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CONSERVATION OF CROP WILD RELATIVES AND ITS UTILITY

Popular Article

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ABSTRACT

A crop wild relative (CWR) is a wild plant closely related to a domesticated plant, whose geographic origins can be traced to regions known as Vavilov Centers (named for the pioneering botanist Nikolai Vavilov). The development of new varieties is essential to increase the productivity of food crops to match the growing world population but with the advent of climate change and greater ecosystem instability we are sensing the loss of genes and agro-ecosystem instability. CWRs are likely to prove a critical resource in ensuring food security and maintaining sustainable agro-ecosystems for the new millennium; CWRs are essential components of natural and agricultural ecosystems and hence are indispensable for maintaining ecosystem health. Like many wild species, Crop Wild Relatives are on the decline, both at the taxonomic and at the genetic level. Their conservation and sustainable use is very important for improving agricultural production, increasing food security, and maintaining a healthy environment.

Introduction

Any genetic material of plant origin that is of potential value for creating improved germplasm is a plant genetic resource. It may be a wild ancestor of the domesticated plant, or another closely related taxon. FAO categorises them into wild and weed species, closely related to cultivated species, landraces, special genetic stocks including elite and current breeders' lines, cultivated and obsolete varieties. Crop Wild Relatives (CWR) have contributed many useful genes to crop plants, and modern varieties of most major crops now contain genes from their wild relatives. Therefore CWRs are wild plants related to socio-economically important species including food, fodder and forage crops, medicinal plants, condiments, ornamental, and forestry species, as well as plants used for industrial purposes, such as oils and fibres, and to which they can contribute beneficial traits.

Crop wild relatives [CWR] and their importance

Wild plant taxon that has an indirect use derived from its relatively close genetic relationship to a crop. This relationship is defined in terms of the CWR belonging to gene pools. To establish the degree of crop relatedness, one method which could be applied is the Harlan and de Wet (1971) Gene Pool concept—close relatives being found in the primary gene pool (GP1), more remote ones in the secondary gene pool (GP2), and very remote ones in the tertiary gene pool (GP3). CWR were first routinely used by agricultural

scientists to improve major crops in the 1940s and 1950s, and by the 1960s and 1970s this practice was leading to some major breeding improvements. Almost all modern varieties of crops contain some genes derived from a CWR and they are now recognized as a critical resource with a vital role in food security and economic stability for the 21st century, as well as contributing to environmental sustainability. CWR value as actual or potential gene donors for example in case of wheat, various CWR for disease resistance has been derived.

Pest and disease resistance: 80% of the beneficial traits of CWR genes confer resistance to pest and diseases. Many examples are available, *Oryza nivara*: grassy stunt virus, *Solanum demissum*: potato late blight, *Lycopersicon pimpinellifolium*: many disease resistances, *L. peruvianum, L. cheesmanii, L. pennellii* – 40% resistance genes and *Agropyron elongatum, Aegilops umbellulata*: stem & leaf rust resistance in wheat. Tropical Manioc Selection [TMS] cassava cultivars developed by IITA using crosses with *Manihot glaziovii* and adopted by no. of African countries against cassava mosaic disease & bacterial blight. **"**Calcutta 4" [*Musa acuminata*] is a wild, non edible diploid banana provides resistance against black sigatoka.

Abiotic stress tolerance: Chickpea cultivar **"**BG1103**"** having drought & temperature tolerance which was derived from *Cicer reticulatum*, developed by IARI. *O.rufipogon* genes provide tolerance of soils with high acidic-sulfate content in vietnam and *O.longistaminata* genes provides drought tolerance in Philippines. Bean cultivars having tolerance to low temperatures and salinity due to incorporation of genes from its wild *Phaseolus*.

Yield increase: Chickpea cultivar **"**BG1103**"** yields 40% more than competing cultivars. This increase is due to wild genes. Rice cultivar NSICRc112 developed Philippines in 2002 from the cross of *O.sativa* & *O.longistaminata* was a high yielding one.

Cytoplasmic male sterility and fertility restorer lines: Wild *Helianthus annuus* & *H. petiolaris* provides CMS lines for high yielding commercial hybrids since 1972. It contributes 100% production in US, 60-70% of production worldwide. In rice, 95% of hybrids in china were derived from crosses using CMS from wild *O.sativa* f. *spontanea*. CMS & fertility restorer lines from *Pennisetum purpureum* was used to develop first pearl millet grain hybrids & commercial forage hybrids.

Improved quality: In tomatoes, the qualities improved are increased soluble solid content, fruit color & adaptation to harvesting. QTL mapping & analysis helps to discovery of useful quality-controlling genes for fruit size, small-fruited ancestor *L. pimpinellifolium*. Protein content was doubled in Brazilian cassava cultivar, ICB 300 which was derived from *Manihot oligantha*.

Importance of CWR conservation

The natural populations of many CWRs are increasingly at risk. They are threatened by habitat loss through the destruction and degradation of natural environment or their conversion to other uses. Deforestation is leading to the loss of many populations of important wild relatives of fruit, nut, and industrial crops. Populations of wild relatives of cereal crops that occur in arid or semi-arid lands are being severely reduced by over grazing and resulting desertification. Anthropogenic pressures are putting a severe strain on the natural distribution of crop wild relatives and threatening their very existence. A unique threat to CWR is many *taxa* are weedy and associated with traditional farming practices. With an increase in industrial farming & cultivation of High yielding varieties, CWR

diversity decreases, resulting in loss of genetic diversity & leads to potential local extinction. 54% of the 1,155 Monocotyledons evaluated in the IUCN 2008 Red List Assessment were classified as endangered or facing a high risk of extinction in the wild, whereas 12% were listed as being critically endangered. This is all the more important when we consider that the Monocotyledon family includes economically important crops such as rice, wheat, maize, barley, sorghum/millet and sugarcane, which alone provide more than half of the dietary energy of the world's population. The Food and Agriculture Organisation of the United Nations (FAO) estimates that about 75% of the genetic diversity of agricultural crops has been lost in the last century due to the widespread abandonment of genetically diverse traditional crops in favour of genetically uniform modern crop varieties.

Conservation strategies

For conservation efforts to be most effective and to be directed at the most important species there needs to be clear guidance on first identifying CWR, followed prioritizing those species most under threat. Conservation priorities at international, regional, national levels are primarily established by agencies with a focus on rare and threatened species.

Ex situ conservation

Ex-situ conservation means literally, "off-site conservation". It is the process of protecting an endangered species of plant or animal outside its natural habitat; for example, by removing part of the population from a threatened habitat and placing it in a new location, which may be a wild area or within the care of humans. While ex-situ conservation comprises some of the oldest and best known conservation methods, it also involves newer, sometimes controversial laboratory methods and is suitable for majority of CWR species. Management interventions are fairly minimal. Helps in Rescue of threatened germplasm, Conserves an adequate representative sample of CWR populations, Ease of accessibility & exchange of germplasm, Ease of documentation and no exposure to pests, disease and other hazards. Most importantly cost effective. Examples are cold storage (5 degree Celsius and -20 degree Celsius for short and long storages respectively), cryopreservation. Seed material, Plant material, tissue culture callus mass etc are stored under this conservation strategy.

In situ and on farm conservation

In-situ conservation is on-site conservation or the conservation of genetic resources in natural populations of plant or animal species, such as forest genetic resources in natural populations of tree species. It is the process of protecting an endangered plant or animal species in its natural habitat, either by protecting or cleaning up the habitat itself, or by defending the species from predators. It is applied to conservation of agricultural biodiversity in agro ecosystems by farmers, especially those using unconventional farming practices. In *situ* means conserved in its own natural habitats managed as genetic reserves; overall need to maintain ecosystem health. Maintains the dynamic evolution of CWR diversity itself in relation to parallel environment changes. Most authentic way to conserve genetic diversity on farm conservation needs support & cooperation of the farming community.

Some reserves in India are,

Protected Area	Link to CWR and Landraces
Dandeli Sanctuary (47,502 ha)	Western ghats in south India. Nutmeg, pepper, wild yam and berry.
Nokrek National park (4748 ha)	Tropical Garo hills – Meghalaya. Least disturbed forest areas of sub-Himalayan ranges: Wild citrus and Musa.
Silent valley National park (8952 ha)	Nilgiri hills: Cardomom, pepper, yams, beans.

Conclusion

Though conservation of wild relatives are taken seriously at technical level, but this concept has to reach local farmers who had conserved earlier but now totally in to profit oriented intensive agriculture. Enhancing the link between in situ conservation and use of crop wild relatives (CWR) to underpin regional food security and mitigate predicted adverse impact of climate change. Hence ex-situ conservation by national and international level public/private institutes/organization and on farm conservation by both institute level and farmer level is very mandatory to continue with agro ecosystem balance in nature and which will be the great gift to our future generations, considering the speed at which we are losing precious genomes and literally the food.

Reference

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www.cropwildrelatives.org/cwr

www.biodiversityinternational.org

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