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The Crucial Role of Plant Genetic Resources in Cultivating New Varieties and Hybrids

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The pivotal responsibility of plant breeders is to feed the ever-growing human population with the limited resources like labor, water and cultivable land. Despite their persistent endeavors and adoption of advanced technologies to develop plant varieties and hybrids; agricultural productivity has reached a plateau because of lack of diversity in field crops. Over time, the depletion of genetic resources has occurred due to diverse human activities such as globalization and the establishment of special economic zones. Hence, it is critically important to carefully gather and conserve germplasm through both *in situ* and *ex situ* conservation methods. This article aims to comprehensively explore a range of strategies and dimensions pertinent to Plant Genetic Resources (PGR), delving into their utilization and analyzing relevant national and international treaties governing this crucial field.

Plant Genetic Resources:

Plant breeders rely on two pivotal factors *viz*., variation and selection for the any crop improvement programs. This variation can be derived from diverse sources such as landraces, officially released varieties, genetic stocks, wild species, and their related variants. Conservation of genetic resources involves both *in situ* preservation within natural habitats and *ex situ* conservation beyond these environments. CGIAR (Consortium of International Agricultural Research) includes the Africa Rice, Center for International Forestry Research (CIFOR), International Center for Agricultural Research in Dry Areas (ICARDA), ICRISAT (International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Food Policy Research Institute (IFPRI), International Institute of Tropical Agriculture (IITA), International Livestock Research Institute (ILRI), CIMMYT (International Maize and Wheat Improvement Center), CIP (International Potato Center), IRRI (International Rice Research Institute), International Water Management Institute (IWMI), Alliance of Biodiversity International and International Center for Tropical Agriculture (CIAT), World Agroforestry and World Fish, significantly contribute to this cause. At the national level in India, the National Bureau of Plant Genetic Resources (NBPGR) plays a crucial role in conserving plant genetic resources.

Conservation of plant genetic resources

(I) *in situ* conservation

It involves the preservation and maintenance of crop genetic diversity within their natural habitats or in environments where they have developed and evolved. This method aims to protect the genetic resources of field crops in their native surroundings, allowing them to continue their evolutionary processes.

(a) Biosphere reserves

It plays a pivotal role in preserving genetic diversity within crop ecosystems, where wild species serve as invaluable genetic resources, offering traits crucial for disease resistance, environmental resilience, and other characteristics that can be harnessed in breeding programs to enhance cultivated rice varieties. The Erebuni State Reserve in Armenia stands as a crucial biosphere reserve committed to safeguarding the genetic diversity of wheat, providing a habitat for essential wild species like *Triticum araraticum*, *T. boeoticum*, *T. urartu*, and *Aegilops tauschii*.

(b) National Parks

It conserves the genetic diversity of wild relatives associated with various crop species within their demarcated areas. For instance, in Keoladeo National Park in Rajasthan, wild relatives of rice and millets thrive, contributing significantly to the preservation of their genetic richness.

(c) Gene Sanctuaries

In India, Gene sanctuaries are established to safeguard the genetic diversity inherent in landraces, ensuring the preservation of their distinct traits and characteristics. An exemplary illustration is the Vavilov Institute of Plant Genetic Resources in Pune, serving as a dedicated Gene Sanctuary focused on protecting the diverse genetic makeup of indigenous crops such as rice and wheat. Similarly, Gene sanctuaries were established within the Garo hills of Meghalaya specifically dedicated to the preservation of wild relatives of citrus.

(II) *ex-situ* conservation

(a) Field gene bank

It is vital repositories that conserve and maintain diverse crop varieties directly within their natural agricultural settings, crucial for safeguarding genetic resources and enhancing crop resilience. They play a crucial role in safeguarding genetic resources and bolstering crop resilience, employing components like arboretums, herbal gardens, and botanical gardens.

(b) Seed gene bank

It involves safeguarding biodiversity beyond its natural habitat, utilizing static conservation methods such as *in vitro* gene banks (either through freezing plant cuttings, or seed banking), cryobanks (freezing plant cells, shoot tips, embryos, pollen, and seeds in liquid nitrogen at -196°C) to ensure the protection of genetic resources.

Treaties in Plant Genetic Resource Conservation: International and National Perspective

The inception of the Convention on Biological Diversity (CBD) in 1992 marked a pivotal influence on global conservation initiatives. As an active member of the CBD, India implemented the National Biodiversity Act, forming the National Biodiversity State Committee. This committee aims to proficiently preserve Plant Genetic Resources (PGR) in harmony with international biodiversity agreements, solidifying India's commitment to conservation of plant genetic resources and ensuring fair access and benefit-sharing for those involved in resource conservation.

Plant Genetic Resources (PGR) form the bedrock of breeding programs

Characterization and evaluation using molecular markers provide valuable insights through passport data, aiding breeders in developing new varieties. Prior to crossing, breeders need to analyze the parent's status, whether it belongs to the primary gene pool, secondary gene pool, or tertiary gene pool. The gene pool encompasses the entire genetic variation within a species' breeding population and its closely related species capable of crossbreeding. It strives to cultivate new crop varieties or hybrids endowed with sought-after traits. These resources empower breeders to imbue cultivated plants with favorable characteristics, elevating their productivity and resilience. Moreover, Plant Genetic Resources play a pivotal role in enhancing global food security by fostering the growth of crops that thrive in harsh conditions, ensuring a steady food supply even amidst challenging environments.

Conclusion

Plant Genetic Resources (PGR) as a wellspring of genetic diversity stands paramount. These resources not only serve as the cornerstone for breeding programs, fostering the development of resilient and high-yielding crop varieties, but they also play a pivotal role in bolstering global food security. The conservation and sustainable utilization of PGR are imperative for ensuring the continued advancement of agriculture, environmental resilience and the preservation of our diverse plant heritage.

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