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PLANT BIOTECHNOLOGY AND BIODIVERSITY

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ABSTRACT

The aim of all agricultural researchers working with plants is to increase crop production and to meet the food that will be need for growing population. By developing the cultivation of crops, crop improvement and breeding, agricultural researchers have been able to supply the food that needs for humans to a certain degree. About 30% of the increase in crop production owes to plant breeding and the use of high-yielding varieties. Some countries, such as Pakistan and India, suffered from food poverty until decades ago and were among the importers of major crops, such as wheat; today, owing to the use of bred crop varieties, not only are these countries self-sufficient, but they are also among the exporters of wheat and rice. Today, by using bred crop varieties, production efficiency has increased considerably for forage plants, industrial plants and cereals, but due to the high population growth, the increasing per capita consumption and food waste, this success is largely overlooked. If the cultivation of crops did not develop and the high-yielding varieties were not bred and replaced with native, low-yielding varieties, starvation and malnutrition would have killed a large number of the population and humans would know no better than to give in to the balance between available food resources and the population. Diversity is the main factor in the survival of creatures, including crops, against environmental changes and pests. Agricultural biodiversity is the most vital component of food security for the future generations. This diversity works to overcome pests and new diseases, to defeat climate

change and to meet the food needs of the growing population of the world and to meet the changes in consumers' needs and further sustain production. Nevertheless, agricultural practices, plant breeding and biotechnology are threats to biodiversity.

Keywords: Biotechnology, Agriculture, Biodiversity

INTRODUCTION

Although plant breeding and the production of high-yielding varieties and uniform genotypes have increased production efficiency per unit area, presenting bred varieties to farmers has gradually decreased genetic diversity. Nearly all farmers around the world have abandoned native varieties that had grown resistant to multiple pests and diseases over the ages through natural selection, and no longer desire to use them, since native varieties decrease production efficiency compared to bred varieties. Genetic diversity slows down the reproduction rate of pests and diseases and thus prevents the emergence of an epidemic. By reducing genetic diversity and making crop varieties uniform, pests and diseases spread rapidly and cause complete crop losses. To defeat pests and diseases and to sustain the most popular varieties, humans resorted to chemical pesticides. However, in addition to controlling the undesirable pests and diseases, chemical pesticides also have direct or indirect harmful effects on other organisms and humans, who are the last link in the food chain. Another strategy used to control pests and diseases and

to protect bred plants was to produce resistant varieties, because resistance to pests and diseases is an intrinsic property for plants and it can be controlled by the genetic structure of plants (Bagheri, 2004).

When researchers learnt of the risk of the loss of genetic diversity, they decided to promptly start protecting germplasm and the remaining native varieties and related species of field crops. They decided to preserve them in gene banks and to identify the genes responsible for resistance whenever required and to transfer them to crop varieties. The common methods of preserving the germplasm of native varieties and other sources of resistance genes are very difficult and costly. Preserving the germplasm of all plants in gene banks is impossible. Even if it were possible, screening them for the genes responsible for resistance, which becomes required in its own time, is very time-consuming (Visser, 1998).

The advantages and disadvantages of biotechnology for biodiversity

In fact like so other technologies, biotechnology has a lot of advantages and disadvantages. Modern biotechnology seeks

the more extensive use of genetic diversity, so as to benefit from the desirable traits of wild plants for breeding field crops. Changing the genomes of field crops might allow the development of farming in lands that are not arable and consequently reduce from the pressure imposed on forests and pastures. Most important agronomic characteristics, such as efficiency, and other quantitative traits are controlled by a multitude of genes. The application of molecular markers has facilitated the identification of the location of genes that have these traits. The available information on the location of genes speeds up the task of breeding, particularly through the use of biotechnology. Marker technologies offer opportunities for benefiting from natural gene banks (collections) for the optimal use of breeding materials. This feature is used for modifying quantitative traits, such as efficiency, minerals, nutritional quality, taste, resistance and adaptation to physical tension (Goto et al. 1999). As most commercial plant varieties have limited genetics, marker technology offers an opportunity for the quick and accurate identification of genes and enables making the appropriate choice that helps increase genetic diversity. Marker technology is capable of determining the relationship between the level of genetic diversity in a

plant and the ability to modify it relative to the changing conditions of the environment. In gene banks, a tissue culture technique are used for reducing viral contaminations in plants, which itself helps sustain genetic diversity. Tissue culture techniques develop somaclonal variation, which itself creates genetic diversity. In some cases, the modification of the agronomic characteristics of a plant using its wild ancestors and by employing genetic engineering techniques has helped produce new genetic combinations. Genetic engineering has increased the resistance of plants and domestic animals to pests and physical tension. The need for using chemical inputs has therefore decreased in agriculture. In developed countries, the use of pesticides has largely reduced in the past few years, which, in some cases, has been due to the use of new varieties resistant to pests and diseases, which improve the pressure of biodiversity loss by minimizing tillage and using no-till systems (Gloughlin, 2002). Biotechnology has lifted the barriers against gene transfer in such a way that gene transfer from bacteria and animals to plants and the vice versa are possible. In the past, however, except for a few cases, gene transfer was only possible among members of the same species. Nanotechnology has therefore helped develop a germplasm that can be used for field crops.

The role of biotechnology in the future of agriculture

The shortage of agricultural irrigation water and the salty quality of water and fields are currently the main limiting factors of crop production in countries located in arid and semi-arid regions; however, in the near future, these deficiencies will create more problems. In a not very distant future, large parts of the world will be seriously threatened by water crisis. By the ever-increasing growth of population, larger areas of pastures and forests are destroyed and the need to import agricultural crops is increased. Strategies therefore need to be developed for providing food security and increasing efficiency and new food resources. Biotechnology contributes significantly to the improvement of agriculture and the preservation and optimal use of germplasm resources through the following strategies (Potyjus, 1999):

1. Using biotechnology, we can preserve the germplasm of million genotypes in extremely low volumes and with insignificant costs compared to the common methods of preserving germplasms (botanical gardens and gene banks that revive plants through their seeds).
2. Cultivation of plant tissues facilitates the propagation of a large number of genetically identical plants. This technology is used for

propagating desired plant genotypes. Tissue cultivation also facilitates the production of colonies with high heterozygosity, which is impossible through sexual reproduction, and also has a great application for plants with low productivity and long-lived generations.

3. Molecular markers are of great help to the identification of the genes responsible for resistance to biotic and abiotic stresses in wild germplasm and their use in breeding field crops. These test kits are used as accurate tools for making the proper choice in control strategies and integrated pest management. Compared to the use of traditional herbicides, integrated pest management will have a positive effect on biodiversity in agroecosystems.

4. With the continual and progressive growth of our knowledge and information about the structure and function of the genome, we are able to more consciously make complex changes to plant varieties. Biotechnology helps create an artificial genetic diversity.

5. Biotechnology has facilitated the transfer of desired genes from distant species and genera (even from bacteria and fungi) to field crops. While in conventional methods of plant breeding, hybridization and gene transfer are limited to members of the same species.

6. Biotechnology helps produce rice varieties that are enriched with vitamin A.

7. Wheat produced in Iran is deficient in iron and several other micronutrients. Biotechnology helps produce wheat with a higher iron content. By transferring the ferritin gene, i.e. an iron-rich storage protein, from soybean to rice, a transgenic rice is produced that has an iron content three times as that of normal rice.

8. Genetic manipulation of field crops facilitates the production of oral vaccines in plants. This achievement then helps reduce the costs of typical vaccination and control the intended diseases.

9. Producing plants resistant to weeds makes tillage cultivation an easier job and reduces the degree of soil degradation.

10. Using genetic engineering in the production of bio-pesticides for field crops decreases the need for chemicals. Reducing the use of chemicals lowers the risk of contaminating food chains and networks and the outspread of potential chemicals and also partially eliminates the risks posed to biodiversity and public health.

11. Increasing the productivity of existing farming systems reduces the degradation process of pastures and forests.

CONCLUSION

In general, as this technology is entirely new, the net impact of biotechnology on biodiversity cannot be estimated; however,

most likely, this technology will not have a significant negative effect on biodiversity. However, the careless application of biotechnology might have a serious impact on biodiversity, especially if the gene in question is present in only a number of varieties. Yet, biotechnology can play a positive role in biodiversity by creating new organisms and providing new techniques for increasing the efficiency of processing industries. According to the views of experts in an international conference held by the World Bank, FAO and UNDP, there is no other solution than genetic engineering and biotechnology to solve the problem of food security and environmental protection. Biotechnology is the new weapon of man. Today, many countries import food products, such as wheat, rice, maize and oil, from other countries. Sometimes in the form of global support to aid developing countries, the benefits and harms of transgenic products needs to be determined so that their trade is prevented in case they are harmful and so that their defective genes are offset. . State policy-making bodies should predict a plant biotechnology unit that, in the form of a developed scientific plan consistent with the needs, facilitates the production of essential biotechnology products given the large reserves of plant germplasm, and then not only will the country no longer need

transgenic products to be imported, but it will also have a share in the global market.

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