IJARASEM

ISSN: 2395-7852

International Journal of Advanced Research in Arts, Science, Engineering & Management

Volume 10, Issue 6, November 2023

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 6.551

International Journal of Advanced Research in Arts, Science, Engineering & Management (IJARASEM)

| ISSN: 2395-7852 | www.ijarasem.com | Impact Factor: 6.551 |Bimonthly, Peer Reviewed & Referred Journal|

| Volume 10, Issue 6, November 2023 |

Ex-SITU Conservation of Plants

Dr. Sanjay Kumar Acharya

Professor, Dept. of Botany, Govt. Dungar College, Bikaner, Rajasthan, India

ABSTRACT: Plants are a vital part of the world's biological diversity and an essential part of our life. We exploit them for our food, shelter, medicine, fuel, clothing, and whatnot. However, the loss of plants' genetic resources has now been a major concern.

Many plant species are either on the verge of extinction, endangered, or already extinct due to their overexploitation, climate change, habitat transformation, pollution, and invasive species introduction. Therefore, efficient conservation techniques are required to preserve the plants' genetic resources.

KEYWORDS-ex-situ, conservation, plants, biodiversity, genetic resources

I.INTRODUCTION

Currently, there are two available ways for the conservation of plants:

- In situ conservation: It's preserving the plants in their own habitat, such as a natural biosphere reserve. However, the method is costly and cumbersome with regard to its size and maintenance aspects.
- Ex-situ conservation: It's preserving plants out of their natural habitat, in an area that mimics the condition in which the play naturally live.

This article is focused on teaching you the methods of ex situ conservation and their advantages.

Conservation Techniques

Ex-situ conservation simply means off-site conservation. There are multiple ways included in this type of approach to conserve plants and preserve their genetics, such as gene banks, botanical gardens, and seed banks.[1,2,3]

Gene Banks

The gene bank stores, maintains, and reproduces living samples of millions of crop varieties and their wild relatives around the world. Here, the genetic resources of the plants and crops are collected and stored in a way that they remain viable at the time of use. The technique ensures the security of food crops and their availability to farmers, breeders, and lab researchers whenever required.

One drawback of the technique is the reproduction-called regeneration of its plant material. It means after a certain period of time, the stored must should be re-grown and seeds should be harvested to protect the plant. Because, even in the best conservation condition, there's a high chance of samples dying.

Also, all the samples should be properly characterized and documented and handed over to those requiring the sample. It's an important tool for breeders and researchers looking to learn about the distribution of crops and their wild relatives.

Seeds Banks

Germplasm conservation using seeds is one of the most efficient and convenient ways of storing genetic resources. It requires a relatively smaller space compared to other techniques. It's generally managed by the government and businesses.

However, there are two types of seed banks observed at a global level: community seeds banks and normal seeds banks (managed by the government).[4,5,6]

The community seeds banks are informal management of seeds banks at the community level, which can be observed in many parts of the developing countries. The storage, treatment, and exchange of seeds from the last harvest is only limited to the local community and is managed at the small-scale community level with limited resources. A robust system is required to be developed for the exchange of seeds at a border community level.

However, despite its advantages, some limitations of the seed banks are:

- They can only maintain distinct clones of inbred and apomicts species and no other varieties.
- Over a period of time, the seeds lose viability and become susceptible to a pathogen or insect attacks.
- Inapplicable to vegetatively propagated crops, such as Dioscorea, Ipomoea, and potato.

The seed banks managed by governments are stored in specific conditions by following techniques developed by the organizations like Plant Genetic Resources Institute (IPGRI) and the Food and Agricultural Organisation of the United Nations (FAO). The technique minimizes generic erosion and allows the preservation of a large population. However, the genetic resource plants with low production of seed or having long-life cycles can not be preserved in seed banks.

Botanical Gardens

Botanical gardens have both, conservational and educational values. The facilities are created to provide housing and care for specimens with informing the public about the endangered species. It also educates people about the factors that threaten the existence of the species.

The purpose of doing so is to make people aware of the condition of the plants so that they take necessary actions to protect them and do everything from their side to promote the survival of the endangered species.

The method is mainly used to conserve wild, ornamental, rare, and endangered species. Some botanical gardens also have built facilities for the seed bank and tissue culture or in vitro propagation.[7,8,9]

Advantages of Ex-situ Conservation Techniques

It's best to apply an integrated approach by balancing in situ and ex situ conservation strategies for the protection of plant species. Both the approaches have their own advantages.

For example, in situ conservation allow the natural selection of plants and maintains viable and self-sustaining populations of wild species. However, habitat destruction is a threat to endangered species. For such cases, ex-situ conservation should be preferred. It allows scientists to understand the plants' biology and their threat in order to implement an effective and efficient conservation strategy for the preservation of plant genetics. Moreover, it also allows the use of plants without damaging the natural populations.

Ex-situ conservation has several purposes, which include:

- Produce material for conservation biology research.
- The collection and storage of germplasm in various types of ex-situ facilities.
- Breed species whose seeds are recalcitrant and cannot be kept in a seed bank.
- Provide materials for conservation education and display.
- Protect threatened germplasm.
- Produce materials to assist with reintroduction, habitat restoration, reinforcement, and management.
- Supply a variety of materials in order to reduce or eliminate wild collecting pressure.

Other than ex-situ conservation techniques, tissue culture is also a way to conserve plant genetic resources or store germplasm by using plant tissues and culture, treating, and storing them in lab conditions. This is an efficient technique that allows the storage of germplasm for many years.[10,11,12]

How Plant Cell Technology Is Helping Culturists Worldwide In Their Tissue Culture Application?

Plant Cell Technology is helping tissue culturists around the world by providing unique and world-class products and services that smoothen their process. It has MS media, agar, gellan gum, Plant Preservative Mixture (PPM), culture vessels, Biocoupler (TM), and masks in its store to facilitate your processes.

II.DISCUSSION

Botanic gardens conserve plant diversity ex situ and can prevent extinction through integrated conservation action. Here we quantify how that diversity is conserved in ex situ collections across the world's botanic gardens. We reveal that botanic gardens manage at least 105,634 species, equating to 30% of all plant species diversity, and conserve over 41% of known threatened species. However, we also reveal that botanic gardens are disproportionately temperate, with 93% of species held in the Northern Hemisphere. Consequently, an estimated 76% of species absent from living collections are tropical in origin. Furthermore, phylogenetic bias ensures that over 50% of vascular genera, but barely 5% of non-vascular genera, are conserved ex situ. While botanic gardens are discernibly responding to the threat of species extinction, just 10% of network capacity is devoted to threatened species. We conclude that botanic gardens play a fundamental role in plant conservation, but identify actions to enhance future conservation of biodiversity.[13,14,15]

III.RESULTS

Ex-situ Conservation is one of the primary objectives of Botanical Survey of India (BSI). It is literally an 'off site' conservation policy that involves a couple of techniques linking the transfer of an objective species, experiencing various threats, away from its native habitat to a much safer abode, like in a Botanical Garden, Zoological Garden, Seed Bank or Gene Bank etc. The prime goal of this technique is to adequately backing conservation strategies by guaranteeing the existence of vanishing and threatened taxa/species and the maintenance of allied genetic diversity thereof. It further supports the idea of reintroduction of species in its natural or original habitat as the species under varying threat perception are preserved in safe custody till the casual factors threatening their survival in the wild have been return to normalcy and the reintroduction becomes possible.[16,17,18]

The preamble of Article 9 of the Convention on Biological Diversity (CBD) stresses the need of establishing Botanic Gardens as a complementary approach to in-situ conservation (conserving plant / animal species in their natural habitat) practices to conserve threatened plant species and taxa of the country of their origin and to adopt appropriate measures

to ward off their extinction. In order to commensurate with the directives of CBD, BSI being the custodian of the floral wealth of the country (even well before CBD came into existence BSI has initiated work in the same lane) has set up several well networked major and minor Botanic Gardens spread across different geographical belts of the country exclusively to conserves its vast, endemic and threatened flora. In some centres storage of seeds, conserving pollen, storage of plant shoot in low temperature (in vitro preservation) as well as tissue culture methods is being employed to this effect.[19,20,21]

The alarming current and predicted species extinction rates have galvanized conservationists in their efforts to avoid future biodiversity losses, but for species extinct in the wild, few options exist. We posed the questions, can these species be restored, and, if so, what role can ex situ plant collections (i.e., botanic gardens, germplasm banks, herbaria) play in the recovery of plant genetic diversity? We reviewed the relevant literature to assess the feasibility of recovering lost plant genetic diversity with using ex situ material and the probability of survival of subsequent translocations. Thirteen attempts to recover species extinct in the wild were found, most of which used material preserved in botanic gardens (12) and seed banks (2). One case of a locally extirpated population was recovered from herbarium material. Eight (60%) of these cases were successful or partially successful translocations of the focal species or population; the other 5 failed or it was too early to determine the outcome. Limiting factors of the use of ex situ source material for the restoration of plant genetic diversity in the wild include the scarcity of source material, low viability and reduced longevity of the material, low genetic variation, lack of evolution (especially for material stored in germplasm banks and herbaria), and socioeconomic factors. However, modern collecting practices present opportunities for plant conservation, such as improved collecting protocols and improved cultivation and storage conditions. Our findings suggest that all types of ex situ collections may contribute effectively to plant species conservation if their use is informed by a thorough understanding of the aforementioned problems. We conclude that the recovery of plant species currently classified as extinct in the wild is not 100% successful, and the possibility of successful reintroduction should not be used to justify insufficient in situ conservation.[22,23,24]

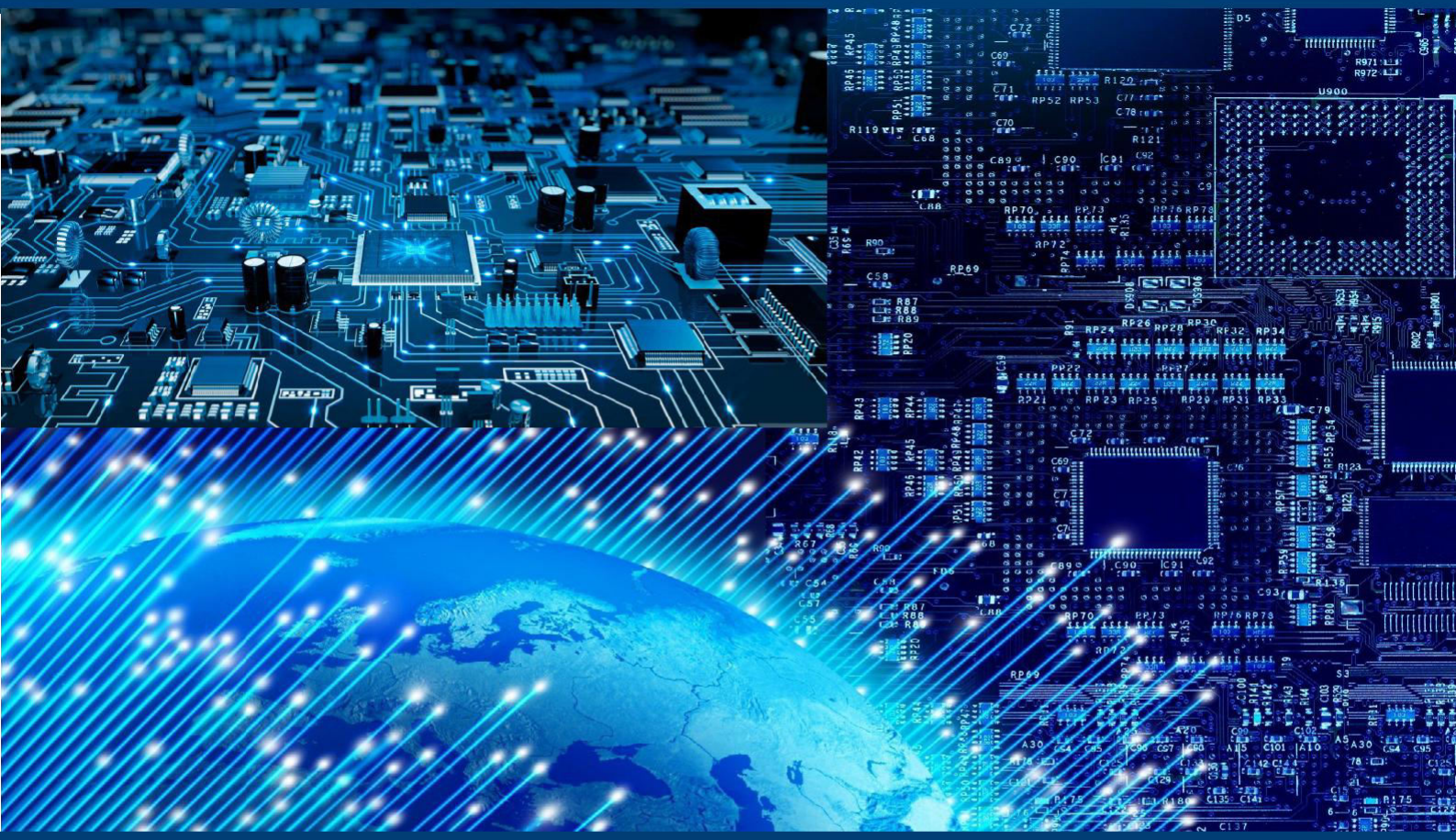
IV.CONCLUSION

In the Anthropocene, the world's plant diversity is threatened with extinction and the erosion of the genetic diversity of natural populations. According to the State of the World's Plants and Fungi 2020 of the Royal Botanic Gardens, Kew, two out of five of the ~350,000 known vascular plant species are at risk of extinction. Despite the considerable toolkit of biodiversity conservation practices, usually it is hard to choose the best option to stop biodiversity loss. Ex situ conservation has seen massive development due to radical losses of natural ecosystems, and its incrementing necessity has been underscored by Target 8 of the 2011-2020 Global Strategy for Plant Conservation. As we crossed the finish line of this strategy in 2020, a review of the accumulated knowledge on the ex situ living collections has become particularly important. Despite the increasing attention received by ex situ conservation, studies on the sustainability, quality, and usability of the plant material prior to establishing the garden collections are few, leaving major gaps unfilled in terms of best ex situ conservation practices. Here we present an overview of the results and experiences in ex situ conservation focusing on living plant collections, with the aim of guiding conservation practitioners towards the most efficient working methods. We evaluate the future needs and perspectives of this conservation technique, based on case studies on both woody and herb species. Possible conservation applications and priorities suggested for future works are summarized.[25,26,27]

REFERENCES

1. Aguiar BI, Freitas MLM, Zannato AS, Tambarussi EV, Moraes MLT, Ambrosano MN, … Sebbenn AM (2020). The effects of pollen dispersal and mating pattern on inbreeding depression and hybrid vigor in Balfourodendron riedelianum (Engl.) Engl. (Rutaceae). Conservation Genetics 21:305-317. https://doi.org/10.1007/s10592-020-01250-0
2. Allendorf FW, Luikart G, Aitken SN (2013). Genetics and the conservation of populations. Wiley-Blackwell Publishing (2nd ed), Oxford, UK.
3. Asgher M, Verma S, Khan NA, Vyas D, Kumari P, Rashid S, … Ahmad P (2020). Physiological, biochemical and reproductive studies on Valeriana wallichii, a critically endangered medicinal plant of the Himalayan region grown under in-situ and ex-situ conditions. Plants 9(2):131. https://doi.org/10.3390/plants9020131
4. Basey AC, Fant JB, Kramer AT (2015). Producing native plant materials for restoration: 10 rules to collect and maintain genetic diversity. Native Plants Journal 16(1):37-53. http://npj.uwpress.org/cgi/doi/10.3368/npj.16.1.37
5. Bennie J, Davies TW, Cruse D, Gaston KJ (2016). Ecological effects of artificial light at night on wild plants. Journal of Ecology 104:611-620. https://doi.org/10.1111/1365-2745.12551
6. Biesmeijer JC (2006). Parallel declines in pollinators and insect-pollinated plants in Britain and the Netherlands. Science 313(5785):351-354. https://doi.org/10.1126/science.1127863

7. Brown ADH, Briggs JD (1991). Sampling strategies for genetic variation in ex situ collections of endangered plant species. In: Falk DA, Holsinger KE (Eds). Genetics and Conservation of Rare Plants. Oxford University Press, New York pp 99-122.
8. Brütting C, Hensen I, Wesche K (2012). Ex situ cultivation affects genetic structure and diversity in arable plants. Plant Biology 15(3):505-513. https://doi.org/10.1111/j.1438-8677.2012.00655.x
9. Chacón-Vargas K, García-Merchán VH, Sanín MJ (2019). From keystone species to conservation: conservation genetics of wax palm Ceroxylon quindiuense in the largest wild populations of Colombia and selected neighbouring ex situ plant collections. Biodiversity and Conservation 29:283-302. https://doi.org/10.1007/s10531-019-01882-w
10. Chen XB, Tian Q, Zhang QX (2013). Genetic diversity and ex situ conservation of Sinocalycanthus chinensis. Acta Horticulturae 977:253-257. https://doi.org/10.17660/ActaHortic.2013.977.29
11. Christe C, Kozlowski G, Frey D, Fazan L, Bétrisey S, Pirintsos S, … Naciri Y (2014). Do living ex situ collections capture the genetic variation of wild populations? A molecular analysis of two relict tree species, Zelkova abelica and Zelkova carpinifolia. Biodiversity and Conservation 23(12):2945-2959. https://doi.org/10.1007/s10531-014-0756-9
12. Cochrane A (2004). Western Australia's ex situ program for threatened species: a model integrated strategy for conservation. In: Guerrant EO, Havens K, Maunder M (Eds). Ex situ Plant Conservation: Supporting Species Survival in the Wild. Island Press, Washington, DC pp 231-285.
13. Corrêa GDC, Da Rocha MR, Naves RV (2000). Germinação de sementes e emergência de plântulas de baru (Dipteryx alata Vog.) nos cerrados do Estado de Goiás [Seed germination and emergence of baru seedlings (Dipteryx alata Vog.) close to the State of Goiás] Pesquisa Agropecuária Tropical 30:17-23. https://doi.org/10.5216/pat.v30i2.2580
14. Cristea V, Jarda L, Holobiuc I (2013). Ex situ conservation of three endemic and/or endangered Dianthus species. Notulae Botanicae Horti Agrobotanici Cluj-Napoca 41(1):73-78. https://doi.org/10.15835/nbha4119110
15. Edesi J, Tolonen J, Ruotsalainen AL, Aspi J, Häggman H (2020). Cryopreservation enables long-term conservation of critically endangered species Rubus humulifolius. Biodiversity and Conservation 29:303-314 https://doi.org/10.1007/s10531-019-01883-9
16. Ellstrand NC (2014). Is gene flow the most important evolutionary force in plants? American Journal of Botany 101(5):737-753. https://doi.org/10.3732/ajb.1400024
17. Ellstrand NC, Elam DR (1993). Population genetic consequences of small population size: implications for plant conservation. Annual Review of Ecology and Systematics 24(1):217-242. https://doi.org/10.3732/ajb.1400024
18. Ensslin A, Sandner TM, Matthies SD (2011). Consequences of ex situ cultivation of plants: Genetic diversity, fitness and adaptation of the monocarpic Cynoglossum officinale L. in botanic gardens. Biological Conservation 144(1):272-278. https://doi.org/10.1016/j.biocon.2010.09.001
19. Ensslin A, Tschöpe O, Burkart M, Joshi J (2015). Fitness decline and adaptation to novel environments in ex situ plant collections: Current knowledge and future perspectives. Biological Conservation 192:394-401. https://doi.org/10.1016/j.biocon.2015.10.012
20. Ensslin A, Van de VyVer A, Vanderborght T, Godefroid S (2018). Ex situ cultivation entails high risk of seed dormancy loss on short-lived wild plant species. Journal of Applied Ecology 55(3):1145-1154. https://doi.org/10.1111/1365-2664.13057
21. Ensslinn A, Godefroid S (2019). How the cultivation of wild plants in botanic gardens can change their genetic and phenotypic status and what this means for their conservation value. Sibbaldia: The Journal of Botanic Garden Horticulture 17:51-69. https://doi.org/10.23823/Sibbaldia/2019.267
22. Ensslin A, Godefroid S (2020). Ex situ cultivation impacts on plant traits and drought stress response in a multi-species experiment. Biological Conservation 248:108630. https://doi.org/10.1016/j.biocon.2020.108630
23. Etisham-Ul-Haq M, Allnutt TR, Smith-Ramiarez C, Gardener MF, Armesto JJ, Newton AC (2001). Patterns of genetic variation in in and ex situ populations of the threatened Chilean vine Berberidopsis corallina, detected using RAPD Markers. Annals of Botany 87(6):813-821. https://doi.org/10.1006/anbo.2001.1420
24. Falk DA (1987). Integrated conservation strategies for endangered plants. Natural Areas Journal 7:118-123.
25. Frankham R, Bradshaw CJA, Brook BW (2014). Genetics in conservation management: Revised recommendations for the 50/500 rules, Red List criteria and population viability analyses. Biological Conservation 170:56-63. https://doi.org/10.1016/j.biocon.2013.12.036
26. Gargiulo R, Saubin M, Rizzuto G, West B, Fay MF, Kallow S, Trivedi C (2019). Genetic diversity in British populations of Taxus baccata L.: Is the seedbank collection representative of the genetic variation in the wild? Biological Conservation 233:289-297. https://doi.org/10.1016/j.biocon.2019.01.014
27. Given DR (1987). What the conservationist requires of ex situ collections. In: Bramwell D, Hamann O, Heywood VH, Synge H (Eds). Botanic gardens and World Conservation Strategy. Academic Press, London pp 103-116.



International Journal of Advanced Research in Arts, Science, Engineering & Management (IJARASEM)

| Mobile No: +91-9940572462 | Whatsapp: +91-9940572462 | ijarasem@gmail.com |