
Glossary

There exist diverse definitions and connotations associated with terminology used in plant genetic resource. This short glossary does not present a standardized formulation for the use of these terms but describes how certain key terms have been used in the present book.

1. **Agriculture:** Agriculture is the science or practice of farming, including cultivation of the soil for growing of crops and rearing of animals to produce food and for other human needs. It evolved by man interactions with bio-resources and the landscape with suitable modifications in them for economic exploitation.
2. **Agrobiodiversity:** An evolutionary divergent but highly interrelated component of biodiversity dealing with variation of plants, animals, fish, insects, microbes, avian, etc., used directly or indirectly for food and agriculture. It comprises the diversity of genetic resources (varieties, breeds) and species used for food, fodder, fiber, fuel, and pharmaceuticals. It also includes the diversity of non-harvested species that support production (soil microorganisms, predators, pollinators) and those in the wider environment support that agroecosystems (agricultural, pastoral, forest and aquatic) as well as the diversity of agroecosystems (after FAO).
3. **Alternate source of food:** Alternative sources of food like new plant species, used by tribal communities that most people do not think of as edible and economical.
4. **Backcrossing:** It is crossing of a hybrid with one of its parents (recurrent parent) or an individual genetically like it, to achieve offspring with a genetic identical or closer to that.
5. **Biogeographical Realms:** These are large spatial regions within which ecosystems share a broadly similar biological evolutionary history
6. **Biological Diversity Act:** Promulgated in 2002 to regulate, access, conservation and sustainable use of biodiversity, protection of associated community knowledge, secure sharing of benefit on commercial use, conservation of rich areas, and protection and rehabilitation of threatened species, involving states.

7. **Biological diversity:** It refers to variation of all living organisms, their genetic material, and the ecosystems of which they are a part. It is described at three levels: genetic, species, and ecosystem diversity.
8. **Biological species:** It is the most widely accepted species concept. It defines species in terms of interbreeding. Ernst Mayr defined a species as “the groups of interbreeding natural populations that are reproductively isolated from other such groups.”
9. **Biosphere reserves:** These are areas of terrestrial and coastal ecosystems which promote the conservation of biodiversity (encompassing all species) with its sustainable use. They are internationally recognized within the framework of UNESCO’s Man and Biosphere (MAB) program and nominated by national governments.
10. **Biosystematics:** The study of living organisms based on observational and experimental data on the breeding system for classification of biological units into taxa, making taxonomic decisions, based on relationships, variability, and dynamic of interrelationships.
11. **Biosystematy:** It deals with attempt to (1) delimit the natural biotic units and (2) to apply these units to a system of nomenclature.
12. **Biotype:** A population of individuals with identical genetic constitution. It may be homozygous or heterozygous.
13. **Carbon sequestration:** A natural or artificial process by which carbon dioxide is removed from the atmosphere and held in solid or liquid form. Here, it refers to capturing of CO₂ from atmosphere through biological process of plants, the photosynthesis, and store on long-term basis.
14. **Cenospesies:** It refers to the closely related independent species, capable of interbreeding and thereby gene exchange.
15. **Center of diversity:** A geographical area where a plant species first developed its distinctive properties (in farmers’ fields or in the wild). A primary center of diversity is the region of true origin (often referred to as the center of origin), and secondary centers of diversity are regions of subsequent spread of a crop.
16. **Center of domestication:** Region where a plant species was first brought into protective use followed by centralized propagation from its local wild progenitors or where agricultural use of a species first originated.
17. **Center of origin:** The center of origin is a geographical area where a plant species is either domesticated or is considered to have first appeared in cultivation from their wild progenitors developing distinct features. The concept of center of origin was developed by NI Vavilov and has been subsequently modified.
18. **Cisgenes:** It refers to those natural indigenous genes, isolated from the crop/cultivated plant species or from cross-compatible or otherwise species that are part of gene pool.
19. **Cis-genesis:** The use of isolated cisgenes coding for desirable traits and incorporating them into crop/cultivated using recombinant DNA/GM technology.
20. **Congeneric species:** It refers to those organism/plant species that belong to the same genus, but form two or more different species.

21. **Conservation of biological resources:** It is concerned with phenomena that affect the maintenance, loss, and restoration of biodiversity and the science of sustaining evolutionary processes that engender genetic, population, species, and ecosystem diversity.
22. **Conservation of plant genetic resources:** Refers to the collection, maintenance, and preservation of intra- and inter-genetic variation of a species (the representative sample of the genetic variation) used in food and agriculture.
23. **Conspecific species:** It refers to those distinct sympatric organism/plant species that are distributed/inhabit the same geographic region.
24. **Convention on Biological Diversity:** It is an international treaty adopted at the Earth Summit in Rio de Janeiro in 1992 and enforced in UN on 29 December 1993, with three main goals, (i) conservation of biological diversity, (ii) sustainable use of its components, and (iii) fair and equitable sharing of benefits arising from use of genetic resources.
25. **Cytoplasmic male sterility:** The complete or partial failure of an individual to produce functional male gametes (pollen). Extrachromosomal hereditary components determine it.
26. **Domestication:** Taming of population of organisms to harness desirable/economic traits.
27. **Domiculture:** Concentrated propagation of plant biodiversity of economic value in a plot by the human community/society as a part of management of overall landscape and economic exploitation of targeted species.
28. **Ecosystem:** The totality of environment comprising living things together with their nonliving habitat.
29. **Ecotype:** A type evolved in response to a habitat, or compatible with a habitat, or a group of biotypes especially adapted to a specific environmental niche.
30. **Evaluation:** Recording of performance of a collections/accessions for desirable traits that are important for genetic enhancement and addition of value about specific feature.
31. **Ex situ conservation:** Means conservation of components of genetic material of biological diversity outside their natural habitat.
32. **Experimental taxonomy:** The classification of organisms based on experimental facts has been termed “experimental taxonomy.”
33. **Forma:** Lowest category of species with sporadic variation in one or two characters.
34. **Gene center:** Generally, the geographical region of a species or genus, often associated with its origin and maximum variability (genetic variation).
35. **Gene flow:** It is the movement of genes from one population to another population, more specifically, the movement of different alleles between the populations of the same species. It creates diversity within a gene pool of a species.
36. **Gene Pool:** It represents the total accessible genetic diversity of a taxa, including the diversity within a cultivated species and in its possible genetically affil-

- iated wild species (within genus and beyond), for introgression of genes at a given time. It has been classified into:
- (a) *Primary gene pool*: Consisting of wild and weedy species/races of cultivated species that are freely cross-compatible producing nearly fertile hybrids
 - (b) *Secondary gene pool*: Consisting of wild relatives, which are cross-compatible (despite ploidy/genomic differences), but produce hybrids with reduced fertility
 - (c) *Tertiary gene pool*: Species that are weakly cross-compatible and conventionally do not produce hybrids with cultivated species
 - (d) *Quaternary gene pool*: The species that are cross-incompatible with cultivated species and form the peripheral limits of a genera
37. **Gene sanctuaries**: Conservation of germplasm under natural conditions, referring to an area where plants of specific species are conserved by protecting the area from—human interference.
38. **Gene sequencing**: It may refer to DNA sequencing or a comprehensive variant of it. Whole genome sequencing is a laboratory process that determines the complete DNA sequence of an organism's genome at a single time, i.e., the precise order of nucleotides within a DNA molecule, and involves any technology that is used to determine the order of the four bases—adenine, guanine, cytosine, and thymine in a strand of DNA.
39. **Genetic diversity**: The genetic variation within a population and among the populations of a species is generally referred to as the genetic diversity.
40. **Genetic drag**: It refers to transfer/incorporation of undesirable traits along with desirable traits in interspecific breeding, because of their tight genetic linkage. Conventionally, repeated backcrossing to recurrent parent is used to break such linkages, but now recombinant cis-genesis DNA approach can overcome this by direct transfer of desired genes surpassing backcrossing.
41. **Genetic engineering**: Genetic manipulation, by which an individual, having a new combination of inherited properties, is established.
42. **Genetic erosion**: It is loss of existing genetic diversity available in form of species, varieties, strains, etc.
43. **Genetic markers**: There are three types of genetic markers, (a) morphological markers based on phenotypic traits variation; (b) biochemical markers, which are called isozymes, including allelic variants of enzymes; and (c) DNA markers (or molecular markers), which reveal sites of variation in DNA.
44. **Genetic resources**: The genetic variability available in gene pool of a species useful for enhancing/improving genetic potential of a cultivated species about agronomic features, resilience against stresses, nutritional traits, etc. over present levels.
45. **Genetic variation**: Variation in the genetic constitution of individuals/species due to the contribution of segregating genes and gene interactions.
46. **Genome**: The complete set of DNAs, including all its genes or genetic material present in a cell or organism. It contains all the information involved in building and maintenance of an organism

47. **Genomics:** The study of genes and their function. It is a branch of molecular genetics concerned with the structure, function, evolution, and mapping of genomes. It deals with study of all the nucleotide sequences, including structural genes, regulatory sequences, and noncoding DNA segments in the chromosomes of an organism.
48. **Germplasm collections:** Genetically distinct sample of crop species collected and maintained at genetic resources center for conservation and use.
49. **Germplasm:** The living genetic resources, in case of plants, mostly seeds, or tissue that is maintained for plant breeding, preservation, and other research uses. It represents the sum of the genetic variable material available for a species.
50. **Habitat:** The sum of environmental condition in a specific place that is occupied by a plant or plant community wherein exchanges occur between the plants and the resources they utilize.
51. **In situ conservation:** Conservation of biodiversity within their natural ecosystems and/or habitats of a species where they have originated and evolved naturally.
52. **In situ/on-farm conservation:** Conservation of crop/cultivated species genetic diversity in the form of varieties, on farm or in the agroecology where they have developed their distinctive features.
53. **Introgression:** The incorporation of genes of one species (donor) into the gene pool of another species (recipient) by hybridization and repeated backcrossing with recipient species. By this process, the recipient species become more variable, displaying certain characters of donor species.
54. **Landraces:** Cultigens that are highly heterogeneous, but with enough characteristics in common to permit their recognition as group.
55. **Molecular biosystematics:** Study using simple molecular biological approaches to sample and analyze variation at biochemical and molecular DNAs level.
56. **National park:** A large protected area used for biodiversity conservation purposes. Often it is a reserve of natural, seminatural, or developed land.
57. **Native species:** A species, which is a part of the original flora of the area.
58. **Natural reserves:** A large protected area of importance for wildlife, flora, fauna, or geological interest reserved and managed for conservation and research.
59. **Naturalized wild species:** Refers to exotic species, introduced centuries/millenniums back and got acclimatize to the extent to appear indigenous and have even evolved new species, subspecies, and botanical varieties.
60. **Orthodox taxonomy:** It deals with classification and naming of organisms and the convenient tabulation and grouping based on morphological similarities and dissimilarities, to indicate natural relationships.
61. **Passport data:** It refers to the information documentation on a germplasm collection, such as location, physical/climatic conditions provenance data dealing with genetic background/pedigree information, reaction to prevailing stresses and threat, etc.

62. **Phylogeny:** The developmental and evolutionary history of group of organisms or species or genus.
63. **Phytoremediation:** It refers to the use of living green plants for in situ removal, degradation, or containment of contaminants in soils, sludges, sediments, surface water, and groundwater.
64. **Plant genetic resources:** Genetic material of plants, including modern cultivars, landraces, and wild relatives of crop plants, of value as a genetic resource for present and future generations of breeders to facilitate genetic improvement.
65. **Population:** A group of individuals belonging to different biotypes. The genotypically heterogenous population represents the basic evolutionary unit (gene pool) from which new types may arise through mutation, genetic recombination under the influence of natural pressure resulting selection/differentiation.
66. **PPV & FR Act:** The Protection of Plant Varieties and Farmers' Rights Act passed in 2001 to establish an effective system for protection of plant varieties and the rights of the farmers and plant breeders and to encourage development of new varieties of plants.
67. **Race:** An intraspecific category, primarily a population or aggregate of populations with recognizable characteristics.
68. **Recombinant DNA technology:** Refers to the technology that uses enzymes to cut and paste DNA sequences of interest together from two different species. The recombined DNA sequence is inserted into a host organism to produce genetically modified (GM) organism with new genetic combinations that are of value to science, medicine, agriculture, and industry.
69. **Red Data Book:** The book contains list/inventory of species whose continued existence is threatened.
70. **Renewable bioenergy:** Plant biomass, which has stored solar energy in the form of chemical energy/organic material and can produce energy in the form of biofuel.
71. **Sampling strategies:** Sampling methods that are followed during germplasm collection with primary emphasis to capture or sample the available genetic diversity.
72. **Selection:** The choice of certain individuals based on distinctiveness for the propagation/conservation and use from a mixed population where individuals vary in their characters. The variation is produced from nonrandom differential reproduction, which leads to individuals of different genotypes being represented unequally by their progeny in latter generations of a population of self-propagating units. Such individuals may not survive natural selection.
73. **Semi-Arid region:** A region with by highly variable and unpredictable rainfall, which is below potential evapotranspiration. Climatic conditions characterized it to be a region with intermediate climates between desert and humid regions. Dominated by short or scrubby vegetation of either grasses or shrubs.
74. **Species diversity:** Refers to the number of species represented in each community and to the evenness of species' abundances.

75. **Species endemism:** Plant species associated with a region. By extension, this term is used to refer to species which are found only in that region.
76. **Species:** A group of potentially interbreeding natural populations which normally are reproductively isolated from other such groups and/or show common characteristics.
77. **Subspecies:** A population of some biotype providing regional appearance/composition/differentiation of a species in relation to physical, chemical, genetic, and biological aspects.
78. **Taxon:** Taxonomic unit of any rank.
79. **Taxonomic characters:** Any observable feature of the plant that can be used for comparison and grouping/classification.
80. **Taxonomy:** A branch of biology engaged in the classification of organisms, especially according to their natural relationships. It covers the laws of and principles of such classification.
81. **The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA):** The International Treaty on Plant Genetic Resources for Food and Agriculture, popularly known as the International Seed Treaty, is a comprehensive international agreement in harmony with Convention on Biological Diversity, which aims at guaranteeing food security through the conservation, exchange and sustainable use of the world's plant genetic resources for food and agriculture, as well as the fair and equitable benefit sharing arising from its use. It implements a *Multilateral System* of access and benefit sharing, among those countries that ratify the treaty, for a list of 64 foods and forage crops (the genera and species are listed in Annex 1 to the Treaty).
82. **Threatened species:** Species categorized into various levels of threats as per IUCN categories are listed below:
 - (a) *Extinct (EX)*: A taxon is extinct when there is no reasonable doubt that the last individual has died. As indicated by exhaustive surveys.
 - (b) *Extinct in the Wild (EW)*: A taxon is extinct in the wild when it is known only to survive in cultivation, in captivity, or as a naturalized population (or populations) well outside the past range. As indicated by exhaustive surveys.
 - (c) *Critically Endangered (CR)*: A taxon is critically endangered when the best available evidence by quantitative analysis indicates a reduction in the number of mature individual's due to continued decline, fluctuation or fragmentation of populations, and extent of occurrence. Thereby facing an extremely high risk of extinction in the wild.
 - (d) *Endangered (EN)*: A taxon is endangered when the best available evidence indicates a species facing a very high risk of extinction in the wild because of either/or due to continued decline, fluctuation or fragmentation of populations, and extent of occurrence.
 - (e) *Vulnerable (VU)*: A taxon is vulnerable when the best available evidence indicates that it is vulnerable, because of either continued decline, fluctuation, or fragmentation of populations and extent of occurrence.

- (f) *Near Threatened (NT)*: A taxon is near threatened when it does not qualify for critically endangered, endangered, or vulnerable now but is close to qualifying for or is likely to qualify for a threatened category in the near future.
- (g) *Least Concern (LC)*: A taxon is least concern when on evaluation, it does not qualify for critically endangered, endangered, vulnerable, or near threatened and abundantly available.
- (h) *Data Deficient (DD)*: A taxon is data deficient when available information is inadequate to make a direct, or indirect, assessment on risk to its distribution and/or population status.
83. **Trans-domestication**: The hypothesis, as per which a wild plant species brought from an exotic destination, is domesticated elsewhere in a foreign land/country.
84. **Variation**: Divergence in the characteristics of an organism caused by the environment or by differences in its genetic constitution. The occurrence of phenotypic differences between individuals due to heritable differences (traceable genotypic differences) or due to differences in external conditions (phenotypic and non-heritable).
85. **Variety**: A population of some biotype forming local appearance/composition of a species in relation to a specific physical, chemical, genetic, and biological aspects
86. **Weed**: A volunteer plant which is adapted to disturbed or open habitats, it may be an ability to take advantage of human disturbances.
87. **Wide hybridization**: A term generally used to designate hybridization between widely diverse organism/plants (distinct species from same genera or different) to generate new genetic combinations from where desired recombinants can be selected.
88. **Wild and weedy relative of crop/cultivated plants**: The uncultivated species that are genetically related to a crop species, including the progenitors from same genera, as well as cross-compatible wild species from the same or other closely related genera.
89. **Wildlife sanctuaries**: A wildlife refuge, which is a naturally occurring sanctuary providing protection for a species from competition and other threats.

Appendices

Appendix I

The wild relatives of crop/cultivated plant species are distributed as per their origin, evolution, and adoption to natural environment suited to their growth and development found in different biogeographical regions. The most commonly accepted 10 + 1 biogeographic regions of Indian Subcontinent listed below, inhabit respective representative wild relatives of cultivated plants species.

Representative wild relatives of cultivated species found in different biogeographic zones of India

Biogeographical zones	Wild relatives of cultivated species recorded
Trans-Himalayan zone (Ladakh and Adjacent Areas)	<i>Allium carolinianum</i> , <i>A. chitralicum</i> , <i>A. gilgiticum</i> , <i>A. rubellum</i> , <i>Amaranthus spinosus</i> , <i>Cicer macracanthum</i> , <i>C. microphyllum</i> , <i>Fagopyrum cymosum</i> , <i>Hippophae salicifolia</i> , <i>H. tibetana</i> , <i>Hordeum brevisubulatum</i> ; syn. <i>H. turkestanicum</i> , <i>H. spontaneum</i> , <i>Lactuca dolichophylla</i> , <i>Lepidium latifolium</i> , <i>Populus ciliata</i> , <i>P. gamblei</i> , <i>P. euphratica</i> , <i>P. jacquemontiana</i> var. <i>glauca</i> , <i>P. laurifolia</i> , <i>Salix acmophylla</i> , <i>S. denticulata</i> , <i>S. elegans</i> , <i>S. fragilis</i> , <i>S. sclerophylla</i> , <i>S. wallichiana</i> , <i>Trigonella emodi</i> , and <i>T. podperae</i> (27)

(continued)

Biogeographical zones	Wild relatives of cultivated species recorded
Himalayan zone (Northwestern and Eastern Himalayas)	<p>Western and Northwestern Himalaya: <i>Abelmoschus manihot</i>, <i>A. moschatus</i>, <i>A. tuberculatus</i>, <i>Aegilops tauschii</i>, <i>Allium altaicum</i>, <i>A. ampeloprasum</i>; syn. <i>A. porrum</i>, <i>A. cernuum</i>, <i>A. chinense</i>, <i>A. fistulosum</i>, <i>A. schoenoprasum</i>, <i>A. senescens</i>, <i>A. stracheyi</i>, <i>A. tuberosum</i>, <i>Avena barbata</i>, <i>A. fatua</i> ssp. <i>fatua</i>, <i>A. sterilis</i> ssp. <i>ludoviciana</i>, <i>Cajanus mollis</i>, <i>C. scarabaeoides</i>, <i>Chenopodium album</i>, <i>C. ambrosioides</i>, <i>C. botrys</i>, <i>C. foliosum</i>, <i>C. giganteum</i>, <i>C. glaucum</i>, <i>C. hybridum</i>, <i>C. murale</i>, <i>Cicer microphyllum</i>, <i>Cucumis hardwickii</i>, <i>Dioscorea hispida</i>, <i>Elymus himalayanus</i>, <i>E. dahuricus</i>, <i>E. dentatus</i>, <i>Fagopyrum acutatum</i>, <i>F. cymosum</i>, <i>F. tartaricum</i> (also cultivated), <i>Hordeum aegiceras</i>, <i>H. brevisubulatum</i>, <i>H. murinum</i> ssp. <i>glaucum</i>, <i>H. spontaneum</i>, <i>Indigofera heterantha</i>, <i>Lactuca serriola</i>, <i>Linum perenne</i>, <i>L. strictum</i>, <i>Luffa graveolens</i>, <i>Malus baccata</i>, <i>M. pumila</i>, <i>Mentha x piperita</i>, <i>M. arvensis</i>, <i>M. spicata</i>, <i>Oryza rufipogon</i>, <i>Prunus jacquemontii</i>, <i>P. jenkinsii</i>, <i>P. tomentosa</i>, <i>Ribes glaciale</i>, <i>Rosa sericea</i>, <i>R. webbiana</i>, <i>Rubus fruticosus</i>, <i>R. hypargyrus</i>, <i>R. lanatus</i>, <i>R. moluccanus</i>, <i>R. niveus</i>, <i>R. nutantiflorus</i>, <i>Rumex acetosella</i>, <i>R. patientia</i>, <i>R. vesicarius</i>, <i>Saccharum filifolium</i>, <i>S. narenga</i>, <i>Salix tetrasperma</i>, <i>Setaria viridis</i>, <i>Solanum incanum</i>, <i>S. xanthocarpum</i>, <i>Taxus wallichiana</i>, <i>Sorbus aucuparia</i>, <i>S. lanata</i>, <i>Trichosanthes himalensis</i>, <i>T. multiloba</i>, <i>T. tricuspidata</i>, <i>Trigonella cachemeriana</i>, <i>T. emodi</i>, <i>T. fimbriata</i>, <i>T. gracilis</i>, <i>T. podperae</i>, <i>Triticum sphaerococcum</i>, <i>Vigna trilobata</i>, <i>V. umbellata</i>, <i>V. vexillata</i> var. <i>vexillata</i>, and <i>Ziziphus oxyphylla</i> (87)</p> <p>Eastern Himalaya: <i>Actinidia strigosa</i>, <i>Albizia kalkora</i>, <i>Allium angulosum</i>, <i>A. wallichii</i>, <i>Amomum aromaticum</i>, <i>A. dealbatum</i>, <i>A. subulatum</i>, <i>Amorphophallus bulbifer</i>, <i>Areca triandra</i>, <i>Artocarpus chaplasha</i>, <i>Avena fatua</i>, <i>Brassica trilocularis</i>, <i>Cajanus elongatus</i>, <i>C. grandiflorus</i>, <i>C. mollis</i>, <i>C. scarabaeoides</i>, <i>C. villosus</i>, <i>Camellia caudata</i>, <i>C. drupifera</i>, <i>C. irrawadiensis</i>, <i>C. kissi</i>, <i>C. sinensis</i>, <i>C. taliensis</i>, <i>Cinnamomum bejolghota</i>; syn. <i>C. obtusifolium</i>, <i>C. caudatum</i>, <i>C. glanduliferum</i>, <i>C. impressinervium</i>, <i>Citrus aurantium</i>, <i>Coffea benghalensis</i>, <i>Cucumis hystrix</i>, <i>Curcuma amada</i>, <i>C. aromatica</i>, <i>C. caesia</i>, <i>C. montana</i>, <i>Digitaria cruciata</i>, <i>Dioscorea deltoidea</i>, <i>D. hamiltonii</i>, <i>D. hispida</i>, <i>D. kamoonsensis</i>, <i>D. lepcharum</i>, <i>D. pentaphylla</i>, <i>D. prazeri</i>, <i>D. wallichii</i>, <i>D. wattii</i>, <i>Duchesnea indica</i>, <i>Eleusine indica</i>, <i>Elymus tangutorum</i>, <i>E. thoroldianus</i>, <i>Eriobotrya dubia</i>, <i>E. hookeriana</i>, <i>E. petiolata</i>, <i>Fragaria vesca</i>, <i>Garcinia hombroniana</i>, <i>G. xanthochymus</i>, <i>Glycine soja</i>, <i>Hordeum agriocrithon</i>, <i>H. spontaneum</i>, <i>Kaempferia sikkimensis</i>, <i>Lactuca cooperi</i>, <i>Lepidium capitatum</i>, <i>Luffa graveolens</i>, <i>Malus baccata</i>, <i>M. sikkimensis</i>, <i>Mangifera khasiana</i>, <i>M. sylvatica</i>, <i>Momordica macrophylla</i>, <i>Musa acuminata</i>, <i>M. balbisiana</i>, <i>M. cheesmani</i>, <i>M. mannii</i>, <i>M. nagensium</i>, <i>M. sikkimensis</i>, <i>M. velutina</i>, <i>Myrica esculenta</i>, <i>Neoluffa sikkimensis</i>, <i>Oryza meyeriana</i>, <i>O. minuta</i>, <i>Phoenix acaulis</i>, <i>P. rupicola</i>, <i>Pimpinella urceolata</i>, <i>Piper betleoides</i>, <i>P. hamiltonii</i>, <i>P. laxivenum</i>, <i>P. mungpooanum</i>, <i>P. ovatistigma</i>, <i>P. peepuloides</i>, <i>P. sikkimense</i>, <i>P. sonadense</i>, <i>P. tenuirameum</i>, <i>P. wallichii</i>, <i>Prunus arborea</i>, <i>P. bracteopadus</i>, <i>P. jenkinsii</i>, <i>Pyrus pashia</i>, <i>P. serotina</i>, <i>Rhus griffithii</i>, <i>Ribes acuminatum</i>, <i>R. glaciale</i>, <i>Rubus ghankantus</i>, <i>R. hypargyrus</i>, <i>R. lineatus</i>, <i>R. moluccanus</i>, <i>R. reticulatus</i>, <i>R. senchalensis</i>, <i>R. sikkimensis</i>, <i>R. wardii</i>, <i>Saccharum filifolium</i>; syn. <i>Erianthus filifolius</i>, <i>S. longisetosum</i>, <i>S. ravennae</i>, <i>S. sikkimense</i>, <i>S. williamsii</i>, <i>Solanum kurzii</i>, <i>S. spirale</i>, <i>Sorbus himalaica</i>, <i>S. microphylla</i>, <i>S. vestita</i>, <i>Trichosanthes cordata</i>, <i>T. tricuspidata</i>, <i>T. wallichiana</i>, <i>Vigna clarkei</i>, <i>Vitis himalayana</i>, <i>V. lanata</i>, <i>V. parviflora</i>, <i>Zingiber capitatum</i>, <i>Z. chrysanthum</i>, <i>Z. clarkei</i>, and <i>Z. zerumbet</i> (129)</p>

(continued)

Biogeographical zones	Wild relatives of cultivated species recorded
Northeast zone [Brahmaputra Valley (Assam), Meghalaya and Northeast Hills]	<p><i>Alocasia cucullata</i>, <i>A. macrorrhiza</i>, <i>Amomum aromaticum</i>, <i>Amorphophallus bulbifer</i>, <i>Brassica trilocularis</i>; syn. <i>B. rapa</i> var. <i>trilocularis</i>, <i>Areca triandra</i>, <i>Camellia caudata</i>, <i>C. kissi</i>, <i>Canavalia gladiata</i>, <i>C. virosa</i>, <i>Cinnamomum bejholgota</i>; syn. <i>C. obtusifolium</i>, <i>C. glanduliferum</i>, <i>C. paniculatum</i>, <i>C. pauciflorum</i>, <i>Citrus assamensis</i>, <i>C. hystrix</i>, <i>C. indica</i>, <i>C. jambhiri</i>, <i>C. latipes</i>, <i>C. medica</i>, <i>Coffea fragrans</i>, <i>C. jenkinsii</i>; syn. <i>Nostolachma jenkinsii</i>, <i>C. khasiana</i>, <i>Colocasia fallax</i>, <i>C. mannii</i>, <i>Corchorus capsularis</i> (wild form), <i>C. pseudo-olitorius</i>, <i>Cucumis hardwickii</i>, <i>C. hystrix</i>, <i>Curcuma aeruginosa</i>, <i>C. amada</i>, <i>C. aromatica</i>, <i>C. comosa</i>, <i>C. latifolia</i>, <i>C. soloensis</i>, <i>C. sylvatica</i>, <i>Digitaria cruciata</i>, <i>Dioscorea alata</i>, <i>D. decipiens</i>, <i>D. hamiltonii</i>, <i>D. hispida</i>, <i>D. lepchanum</i>, <i>D. pentaphylla</i>, <i>D. prazeri</i>, <i>D. pubera</i>, <i>D. trinervia</i>, <i>D. wattii</i>, <i>Diospyros lotus</i>, <i>Dolichos falcatus</i>, <i>Echinochloa crus-galli</i>, <i>Elaeocarpus floribundus</i>, <i>Eleusine indica</i>, <i>Erianthus ravennae</i>, <i>Fragaria nilgerrensis</i>, <i>Garcinia cowa</i>, <i>G. spicata</i>, <i>G. sopsopia</i>, <i>Gossypium arboreum</i>, <i>Hibiscus furcatus</i>, <i>Indigofera dosua</i>, <i>I. heterantha</i> (Himalyan indigo), <i>Leersia hexendra</i> (Manipur), <i>Luffa aegyptiaca</i>, <i>L. graveolens</i>, <i>Malus baccata</i>, <i>Mangifera khasiana</i>, <i>M. sylvatica</i>, <i>Miscanthus nepalensis</i>, <i>M. nudipes</i>, <i>M. taylorii</i>, <i>M. wardii</i>, <i>Momordica macrophylla</i>, <i>M. subangulata</i>, <i>Mucuna bracteata</i>, <i>Musa acuminata</i>, <i>M. assamica</i>, <i>M. balbisiana</i>, <i>M. cheesmani</i>, <i>M. flaviflora</i>; syn. <i>M. thomsoni</i>, <i>M. itinerans</i>, <i>M. mannii</i>, <i>M. nagensium</i>, <i>M. paradisiaca</i>, <i>M. sikkimensis</i>, <i>M. superba</i>; syn. <i>Ensete superba</i>, <i>M. velutina</i>, <i>Myrica esculenta</i>, <i>Naranga fallax</i>; syn. <i>Saccharum longifolium</i>, <i>Nicotiana excelsior</i>, <i>Oryza granulata</i>, <i>O. rufipogon</i>, <i>Phoenix acaulis</i>, <i>P. dactylifera</i>, <i>P. robusta</i>, <i>P. rupicola</i>, <i>Piper attenuatum</i>, <i>P. cornilimbum</i>, <i>P. hamiltonii</i>, <i>P. khasianum</i>, <i>P. makruense</i>, <i>P. meeboldii</i>, <i>P. oldhamii</i>, <i>P. peepuloides</i>, <i>P. sylvaticum</i>, <i>P. wallichii</i>, <i>Prunus arborea</i>, <i>P. cornuta</i>, <i>P. cerasioides</i>, <i>P. jenkinsii</i>, <i>P. napanlensis</i>, <i>P. undulata</i>, <i>P. wallichii</i>; <i>Psilanthus bengalensis</i>; syn. <i>Coffea bengalensis</i>, <i>Pyrus khasiana</i>, <i>P. pashia</i>, <i>P. pyrifolia</i>, <i>Rosa gigantea</i>, <i>R. longicuspis</i>, <i>Rubus ellipticus</i>, <i>R. moluccanus</i>, <i>R. paniculatus</i>, <i>R. rosifolius</i>, <i>Rumex dentatus</i>, <i>Saccharum longisetosuma</i>, <i>S. procerum</i>, <i>S. rufipilum</i>, <i>S. wardii</i>, <i>Sclerostachya fusca</i>, <i>Setaria pallide-fusca</i>, <i>Solanum khasianum</i>, <i>S. kurzii</i>, <i>S. nigrum</i>, <i>S. spirale</i>, <i>S. torvum</i>, <i>Sorbus aucuparia</i>, <i>S. vestita</i>, <i>Syzygium assamicum</i>, <i>Trichosanthes bracteata</i>, <i>T. cordata</i>, <i>T. cucumerina</i>, <i>T. himalensis</i>, <i>T. khasiana</i>, <i>T. tomentosa</i>, <i>T. wallichiana</i>, <i>Vigna clarkei</i>, <i>V. trilobata</i>, <i>Zingiber capitatum</i>, <i>Z. cassumunar</i>, <i>Z. intermedium</i>, <i>Z. rubens</i>, and <i>Z. spectabile</i> (150)</p>
Desert zone (Thar and Kutch)	<p><i>Acacia nilotica</i> (wild form), <i>Aegle marmelos</i> (wild form), <i>Amaranthus spinosus</i>, <i>Citrullus colocynthis</i>, <i>Commiphora wightii</i> (wild form), <i>C. caudata</i>, <i>Crotalaria burhia</i>, <i>Cucumis prophetarum</i>, <i>Ipomoea cairica</i> var. <i>semineglabra</i>, <i>Momordica balsamina</i>, <i>Moringa concanensis</i>, <i>Psoralea corylifolia</i>, <i>Saccharum spontaneum</i>, <i>Salvadora persica</i>, <i>Sorghum bicolor</i> (weedy forms), <i>Sorghum halepense</i>, <i>Withania coagulans</i>, and <i>Ziziphus nummularia</i> (18)</p>
Semi-Arid zone (Gujarat, parts of Northwestern Madhya Pradesh, Haryana, Punjab)	<p><i>Corchorus olitorius</i>, <i>Grewia bicolor</i>, <i>G. flavescens</i>, <i>Indigofera coerulea</i> var. <i>monosperma</i>, <i>I. cordifolia</i>, <i>Salvadora oleoides</i>, <i>Sesamum alatum</i>, <i>Sesbania concolor</i>, <i>Solanum nigrum</i>, <i>S. purpureilineatum</i>, <i>Sorghum halepense</i>, <i>Trigonella occulta</i>, <i>T. uncata</i>, <i>Vinga khandalensis</i>, <i>Ziziphus nummularia</i> (jharber), and <i>Z. williamsii</i> (16)</p>

(continued)

Biogeographical zones	Wild relatives of cultivated species recorded
Gangetic Plains (upper, middle, and lower Gangetic Plains)	<p><i>Abelmoschus cancellatus</i>, <i>A. manihot</i>, <i>A. tuberculatus</i>, <i>Allium stracheyi</i>, <i>Amaranthus polygamus</i>, <i>A. spinosus</i>, <i>Amorphophallus bulbifer</i>, <i>Asparagus curillus</i>, <i>A. sarmentosus</i>, <i>Brassica quadrivalvis</i>, <i>Cajanus scarabaeoides</i>, <i>C. volubilis</i>; syn. <i>C. crassa</i>, <i>Carissa spinarum</i>, <i>Carthamus oxyacantha</i>, <i>Carum villosum</i>, <i>Chenopodium album</i>, <i>C. murale</i>, <i>Cichorium intybus</i>, <i>Coccinia indica</i>; syn. <i>C. grandis</i>, <i>Coix agrestis</i>, <i>C. aquatica</i>, <i>C. lacryma-jobi</i>, <i>Corchorus trilocularis</i>, <i>C. acutangulus</i>, <i>Cucumis setosus</i>, <i>Curcuma amada</i>, <i>C. ferruginea</i>, <i>C. leucorhiza</i>, <i>C. rubescens</i>, <i>Dioscorea deltoidea</i>, <i>D. hamiltonii</i>, <i>D. kalkapershadii</i>, <i>Echinochloa colonum</i>, <i>E. crus-galli</i>, <i>Ficus palmata</i>, <i>Grewia asiatica</i> (wild form), <i>G. optiva</i>, <i>Hibiscus surattensis</i>, <i>Indigofera caerulea</i>, <i>I. gangetica</i>, <i>I. thothathri</i>, <i>Ipomoea aquatica</i>, <i>Lactuca remotiflora</i>, <i>Lathyrus aphaca</i>, <i>Lepidium draba</i>, <i>Luffa echinata</i> var. <i>longistylis</i>, <i>Malva sylvestris</i>, <i>Momordica balsamina</i>, <i>M. cochinchinensis</i>, <i>M. subangulata</i> var. <i>renigera</i>, <i>Oryza rufipogon</i>, <i>O. sativa</i> var. <i>spontanea</i>; syn. <i>O. perennis</i>, <i>Panicum notatum</i>, <i>Paspalum scrobiculatum</i>, <i>Pennisetum orientale</i>, <i>Phoenix paludosa</i>, <i>P. robusta</i>, <i>P. sylvestris</i>, <i>Piper sylvaticum</i>, <i>Polyalthia suberosa</i>, <i>Prunus rufa</i>, <i>Psilanthus bengalensis</i>; syn. <i>Coffea bengalensis</i>, <i>Saccharum arundinaceum</i>; syn. <i>S. procerum</i>, <i>S. bengalense</i>, <i>S. longisetosum</i>, <i>S. narenga</i>, <i>S. ravennae</i>, <i>S. spontaneum</i>, <i>S. williamsii</i>, <i>Sclerophyllum coarctatum</i>; syn. <i>Oryza coarctata</i> (tetraploid), <i>Sclerostachya fusca</i>, <i>Setaria sphacelata</i>, <i>Solanum incanum</i>, <i>S. indicum</i>, <i>S. surattense</i>, <i>Syzygium heyneanum</i>, <i>Taxus wallichiana</i> var. <i>chinensis</i>, <i>Trichosanthes bracteata</i>, <i>T. cucumerina</i>, <i>Trigonella corniculata</i>, <i>T. obcordata</i>, <i>T. occulta</i>, <i>T. polycerata</i>, <i>Urena repanda</i>, <i>Vigna prainiana</i>, <i>V. radiata</i> var. <i>sublobata</i>, <i>Vitis latifolia</i>, <i>Ziziphus oenoplia</i>, and <i>Z. oxyphylla</i> (90)</p>
Indian Peninsula (Central Highlands: Malwa Plateau, Bundelkhand, Chota Nagpur and Central and Deccan Plateau)	<p>Central Highland: <i>Abelmoschus crinitus</i>; syn. <i>A. cancellatus</i>, <i>A. ficulneus</i>, <i>A. manihot</i> ssp. <i>tetraphyllum</i> var. <i>megaspermus</i>, <i>A. manihot</i> ssp. <i>tetraphyllum</i> var. <i>pungens</i>; syn. <i>Hibiscus pungens</i>, <i>A. tuberculatus</i>, <i>Acacia donaldii</i>, <i>Alocasia macrorrhizos</i>, <i>Alysicarpus monilifer</i>; syn. <i>Hedysarum moniliferum</i>, <i>Amaranthus spinosus</i>, <i>A. viridis</i>, <i>Cajanus cajanifolius</i>, <i>C. scarabaeoides</i>, <i>C. sericeus</i>, <i>Coccinia indica</i>; syn. <i>C. grandis</i>, <i>Coix aquatica</i>, <i>Colocasia esculenta</i>, <i>Corchorus fascicularis</i>, <i>C. tridens</i>, <i>Cucumis callosus</i>, <i>C. hardwickii</i>, <i>C. setosus</i>, <i>Cucurma longa</i>; syn. <i>C. domestica</i>, <i>C. angustifolia</i>, <i>Dioscorea bulbifera</i>; syn. <i>D. sativa</i>, <i>D. glabra</i>, <i>D. wightii</i>, <i>Diospyros chloroxylon</i>, <i>D. melanoxylon</i> (wild form), <i>D. peregrina</i>, <i>D. sylvatica</i>, <i>D. tomentosa</i>, <i>Echinochloa crus-galli</i>, <i>Eleusine indica</i>, <i>Grewia damine</i>, <i>G. tenax</i>, <i>G. villosa</i>, <i>Indigofera pulchella</i>, <i>I. tinctoria</i>, <i>Madhuca indica</i> (wild form), <i>Momordica balsamina</i>, <i>M. dioica</i>, <i>M. subangulata</i> var. <i>renigera</i>, <i>Mucuna capitata</i>, <i>Narenga porphyrocoma</i>, <i>Oryza rufipogon</i>, <i>Phoenix robusta</i>, <i>P. sylvestris</i>, <i>Rhynchosia bracteata</i>, <i>R. minima</i>, <i>R. rufescens</i>, <i>Saccharum spontaneum</i>, <i>Sesamum laciniatum</i>, <i>Solanum torvum</i>, <i>Sorghum cernuum</i> var. <i>yemense</i>, <i>S. controversum</i>, <i>S. halepense</i>; syn. <i>S. miliaceum</i>, <i>S. nitidum</i>, <i>Spondias pinnata</i>, <i>Syzygium cumini</i> (wild form), <i>Trigonella corniculata</i>, <i>T. occulta</i>, <i>Vigna aconitifolia</i>, <i>V. dalzelliana</i>, <i>V. hainiana</i>, <i>V. mungo</i> var. <i>sylvestris</i>, <i>V. radiata</i> var. <i>setulosa</i>; syn. <i>V. sublobata</i>, <i>V. trilobata</i>, <i>Zingiber capitatum</i>, <i>Z. cassumunar</i>; syn. <i>Z. purpureum</i>, <i>Z. mauritiana</i>, (wild form), <i>Z. nummularia</i>, and <i>Z. xylopyra</i> (72)</p>

(continued)

Biogeographical zones	Wild relatives of cultivated species recorded
Eastern Ghats [Northeastern Ghats: Koraput, Bastar (Dandakaranya) and parts of Andhra Pradesh; South-central Eastern Ghats: Parts of Andhra Pradesh and Tamil Nadu]	<p>Central and Deccan Plateau: <i>Abelmoschus ficulneus</i>, <i>A. manihot</i> ssp. <i>tetraphyllum</i> var. <i>megaspermum</i>, <i>Boehmeria platyphylla</i>, <i>Canavalia stocksii</i> (variant of <i>C. ensiformis</i>), <i>Capparis decidua</i>, <i>Chionachne koenigii</i>, <i>Cichorium intybus</i>, <i>Corchorus antichorus</i>; syn. <i>C. depressus</i>, <i>C. urticaefolius</i>, <i>Crotalaria</i> spp. (27), <i>Eleusine indica</i>, <i>Grewia tenax</i>, <i>G. villosa</i>, <i>Indigofera deccanensis</i>, <i>I. glandulosa</i> var. <i>sykesii</i>, <i>Linum mysorense</i>, <i>Malva rotundifolia</i>, <i>M. subangulata</i>, <i>M. sylvestris</i>, <i>Momordica cymbalaria</i>, <i>Panicum hippothrix</i> (grains are cooked like rice), <i>P. psilopodium</i>, <i>P. trypheron</i>, <i>Phoenix robusta</i>, <i>P. sylvestris</i>, <i>Sesamum laciniatum</i>, <i>Setaria glauca</i>, <i>S. pallide-fusca</i>, <i>S. pumila</i>, <i>Solanum nigrum</i>, <i>Sorghum deccanense</i>, <i>S. stapfii</i>, <i>Vigna hainiana</i>, <i>Vigna trilobata</i>, and <i>V. trilobata</i> var. <i>pusilla</i> (34 + 26 <i>Crotalaria</i>).</p> <p><i>Abelmoschus angulosus</i>, <i>A. cancellatus</i>, <i>A. crinitus</i>, <i>A. ficulneus</i>, <i>A. moschatus</i>, <i>Allium porrum</i>, <i>Amaranthus dubius</i>, <i>A. spinosus</i>, <i>A. tenuifolius</i>, <i>Amorphophallus campanulatus</i>, <i>Boehmeria platyphylla</i>, <i>Cajanus cajanifolia</i>, <i>C. scarabaeoides</i>, <i>C. sericeus</i>, <i>C. volubilis</i>, <i>Canavalia stocksii</i>; syn. <i>C. cathartica</i>, <i>Carissa inermis</i>, <i>Cissus vitiginea</i>, <i>Coleus forskohlii</i>, <i>Corchorus antichorus</i>, <i>Crotalaria perfoliata</i>, <i>C. shevaroyensis</i> <i>Cucumis hystrix</i>, <i>C. melo</i> var. <i>agrestis</i>, <i>C. pubescens</i>, <i>Cucurma amada</i>, <i>C. angustifolia</i>, <i>C. pseudomontana</i>, <i>C. montana</i>, <i>C. zedoaria</i>, <i>Cymbopogon flexuosus</i>, <i>Dioscorea bulbifera</i>, <i>D. hamiltonii</i>, <i>D. hispida</i>, <i>D. intermedia</i>, <i>D. oppositifolia</i>, <i>D. pentaphylla</i>, <i>D. puber</i>, <i>D. wallichii</i>, <i>D. wightii</i>, <i>Diospyros melanoxylon</i>, <i>D. peregrina</i>, <i>D. racemosa</i>, <i>D. tomentosa</i>, <i>Echinochloa crus-galli</i>, <i>Eleusine indica</i> (wild form), <i>Grewia abutilifolia</i>, <i>G. hirsuta</i>, <i>G. tiliaefolia</i>, <i>G. tenax</i>, <i>G. villosa</i>, <i>Indigofera caerulea</i>, <i>I. pulchella</i>, <i>I. trifoliata</i>; syn. <i>I. barberi</i>, <i>Jasminum angustifolium</i>, <i>J. auriculatum</i>, <i>J. scandens</i>, <i>Lablab niger</i> var. <i>lignosus</i>, <i>Luffa graveolens</i>, <i>L. umbellata</i> (acutangula), <i>Malva rotundifolia</i>, <i>M. sylvestris</i>, <i>Mangifera sylvatica</i>, <i>Momordica balsamina</i>, <i>M. cochinchinensis</i>, <i>M. subangulata</i>, <i>M. tuberosa</i>; syn. <i>M. cymbalaria</i>, <i>Musa ornata</i>, <i>Oryza coarctata</i>; syn. <i>Sclerophyllum coarctatum</i> (tetraploid), <i>O. granulata</i>, <i>O. jeyporensis</i>, <i>O. meyeriana</i>, <i>O. nivara</i> (annual); syn. <i>O. rufipogon</i>, <i>O. officinalis</i> subsp. <i>malampuzhaensis</i>, <i>O. sativa</i> var. <i>plena</i>, <i>Panicum hippothrix</i>, <i>P. typheron</i>, <i>Phoenix humilis</i> var. <i>pedunculata</i>, <i>P. loureiroi</i> var. <i>pedunculata</i>; syn. <i>P. robusta</i>, <i>P. pusilla</i>, <i>Phyllanthus fischeri</i>, <i>P. narayanswami</i>, <i>Sesamum alatum</i>, <i>S. laciniatum</i>, <i>S. prostratum</i>, <i>Solanum erianthum</i>, <i>S. incanum</i>, <i>S. indicum</i>, <i>S. nigrum</i>, <i>S. surattense</i>, <i>S. torvum</i>, <i>S. viarum</i>, <i>Sorghum miliaceum</i>; syn. <i>S. halepense</i>, <i>Syzygium alternifolium</i>, <i>S. zeylanicum</i>, <i>Trichosanthes bracteata</i>, <i>T. cucumerina</i>, <i>T. cordata</i>, <i>T. himalensis</i>, <i>T. multiloba</i>, <i>T. occulta</i>, <i>Vigna pilosa</i>, <i>V. umbellata</i>, <i>Vitis pallida</i>; syn. <i>Cissus adnata</i>, <i>V. pedata</i>; syn. <i>Cayratia pedata</i>, <i>V. repanda</i>; syn. <i>Cissus repanda</i>, <i>V. setosa</i>, <i>V. woodrowii</i>; syn. <i>Cissus woodrowii</i>, <i>Ziziphus oenoplia</i>, and <i>Z. rugosa</i> (108).</p>

(continued)

Biogeographical zones	Wild relatives of cultivated species recorded
Western Ghats (Northwestern Ghats: Konkan and Southwestern Ghats: Malabar Coast)	<p>North Western Ghats: <i>Abelmoschus angulosus</i>, <i>A. ficulneus</i>, <i>A. manihot</i>, <i>Cajanus lineatus</i>, <i>C. sericeus</i>, <i>Canavalia lineata</i>, <i>Cinnamomum goaense</i>, <i>Coffea wightiana</i>, <i>C. crassifolia</i>, <i>Cucumis ritchiei</i>, <i>C. setosus</i>, <i>Curcuma inodora</i>, <i>C. pseudomontana</i>, <i>C. purpurea</i>, <i>C. reclinata</i>, <i>Dolichos bracteatus</i>; syn. <i>Sphenostylis bracteata</i>, <i>Echinochloa colonum</i>, <i>Garcinia malabarica</i>, <i>G. morella</i>, <i>G. talbotii</i>, <i>Mangifera sylvatica</i>, <i>Momordica tuberosa</i>; syn. <i>M. cymbalaria</i>, <i>Oryza meyeriana</i>; syn. <i>O. indandamanica</i>, <i>Panicum hippothrix</i>, <i>Pennisetum orientale</i>, <i>Piper argyrophyllum</i>, <i>P. galeatum</i>, <i>P. hookeri</i>, <i>P. hymenophyllum</i>, <i>P. trichostachyon</i>, <i>Vigna dalzelliana</i>, <i>V. khandalensis</i>; syn. <i>V. grandis</i>, <i>Zingiber neesatum</i>; syn. <i>Z. macrostachyum</i>, and <i>Z. purpureum</i> (34)</p> <p>South Western Ghats: <i>Abelmoschus angulosus</i>, <i>A. manihot</i> ssp. <i>tetraphyllum</i>, <i>Amorphophallus bonoccordensis</i>, <i>A. commutatus</i>, <i>A. hohenackeri</i>, <i>A. mysorensis</i>, <i>A. nicolsianus</i>, <i>A. smithsonianus</i>, <i>Artocarpus gomezianus</i> ssp. <i>zeylanicus</i>, <i>A. hirsutus</i>, <i>Cajanus candollei</i>, <i>C. lineatus</i>, <i>Carissa spinarum</i>; syn. <i>C. paucinervia</i>, <i>Cinnamomum filipedicellatum</i>, <i>C. heyneanum</i>, <i>C. macrocarpum</i>, <i>C. malabratrum</i>, <i>C. riparium</i>, <i>C. travancoricum</i>, <i>C. wightii</i>, <i>Colocasia esculenta</i>, <i>Corchorus pseudo-olitorius</i>, <i>Crotalaria clarkei</i>, <i>C. digitata</i>, <i>C. grahamiana</i>, <i>Curcuma aromatica</i>, <i>C. aurantiaca</i>, <i>C. caesia</i>; syn. <i>C. malabarica</i>, <i>C. coriacea</i>, <i>C. decipiens</i>, <i>C. ecalcarata</i>, <i>C. haritha</i>, <i>C. karnatakensis</i>, <i>C. kudagensis</i>, <i>C. nilamburensis</i>, <i>C. neilgherrensis</i>, <i>C. oligantha</i>; syn. <i>C. kannanorensis</i>, <i>C. raktakanta</i>, <i>C. reclinata</i>, <i>C. thalakaveriensis</i>, <i>C. vamana</i>, <i>Dioscorea hamiltonii</i>, <i>D. hispida</i>; syn. <i>D. daemona</i>, <i>D. intermedia</i>, <i>D. oppositifolia</i>, <i>D. pentaphylla</i>; syn. <i>D. jacquemontii</i>, <i>D. spicata</i>, <i>D. tomentosa</i>, <i>D. wallichii</i>, <i>D. wightii</i>, <i>Dolichos uniflorus</i>, <i>Ensete superbum</i>, <i>Eugenia singampattiana</i>, <i>Fragaria nilgerrensis</i>, <i>Garcinia morella</i>, <i>G. travancorica</i>, <i>G. wightii</i>, <i>G. xanthochymus</i>, <i>Jasminum angustifolium</i>, <i>J. flexile</i>, <i>J. malabaricum</i>, <i>J. mesnyi</i>, <i>Linum mysorensis</i>, <i>Luffa umbellata</i> (<i>acutangula</i>), <i>Momordica dioica</i>, <i>M. sahyadrica</i>, <i>Musa superba</i>, <i>Myristica dactyloides</i>, <i>M. malabarica</i>, <i>Olea glandulifera</i>, <i>Oryza meyeriana</i>, <i>O. officinalis</i>; syn. <i>O. officinalis</i> ssp. <i>malampuzhaensis</i>, <i>Piper argyrophyllum</i>, <i>P. barberi</i>, <i>P. galeatum</i>, <i>P. hapnium</i>, <i>P. hookeri</i>, <i>P. pykaraehense</i>, <i>P. schmidtii</i>, <i>P. silentvalleyensis</i>, <i>P. trichostachyon</i>, <i>Pueraria tuberosa</i>, <i>Sesamum laciniatum</i>, <i>S. malabaricum</i>, <i>S. mulayanum</i>, <i>S. radiatum</i>, <i>Solanum anguivi</i>; syn. <i>S. indicum</i>, <i>S. erianthum</i>, <i>S. incanum</i>, <i>S. nigrum</i>, <i>S. pubescens</i>; syn. <i>S. torvum</i>, <i>S. viarum</i>, <i>Syzygium arnottianum</i>, <i>S. beddomei</i>, <i>S. malabaricum</i>, <i>Trichosanthes cucumerina</i>, <i>T. nervifolia</i>, <i>T. tricuspidata</i>; syn. <i>T. bracteata</i>, <i>T. villosula</i>, <i>T. wallichiana</i>, <i>Vigna bournaea</i>, <i>V. pilosa</i>, <i>V. vexillata</i> var. <i>wightii</i>, <i>Vitis pedata</i>, <i>V. repanda</i>; syn. <i>Cissus repanda</i>, <i>Zingiber cernuum</i>, <i>Z. neesatum</i>; syn. <i>Z. macrostachyum</i>, <i>Z. purpureum</i>, <i>Z. roseum</i>, <i>Z. wightianum</i>, and <i>Z. zerumbet</i> (112)</p>
Coastal zone (Sand dunes of West and East Coast)	<p><i>Caesalpinia pulcherrima</i>, <i>Canavalia cathartica</i>, <i>C. maritima</i>, <i>Cassia siamea</i>, <i>C. tora</i>, <i>Casuarina equisetifolia</i> (wild forms), <i>Cissus quadrangularis</i>, <i>Citrullus colocynthis</i>, <i>Cocos nucifera</i> (wild forms), <i>Crotalaria pallida</i>, <i>C. retusa</i>, <i>C. verrucosa</i>, <i>Ipomoea aquatica</i>, <i>I. carnea</i> ssp. <i>fistulosa</i>, <i>I. pes-caprae</i>, <i>Ixora arborea</i>; syn. <i>I. parviflora</i>, <i>Phoenix paludosa</i>, <i>Physalis minima</i>, <i>Saccharum spontaneum</i>, <i>Uniola paniculata</i>, and <i>Ziziphus williamsii</i> (21)</p>

(continued)

Biogeographical zones	Wild relatives of cultivated species recorded
Islands (Andaman and Nicobar and Lakshadweep Islands)	<i>Amorphophallus carnosus</i> , <i>A. longistylus</i> , <i>Bauhinia nicobarica</i> ; syn. <i>B. stipularis</i> , <i>Bombax insigne</i> var. <i>andamanica</i> , <i>B. insigne</i> var. <i>polystemon</i> , <i>Canavalia turgid</i> , <i>Dioscorea nummularia</i> , <i>D. rogersii</i> , <i>D. vexans</i> , <i>Dipterocarpus andamanicus</i> , <i>Ficus andamanica</i> , <i>Garcinia andamanica</i> , <i>G. cadelliana</i> , <i>G. calycina</i> , <i>G. kurzii</i> , <i>Grewia calophylla</i> , <i>Hornstedtia fenzlii</i> , <i>Ixora capitulifera</i> , <i>I. hymenophylla</i> , <i>Jasminum cordifolium</i> , <i>J. andamanicum</i> , <i>J. multiflorum</i> , <i>J. unifoliolatum</i> , <i>Mangifera andamanica</i> , <i>M. camptosperma</i> , <i>Manilkara littoralis</i> , <i>Nypa fruticans</i> , <i>Oryza indandamanica</i> , <i>Phyllanthus andamanicus</i> , <i>Piper sarmentosum</i> , <i>Polyalthia parkinsonii</i> , <i>Pterocarpus dalbergioides</i> , <i>Syzygium andamanicum</i> , <i>S. kurzii</i> , <i>S. manii</i> , <i>S. polyanthum</i> , <i>S. samarangense</i> , <i>Terminalia bialata</i> , <i>T. catappa</i> , <i>T. manii</i> , <i>T. procera</i> , <i>Vanilla andamanica</i> , and <i>Vigna marina</i> (44)

Source: Singh (2017)

Appendix II

Exploration, surveys, and bio-perspective assessment has led to identification around 1500 plant species to be under threat in India. This includes more than 1100 higher plants, including the wild relatives of crop/cultivated species. The rarity and the threat to these species have been caused by urbanization, developmental activities, destruction of habitats by anthropogenic factors like over grazing, mining, etc. Botanical Survey of India have published five volumes (3 published and 2 in press) of the Red Data Books of Indian Plants listing 1182 species, 623 listed published earlier. In 2001, a tentative list of species needing conservation was also drawn (Archive 2001) to facilitate both in situ and ex situ conservation. Further investigations, in many plant species has confirmed the threat perception with ICUN categories. Based on survey and the investigations in this direction, the Ministry of Environment and Forest, Government of India releases press release on the plant species under threat to draw public/scientific attention and develop awareness and support for conservation of plant species, particularly those of economic value, including wild relatives of crops/cultivated species. An attempt is being made to list the representative crop/cultivated species for a bird's-eye view.

Representative Wild Relatives of Crop/Cultivated Species Reported to Be Under Threat

Wild relatives of cultivated species	Crop group ^a	ICUN category
<i>Abutilon bidentatum</i> var. <i>major</i>	ORN	R
<i>Abutilon ranadei</i>	ORN	CR
<i>Acacia campbelii</i>	AGFOR	VU
<i>Acacia donaldii</i>	AGFOR	DD
<i>Acer caesium</i>	ORN	VU
<i>Acer oblongum</i> var. <i>membranaceum</i>	ORN	CR
<i>Acer osmastonii</i>	ORN	EN
<i>Aconitum balfourii</i>	ORN/M	DD

(continued)

Wild relatives of cultivated species	Crop group ^a	ICUN category
<i>Acorus calamus</i>	M & AP	EN
<i>Aconitum heterophyllum</i>	ORN	EN
<i>Aconitum kashmiranum</i>	ORN	EN
<i>Aconitum violaceum</i>	ORN	VU
<i>Aegle marmelos</i> var. <i>mahurensis</i>	F & NT	R
<i>Albizia thompsonii</i>	AGFOR	R
<i>Albizia thompsonii</i> var. <i>galbana</i>	AGFOR	R
<i>Allium auriculatum</i>	VEG	EN
<i>Allium loratum</i>	VEG	EN
<i>Allium roylei</i>	VEG	EN
<i>Allium stracheyi</i>	VEG	VU
<i>Anogeissus sericea</i> var. <i>nummularia</i>	IND CR	R
<i>Arnebia benthamii</i>	M & AP	CR
<i>Asparagus jacquemonti</i>	VEG	DD
<i>Asparagus rottleri</i>	VEG	DD
<i>Barleria gibsonioides</i>	ORN/M	R
<i>Barleria prionitis</i> ssp. <i>dicantha</i>	ORN/M	DD
<i>Barleria stocksii</i>	ORN/M	
<i>Bauhinia variegata</i>	ORN	DD
<i>Berberis affinis</i>	M & AP	R
<i>Berberis apiculata</i>	M & AP	R
<i>Berberis kashmirian</i>	M & AP	R
<i>Berberis lambertii</i>	M & AP	VU
<i>Berberis pseudoumbellata</i>	M & AP	DD
<i>Berberis royleana</i>	M & AP	DD
<i>Bombax insigne</i>	COTIN	CR
<i>Boswellia ovelifoliolata</i>	M & AP	EN
<i>Boswellia serrata</i>	M & AP	
<i>Brachystelma laevigatum</i>	ORN	VU
<i>Brachystelma pauciflorum</i>	ORN	EN
<i>Butea monosperma</i> var. <i>lutea</i>	M & AP	EN
<i>Brachystelma volubile</i>	ORN	DD
<i>Cajanus cajanifolius</i>	GL	DD
<i>Cajanus lineatus</i>	GL	DD
<i>Calamus brandisii</i>	ORN/IND	R
<i>Calamus inermis</i>	ORN	VU
<i>Camellia sinensis</i>	COMC	
<i>Canavalia stocksii</i>	VEG	R
<i>Capparis cinerea</i>	F & NT	DD
<i>Capparis diversifolia</i>	F & NT	VU
<i>Capparis grandis</i>	F & NT	DD
<i>Capparis pachyphylla</i>	F & NT	VU
<i>Carum villosum</i>	SP & CON	EN
<i>Cenchrus rajasthanensis</i>	FOR	DD
<i>Ceropegia attenuata</i>	FOR	R
<i>Ceropegia bulbosa</i>	FOR	VU

(continued)

Wild relatives of cultivated species	Crop group ^a	ICUN category
<i>Ceropegia fantastica</i>	FOR	EN
<i>Ceropegia fimbriifera</i>	FOR	VU/R
<i>Ceropegia intermedia</i>	FOR	DD
<i>Ceropegia maccannii</i>	FOR	EN
<i>Ceropegia odorata</i>	FOR	EN
<i>Ceropegia pusilla</i>	FOR	R
<i>Ceropegia spiralis</i>	FOR	R
<i>Chlorophytum borivilianum</i>	M & AP	CR
<i>Chlorophytum malabaricum</i>	M & AP	R
<i>Cinnamomum filipedicellatum</i>	SP & CO	EN
<i>Cinnamomum heyneanum</i>	SP & CO	DD
<i>Cinnamomum perrottetii</i>	SP & CO	VU
<i>Cinnamomum riparium</i>	SP & CO	VU
<i>Cinnamomum travancoricum</i>	SP & CO	VU
<i>Citrus indica</i>	F & NT	EN
<i>Citrus macroptera</i>	F & NT	EN
<i>Coffea crassifolia</i>	COMC	R
<i>Commiphora wightii</i>	M & AP	R
<i>Crinum brachynema</i>	ORN	CR
<i>Crinum eleonorae</i>	ORN	EX
<i>Crinum woodrowii</i>	ORN	R/CR
<i>Crotalaria bourneae</i>	FIB	DD
<i>Crotalaria clarkei</i>	FIB	R
<i>Crotalaria clavata</i>	FIB	EN
<i>Crotalaria digitata</i>	FIB	EN/R
<i>Crotalaria fysonii</i> var. <i>glabra</i>	FIB	EN
<i>Crotalaria grahamiana</i>	FIB	R
<i>Crotalaria longipes</i>	FIB	EN
<i>Crotalaria medicaginea</i> var. <i>rigida</i>	FIB	
<i>Crotalaria paniculata</i>	FIB	NT/LC
<i>Crotalaria willdenowiana galbrifoliata</i>	FIB	R
<i>Curcuma caesia</i>	SP & CO	EN
<i>Curcuma coriacea</i>	SP & CO	EN
<i>Curcuma decipiens</i>	SP & CO	R
<i>Curcuma pseudomontana</i>	SP & CO	
<i>Curculigo orchiioides</i>	M & AP	EN
<i>Cycas beddomei</i>	ORN	EN
<i>Cycas circinalis</i>	ORN	EN
<i>Cymbidium aloifolium</i>	ORN	NT
<i>Cymbidium whiteae</i>	ORN	
<i>Cymbopogon flexuosus</i>	FOR	EN
<i>Cyperus dwarkensis</i>	FOR	R
<i>Cypripedium himalaicum</i>	ORN	EN
<i>Dactylorhiza hatagirea</i>	ORN/M	
<i>Dalbergia congesta</i>	AGFOR	EN
<i>Delphinium malabaricum</i> var. <i>ghaticum</i>	ORN	VU

(continued)

Wild relatives of cultivated species	Crop group ^a	ICUN category
<i>Dendrobium pauciflorum</i>	ORN	EN
<i>Dichanthium armatum</i>	FOR	R
<i>Dioscorea deltoidea</i>	VEG	EN
<i>Dioscorea wightii</i>	VEG	R
<i>Diospyros barberi</i>	F & NT	
<i>Diospyros holeana</i>	F & NT	VU
<i>Diospyros paniculata</i>	F & NT	VU
<i>Dipcadi ursulae</i> var. <i>longiracemosa</i>	ORN	
<i>Elaeocarpus munronii</i> (Rudraksha)	INCR	NT
<i>Elaeocarpus recurvatus</i>	INCR	VU
<i>Ephedra gerardiana</i>	M & AP	EN
<i>Ephedra foliata</i>	M & AP	
<i>Embelia ribes</i>	M & AP	CR
<i>Eugenia argentea</i>	ORN	EN/EX
<i>Eugenia cotinifolia</i> ssp. <i>codyensis</i>	ORN	EN
<i>Eugenia discifera</i>	ORN	EN
<i>Eugenia indica</i>	ORN	EN
<i>Euphorbia katrajensis</i>	INCR	R
<i>Ficus andamanica</i>	F & NT	EN
<i>Ficus angladei</i>	F & NT	CR
<i>Garcinia kingii</i>	F & NT	DD
<i>Garcinia talbotii</i>	F & NT	
<i>Garcinia travancorica</i>	F & NT	VU
<i>Garcinia wightii</i>	F & NT	VU
<i>Grewia damine</i>	F & NT	
<i>Grewia gamblei</i>	F & NT	EN
<i>Grewia pandaica</i>	F & NT	CR
<i>Hildegardia populifolia</i>	FIB	CR/VU
<i>Impatiens johnii</i>	ORN	EN/EX
<i>Impatiens macrocarpa</i>	ORN	CR
<i>Impatiens neo-barnesii</i>	ORN	EN
<i>Impatiens orchioides</i>	ORN	VU
<i>Impatiens tenella</i>	ORN	EN
<i>Impatiens nilagirica</i>	ORN	CR
<i>Indigofera barberi</i>	INCR	R
<i>Indigofera coerulea</i> var. <i>monosperma</i>	INCR	R
<i>Indigofera constricta</i>	INCR	R
<i>Indigofera thothathri</i>	INCR	VU
<i>Ipomoea clarkei</i>	VEG/ORN	EN
<i>Ixonanthes khasiana</i>	INCR	VU
<i>Ixora lawsonii</i>	ORN	EN
<i>Ixora longibracteata</i>	ORN	DD
<i>Jasminum adenophyllum</i>	ORN	EN
<i>Jasminum strictum</i>	ORN	CR
<i>Jasminum wightii</i>	ORN	R
<i>Lactuca benthamii</i>	VEG	EN

(continued)

Wild relatives of cultivated species	Crop group ^a	ICUN category
<i>Lactuca cooperi</i>	VEG	EN
<i>Lactuca filicina</i>	VEG	EN
<i>Lactuca undulata</i>	VEG	EN
<i>Livistonia jenkinsiana</i>	ORN	EN
<i>Madhuca bourdillonii</i>	AGFOR	EN
<i>Madhuca diplostemon</i>	AGFOR	EN
<i>Magnolia gustavii</i>	ORN	CR
<i>Mallotus philippensis</i>	INCR	R
<i>Mangifera andamanica</i>	F & NT	VU/NT
<i>Mangifera khasiana</i>	F & NT	DD
<i>Michelia kisopa</i>	ORN	DD
<i>Michelia punduana</i>	ORN	R
<i>Mucuna pruriens</i>	FOR	DD
<i>Myristica dactyloides</i>	SP & CO	VU
<i>Myristica malabarica</i>	SP & CO	VU
<i>Nardostachys grandiflora (jatamansi)</i>	M & AP	CR
<i>Nepenthes khasiana</i>	M & AP	EN
<i>Nymphaea pygmaea</i>	ORN	EX
<i>Oryza nivara</i>	C	DD
<i>Panax pseudoginseng</i>	M & AP	VU/CR
<i>Paphiopedilum insigne</i>	ORN	EN
<i>Paphiopedilum spicerianum</i>	ORN	EN
<i>Paphiopedilum venustum</i>	ORN	EN
<i>Paphiopedilum villosum</i>	ORN	VU
<i>Pandanus mangalorensis</i>	INCR	CR
<i>Pandanus martinianus</i>	INCR	EN
<i>Pandanus palakkadensis</i>	INCR	CR
<i>Pandanus unguifer</i>	INCR	EN
<i>Phoenix rupicola</i>	COMCR	NT
<i>Phyllanthus narayanswami</i>	M & AP	EN
<i>Phyllanthus talbotii</i>	M & AP	R
<i>Picrorhiza kurroa</i>	M & AP	EN
<i>Pimpinella katrajensis</i>	INCR	R
<i>Pimpinella tirupatiensis</i>	INCR	EN
<i>Pinus gerardiana</i>	INCR	R
<i>Piper barberi</i>	SP&CON	CR
<i>Piper mullesua</i>	SP&CON	VU
<i>Piper pykarahense</i>	SP&CON	
<i>Podophyllum hexandrum</i>	M & AP	EN
<i>Portulaca oleracea</i>	VEG	
<i>Prunus himalaica</i>	F & NT	R
<i>Pterocarpus santalinus</i>	M & AP	EN
<i>Pueraria tuberosa</i>	M & AP	NT
<i>Rauvolfia beddomei</i>	M & AP	
<i>Rauvolfia micrantha</i>	M & AP	
<i>Rauvolfia serpentina</i>	M & AP	VU

(continued)

Wild relatives of cultivated species	Crop group ^a	ICUN category
<i>Rhododendron arboreum</i> ssp. <i>arboreum</i>	ORN	
<i>Rhododendron concinnooides</i>	ORN	VU
<i>Rhododendron elliotii</i>	ORN	DD
<i>Rhododendron formosum</i>	ORN	VU
<i>Rhododendron johnstoneanum</i>	ORN	DD
<i>Rhododendron santapau</i>	ORN	EN
<i>Rhododendron subansiriense</i>	ORN	
<i>Rhododendron wattii</i>	ORN	EN
<i>Rubus almoresis</i>	F & NT	DD
<i>Rubus fockei</i>	F & NT	DD
<i>Rhynchosia beddomei</i>	GL	R
<i>Rhynchosia velutina</i>	GL	VU
<i>Rubia himalayensis</i>	INCR	VU
<i>Salix obscura</i>	AGFOR	
<i>Salvadora oleoides</i>	F/AGFOR	
<i>Salvadora Persica</i>	F/AGFOR	
<i>Santalum album</i>	INCR	VU
<i>Saussurea bracteata</i>	M & AP	R
<i>Saussurea clarkei</i>	M & AP	
<i>Saussurea costus</i>	M & AP	CR
<i>Saussurea involucrata</i>	M & AP	R
<i>Saussurea obvallata</i>	M & AP	VU
<i>Shorea tumbugaia</i>	INCR	EN
<i>Sterculia khasiana</i>	M & AP	EX
<i>Sterculia urens</i>	M & AP	EN
<i>Syzygium alternifolium</i>	F & NT/M	EN
<i>Syzygium andamanicum</i>	F & NT	CR
<i>Syzygium benthamiana</i>	F & NT	DD
<i>Syzygium beddomei</i>	F & NT	R
<i>Syzygium bourdillonii</i>	F & NT	EN
<i>Syzygium caryophyllatum</i>	F & NT	
<i>Syzygium chavaran</i>	F & NT	EN
<i>Syzygium gambleanum</i>	F & NT	E
<i>Syzygium manii</i>	F & NT	CR
<i>Syzygium occidentalis</i>	F & NT	DD
<i>Syzygium palghatense</i>	F & NT	EX/EN
<i>Syzygium stocksii</i>	F & NT	DD
<i>Syzygium travancoricum</i>	F & NT	EN/CR
<i>Taxus wallichiana</i>	M & AP	EN
<i>Tecomella undulata</i>	INCR	
<i>Terminalia arjuna</i>	M & AP	DD
<i>Terminalia pallida</i>	M & AP	EN
<i>Tinospora sinensis</i>	M & AP	VU
<i>Vanda coerulea</i>	ORN	R/CR
<i>Vanda wightii</i>	ORN	EX/RD
<i>Vanilla andamanica</i>	SP & CO	CR

(continued)

Wild relatives of cultivated species	Crop group ^a	ICUN category
<i>Vanilla wightiana</i>	SP & CO	R
<i>Vigna dalzelliana</i>	GL	
<i>Vigna khandalensis</i>	GL	R
<i>Withania coagulans</i>	M & AP	
<i>Zingiber cernuum</i>	SP & CO	DD
<i>Zingiber purpureum</i> var. <i>palamaunsis</i>	SP & CO	EN
<i>Ziziphus truncata</i>	F & NT	
<i>Ziziphus williamsii</i>	F & NT	

^aC cereals, GL grain legumes, OS oilseed, FIB fiber, FOR forage, VEG vegetable, F & NT fruit and nuts, SP & CO spices and condiments, COMCR commercial crops, M & AP medicinal and aromatic plants; ORN ornamentals, AGFOR agroforestry, INCR industrial crops

Source: CAMP Workshop (1998), Chadburn (2012a, b, c, d, e, f), MoEF (2010), Nayar and Sastry (1987–1990), Rawat (2008), Red Data Book of Indian Plants, Singh (2004, 2015), Ved et al. (2015), Walter and Gillett (1998), WCMC (1998h)

Appendix III

The germplasm collections of wild relatives in major crop species have been evaluated against main yield reducing factors, particularly the biotic and abiotic stresses and for nutritional traits in food crops and yield and quality-related traits in others. This has resulted in identification many desirable traits in these wild species. However, the possible genetic diversity that may exist within a species is yet to be studied in greater details in most of cases. This has created an expectation of the specific desirable trait(s) in all accessions of that species, which in many cases may not be true.

A great variation has been observed in identification wild relatives of crop/cultivated species under various crop groups with desirable traits. A large number desirable traits have been discovered in wild relatives of field and horticultural crops of food and forage value. However, the same is not true for other groups, such as spices and condiments, floriculture, medicinal and aromatic plants, agroforestry and cottage industry crops, and others, because of several inherent lacunas or constraints, such as:

1. Many are yet to reach crop status and mostly cultivated in gardens and home-stead gardens.
2. Many of them are perennial in nature with difficulties in their evaluation for desirable features.
3. Many have complex breeding system.
4. Crop or genetic improvement activities in many are still in infancy.
5. There has been lack of efforts in developing screening methodologies for/against various traits.
6. Lack of efforts toward evaluation for desirable traits.

Recognizing these constraints, a list of representative's wild relatives with desirable features is being produced herewith in summary.

Representative wild species related to crop/cultivated species with potential useful traits

	Wild-related species	Identified desirable trait(s)
Cereals		
1.	<i>Aegilops tauschii</i>	Source of disease and pest
2.	<i>Avena barbata</i>	Source of disease resistance (virus, rust, mildew) and quality
3.	<i>Avena fatua</i>	Resistant to drought, diseases (virus, rust, mildew), and high yield
4.	<i>Avena sterilis</i>	Resistant to diseases (virus, rust, mildew), herbicides, and high grain yield
5.	<i>Elymus dahuricus</i>	Source of salt tolerance (wheat and barley)
6.	<i>Hordeum spontaneum</i>	Source for quality, yield, disease resistance, cold, salt, and waterlogging tolerance
7.	<i>Eleusine compressa</i>	Drought tolerance (finger millet)
8.	<i>Oryza granulata</i>	Tolerant to drought, shade, and aerobic soil, immune to bacterial leaf blight (BLB) and resistance to brown plant hopper (BPH), yellow stem borer
9.	<i>Oryza minuta</i>	Source of resistance to BLB, green leaf hopper (GLH), whitebacked plant hopper (WBPH) and BPH
10.	<i>Oryza nivara</i>	Source of grassy stunt virus and sheath blight (SB) resistance
11.	<i>Oryza officinalis</i>	Source of BPH, GLH, and BLB resistance
12.	<i>Oryza rufipogon</i>	Source of cytoplasmic male sterility (CMS), quality, yield, metal and salt tolerance, and SB resistance
13.	<i>Panicum turgidum</i>	Drought and salt tolerant
14.	<i>Paspalum scrobiculatum</i>	Drought and salt resistant
15.	<i>Pennisetum orientale</i>	Drought resistant, prolonged green
16.	<i>Triticum turgidum/dicoccoides</i> (wild tetraploid wheat)	High protein content
Grain legumes		
1.	<i>Cajanus albicans</i>	Source of high seed protein (HSP) and sterility mosaic virus (SMV)
2.	<i>Cajanus cajanifolius</i>	Source of nuclear male sterility (NMS) and (CMS), soil salinity
3.	<i>Cajanus crassus</i>	Resistance to SMV
4.	<i>Cajanus lineatus</i>	Source of cleistogamy and CMS
5.	<i>Cajanus mollis</i>	Source of highest seed protein (HSP) content
6.	<i>Cajanus platycarpus</i>	Resistance to <i>Phytophthora</i> blight (PB), soil salinity
7.	<i>Cajanus scarabaeoides</i>	Source of CMS, HSP and dwarfism, and resistance to pod borer (PB), SMV
8.	<i>Cajanus sericeus</i>	Source of HSP, CMS, and resistance to both PB and SMV
9.	<i>Cicer microphyllum</i>	Drought resistance
10.	<i>Glycine soja</i>	Source for resistance to yellow mosaic virus (YMV), adaptability, cold tolerance, and short season

(continued)

	Wild-related species	Identified desirable trait(s)
11.	<i>Macrotyloma sar-garhwalensis</i>	Source of high protein content
12.	<i>Vigna acontifolia</i>	Drought resistant
13.	<i>Vigna mungo</i> var. <i>silvestris</i>	Hard seed coat
14.	<i>Vigna radiata</i> var. <i>setulosa</i>	Source of drought and buchiids resistance
15.	<i>Vigna vexillata</i>	Resistant to cowpea weevil
Oilseeds		
1.	<i>Brassica tournefortii</i>	Source of cytoplasmic male sterility (CMS)
2.	<i>Carthamus oxyacantha</i>	Highly drought tolerant
3.	<i>Lepidium latifolium</i>	Source of cold tolerance
4.	<i>Linum perenne</i>	Cold tolerance
5.	<i>Linum strictum</i>	Source of fiber strictness
6.	<i>Sesamum alatum</i>	Resistance to phyllody disease
7.	<i>Sesamum laciniatum</i>	Resistance to diseases and pests of sesame
8.	<i>Sesamum malabaricum</i>	Source of cytoplasmic sterility and powdery mildew in sesame
9.	<i>Sesamum mulayanum</i>	Source of resistance to phyllody, powdery mildew, and wilt
Fiber yielding plants/crops		
1.	<i>Boehmeria macrophylla</i>	Fiber quality
2.	<i>Boehmeria platyphylla</i>	Source of fiber strength
3.	<i>Corchorus aestuans</i>	Source of resistance to stem rot
4.	<i>Corchorus depressus</i>	Source of drought/heat tolerant
5.	<i>Corchorus fascicularis</i>	Source of drought/heat tolerant and adaptability
6.	<i>Corchorus pseudo-olitorius</i>	Immune to fungal diseases, stem rot, root rot, black band, soft rot, and anthracnose
7.	<i>Corchorus tridens</i>	Source high protein (vegetable/fodder)
8.	<i>Gossypium arboreum</i>	Source for resistance pest and diseases and tolerance to drought and CMS
9.	<i>Gossypium herbaceum</i>	Resistance to biotic and drought stresses, source of adaptability and yield, and quality traits and CMS
Forage crops		
1.	<i>Cenchrus setigerus</i>	Source of drought resistant
2.	<i>Cenchrus rajasthanensis</i>	Source of drought resistant
3.	<i>Chrysopogon aciculatus</i>	Tolerant to heavy grazing
4.	<i>Dichanthium annulatum</i>	Tolerant to heavy grazing and lodging
5.	<i>Diplachne fusca</i>	Source of salt tolerance
6.	<i>Eragrostis curvula</i>	Extremely drought tolerant
Vegetables		
1.	<i>Abelmoschus angulosus</i>	Source of resistance to yellow vein mosaic virus (YVMV), mites, and tolerance to low temperatures and light frost
2.	<i>Abelmoschus caillei</i>	Source of resistance to YVMV and shoot and fruit borer
3.	<i>Abelmoschus crinitus</i>	Source of resistant <i>Cercospora</i> blight
4.	<i>Abelmoschus manihot tetraphyllus</i> var. <i>pungens</i>	Resistant to enation leaf curl virus

(continued)

	Wild-related species	Identified desirable trait(s)
5.	<i>Abelmoschus manihot</i>	Source of resistant to YVMV
6.	<i>Abelmoschus tuberculatus</i>	Tolerant to YVMV and fruit borer
7.	<i>Allium roylei</i>	Source of resistance to powdery mildew, leaf blight, etc.
8.	<i>Canavalia cathartica</i>	Source of nutritional traits
9.	<i>Canavalia rosea</i>	Highly salt tolerant
10.	<i>Citrullus colocynthis</i>	Source for drought tolerance and pest resistance
11.	<i>Cucumis callosus</i>	Resistance to fruit fly and leaf-eating caterpillars and tolerance to drought
12.	<i>Cucumis hardwickii</i>	Source of cold tolerant and resistance to powdery mildew
13.	<i>Lablab purpureus</i> var. <i>typicus</i>	Drought hardy
14.	<i>Momordica cochinchinensis</i>	Rich in nutrients
15.	<i>Solanum anguivi</i> (<i>indicum</i>)	Source of resistance to <i>Fusarium</i> wilt
16.	<i>Solanum melongena</i> Linn var. <i>incanum</i>	Source of variation for phenolic content, <i>Fusarium</i> wilt, and frost and drought resistance
17.	<i>Solanum melongena</i> Linn var. <i>insanum</i>	Source of resistant to bacterial wilt, shoot, and fruit borer
18.	<i>Solanum nigrum</i>	Source of resistant to potato bacterial wilt
19.	<i>Solanum sisymbriifolium</i>	Source of resistance to <i>Verticillium</i> wilt resistance, <i>Meloidogyne</i> spp. and eggplant pest, such as aphid, shoot, and fruit borer
20.	<i>Solanum torvum</i>	Source of resistance to <i>Verticillium</i> wilt, bacterial wilt, pest <i>Meloidogyne</i> spp., root stock for eggplant
21.	<i>Solanum virginianum</i> (<i>xanthocarpum</i>)	Source of resistance to bacterial wilt
22.	<i>Trichosanthes dioica</i> (wild type)	Source of resilience to stresses
Fruits and nuts		
1.	<i>Citrus assamensis</i>	Source for waterlogging tolerance
2.	<i>Citrus cavaleriei</i>	Source of cold tolerance and graft stock
3.	<i>Citrus hystrix</i>	Source of <i>Citrus</i> pest resistance
4.	<i>Citrus indica</i>	Source of <i>Citrus</i> disease resistance
5.	<i>Citrus jambhiri</i>	Cold hardiness, source of drought resistance, also used as rootstock
6.	<i>Citrus karna</i>	Source of graft stock
7.	<i>Citrus latipes</i>	Source cold tolerant, potential disease resistance, and graft stock
8.	<i>Citrus limonia</i>	Most used source of rootstock and <i>Citrus</i> disease resistance
9.	<i>Citrus maderaspatana</i>	Source of graft stock
10.	<i>Citrus reshni</i>	Gene sources for salt tolerance in graft stock
11.	<i>Citrus reticulata</i>	Source of graft stock and winter hardiness
12.	<i>Citrus trifoliata</i>	Source of dwarfing, graft stock, hardiness, and disease resistance
13.	<i>Diospyros lotus</i>	Gene sources for graft stock
14.	<i>Ficus palmata</i>	Source of graft stock for fig
15.	<i>Fragaria daltoniana</i>	Frost tolerant strawberry
16.	<i>Fragaria nilgerrensis</i>	Source of quality

(continued)

	Wild-related species	Identified desirable trait(s)
17.	<i>Garcinia hombroniana</i>	Source of rootstock
18.	<i>Garcinia sopsopia</i>	A suitable rootstock for mangosteen
19.	<i>Garcinia xanthochymus</i>	Source of graft stock for cultivated mangosteen
20.	<i>Grewia oppositifolia</i>	Tolerant to frost
21.	<i>Malus baccata</i>	Source of resistance to diseases, cold tolerance and graft stock
22.	<i>Malus sikkimensis</i>	Source for disease resistance and dwarfing gene
23.	<i>Mangifera indica</i>	Source of graft stock
24.	<i>Mangifera sylvatica</i>	Potential source of graft stock for mango
25.	<i>Manilkara zapota</i>	For variability in fruit size
26.	<i>Musa balbisiana</i>	Source of improved vigor and tolerance to biotic and abiotic stresses
27.	<i>Prunus cerasoides</i>	Source of disease resistance and graft stock for sweet cherry
28.	<i>Prunus cornuta</i>	Source of disease resistance for sweet cherry and as graft stock
29.	<i>Prunus prostrata</i>	Used as graft stock and potential source of disease resistance
30.	<i>Pyrus pashia</i>	Common rootstock for Asian pear
31.	<i>Pyrus polycarpa</i>	Field resistant to powdery mildew and fire blight
32.	<i>Pyrus pyrifolia</i>	Preferred rootstock for pear
33.	<i>Ribes glaciale</i>	Immunity to rust caused by <i>Cronartium ribicola</i>
34.	<i>Rubus ellipticus</i>	Shade tolerant
35.	<i>Syzygium cumini</i>	Variability used in genetic improvement
36.	<i>Vitis lanata</i>	Source of late ripening and resistant to disease
37.	<i>Ziziphus nummularia</i>	Genetic source of rootstock
Spices and condiments		
1.	<i>Alpinia galangal</i>	Source of aromatic rootstock
2.	<i>Cinnamomum travancoricum</i>	Source of antifungal activities
3.	<i>Cinnamomum curvifolium</i>	Source of high essential oil
4.	<i>Curcuma ecalcarata</i>	Source of pinocembrin and piperitenone
5.	<i>Curcuma leucorhiza</i>	Source of edible starch
6.	<i>Curcuma sylvatica</i>	Source of highest concentration (320 mg/100 g) of biologically active peptide turmerin
7.	<i>Myristica beddomei</i>	Fruit pericarp is a rich source of nutritional compounds
8.	<i>Myristica malabarica</i>	Source of good rootstock for grafting the true nutmeg
9.	<i>Piper attenuatum</i>	Source of highest percentage of crotepoxide
10.	<i>Piper galeatum</i>	Source of bold fruits
11.	<i>Piper hamiltonii</i>	Source of resistance to betelvine blackfly
12.	<i>Piper nigrum</i> (INGR 8100)	Source of proliferating spikes
13.	<i>Piper thomsonii</i> (INGR 8009)	Source of sex change from male to bisexual plant
14.	<i>Zingiber cassumunar</i>	Source of fungitoxic action against <i>Rhizoctonia solani</i> , the damping off pathogen

(continued)

	Wild-related species	Identified desirable trait(s)
15.	<i>Zingiber rubens</i>	Source of cold hardiness
16.	<i>Zingiber zerumbet</i>	Sources of ginger disease resistance
Commercial crops		
1.	<i>Camellia oleifera</i>	Source of edible seed oil
2.	<i>Camellia taliensis</i>	Gene resources for tea improvement
3.	<i>Miscanthus nepalensis</i>	Potential ornamental
4.	<i>Narenga porphyrocoma</i>	Source of temperature tolerance and resistance to red rot disease of sugarcane
5.	<i>Phoenix paludosa</i>	Source for poor soil tolerance
6.	<i>Saccharum arundinaceum</i>	Source of drought and disease resistance
7.	<i>Saccharum spontaneum</i>	Source of vigor, cold tolerance, hardiness, and disease resistance and yield
8.	<i>Sclerostachya fusca</i>	Source of waterlogging resistance, heavy tillering, and earliness in sugarcane
Medicinal and aromatic plants		
1.	<i>Albizia procera</i>	Drought tolerant
2.	<i>Alpinia malaccensis</i>	Potential ornamental plant
3.	<i>Cymbopogon khasianus</i>	Source of essential oil and methyl eugenol
4.	<i>Plectranthus hadiensis</i> var. <i>tomentosus</i>	Source of bioactive phytochemicals, especially terpenoids
Ornamental plants for floriculture		
1.	<i>Barleria grandiflora</i>	Potential regular ornamental
2.	<i>Begonia griffithiana</i>	Potential regular ornamental
3.	<i>Hedychium coccineum</i>	Early bloomer
4.	<i>Hedychium marginatum</i>	Potential regular ornamental
5.	<i>Jasminum parkeri</i>	Potential regular ornamental for rockeries
6.	<i>Rhododendron arboreum</i>	Source of variability as parent in hybrids
7.	<i>Rosa macrophylla</i>	Source of variability
Agroforestry trees		
1.	<i>Acacia jacquemontii</i>	Source of high temperature and excessive drought tolerance
2.	<i>Acer caesium</i> ssp. <i>caesium</i>	Source of seed dormancy
3.	<i>Populus euphratica</i>	Source of drought and salinity tolerance
4.	<i>Salix wallichiana</i>	Frost resistant
Cottage industry plants and others		
1.	<i>Bambusa pallida</i>	Source of cane and quality fiber
2.	<i>Dendrocalamus hamiltonii</i>	Source of palatable shoots
3.	<i>Indigofera glandulosa</i>	Source of high protein
4.	<i>Millettia pinnata</i>	Drought resistant
5.	<i>Morus alba</i>	Drought tolerant
6.	<i>Morus macroua</i>	Source of resistant to drought, salinity, and frost

Source: Analysis of reviewed literature

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