

# Centres of Origin and Diversity of Crop Plants - Importance in Management of Plant Genetic Resources

E. Roshini Nayar

ICAR-National Bureau of Plant Genetic Resources, New Delhi

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## Introduction

*“The coevolution of crops and man in subsistence agricultural economies....., as with so many things in this world, (the past) is being destroyed by the present. Centers of diversity have been wiped out in recent decades. Indigenous tribal cultures and social customs have collapsed as well. Authentic indigenous cultivars and landraces are becoming collector's items .....The world of N.I. Vavilov is vanishing and the sources of genetic variability he knew are drying up. The patterns of variation... may no longer be discernible in a few decades and living traces of the long coevolution of cultivated plants may well disappear forever.”* J.R. Harlan (1975) Our Vanishing Genetic Resources.

This statement sums up the link between centres of diversity and concerns of plant genetic resources (PGR). Three aspects have been covered under this topic- 1) Understanding of the diversity build-up in crop species in response to their domestication from the wild and spread in cultivation provides the basis for working out the centres of origin and diversity in crop gene pools; 2) Indian region as one of the designated megacentres of agro-diversity, characterized by availability of nearly 170 native crops and related wild species, dependence on species from the wild in common with other Asian megacentres, long history of exchange of economically important species, several introduced species outperforming both native crop species and the species in their centre of origin, and vice-versa; and 3) Specific examples of crops have been considered to bring out the significance of this knowledge to strategize and use plant genetic resources.

## Centres of origin and diversity of crop plants

Centre of origin and diversity of crop plants are concepts relating to the patterns of distribution and build-up in regions and habitats, consequent to use and domestication by man in areas representing independent agricultural systems and separated by major geographical barriers. Various terms have been used to designate these ‘geobotanical’ diversity patterns in crop plants *viz.* primary and secondary centres of diversity, gene centres, cradles/ subcradles of agriculture, megacentres, regions (von Humboldt, 1807; de Candolle, 1855; Vavilov, 1926; Darlington, 1952, 1969; Zhukovsky, 1968; Zeven and de Wet, 1982), non-centres, microcentres (Harlan, 1951, 1971), cradles of angiosperm diversity (Takhtajan, 1969). Diversity in different crop species, coinciding at particular sites, occur at sites between 20-45° N and S latitudes and encompass mountain areas. Substantiating evidences from plant geography, wild and weedy species, palaeobotany, philology, all have gone into understanding these terms and their use. Changes therein with the spread of crops in cultivation and use makes the determination of centres of origin a hypothetical concept, more often than not, difficult to prove. However, within centres of diversity, geobotanical patterns of variation, add a practical connotation to the use of these concepts in PGR.

The significant point, as stated above is that centres of diversity are the consequence of continuing processes of evolution and domestication, and hence subject to change. Genecological studies undertaken in the 1920s to 1940s (Briggs and Walters, ) and the concept of ‘ecological passports’ in different sites where different crops show parallelism in characters by Vavilov (described by Zeven

and de Wet, 1982), form the basis for understanding the diversity within the crop species, and in relation to the crop gene pool (Harlan and de Wet, 1971).

### **Indian megacentre of agro-diversity**

Indian region has been identified as one of twelve megacentres of agrodiversity (Zeven and Zhukovsky, 1978). It has been described as being maximum diverse, probably in the globe, for an area its size, due to its geological and geographical extremes, along with its monsoonic climate, and due to its long history of agriculture, important for crop plants. It has two 'hot-spots' from among the twenty five designated in the world, and a third high diversity area referred to as the 'cradle of flowering plants', a 'group' identified in the north Indian region with a uniform set of characters ('ecological passport'), and a 'subgroup' in north western parts, and a dependence on wild species, in common with China. Furthermore, it is in close proximity to two other megadiversitycentres- Chinese- Japanese region to the north, Indomalayan-Indonesian to the east and African on the west, with shared diversity, and with a long history of exchange of resources and products with other regions. Despite this, almost fifty percent dependence on native diversity has been noted for the region, second to the Mediterranean region.

Nearly 170 crop species have native diversity in the Indian region. These include native crops such as pigeon pea (*Cajanus cajan*), paddy, pulses such as mung bean and urid bean (*Vigna* spp.), brinjal, black pepper, trans domesticates viz. guar, and others such as sugarcane, citrus fruits for which the Indian region is part of a regional centre of diversity others, crops introduced and well adapted to the area, with a secondary centre of diversity in safflower, chilli, maize etc. Corresponding rich diversity in wild species belonging to the crop gene pool also exists, where the priority species with potential for use, or identified as progenitor species or which morphologically, cytologically or on the basis of other biosystematics evidence, are diagnosed as belonging to the gene pool of the crop. A total of 326 species were diagnosed as priority species; these amount to a small portion of the total species of the crop genus available in the region (Arora and Nayar, 1984; Pradheep et al., 2014). Further analysis of distribution patterns and relatedness of species have added approx. 90 species to this list, and a native component is clearly discernible to the total wild resources diversity available.

### **Plant genetic resources (PGR)**

Plant genetic resources (definition in Annexure 1), with increasing concerns of rapid deterioration, change and loss of biodiversity and habitats of occurrence of these resources, was a major concern since the 70s, and reflected in terms such as 'hot-spot' of diversity. This concern accelerated efforts towards estimation of diversity known, collected, conserved and used, on the one hand, and modification of sovereign rights for equitable sharing of rights and benefits of owning diversity, on the other. Centres of agrodiversity and the inter-linkages between various regions of the world, through deliberate and fortuitous introduction and exchange of crops, related wild species, and weedy species have projected the current scenario. Standardized methods and strategies have been worked out for universal use across genebanks/ databanks at global and national levels for

- (a) collection, characterization, evaluation and conservation of a large number of diverse species, varying in their viability, longevity and growth and habitat preferences;
- (b) database creation and data exchange;
- (c) digitized data from genebanks, herbaria, for use in inventorising diversity, determining gaps in collection and conservation, and prioritizing species with potential for use; and
- (d) digital data on available resources for estimating diversity distribution of species both crop and wild.

The significant aspects of PGR strategies, illustrated by some examples in *Vigna*, *Solanum*, *Sorghum*, *Oryza*, *Abelmoschus*, *Saccharum*, *Curcuma* etc. exemplify and describe the centres diversity of crop

plants *vis-à-vis* their wild relatives, and good practices *vis-à-vis* PGR programmes that have been adopted and refined over the past decades.

## References

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- Damania, A.B., J. Valkoun, G. Willcox and C.O. Qualset (Eds.). 1998. The Origins of Agriculture and Crop Domestication. ICARDA, Aleppo, Syria, xi + 345 pp. (*cross-ref. centres of diversity*)
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- Pradheep, K., D. C. Bhandari and K. C. Bansal. 2014. Wild relatives of crop plants in India. Directorate of Knowledge Management in Agriculture, Indian Council of Agricultural Research, New Delhi. 728 p.
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## Annexure 1

### *Definition of Plant Genetic Resources*

International Undertaking on Plant Genetic Resources (FAO, 1983): the reproductive or vegetative propagating material of (i) cultivated varieties (cultivars) in current use and newly developed varieties; (ii) obsolete cultivars; (iii) primitive cultivars (landraces); (iv) wild and weed species, near relatives of cultivated varieties; and (v) special genetic stocks (including elite and current breeder's lines and mutants).

Convention for Biological Diversity (CBD, 1992), any living material of present and potential value for humans.

Thus, what is potential is a matter of interpretation and the state of technological advancements.

[http://www.nbpgr.ernet.in/Why\\_Conserve\\_PGR.aspx](http://www.nbpgr.ernet.in/Why_Conserve_PGR.aspx)