

Conservation Meets Innovation: Pre-Breeding with Crop Wild Relatives for Future-Proof Crops

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Abstract

Narrow genetic base in the cultivated varieties of crop species made them vulnerable for many biotic and abiotic stresses and created narrow space for scientific intervention by to develop new varieties with broad genetic base. The only way to possibly find the solution is inclusion of crop wild relatives in the breeding programs for crop improvement. The crop wild relatives are a gem of huge untapped diversity which could change the fate of the agriculture scenario existed. This paper gives insight into the international project that focuses on collection, conservation and utilization of crop wild relatives from all around the world ensuring food and nutritional security.

Introduction

Crop wild relatives (CWR) are the cousins of our food crops that still grow in nature. Many have modified their DNA to survive hardships like dryness, wetness, high temperatures and poor soils, pest and diseases. Their survival through many harsh conditions tells us they are the germplasm that followed survival of the fittest rule. This means they can be a source of new genetic diversity that plant breeders can tap to develop more-resilient food crops. But their worth was not recognised and their existence of CWR is being threatened by deforestation, the expansion of cities and agriculture and climate change. If they disappear from the wild, the valuable genes they contain will be lost forever. There is a lack of national and international research investment on indigenous crops with good nutritional qualities in favour of familiar crops of commercial interest (Massawe et al., 2005).

The Global Crop Diversity Trust (Crop Trust) is an international non-profit organization that was established in 2004 by the Food and Agriculture Organization of the United Nations (FAO) and Bioversity International. The Crop Trust's mission is to protect the world's crop diversity for future food security and to make it available for use globally. Crop Trust has launched a project called "The Crop Wild Relatives (CWR) Project" (formally titled

“Adapting Agriculture to Climate Change: Collecting, Protecting, and Preparing Crop Wild Relatives”) that brought together institutions, researchers, plant breeders, farmers and industry to collect, conserve and use the wild relatives of priority crops to help future-proof the world’s food supplies.

Project activities:

- 1. Prioritization:** Based on the gap analysis, the project focussed on identifying key wild relatives of 29 crops which need to be collected in the identified locations where they could be found. The crops include Alfalfa, apple, African rice, Asian rice, Bambara groundnut, banana/plantain, barley, bean, carrot, chickpea, cowpea, Durum wheat/bread wheat, brinjal/eggplant, faba bean, finger millet/ragi, grass pea, lentil, oats, pea, pearl millet, pigeon pea, potato, rye, sorghum, sunflower, sweet potato and vetch.
- 2. Collection:** Nearly 5,000 seed samples of more than 320 species of CWR, which also include many endangered species of 28 globally important crops from 25 countries on four continents were collected in 6 years so that scientists and breeders can use them to make our crops more productive in increasingly challenging climates.
- 3. Conservation:** The collected CWRs were conserved properly in *ex situ* collections in different places of the world like national collections of the country of origin, the Millennium Seed Bank at Kew, UK, appropriate CGIAR (Consultative Group on International Agricultural Research) international collections and ultimately, the Svalbard Global Seed Vault to make sure that they are available to plant breeders and other researchers and to ensure that their genetic diversity does not disappear if they become extinct in the wild.
- 4. Pre-breeding:** Pre-breeding refers to all concerted activities and/or procedures designed to identify desirable characteristics and/or heritable genes from otherwise unadapted and unimproved plant genetic materials and their subsequent manipulation in the actual breeding of crop cultivars (Nass and Paterniani, 2000). CWR are a rich source of diversity that plant breeders are looking for, such as quality aspects, yield aspects, biotic and abiotic stresses, but they tend to be weedy, wild and unmanageable to the level of not well suited to life in the farmer’s field. To help plant breeders get over this hurdle, the project ran pre-breeding projects on 19 crops (Alfalfa, Asian rice, banana, barley, bean, carrot, chickpea, cowpea, durum wheat, brinjal, finger millet, grass pea,

lentil, pearl millet, pigeon pea, potato, sorghum, sunflower and sweet potato) to isolate the desired genetic traits and introduce them into breeding lines that are more readily crossable with modern, elite varieties. These projects involved 62 national and international partners in 34 countries all over the world. Pre-bred lines of all the target crops were developed under the respective projects and seeds of more than 14,000 CWR-derived plants were deposited in the genebanks. Data about the characteristics of the CWR parents are available through Genesys, while data from the pre-breeding and evaluation projects are available through Germinate databases.

Examples of first promising pre-breeding materials becoming now available

- ✚ **Bean:** Accessions which can tolerate high night temperatures, waterlogging and root rot pathogen were identified.
- ✚ **Pigeonpea:** ICPL 15028 is a high-yielding line which has resistance to multiple diseases viz., wilt, sterility mosaic disease and phytophthora by Pre-breeders of International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).
- ✚ **Pearl millet:** Four pre-breeding populations were developed by researchers at ICRISAT which have resistance to multiple forms of blast.
- ✚ **Finger millet:** Progress has been made in Kenya to identify crop wild relatives tolerant to the parasitic plant Striga (witchweed), which can cause crop losses of up to 100%.
- ✚ **Eggplant:** Promising materials and lines with drought tolerance were generated and they will be evaluated in different environments.

Conclusion

CWR project was intended to collect, conserve and provide pre breeding lines of prioritized crops to the breeders at ease. The data sharing system is the concept brought up the project by which the breeders can screen out the desirable lines at their desk. Further details of the project are available at <https://www.cwrdiversity.org/project/>.

References

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