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DNA Genebank: A Complementary Approach for Safe Conservation of the Genetic Diversity

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INTRODUCTION

Biodiversity is the variability present among all living organisms. As per the United Nations 'convention on Biological Diversity, biodiversity is "the variability among living organisms from all sources, including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species, and of ecosystems" (UNEP, 1992). Human kind are the beneficiary of biodiversity, for its basic necessities such as food, fiber and medicine as well as luxuries. However, the over-exploitation of biodiversity without the sustainable conservation measures, has led to substantial loss and the negative effects are evident globally. Therefore, there is urgent need to take measures for conservation of biodiversity and its sustainable use. There are three major levels of biodiversity, ecosystem diversity, species diversity and Genetic diversity which is variations in the genetic makeup of individuals/populations within a species).

This article is focused on conservation of genetic diversity through DNA banking.

Importance of Genetic Diversity and Threats

Post-green revolution in 1060s, agriculture is being dominated by a few major crop plants and a few improved and uniform cultivars. Moreover, these cultivars have been bred using limited germplasm and thus with narrow genetic base. The narrow genetic base of cultivars makes them vulnerable to pest and diseases. Therefore, it is very important not only to conserve the genetic diversity but also to use it to broaden the genetic base of crop plants.

There are three major threats to the genetic diversity of crop plant, genetic erosion, genetic vulnerability, and genetic wipe-outs (Paroda and Arora, 1991).

Genetic erosion occurs with loss of variation of a crop due to prevalence of a few cultivars in agriculture due to modernization. It is the loss of alleles, allele combinations associated with loss of locally adapted varieties and breeds. Genetic erosion begins with replacement of locally adapted land races with modern cultivars. Further, use of modern breeding practice and preferences for particular allele, allele combinations also lead to genetic erosion. Anthropogenic activities such as urbanization, industrialization, etc., also responsible for the loss of natural habitat of wild progenitors and weedy forms of crop plants (Paroda and Arora, 1991). Further, a reduction in population size without substantial increase in recombination is also a major cause of genetic erosion (Mathur, 2011). Genetic vulnerability is defined as "the condition that results when a widely planted crop is uniformly susceptible to a pest, pathogen, or environmental hazard as a result of its genetic constitution, thereby creating a potential for widespread crop losses" (NRC, 1972). The narrow genetic base of crop varieties put them at higher risk of complete failures.

Genetic wipeout is sudden/destruction loss of genetic resources through varied causes such as famines, floods, crop failures, institutional failures and political instability.

DNA Genebanks

There several approaches for conservation genetic diversity such as *in situ* (natural parks, gene sanctuaries etc) or *ex situ* conservation (Seed banks, field gene banks etc). These are the principal approaches for conservation of genetic diversity; however, all these have their own inherent advantages and limitations. To overcome the same, it has been opined by the experts to have a complementary approach for safe conservation of the genetic diversity of the crops (Bowen, 1999). Molecular biology and biotechnology with its tools and techniques (such as DNA-based markers) could facilitate effective conservation and utilization of plant genetic resources. The application and efficiency of DNA-based markers in the management of genebanks has been well recognized, such as characterization of genotypes, assessment of genetic diversity, genetic relationships studies within collections, duplicate identification, setting of core collections, and assessing genetic stability and integrity (Yadav et al. 2018).

DNA-based molecular markers are proxy of DNA analysis and use total DNA or DNA libraries as a target. In recent times, DNA and libraries are being conserved after completion of research project as it constitutes valuable resources. DNA-based resources can be maintained up to 2 years at –20ºC and for longer periods at –70ºC or in liquid nitrogen. There also have been efforts in recent past to establish DNA banks to conserve DNA based resources. It is important to underpin that conserving complete genome or a gene is different from conserving living organism as an entire genotype for future use. Therefore, DNA banks are not means to replace traditional ways of conserving genetic resources/germplasm (de Vicente et al., 2006, Yadav et al. 2018).

Genetic analyses are crucial to take decision of strategic conservation of genetic diversity. Conservation of the species are likely to enhance with the access of its DNA and molecular analysis. It has been observed that the genetic variation within plant populations have had a significant impact on the conservation genetics of the species (Yadav et al. 20218). Therefore, it has been recognized that documented DNA samples serve a crucial infrastructure need in conservation science and complements efforts to preserve biological diversity both *in situ* and *ex situ* (Dulloo et al., 2006).

The quality of the DNA is the most important factor before the sample is deposited in the DNA bank. It not protected well from nucleases, ionizing radiation, or activated oxygen DNA shows degradation faster. In the DNA banks, DNA is generally stored for medium term (6 months to 2 years, at –20ºC or

–70ºC) and long term (more than 2 years, at –70ºC or in liquid nitrogen) (Yadav et al. 2018). The list of the major DNA banks worldwide is given below.

- The Royal Botanic Gardens, Kew, UK
- The US Missouri Botanical Garden, Advanced Molecular Plant Breeding
- The Australian Plant DNA Bank, Southern Cross University
- The DNA bank, Leslie Hill Molecular Systematics Laboratory of the National Botanical Institute (NBI), Kirstenbosch, South Africa
- The DNA bank, the National Institute of Agrobiological Sciences (NIAS), Ibaraki, Japan
- Plant DNA Bank in Korea (PDBK)
- DNA Bank Brazilian Flora Species
- National Plant Genomic Resources Repository, ICAR-National Bu¬reau of Plant Genetic Resources, New Delhi, India
- National Plant Gene Repository, National Institute of Plant Genome Research, New Delhi, India

CONCLUSION

In addition to the conventional approaches, DNA Genebanks can serve the objective of conservation of genetic diversity efficiently as a complementary approach. DNA Genebanks are not meant to replace traditional ways of conserving genetic resources.

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