Chapter 14
Role of Biotechnology in Plant Preservation for Food Security:
In Situ and Ex Situ Preservation

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ABSTRACT

Overpopulation and the consequences of urbanization and reduction of agricultural lands represent the most important challenges that face scientists nowadays. In addition, extinction of specific species or reduction in their number occurs continuously in different places of the world at a rapid rate. These challenges urge scientists to use the biotechnological techniques to secure food and to alleviate the risk of loss of the genetic variability of cultivated plants as a result of environmental changes and human practices. These techniques are based on preservation of the genetic materials for long periods. Plants can be stored either in vivo or in vitro. The plant preservation includes in situ and ex situ. One form of the ex situ plant preservation is the in vitro plant preservation. There are different in vitro preservation techniques. However, the two main approaches of in vitro preservation of plants germplasm are slowing the growth and crysoperservation. The former technique could be achieved through either modifying the culture medium or reducing temperature and/or light intensity. The latter is taking place through storing the species between -79 and -196°C, the temperature of liquid nitrogen. Each approach includes several techniques that will be thoroughly discussed with examples in this chapter.

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INTRODUCTION

Plant biotechnology includes all the promising approaches to develop new plant properties and varieties. These new varieties could be produced in a large scale to be commercialized and to fulfill the human needs (Bhatia, 2015). In additions, there are numerous techniques and routes that are utilized by plant biotechnology for genetic control and screening to improve plant/plant products (Kalia, 2018).

Plant genetic resources describe the plants genetic material of potential value in the present and future. In general speaking, it is specific for crop plants and their wild relatives, yet it can be extended to include all plant species (Maxted & Kell, 2003).

Plant preservation is usually concern with the safety of the plant from any form of injury, destruction or extinction. Preservation of plant genetic resources has become extremely important for improvement of crops so as to face the increasing depletion of natural resources. Preservation of plant genetic resources is necessary for security of food and agro – biodiversity. Genetic diversity provides new and more productive crops which are resistant to different stresses (Rao, 2004).

Preservation of plant genetic resources can be performed *in vivo* or *in vitro,* and either *in- situ* or *ex- situ. In- situ* approach depends on keeping of the plant species in their natural environment, besides maintaining the cultivated species where they have advanced their distinguishing characteristics such as farms (United Nations Conference on Environment and Development, 1992). However, in- situ strategy suffers from some drawbacks as for example, a decline of species and biodiversity loss due to populations and ecosystem composition that result in destroying their habitat. Therefore, the *in- situ* strategies alone are insufficient for saving endangered species.

The *ex- situ* strategies may solve these problems. The *ex -situ* strategies tend to preserve the biological material away from their natural habitats (United Nations Conference on Environment and Development, 1992). The ex-situ strategies include different approaches depends on either they use the whole plant to be conserved like botanical gardens, and field banks or they use parts from the plants to be conserved like seed banks, gene banks or *in- vitro* preservation. There are many botanical gardens all over the word as an example for them; the Royal Botanical Garden in Sidney (Fig. 1). It is considered one of the major botanical gardens and it is located in the middle of Sydney at Australia. It was opened in 1816; the garden is considered the oldest scientific institution in Australia and one of the most important botanical institutions in the world. It covers about 74 acres.

As for the gene banks, the Svalbard Global Seed Vault could be considered as the most famous example for them (Fig. 2). It occupies the deep inside the Norwegian mountain, has the capacity to store about 4.5 million samples. Currently, it holds one million samples. They are collecting samples from all the countries around the world.

Gene banks conserve genetic resources. The most important activity in a gene bank is to treat the samples in a way which will lead for prolonging its viability as long as possible while ensuring its genetic stability. The samples are monitored to be sure that they are not losing viability. Plant samples must periodically regenerated, and new seeds harvested because, even under the optimum conditions of conservation, samples will eventually be lost. However, gene banks are intended to ensure that the genetic resources are adequately collected and used. This means to make sure that the collections are characterized and documented. Gene banks must be able to serve the healthy samples to those who need them (Fig. 3).