenne* L., a wild relative of cultivated *Linum usitatissimum* L. (linseed) with cold hardiness traits from Lahul and Spiti region and other parts of Western Himalaya; *Citrus latipes* (Swingle) Tanaka, a wild relative of cultivated *Citrus* species (lemon and limes) with cold resistance from the Shillong plateau and Khasi hills in north-eastern India; *Abelmoschus tuberculatus* Pal et Singh, a wild relative of *Abelmoschus esculentus* (L.) Moench (lady's finger) having tolerance/resistance to yellow vein mosaic virus and fruit borer from drier regions of north-western India.

The wild relatives of crop plants occur in all the major phytogeographical regions of India as component of different vegetation types, and exhibit variable life forms and habitat specificity. High priority demand is towards collection of those that are at the risk of erosion due to habitat disturbance by man made/natural causes and over-exploitation of species for commercial use.

Phytogeographical regions of India having concentration of rich diversity are of special significance for undertaking programmes for their collection and for *in situ* conservation. These have been the least explored areas with respect to collection of wild relatives of crops. Some efforts have been made in the past for collection, analysis and documentation of the diversity in wild relatives of crop plants of India. Important diversity in wild relatives of crop plants has been collected from Himalaya (Negi et al. 1991), parts of Rajasthan desert and Gujarat (Singh and Pandey 1996; Bisht et al. 1997; Pandey and Padhye 2000), Orissa and West Bengal (Subudhi et al. 2000;

Patra et al. 2002) and other regions of India (Malik et al. 2001; Singh and Singh 2003).

Identification of wild relatives of many crop plants and establishing their close genetic affinities have made possible to utilize them as potential source of genetic variation by the breeders (Jambhale 1986; Kalloo and Chowdhary 1992; Kalloo and Bergh 1993; Sharma et al. 2003). The wild progenitors of crop plants, their wild and weedy forms (primary genepool) (Harlan and de Wet 1971) and the distantly but cross compatible wild related species, leading to partially fertile cross-progenies (secondary genepool) have been used in major plant improvement programmes (Stalker 1980; Chang 1985; Goodman et al. 1987; Khush and Brar 1988).

The wild relatives of crop plants for all their proven value and obvious potential have not been fully utilized. Lack of awareness about the potential, pattern of variability, reproductive biology, the knowledge and aptitude for identification, etc. are the major difficulties associated with different breeding programmes while using germplasm of wild relatives. Collection of germplasm from natural population is difficult due to asynchronized seed maturity, shattering habit, availability of insufficient material due to poor density of plant population and dormancy in the bud woods, particularly in trees and vegetatively propagated species.

The present paper deals with the significant diversity collected in wild relatives of crop plants from different phytogeographical regions of India under a mission mode programme of Indian Council of Agricultural Research under National Agricultural Technology Project (NATP) sub-project on Sustainable Management of Plant Biodiversity, implemented at National Bureau of Plant Genetic Resources (NBPGR), New Delhi during 1999–2005. This information would help setting priority for collection, conservation and utilization of important species of this region.

Materials and methods

The material was collected in the form of seed or vegetative propagules using modified standard procedures for collection of wild relatives (Pandey et al. 2005). Based on germplasm collected from different phytogeographical regions and distribution of species

in explored areas, initial checklist was prepared. The species identity were verified with the help of regional and national floras, published literature (Arora and Nayar 1984; Hajra et al. 1993; Sharma et al. 1993; Greuter et al. 1994; Pullaiah et al. 2000; Singh et al. 2000) and herbarium records available with Botanical Survey of India, National Botanical Research Institute, Lucknow and different State and Central Universities located in different parts of the country.

The compiled data included information on wild relatives of major crop-group(s) pertaining to plant attributes, phytogeographical distribution, life form (habit), economic types, assessment of threat and thrust areas for future target collections and conservation. Evaluation of status for priority for conservation was based on species distribution (endemic, rare/threatened/endangered, etc.), utilization in crop improvement programmes and potential traits. Validation was based on literature, records, database and field work (Wealth of India 1948–1976; Tanaka 1976; Jain and Rao 1983; Arora and Nayar 1984; Ahmedullah and Nayar 1986; Ambasta et al. 1986; Terrell et al. 1986; Nayar and Sastry 1987–1990; Trehane et al. 1995; Wiersema and Leon 1999; Gopalan and Henry 2000; IUCN 2000, 2001; Rao et al. 2003; <http://www.sp2000.org/>; <http://www.ipni.org/>).

Wild relatives

In the present study authors have considered wild relatives of crop plant species occurring in India including the crop progenitors and wild/weedy relatives (as component of genepool I; primary genepool) and distantly related taxa, having potential for crop improvement (genepools II and III; secondary and tertiary genepools) that are important but scarcely exploited component of the genepool of domesticated species available to plant breeders.

Results and discussion

The survey and collection of wild relatives of crop plant species resulted in augmentation of 373 species (belonging to 120 genera and 48 families), including 207 wild relatives of 82 native cultivated species and 179 species reported by Arora and Nayar (1984). A

considerable number in the holdings represented those belonging to primary genepool.

Significant diversity in wild relatives of crop plants was collected in different crop groups from eight phytogeographical regions of the country during the period 1999–2005 (Table 1, Fig. 1). Species belonging to crop groups namely fruits and vegetables dominated the collection. The species strength in the phytogeographical regions pointed out the largest representation from temperate and subtropical parts of Western Himalaya and warm humid and subtropical regions in Western and Eastern Ghats while low collections were made from islands, Eastern Himalaya and drier regions of North-west plains (Table 2).

Species richness was predominant in genera (species represented in parenthesis) *Piper* (16 species), *Vigna* (13 species), *Solanum* (12 species), *Citrus*, *Cinnamomum*, *Dioscorea* and *Syzygium* (each represented by 9–10 species), *Abelmoschus*, *Allium*, *Curcuma*, *Oryza* and related genera (each represented by 8 species) and *Corchorus*, *Cucumis*, *Momordica*, *Trichosanthes* and *Sesamum* (each represented by 7 species). Major families included Fabaceae (32), Rosaceae (23), Cucurbitaceae (23), Poaceae (19), Zingiberaceae (17), Malvaceae (14), Solanaceae (12) and Piperaceae (10).

The flora of India shows great affinity to the flora of Indo-Malaya and Indo-Chinese region. Analysis of collected diversity in wild relatives revealed the dominance of species from Indian subcontinent (Hindustani center; 37%), Indo-Malayan (16%), followed by Indo-African (9.3%) and Europe-Afghanistan (8.6%) regions. Large number of

Table 1 Number of genera and species in different crop groups collected in wild relatives of crop plants

Crop groups	Genera	Species
Cereals and millets	9	17
Legumes	9	26
Oilseeds	7	16
Fibres	6	19
Vegetables	18	59
Tubres	6	24
Fruits	38	111
Spices and condiments	12	71
Medicinal and aromatic plants	16	26
Others	8	16



Fig. 1 Collection of wild relatives of crop plants from different phytogeographical regions of India (1999–2005)

Table 2 Number of wild relatives collected from different phytogeographical regions of India

Phytogeographical region	Species
Western Himalaya	105
Eastern Himalaya	38
North-eastern region	53
Gangetic plains	82
Indus plain (North-west plains)	42
Malabar/Western Peninsular region/Western Ghats	123
Deccan/Eastern Peninsular region/Eastern Ghats	101
Islands	32

holdings represented indigenous flora claiming endemic species (Nayar 1977, 2004) (Table 7).

Analysis of life form

The wild relatives collected from Indian region represented a diverse assemblage of herbs, scapigerous annuals, shrubs, undershrubs, climbers and trees adapted to fallow land, field margin and forest undergrowth and fringes of forest. Perennial herbs as wild *Oryza* and related genera, *Panicum*, *Amaranthus*, *Vigna*, *Saccharum*, etc. were found confined to

specific habit as water logged areas, saline and/river side and field margins. Shrubs predominated forming a part of temperate to subtropical vegetation in species under genera *Rosa*, *Rubus*, *Ribes*, *Rauvolfia*, *Indigofera*, etc. Perennial shrubby/woody climbers were represented in *Vitis*, *Piper*, *Rosa*, *Rubus* and occurred as part of forest floor. Trees predominated in genera *Cordia*, *Madhuca*, *Artocarpus*, *Diospyros*, *Docynia*, *Ficus*, *Garcinia*, *Malus*, *Mangifera*, *Morus*, *Mimusops*, *Prunus*, *Pyrus*, *Syzygium*, *Ziziphus*, *Cinnamomum*, etc. forming the top storey of forest types in different climatic zones. In general, majority of the taxa represented herbaceous life form with annual to perennial habit and annual climbers, followed by perennials as shrubs/woody climbers and trees (Table 3).

Habitat

The predominant areas of collection were evergreen broadleaved forests, subalpine or alpine meadows, alpine deserts, conifer broad-leaved mix forests and alpine scrubs. Diversity in fruit trees (*Artocarpus*, *Citrus*, *Garcinia*, *Diospyros*, *Syzygium*, *Spondias*, *Mimusops*, *Mangifera*), tall herbs (*Musa* and *Ensete* at lower altitudes) and spices/condiment yielding trees (*Cinnamomum* and *Myristica*) was collected from tropical moist evergreen/semi-evergreen climax forest in western and eastern peninsular tract and in north-eastern region. Different species of *Piper* and *Dioscorea* clothed the trunk of large and small trees and shrubs like *Zingiber*, *Amomum* and *Solanum* prevalently occurred as forest undergrowth. In the forest openings, legumes and cucurbits—*Vigna*, *Atylosia*, *Moghania*, *Luffa*, *Momordica*, *Cucumis* and others like *Solanum*, *Abelmoschus*, *Corchorus* and *Vitis* occurred along with species in genera *Saccharum*, *Carissa* and *Grewia*. Specific habitats as

low lying waterlogged areas for *Coix lacryma-jobi* L. marshy and brackish water for wild rice (*Oryza nivara*, *O. rufipogon* Griff., *Porteresia coarctata* (Roxb.) Tateoka, moist habitat for *Hygroryza aristata* (Retz.) Nees ex Wight et Arn. and grassy swords for *Crotalaria alata* Buch.-Ham. were explored for gathering diversity.

Dry tropical vegetation in deciduous forests in southern peninsular tract and northern plains were explored to capture diversity in trees—*Cordia myxa* L., *Embllica officinalis* Gaertn., *Diospyros*, *Morus*, *Grewia* alongwith thorny shrubs in *Carissa*, *Ziziphus* and viny types as *Vitis*, *Momordica*, *Coccinia cordifolia* (L.) Cogn. (*C. indica* Wight et Arn.) and *Cucumis prophetarum* L. widely occurring in forest openings/edges. Rich diversity was gathered from semi-arid desert in the north-western drier plains in *Carissa congesta* Wight, *C. spinarum* L., *Ziziphus nummularia* (Burm. f.) Wight et Arn. and sandy/rocky habitat in *Grewia tenax* (Forssk.) Aschers. et Schweinf.

The montane sub-tropical climax vegetation in the peninsular tract, hills of Western Ghats and north-eastern regions were explored and diversity in fruit trees such as in *Prunus*, *Pyrus*, *Docynia* and herbaceous forms/shrubby types in *Rubus*, *Solanum*, *Vigna*, *Atylosia*, *Cajanus*, *Trichosanthes*, *Abelmoschus* and *Fragaria* (as undergrowth) was collected.

Rich diversity collected from the montane temperate vegetation in the Himalaya was predominated by fruit trees (*Pyrus*, *Prunus*, *Malus*, *Myrica*, *Juglans*); shrubs and undershrubs (*Rubus*, *Fragaria*, *Linum*, *Allium*, *Hordeum*) as undergrowth of the above forest types and viny types (*Cucumis callosus* (Rottl.) Cogn., *Cucumis sativus* L. var. *hardwickii* (Royle) Gabaev, *Trichosanthes* spp.) and rhizomatous herbs (*Hedychium*, *Zingiber*) in forest openings/outskirts.

From higher elevation zone of Himalaya, alpine species in genus *Sorbus*, *Prunus*, *Ribes*, *Fragaria*, *Rosa* and *Rubus* were collected. Alpine meadows and alpine scrub vegetation were intensively explored for collection of diversity in species of *Fragaria*, *Allium*, *Avena*, *Cicer* and *Linum* for cold hardiness and drought tolerance traits.

Occurrence of wild relatives on specific habitats

Specific habitats were explored to collect germplasm of the following species—*Allium rubellum* M. Bieb., *A. tuberosum* Rottler ex Spreng. on alpine/snow laden

Table 3 Life form of wild relatives of crop plants

Life form	Species (%)
Medium to large trees	20.6
Small trees/large shrubs	15.8
Subshrubs to undershrubs	6.2
Tall herbs	3.4
Herbs	33.5
Woody climbers	5.2
Non-woody climbers	15.3

areas/exposed hillocks; *Aegilops tauschii* Cosson and *Cicer microphyllum* Royle on alpine stony desert; *Porteresia coarctata* (Roxb.) Tateoka growing on tidal back water, estuarine delta, river/saline water/tidal swamps; *Oryza nivara* on water logged habitats in field borders of cultivated rice; *Oryza meyeriana* (Zollin et Mor. ex Steud.) ssp. *granulata* Tateoka in shady places near forest edges, *Oryza officinalis* Wall. ex G. Watt (rare species) along stream side of foot hills and forested areas, *Hygroryza aristata* on hygrophytic habitat and *Momordica balsamina* L., *Saccharum arundinaceum* Retz. (*Erianthus arundinaceus* (Retz.) Jesw. ex Heyne) on dry sandy soils and *Saccharum spontaneum* L. on sandy riverbanks, and *Carthamus lanatus* L. on dry elevated areas in hills.

Mode of propagation

The collected germplasm predominated with seed as propagating unit. However, in some taxa vegetative as well as seed propagules were collected - *Ensete* and *Musa* (seed and rhizome); *Oryza*, *Saccharum* (seed and rootstock) and *Allium* (seed and bulb) and only root suckers/rootstocks in *Pyrus*, *Malus*, *Prunus*, *Juglans*, etc. In seed producing taxa, asynchronous and seed shattering was predominant in family Poaceae (wild *Oryza*, *Saccharum*); Leguminosae (*Vicia*, *Vigna*), Malvaceae (*Abelmoschus*), Tiliaceae (*Corchorus*), Brassicaceae (wild Brassicaceae), Solanaceae (*Nicotiana*, *Solanum*, *Withania*).

Economically important germplasm

Among the genetic resources of wild relatives of crop plants there was large representation of wild useful and potential material. Species having edible and medicinal value and having abiotic/biotic traits were predominantly represented in the collection (Table 4). Besides, some species were also reported as protected or semi-domesticated and less-known cultivated types (Table 5). These species are domesticated in restricted pockets of the country.

Wild/weedy types of cultivated species

Over 50 species were assembled in this group. These species have been widely used for different purposes (Tables 4 and 5). The wild and weedy relatives of cultivated species hold characters for hardiness and

Table 4 Wild related species of economic value

Economic importance	Species (%)
Edible (as raw, processed, spice/condiment, beverage)	40.64
Oil	6.41
Fodder	6.10
Fibre	4.50
Timber	5.60
Gum, tannin and dye	2.13
Medicines and aroma	15.04
Ornamental	1.87
Biotic and abiotic stress	17.71

disease resistance that have been lost during the process of domestication and deserve to be conserved as component of crop genepool (Gadgil et al. 1996). Thus, this type of material is of immense value in improvement of cultivated species.

Significant diversity collected

The significant diversity in wild relatives of crop plant taxa gathered in different groups has been discussed below:

New species or new records

This group exhibited new species collected or recorded from the area. For example, *Corchorus pseudo-olitorius* Islam et Zaid from Tamil Nadu and Rajasthan, *Piper hapnium* Buch.-Ham. from Kerala (new record), *Musa acuminata* × *M. balbisiana* (a natural tetraploid of banana) and *Piper nigrum* L. (with bisexual flowers) in wild, occurred as undergrowth in forests of Nelliambathy, Kerala. *Corchorus pseudo-olitorius*, a new species (the eighth species recorded from India) (Mahapatra et al. 2003) was collected from black soil bunds of rice and sugarcane fields occurring as a weed.

Rare and endangered species

In this group, the collected diversity represented endangered species namely *Syzygium bourdillonii* (Gamble) Rathakr. et N. C. Nair (species presumably lost due to habitat destruction and was rediscovered

Table 5 Wild/weedy relatives of crop plants in India

Species	Species
<i>Abelmoschus moschatus</i> Medik.	<i>Juglans regia</i> L.
<i>Acorus calamus</i> L.	<i>Lathyrus sativus</i> L.
<i>Aegle marmelos</i> (L.) Correa	<i>Madhuca longifolia</i> (Koenig) J.F. Macbr.
<i>Allium rubellum</i> M. Bieb.	<i>Malus baccata</i> (L.) Borkh. var. <i>baccata</i>
<i>Allium tuberosum</i> Rottler ex Spreng.	<i>Mangifera indica</i> L.
<i>Amaranthus blitum</i> L.	<i>Manilkara hexandra</i> (Roxb.) Dubard
<i>Asparagus racemosus</i> Willd.	<i>Mimusops elengi</i> L.
<i>Canavalia ensiformis</i> (L.) DC.	<i>Moghania vestita</i> (L.) O. Kuntze (<i>Flemingia vestita</i> Benth. et Bak.)
<i>Carissa congesta</i> Wight (<i>C. carandas</i> L.)	<i>Momordica charantia</i> L.
<i>Carum carvi</i> L.	<i>Morus alba</i> L.
<i>Chenopodium album</i> L.	<i>Morus serrata</i> Roxb.
<i>Cichorium intybus</i> L.	<i>Murraya koenigii</i> (L.) Spreng.
<i>Cinnamomum verum</i> J. Presl (<i>C. zeylanicum</i> Blume)	<i>Myrica esculenta</i> Buch.-Ham.
<i>Colocasia esculenta</i> (L.) Schott	<i>Phoenix sylvestris</i> (L.) Roxb.
<i>Corchorus capsularis</i> L.	<i>Piper nigrum</i> L.
<i>Corchorus olitorius</i> L.	<i>Punica granatum</i> L.
<i>Crotalaria retusa</i> L.	<i>Pyrus pashia</i> Ham. ex D. Don
<i>Curcuma longa</i> L.	<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz
<i>Curcuma zedoaria</i> Roscoe	<i>Ricinus communis</i> L.
<i>Cyamopsis tetragonolobus</i> (L.) Taub.	<i>Spondias pinnata</i> (Koenig et L.f.) Kurz
<i>Dimocarpus longan</i> Lour.	<i>Syzygium cuminii</i> (L.) Skeels
<i>Dioscorea esculenta</i> (Lour.) Burkill	<i>Vigna umbellata</i> (Thunb.) Ohwi et H. Ohashi
<i>Diospyros melanoxylon</i> Roxb.	<i>Vigna vexillata</i> (L.) R. Rich
<i>Emblica officinalis</i> Gaertn. (<i>Phyllanthus emblica</i> L.)	<i>Withania somnifera</i> (L.) Dunal
<i>Garcinia indica</i> (Thouars) Choisy	<i>Ziziphus mauritiana</i> Lam.
<i>Gossypium arboreum</i> L.	
<i>Hibiscus cannabinus</i> L.	

after 94 years) from tropical evergreen/semi-evergreen forest of Thiruvananthapuram, Kerala (Mohanani 1996); *Piper schmidtii* Hk. f. occurring at high altitude (over 1500 m) region; *Dioscorea wightii* Hk. f., *D. deltoidea* Wall. ex Kunth, *Garcinia imbertii* Bourd. and *P. barberi* Gamble (critically endangered species) from Western Ghats (Mohanani et al. 1997; Rao et al. 2001; Mohanani and Sivadasan 2002). Besides, *Rauwolfia serpentina* (L.) Benth. ex Kurz and *Chlorophytum borivilianum* Sant. et Fernandez were reported to be endangered mainly due to large-scale collection of the economic product. *Solanum giganteum* Jacq., *Luffa hermaphrodita* Singh et Bhandari and *Cucumis prophetarum* L. were among the rare species collected from dry arid

regions in outer skirts of forested land in Aravali ranges (Rajasthan). Other rare species included *Musa sikkimensis* Kurz from eastern Himalaya and *Myristica malabarica* Lam. and *Vanilla wightii* Lindl. ex Wight from Western Ghats (Table 7).

Endemic species

The endemic diversity was collected in diverse crop-groups, viz. legumes, vegetables, fruits, oilseeds and fibres. This included *Cajanus cajanifolia* Haines from Orissa and *Vigna khandalensis* (Santapau) Raghavan et Wadhwa from Western Ghats; *Abelmoschus tuberculatus* from drier habitats in North-western plains; *Citrus assamensis* Dutta et Bhattacharya, *C.*

ichangensis Swingle, *C. indica* Tanaka from North-eastern region; *Ensete glaucum* (Roxb.) Cheesman from Mizoram and *E. superbum* (Roxb.) Cheesman from Uttar Kannada in Western Ghats (Karnataka); *Sesamum laciniatum* Klein ex Willd. from Ghats, *Cinnamomum* spp. from the peninsular region. *Mangifera andamanica* King from Andaman and Nicobar Islands and *M. sylvatica* Roxb. from North-eastern hills; and *Malus sikkimensis* (Wenz.) Koehne ex C.K. Schneid. from Himalaya, *Crotalaria tetragona* Roxb. ex Ander. from Western Himalaya (Tables 6 and 7).

Trait specific germplasm

The wild/weedy relatives of crop plants have donated many useful genes for crop improvement/breeding programmes. Germplasm with known desirable traits for resistance to diseases and pest and biotic/abiotic stress were collected from wider habitat range to make best use in selection for desirable types. These species have either been utilized earlier in crop improvement programmes or have known potential for desirable traits, viz. *Aegilops tauschii* Cosson in cultivated species of *Triticum*, *Cajanus/Atylosia* spp. in *Cajanus cajan* (L.) Millsp., *Cucumis sativus* var. *hardwickii* in cucumber (Table 7).

Species collected from wider habitats

Some of the species collected from diverse habitats, viz. *Vigna radiata* var. *sublobata* (Roxb.) Verdc. and *V. trilobata* (L.) Verdc. var. *trilobata* from saline areas of Western Ghats (southern part), Kerala, Tamil Nadu, Orissa, Chhattisgarh and Madhya Pradesh; *V. vexillata* (L.) A. Rich. from hill tracts of Himachal Pradesh and Maharashtra; *V. umbellata* (Thunb.) Ohwi et Ohashi from diverse pockets of Uttarakhand and south Kerala and Tamil Nadu; *V. khandalensis* and *V. mungo* var. *silvestris* from Western Ghats (Maharashtra), Rajasthan and Madhya Pradesh and *Cucumis sativus* var. *hardwickii* from forest openings and out skirts of hilly and submontane areas of North and South India; *Citrullus colocynthis* (L.) Schrad. from Rajasthan, peninsular region and Andaman and Nicobar Islands. These taxa were earlier reported from restricted habitats (Arora and Nayar 1984).

Collection and conservation priorities

The centres of endemism are also centres of genetic diversity and consequently centres of speciation. Unless suitable conservation methods are applied, important wild relatives of crop plants and rare endemic species in particular have poor chances of survival (Ahmedullah and Nayar 1986). Based on the efforts made in the past for collection of diversity in wild relatives of crop plants priorities have been recommended for their conservation on the basis of species status (endemic, rare/threatened/endangered, etc.) (Table 7) and those that have high demand in crop improvement programmes (Arora and Nayar 1984; Nayar 1996, 1997; Wiersema and Leon 1999; Hanelt and Institute of Plant Genetics and Crop Plant Research 2001). Rehabilitation of such wealth by adopting *ex situ* measures or through protection of habitats using *in situ* measures is desirable for wild related species in genera *Saccharum*, *Citrus* and *Musa* spp. and others in the north-eastern region; *Lathyrus*, *Crotalaria*, *Linum*, *Prunus*, *Pyrus* and *Allium* in the western Himalaya and *Cajanus/Atylosia*, *Vigna*, *Crotalaria*, *Garcinia*, *Artocarpus*, *Zingiber* and *Piper* species in Ghats in peninsular region and *Mangifera*, *Zingiber* and *Piper* spp. in Andaman and Nicobar Islands.

Taxa occurring widely on diverse habitats such as *Corchorus*, *Trichosanthes*, *Cucumis*, *Solanum*, *Abelmoschus*, etc. are at low risk owing to high adaptability. On the contrary, endemic species of *Cajanus/Atylosia*, *Citrus*, *Allium*, *Abelmoschus*, *Linum*, *Cicer*, etc. occurring on narrow range but in abundance are only at risk if habitats are disturbed. Conservation priority (high, medium and low) based on occurrence/ distribution status and biotic pressure of some taxa of wild relatives is enumerated in Table 7.

High priority needs to be assigned to rare/ threatened/endangered and endemic taxa at major threat due to lose of habitat (*Syzygium bourdillonii*), species having extremely narrow range of distribution (*Musa sikkimensis* and *Sesamum laciniatum*) or those that are widely distributed but over-exploited from natural habitats (*Chlorophytum borivilianum* and *Rauvolfia serpentina*).

High priority may also be assigned to species that are endemic or having narrow/restricted distribution and cannot be propagated under experimental

Table 6 Significant collections of wild relatives of crop plants (1999–2005)

Species	Area(s) of collection
Cereals and millets	
<i>Aegilops tauschii</i> Cosson	Himachal Pradesh
<i>Avena fatua</i> L.	Chamoli (Uttarakhand)
<i>Oryza nivara</i> Sharma et Shastry; <i>O. meyeriana</i> (Zollin et Mor. ex Steud.) ssp. <i>granulata</i> Tateoka, <i>Oryza officinalis</i> var. <i>malampuzhaensis</i> (Krishnasw. et Chandras.) Tateoka; <i>O. rufipogon</i>	Eastern Uttar Pradesh; Western Ghats (Kerala and Tamil Nadu), Bihar and Orissa; Eastern Uttar Pradesh, southern and central region of Kerala
<i>Cajanus cajanifolia</i> Haines	Mahendragiri, Gajapatti (Orissa)
<i>Cajanus scarabaeoides</i> (L.) Thouars	Jharkhand, Chhattisgarh and Dehradun (Uttarakhand)
<i>Lathyrus aphaca</i> L.	Kashmir (J & K)
<i>Vigna dalzelliana</i> (Kuntze) Verdc., <i>V. hainiana</i> Sharma, Babu and Gopinathan; <i>V. khandalensis</i> ; <i>Vigna radiata</i> var. <i>sublobata</i> (Roxb.) Verdc., <i>V. trilobata</i> Verdc., <i>V. umbellata</i> ; <i>V. vexillata</i>	Rajasthan, Maharashtra, Andhra Pradesh, North-western Himalaya, Madhya Pradesh and Orissa; Western Ghats, Pune (Maharashtra); Southern parts of Western Ghats, Himachal Pradesh, Uttarakhand, Madhya Pradesh and coastal region of Kanyakumari (Tamil Nadu); hilly regions of Maharashtra, Himachal Pradesh
<i>Vigna mungo</i> var. <i>silvestris</i> Lukoki, Marechal et Otoul	Western Ghats (Maharashtra), parts of Rajasthan and Madhya Pradesh
Oilseeds	
<i>Sesamum alatum</i> L., <i>S. laciniatum</i> Klein ex Willd., <i>S. prostratum</i> Retz.; <i>S. mulayanum</i> L.	Western Ghats including parts of Tamil Nadu, Andhra Pradesh and Kerala; Kerala, Tamil Nadu, Madhya Pradesh, Maharashtra, Orissa and Uttarakhand
<i>Carthamus lanatus</i> L.	Kashmir (J & K)
Fibres	
<i>Corchorus pseudo-olitorius</i> ; <i>C. capsularis</i> L.; <i>C. trilocularis</i> L.	North-west Rajasthan, Tamil Nadu; Saline Runn of Kuchchh, Sunderban region (West Bengal); North Gujarat
<i>Crotalaria tetragona</i> Roxb. ex Ander.	Western Himalaya (Uttarakhand)
<i>Linum perenne</i> L.	Cold desert of Lahul & Spiti (Himachal Pradesh)
Vegetables	
<i>Abelmoschus crinitus</i> Wall.; <i>A. tetraphyllus</i> var. <i>pungens</i> (Roxb. ex Hornem.) Boiss.; <i>A. tuberculatus</i> Pal et Singh; <i>A. ficulneus</i> (L.) Wight et Arn.	Cold arid tracts of Chamoli district (Uttarakhand), Vidarbha (Maharashtra); Madhya Pradesh, Orissa, Goa, Chhattisgarh and Rajasthan; Madhya Pradesh, Maharashtra and Rajasthan; Vidarbha (Maharashtra)
<i>Citrullus colocynthis</i>	Rajasthan, Peninsular region and Andaman & Nicobar Islands
<i>Cucumis melo</i> var. <i>agrestis</i> , <i>C. melo</i> var. <i>momordica</i> (Roxb.) Duthie et J.B. Fuller; <i>C. prophetarum</i> L.; <i>C. sativus</i> var. <i>hardwickii</i>	Rajasthan, Western Uttar Pradesh, Punjab; Rajasthan; Madhya Pradesh, Uttarakhand, Himachal Pradesh, Orissa, Chhattisgarh, Maharashtra, Goa
<i>Luffa hermaphrodita</i> Singh et Bhandari	Rajasthan and adjoining areas
<i>Solanum incanum</i> L.; <i>S. indicum</i> L.; <i>S. torvum</i> Sw.; <i>S. giganteum</i> Jacq.	Tamil Nadu, Gujarat; Madhya Pradesh, Gujarat; Kerala and Tamil Nadu (Western Ghats), Andhra Pradesh and Orissa; Rajasthan
<i>Trichosanthes cucumerina</i> var. <i>anguina</i> (L.) Haines, <i>T. bracteata</i> L.	Tamil Nadu, Western Ghats and coastal regions of Kerala, Uttarakhand
Tubers	
<i>Dioscorea alata</i> L., <i>D. bulbifera</i> L.; <i>D. deltoidea</i> Wall. ex Kunth, <i>D. oppositifolia</i> L., <i>D. tomentosa</i> Koenig ex Spreng., <i>D. wallichii</i> Hk. F.; <i>D. wightii</i>	Andhra Pradesh, Gujarat; southern Western Ghats (Kerala) and adjoining region

Table 6 continued

Species	Area(s) of collection
Fruits	
<i>Citrus assamensis</i> Dutta et Bhattacharya, <i>C. ichangensis</i> Swingle, <i>C. indica</i> Tanaka, <i>C. latipes</i> (Swingle) Tanaka, <i>C. megaloxycarpa</i> Lush	Himalaya and North-eastern region, East Godavari (Andhra Pradesh)
<i>Ensete glaucum</i> (Roxb.) Cheesman, <i>Musa sikkimensis</i> Kurz; <i>E. superbum</i> (Roxb.) Cheesman, <i>M. acuminata</i> Colla, <i>M. ornata</i> Roxb.	Deep forests of Mizoram, eastern Himalaya; Western Ghats and coastal regions of Kerala
<i>Garcinia imbertii</i> Bourd., <i>G. indica</i> (Thours) Choisy, <i>G. morella</i> (Gaertn.) Desr., <i>G. xanthochymus</i> Hk. f. ex T. Anderson	Western Ghats
<i>Mangifera andamanica</i> King; <i>M. indica</i> L. (wild type); <i>M. sylvatica</i> Roxb.	Andaman and Nicobar Islands; Western Ghats (Sirsi forests, Karnataka); North-eastern hill
<i>Malus sikkimensis</i> (Wenz.) Koehne ex C.K. Schneid.	Western Himalaya
<i>Syzygium bourdillonii</i> (Gamble) Rathakr. et N.C. Nair, <i>S. cumini</i> , <i>S. hemisphericum</i> (Walp.) Alston., <i>S. travancoricum</i> Gamble	Western Ghats (Kerala)
Spices and condiments	
<i>Allium humile</i> Kunth, <i>A. stracheyi</i> , <i>A. wallichii</i> Kunth	Uttarakhand, Himachal Pradesh and Jammu & Kashmir
<i>Curcuma pseudomontana</i> J. Graham	Kerala and Western Ghats (Tamil Nadu)
<i>Cinnamomum</i> spp.	Peninsular region
<i>Piper barberi</i> Gamble, <i>P. schmidtii</i> Hk. f.; <i>P. galeatum</i> C. DC., <i>P. nigrum</i> L. (wild), <i>P. harnium</i> Buch.-Ham.; <i>P. hymenophyllum</i> Miq.	Western Ghats (Kerala); South Andaman & Nicobar Islands; Karnataka, Andhra Pradesh, Tamil Nadu
<i>Myristica malabarica</i> ; <i>Zingiber</i> spp.	Western Ghats; Western and Eastern Ghats
Medicinal and aromatic plants	
<i>Asparagus adscendens</i> Roxb., <i>A. racemosus</i> Willd.; <i>Chlorophytum borivilianum</i> ; <i>Rauwolfia serpentina</i>	Gujarat (Western Ghats), Himalaya; Bihar, Jharkhand and adjoining areas, Eastern Ghats; Chhattisgarh, Maharashtra, Madhya Pradesh, Uttar Pradesh
<i>Vanilla wightii</i> Lindl. ex Wight	East Godavari (Andhra Pradesh)
Others	
<i>Saccharum arundinaceum</i> Retz.; <i>S. spontaneum</i> L.	North-western parts of Bihar and adjoining areas; Andhra Pradesh, Tamil Nadu, North-western Bihar and adjoining regions

conditions or outside their habitats. For example *Citrus indica* could not survive outside its natural habitat in *Citrus* gene sanctuary. Such species need highest priority using *ex situ* conservation. Some species such as *Allium stracheyi* and *A. rubellum* do not flower or set seeds beyond their range of occurrence and need to be conserved in backyard/experimental gardens located in the same phytogeographical regions by the local farmers. Species reported to have problems associated with seed germination (*Rauwolfia*) or low seed viability (wild *Allium*) need to be investigated thoroughly. Reproductive biology of uninvestigated wild relatives needs to be studied.

Medium priority may be given to species occurring widely within the distributional range and used in crop improvement programme. *Viz.* *Cucumis sativus* var. *hardwickii*, *Aegilops tauschii*, *Oryza nivara*, *O. rufipogon*, *O. officinalis*; species used as rootstock/graft for cultivated types in *Prunus* (wild type in *P. armeniaca*, *P. cerasoides*, *P. jacquemontii*), *Malus baccata*, *Cajanus scarabaeoides*, etc. Low priority has been assigned to wild relatives having known potential traits but not been utilized (taxa belonging to tertiary and secondary genepools) (Table 7).

In order to utilize wild relatives, it is imperative to collect material from wider distributional range,

Table 7 Assessment of status/threat level for selected species of wild relatives and suggested conservation priority

Species	Family	Status of occurrence ^a / Threat level	Conservation priority	Remarks/Traits
<i>Abelmoschus ficulneus</i> (L.) Wight et Arn.	Malvaceae	Rare	Low	
<i>Abelmoschus tetraphyllus</i> var. <i>pungens</i> (Roxb. ex Hornem.) Boiss.	Malvaceae		Medium	Disease resistance
<i>Abelmoschus tuberculatus</i> Pal et Singh	Malvaceae	Endemic	High	Used in crossability programmes
<i>Aconitum ferox</i> Wall. ex Ser.	Ranunculaceae	Endemic and rare	High	Over-exploited; OC
<i>Aegilops tauschii</i> Cosson	Poaceae		Medium	Related to <i>Triticum</i> ; disease/pest resistance
<i>Allium rubellum</i> M. Bieb.	Alliaceae	Endangered	High	OC
<i>Allium stracheyi</i> Baker	Alliaceae	Endangered	High	OC
<i>Amorphophalus hohenackeri</i> (Schott.) Engl. et Gehrm.	Araceae	Rare and threatened	High	
<i>Artocarpus hirsutus</i> Lam.	Moraceae	Endemic	Medium	OC
<i>Bunium persicum</i> (Boiss.) B. Fedtsch.	Apiaceae		Medium	OC
<i>Cajanus cajanifolia</i> Haines	Fabaceae	Endemic	High	Close relative and ancestral form of pigeonpea)
<i>Cajanus scarabaeoides</i> (L.) Thouars	Fabaceae		Medium	Related to pigeonpea; OC
<i>Carthamus lanatus</i> L.	Asteraceae	Rare	Medium	
<i>Chlorophytum borivilianum</i> Sant. et Fernadez	Liliaceae		High	Over-exploited; OC
<i>Cicer microphyllum</i> Royle	Fabaceae	Endemic	Medium	
<i>Cinnamomum macrocarpum</i> Hk. f.	Lauraceae	Endemic	Medium	
<i>Cinnamomum sulphuratum</i> Nees	Lauraceae	Endemic	Medium	
<i>Cinnamomum wightii</i> Meissn.	Lauraceae	Endemic	Medium	
<i>Citrus assamensis</i> Dutta et Bhattacharya	Rutaceae		Medium	OC
<i>Citrus ichangensis</i> Swingle	Rutaceae	Endemic	High	Disease and cold resistance; rootstock/graft
<i>Citrus indica</i> Tanaka	Rutaceae	Endemic	High	Progenitor, rootstock/graft
<i>Citrus jambhiri</i> (Engl.) Lush.	Rutaceae	Endemic	High	Semi-wild form; rootstock/graft, disease resistance
<i>Citrus latipes</i> (Swingle) Tanaka	Rutaceae		Medium	Cold tolerance
<i>Citrus medica</i> L.	Rutaceae	Endemic	Medium	OC
<i>Corchorus capsularis</i> L.	Tiliaceae		Medium	Disease resistance
<i>Crotalaria tetragona</i> Roxb. ex Ander.	Fabaceae	Endemic	Medium	Related to sunhemp
<i>Cucumis melo</i> ssp. <i>agrestis</i> (Naud.) Pangalo	Cucurbitaceae		Low	Related to melon; OC
<i>Cucumis prophetarum</i> L.	Cucurbitaceae	Rare	Low	
<i>Cucumis sativus</i> L. var. <i>hardwickii</i> (Royle) Gabaev	Cucurbitaceae		Medium	High yield trait, resistance to cucumber mosaic
<i>Curcuma amada</i> Roxb.	Zingiberaceae	Endemic	Medium	OC

Table 7 continued

Species	Family	Status of occurrence ^a / Threat level	Conservation priority	Remarks/Traits
<i>Curcuma angustifolia</i> Roxb.	Zingiberaceae	Endemic	Medium	OC
<i>Curcuma neilgherrensis</i> Wight	Zingiberaceae	Endemic	Medium	
<i>Curcuma pseudomontana</i> J. Graham	Zingiberaceae	Endemic	Medium	
<i>Dioscorea bellophylla</i> Voigt. ex Haines	Dioscoreaceae	Rare and threatened	High	
<i>Dioscorea deltoidea</i> Wall. ex Kunth	Dioscoreaceae	Endangered (CITES II)	High	Over-exploited; OC
<i>Dioscorea hamiltonii</i> Hk. f.	Dioscoreaceae		Medium	Ancestral form of <i>D. alata</i>
<i>Dioscorea wightii</i> Hk. f.	Dioscoreaceae	Rare and threatened	High	Over-exploited
<i>Ensete glaucum</i> (Roxb.) Cheesman	Musaceae	Endemic	Medium	
<i>Ensete superbum</i> (Roxb.) Cheesman	Musaceae	Endemic	Medium	
<i>Garcinia cowa</i> Roxb. ex DC.	Clusiaceae	Rare	High	Graft for mangosteen; OC
<i>Garcinia gummi-gutta</i> (L.) Robs.	Clusiaceae		Medium	
<i>Garcinia imbertii</i> Bourd.	Clusiaceae	Endemic; critically endangered	High	
<i>Garcinia indica</i> (Thours) Choisy	Clusiaceae	Endemic	Medium	OC
<i>Garcinia xanthochymus</i> Hk. f. ex T. Anderson	Clusiaceae		Low	OC
<i>Grewia subinaequalis</i> DC.	Tiliaceae	Endemic	Medium	OC
<i>Hygroryza aristata</i> (Retz.) Nees ex Wight et Arn.	Poaceae		Low	
<i>Linum perenne</i> ssp. <i>perenne</i> L.	Linaceae		Low	OC
<i>Luffa acutangula</i> var. <i>amara</i> (Roxb.) Clarke	Cucurbitaceae	Rare	Medium	
<i>Luffa hermaphrodita</i> Singh et Bhandari	Cucurbitaceae	Rare	Medium	OC
<i>Madhuca longifolia</i> (Koenig) J.F. Macbr.	Sapotaceae		Medium	Graft for sapota
<i>Malus baccata</i> var. <i>baccata</i> (L.) Borkh.	Rosaceae		Medium	Resistance to apple scab disease
<i>Malus baccata</i> var. <i>himalaica</i> (Maxim.) C.K. Schneid. (<i>M. himalaica</i> Maxim.)	Rosaceae		Medium	Rootstock/graft for frost resistance; OC
<i>Malus sikkimensis</i> (Wenz.) Koehne ex C.K. Schneid.	Rosaceae	Endemic	Medium	
<i>Mangifera andamanica</i> King	Anacardiaceae	Endemic	Medium	
<i>Mangifera camptosperma</i> Pieere	Anacardiaceae	Endemic	Medium	
<i>Mangifera sylvatica</i> Roxb.	Anacardiaceae	Endemic	Medium	
<i>Manilkara hexandra</i> (Roxb.) Dubard.	Sapotaceae		Medium	Rootstock for sapota
<i>Morus serrata</i> Roxb.	Moraceae		Low	OC
<i>Moghania vestita</i> Kuntze (<i>Flemingia vestita</i> Benth. et Baker)	Fabaceae	Endemic	Medium	Domesticated only in last century in Assam; OC

Table 7 continued

Species	Family	Status of occurrence ^a / Threat level	Conservation priority	Remarks/Traits
<i>Musa sikkimensis</i> Kurz	Musaceae	Rare and endemic	High	
<i>Musa velutina</i> H. Wendl. et Drude	Musaceae	Endemic	Medium	OC
<i>Myristica malabarica</i> Lam.	Myristicaceae	Endemic and threatened	High	
<i>Oryza meyeriana</i> (Zollin et Mor. ex Steud.) ssp. <i>granulata</i> Tateoka	Poaceae	Endemic	Medium	
<i>Oryza nivara</i> Sharma et Shastry	Poaceae		Medium	Close relative to <i>O. sativa</i> and <i>O. rufipogon</i> ; resistance to grassy stunt virus
<i>Oryza officinalis</i> var. <i>malampuzhaensis</i> (Krishnasw. et Chandras.) Tateoka	Poaceae	Rare	Low	
<i>Oryza officinalis</i> Wall. ex G. Watt	Poaceae		Medium	Resistance to yellow stem borer and brown plant hopper
<i>Oryza rufipogon</i> Griff.	Poaceae		Medium	Resistance to bacterial blight and tolerance to salinity, flood tolerance; source of CMS
<i>Piper barberi</i> Gamble	Piperaceae	Endangered	High	Endangered due to habitat loss
<i>Piper galeatum</i> C. DC.	Piperaceae	Endemic	Medium	
<i>Piper hapnium</i> Buch.-Ham.	Piperaceae	Rare and threatened	High	
<i>Piper hookeri</i> Miq.	Piperaceae	Endemic	Medium	
<i>Piper hymenophyllum</i> Miq.	Piperaceae	Endemic	Medium	OC
<i>Piper schmidtii</i> Hk. f.	Piperaceae	Endangered	High	OC
<i>Piper trichostachyon</i> DC.	Piperaceae	Endemic	Medium	
<i>Prunus cornuta</i> (Wall. ex Royle) Steud.	Rosaceae		Medium	Rootstock
<i>Prunus armeniaca</i> L.	Rosaceae		Medium	Disease resistance; as rootstock
<i>Prunus cerasoides</i> D. Don	Rosaceae		Medium	Resistance/tolerance to powdery mildew; as rootstock
<i>Prunus jacquemontii</i> Hk. f.	Rosaceae		Medium	Resistance to powdery mildew
<i>Porteresia coarctata</i> (Roxb.) Tateoka	Poaceae		Medium	Salinity tolerance to cultivated rice, erosion control
<i>Pyrus pashia</i> Buch.-Ham. ex D. Don	Rosaceae		Medium	Rootstock; OC
<i>Rauwolfia serpentina</i> (L.) Benth. ex Kurz	Apocynaceae	Endangered (CITES II)	High	Over-exploited; OC
<i>Rosa webbiana</i> Royle	Rosaceae		Low	
<i>Saccharum spontaneum</i> L.	Poaceae		Medium	Resistance to most disease of sugarcane
<i>Sesamum laciniatum</i> Klein ex Willd.	Pedaliaceae	Rare and endemic	High	Resistance to phyllody and powdery mildew
<i>Sesamum malabaricum</i> Burm.	Pedaliaceae	Endemic	Medium	
<i>Sesamum prostratum</i> Retz.	Pedaliaceae	Endemic	Medium	Resistance to phyllody and powdery mildew
<i>Solanum giganteum</i> Jacq.	Solanaceae	Rare	Low	

Table 7 continued

Species	Family	Status of occurrence ^a / Threat level	Conservation priority	Remarks/Traits
<i>Solanum incanum</i> L.	Solanaceae		Medium	Close relative of brinjal; resistance to disease and pests
<i>Solanum torvum</i> Sw.	Solanaceae		Medium	Rootstock; OC
<i>Solanum virginianum</i> L. (<i>S. surattense</i> Burm. f.)	Solanaceae		Medium	Disease resistance
<i>Syzygium bourdillonii</i> (Gamble) Rathakr. et N.C. Nair	Myrtaceae	Endemic and critically endangered	High	Endangered due to habitat loss
<i>Vanilla wightii</i> Lindl. ex Wight	Orchidaceae	Endemic, rare and threatened	High	Over-exploited; threatened due to destruction of habitat; OC
<i>Vigna bourneae</i> Gamble	Fabaceae	Endemic	Medium	
<i>Vigna khandalensis</i> (Santapau) Raghavan et Wadhwa	Fabaceae	Endemic	Medium	
<i>Vigna marina</i> (Burman) Merrill	Fabaceae		Low	Potential for breeding in cowpea
<i>Vigna mungo</i> var. <i>silvestris</i> Lukoki, Marechal et Otoul	Fabaceae	Rare	Medium	Resistance to yellow mosaic disease
<i>Vigna radiata</i> (L.) Wilczek var. <i>setulosa</i>	Fabaceae	Endemic	Medium	
<i>Vigna radiata</i> var. <i>sublobata</i> (Roxb.) Verdc.	Fabaceae		Medium	Used in crop improvement
<i>Vigna wightii</i> Benth. ex Bedd.	Fabaceae	Endemic	Medium	
<i>Zingiber cernuum</i> Dalz.	Zingiberaceae	Endemic	Medium	
<i>Zingiber neesatum</i> (Grah.) Ramamorthy	Zingiberaceae	Endemic	Medium	
<i>Zingiber roseum</i> Rosc.	Zingiberaceae	Endemic	Medium	
<i>Ziziphus nummularia</i> (Burm. f.) Wight et Arn.	Rhamnaceae		Medium	Rootstock; OC

OC: occasionally cultivated; CMS: cytoplasmic male sterility; ^a: in natural condition (validated from Brumitt and Powell 1992; Mabblerley 1997; Hanelt and Institute of Plant Genetics and Crop Plant Research 2001 and all latest treaties/floras of India)

particularly from the diversity rich areas of the species. This will facilitate to study the nature and range of genetic variation of each species as well as to select for adaptability traits/economic potential.

Due to advancement in gene transfer techniques using biotechnological means, the diversity in wild species has become more accessible through the application of modern methodology. Utilization of secondary and tertiary genepools has now become possible. However, our basic knowledge on the wild/weedy relatives and distantly related taxa of most crops is fragmentary on species delimitation, distribution range and diversity of desirable traits, genetic variation, crossability aspects, etc. and it needs to be broadened.

Conclusion

This was a preliminary effort towards collection of diversity representing 373 species of wild relatives (120 genera, of 48 families) from different phyto-geographical regions of India. Dominance of species from Indian subcontinent followed by Indo-Malayan region and Indo-African region was evident in the holdings. Large number of rare/endemic taxa and those possessing high economic value/potential trait (s) deserve special attention for strengthening collection, evaluation and conservation activities.

All economically important species at the risk of genetic erosion require attention for collection and conservation. Highest priority may be assigned to those having highly specialized habitat requirement

and those that are endemic/rare/endangered to Indian region. Species producing seeds in large quantity and having easy method of multiplication or conservation are at lower risk than those producing less seed and of the recalcitrant or orthodox types where the storage protocols have been least worked out. Species having short seed viability or low germinability need special investigation. We hope that the information given in this paper would provide base line for the researchers and scientists engaged in the genetic resource management.

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