ORIGINAL ARTICLE

MOLECULAR MARKERS AND PLANT BIOTECHNOLOGY

NIRAJ TRIPATHI

Biotechnology Centre, JNKVV, Jabalpur.

Abstract:

Biotechnology is a group of techniques. Biotechnology is any technique which involves the application of biological organisms or their components, systems or processes to manufacturing and service industries to make or modify products, to improve plants or animals or to develop micro-organisms for special uses. After discovery of DNA by James Watson and Francis Crick the scientific understanding of biological and genetic processes has dramatically accelerated. Modern biotechnology allows for the transfer of only one or a few desirable genes, thereby permitting scientists to develop crops with specific beneficial traits and reduce undesirable traits. Benefits can also be seen in the environment, where insect-protected biotech crops reduce the need for chemical pesticide use. Governments also rely on scientific research because they are responsible for setting health and safety standards regarding new developments. National governments and international organizations support food biotechnology as a means to avoid global food shortages. Many policymaking bodies are also trying to balance support of the food biotechnology industry with public calls for the regulation. Such regulations are necessary to protect public health and safety, to promote international trade, conserve natural resources, and account for ethical issues. This paper studies the performance of Biotechnology in the development of Agriculture sector in the various forms. Biotechnology revolution has spawned new industries focused on manipulating human, animal, plant and microbial agents to create heretofore unattainable products and services. Biotechnology occupies a very strategic position in the socio-economic advancement and development of the nation in particular and the world at large.

KEYWORDS:

Biotechnology, food, genetic technology, DNA, microbes.

BACKGROUND:

Biotechnology are techniques involve the applications of organisms or their components, systems or processes to manufacturing and service industries make or modify products, for the improvement of plants or animals. Some people use the term biotechnology to refer to the tools of genetic engineering. But biology, technology, and human-directed genetic change have been a part of agriculture since the beginning of cultivated crops. Biotechnology has, in a general sense, been used as a tool for production since the first breeders decided to selectively plant or breed only the best kinds of plant or animal. Biotechnology is a tool we use to achieve a goal, such as improved quality of food.

The development in science has relied on the advancement of new tools to improve health care, agricultural production, and environmental protection. The technology tools have changed rapidly since scientists became able to transfer gene specific for a particular trait from one organism to another. The

Please cite this Article as : NIRAJ TRIPATHI , MOLECULAR MARKERS AND PLANT BIOTECHNOLOGY : International Journal Of Creative Research Thoughts (Jan. ; 2013)

change began after discovery of the structure of DNA by Watson and Crick. DNA is bimolecular part of living organism consists chemical language that determines the features and characteristics of them. The different traits and physical features of plants are encoded in the plant's genetic material, the deoxyribonucleic acid (DNA). Now a day, scientists can determine which parts of the DNA are responsible for certain traits.

Proteins and enzymes are useful parts of all living organisms to grow, metabolize energy, and become what their genetic code dictates. Genes determine traits by controlling the production of proteins, including enzymes. Every cell contains the entire genetic information in the form of code needed to create and develop the organism. The interaction of genetic makeup and environmental factors shapes the nature of all living things.

Applications of agricultural biotechnology have considerably shortened the time of the development of new crop varieties using molecular marker techniques. The method, which makes it easier and faster for scientists to select plant traits, is called marker-assisted selection (MAS). All of the plant's genes together make up its genome. Some traits like flower color, may be controlled by single gene called monogenic and complex characteristics, like crop yield, maybe influenced by several genes called polygenic. Traditionally, plant breeders have selected plants based on their visible or morphological traits, called the phenotype. But, this process takes time and influenced by the environmental conditions, and costly – not only in the development itself, but also for the economy, as farmers suffer crop losses. As a shortcut, plant breeders now use marker-assisted selection. Molecular markers help in the identification of specific genes. The molecular markers are located near the DNA sequence of the desired gene. Since the markers and the genes are close together on the same chromosome, they tend to stay together as each generation by generation. This is called genetic linkage. This linkage helps scientists to predict whether a plant will have the desired gene. If researchers find the marker for a particular gene, it is called linked or specific marker for that gene. If the marker is present in any generation of plant it means the gene itself is present in that. As scientists find the location of molecular marker on a chromosome, and how close it is to a desired gene, they can determined the position of the markers and create a map which helps in the identification of genes on specific chromosomes. Now Scientists can produce detailed maps in only one generation of plant breeding. Using detailed information regarding genetic maps and locations of molecular markers, researchers can analyze a tiny bit of tissue from a newly germinated seedling. This makes molecular marker approach faster in comparision to conventional breeding. Once the tissue is analyzed through molecular techniques; scientists know whether that seedling contains the appropriate gene. If it doesn't, they can quickly move on and concentrate analysis on another seedling, eventually working only with the plants which contain the desired trait. Currently, molecular marker-assisted selection is already a routine step in breeding of most crops where the gene and the markers for a desired trait are known. This technique is being used in the efficient introgression of important genes into rice such as increased beta carotene content, bacterial blight resistance and submergence tolerance, in maize opaque gene to enhance the level of essential amino acids. Molecular markers are also used to differentiation of a line or variety. Biotechnology is depending on bioinformatics for data analysis. Bioinformatics use computer programme to analyze the genetic relationship of different lines or varieties. The genetically diverse lines or varieties used for selection of parents for the production of hybrid seeds. The genetic information also provides detail on the parentage of the line, the possible traits, and the unique identity of the plant useful for germplasm collection database.

One of the most striking differences between conventional breeding and the molecular approach is that the source of genetic material need not come from the same species. These new biotechnology techniques have prompted considerable debate on the ethical and moral aspects of this branch of science. All living organisms share the same genetic language in the form of their genetic material made up of four nucleotides. In fact, person probably share about half of his or her genetic information with a plant. And the genetic information from that plant can function in a other plant. New techniques even allow scientists to decide in which part of the plant tissue a trait should be expressed, such as the pulp versus the skin of a tomato.

When working with plant based foods, scientists seek to improve foods for the benefit of producers, consumers, or the environment. Consumers may benefit from improved nutritional value or food quality of that. Producers should be able to grow crops under adverse conditions, such as drought. Some genetically improved plant foods require fewer chemical applications during their growth and therefore have less environmental impact. the first food plants produced using the tools of biotechnology was slow-ripening Flavr Savr tomato. When scientists isolated the gene responsible for the softening enzyme and inserted it backwards into the tomato's genetic code, the resulting tomato was able to maintain good eating quality for a longer time than regular tomatoes. This technique allowed better tasting tomatoes to be grown and shipped to distant markets.

Crops in development using biotechnology include soybeans with greater level of protein; potatoes with higher amount of nutritionally available starch and with improved amino acid content; pulses have been altered to produce essential amino acids; crops with the ability to produce beta carotene, a precursor of vitamin A; and plants with a modified fatty acid profile. Different types of peppers and melons with improved flavour are currently in coming in the markets. Flavour may also be improved by enhancing the activity of plant enzymes which transform aroma precursors into flavouring compounds.

Scientists aim to improve the keeping properties for transport of fresh produce easier, giving consumers access to nutritionally improved whole foods and preventing decay, damage and loss of nutrients. Research is underway on making genetic modifications to, celery, broccoli melon, carrots and raspberries. The shelf-life of some processed foods such as peanuts has also been improved by using raw materials with altered fatty acid profile.

Biotechnologists are in the process to reduce the level of toxicants. This approach will be helpful to allow a wider range of plants to be used as food crops. Biotechnologists are often employed to scale up bio processes from the laboratory scale to the manufacturing scale. The increasing number of biotech enterprises is likely to create a need for bioengineers in the years to come.

SOURCESAND FURTHER READING:

Alfonso, A. 2007. Rice Biotechnology. Presentation during PhilRice R&D. March 13-15, 2007.

Biotechnology and Research Education Initiative (BREI, 2006) http://www.ca.uky.edu/brei

Edema MO (2004). Microbes and national development first international conference on science and national development, college of natural sciences, University of Agriculture, Abeokuta. October 25-28, 2004. Book of Abstracts No. 55

FAO 2002 Crop Biotechnology: A working paper for administrators and policy makers in sub-Saharan Africa. Kitch, L., Koch, M., and Sithole-Nang, I.

Food and Agriculture Organization (FAO), (2000). Application of biotechnology to the processing of food (including beverages) produced from agriculture. FAO Biotechnology Forum

Food and Agriculture Organization (FAO), 2004. Biotechnology applications in food processing: Can developing countries benefit? FAO Biotechnology Forum 3 June, 2004

Odland, W., A. Baumgarten, and R. Phillips. 2006. Ancestral rice blocks define multiple related regions in the maize genome. The Plant Genome 1: 541-548 (Supplement to Crop Sci. 46).

Phillips, R.L. 2006. Genetic tools from nature and the nature of genetic tools. In: CSSA Golden Anniversary Symposium. Ed. C. Stuber. Crop Sci. 46: 2245-2252.

Rines, H.W., S.J. Molnar, N.A. Tinker, and R.L. Phillips. 2006. Oat. In: Kole, C. (ed.). Genome Mapping and Molecular Breeding in Plants: Cereals and Millets Vol. 1. Springer, Inc., NY, USA. pp. 211-242.

Swapna N 2012 Role of Bio-Technology in the Development of Agriculture Sector in India Interscience Management Review (IMR) ISSN: 2231-1513 Volume-2, Issue-2,

Tietyen JL, McGough S, Kurzynske JS (2000). Consumer perceptions of food-related health risks. Society for Nutrition Education Annual Meeting, Charleston, S.C. July