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Role of Biotechnology in Agriculture

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Introduction

All living organisms have the ability to improve themselves through natural means in order to adapt to changing environmental condition. However, it takes hundreds of years before any detectable improvement is obtained. Human then learned how to domesticate and breed plants in order to develop crops to his own interest and needs various means including biotechnology. Biotechnology defined as a set of tools that uses loving organism (or parts of organisms) to make modify a product improve plants, trees, animals or develop microorganisms for specific uses. Biotechnology can be applied to all genus of organisms from viruses and bacteria to plants and animals and it is becoming a major feature of modern medicine, agriculture and industry. Agricultural biotechnology plays a key role in research tools that scientists use to understand and manipulate the genetic makeup of organisms for use in agriculture: crops, livestock, forestry and fisheries. Biotechnology has vast application than genetic engineering; it also includes genomics and bioinformatics, markers-assisted selection, micro-propagation, tissue culture, cloning, artificial insemination, embryo transfer and other technologies. Modern agricultural biotechnology includes a range of tools that scientists utilize to understand and manipulate the genetic make-up of organisms for use in the production or processing of agricultural products. Biotechnology is being used to address problems in all areas of agricultural production and processing.

Role of Biotechnology in Different Field of Agriculture

- Micro propagation of disease free plants like Banana.
- Agriculture on acid soils: Improving Aluminum tolerance in Cereals.
- Bio-fortification of crops.
- DNA Markers used in Aqua culture as well as agricultural crops.

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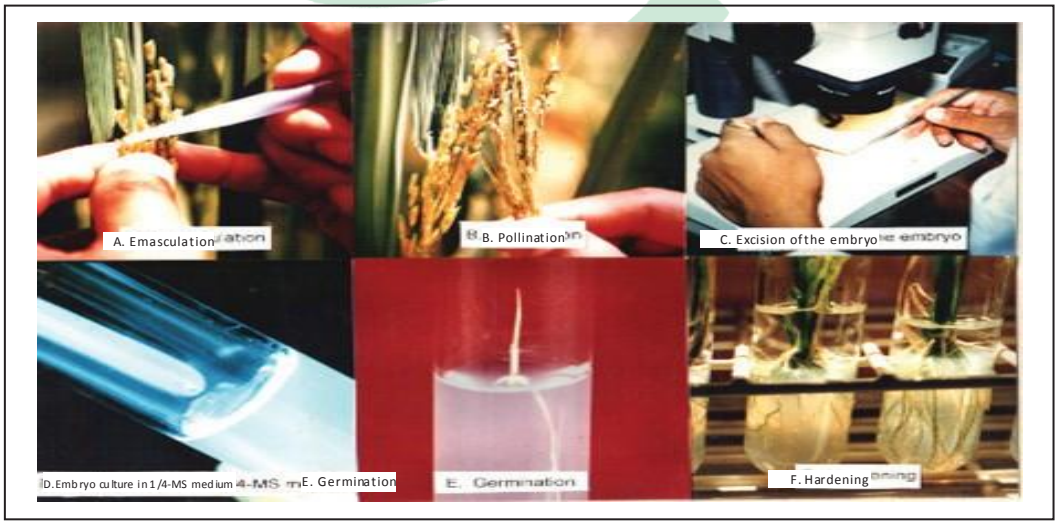
- Breeding and reproducing in Aquaculture.
- Artificial insemination (AI) and Multiple Ovulation/ Embryo Transfer in Livestock.
- Genetically modified crops for human & animal feed.
- Pest and Herbicide Resistant Cultivars.
- Genetically engineered Herbicide-tolerant (HT) crops.
- Genetically engineered Drought Resistant crops.
- Production of Bio-fuel by Agricultural waste.
- Diagnostics and epidemiology.
- Vaccine development for livestock.
- Animal nutrition.
- Allergens and toxins.
- Use of bio-fertilizer.
- Improvement in floriculture.

Biotechnological Tools That are Important for Agricultural Biotechnology

- Tissue culture and micro-propagation
- Molecular breeding and marker assisted selection
- Genetic engineering and GM crops

Tissue Culture and Micropropagation

Tissue culture is the cultivation of plant cells, tissues, or organs on specially formulated nutrient media. Under the right conditions, an entire plant can be regenerated from a single cell. There are several types of tissue depending on the part of the plant used.



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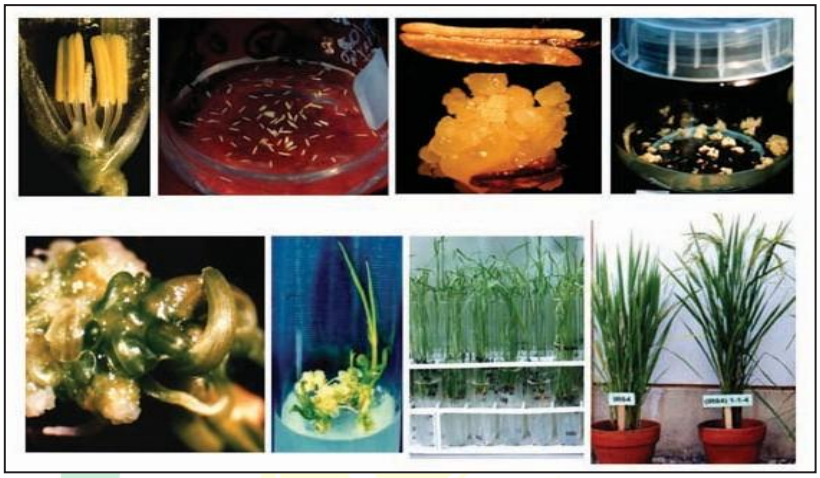
Anther Culture:- Anther culture is a tissue culture method used to develop improved varieties in a short time. Pollen within an anther contains half dose of the genome (haploid) which spontaneously double (diploid) during culture. In some species however, colchicine treatment is necessary to induce doubling. Doubling of the genome will allow the expression of recessive traits which were suppressed, masked or undetected in routine plant breeding.



Micro-propagation: - It is a tissue culture method developed for the production of disease-free, high quality planting material and for rapid production of many uniform plants. Actively-dividing young cells (meri-stem) are placed in a special medium and treated with plant hormones to produce many similar sister plantlets. Since the meri-stem divides faster than disease-causing virus, clean materials are propagated and hundreds of uniform plantlets are produced in ashort time.

Molecular Breeding and Marker Assisted Selection

The process of developing new crop varieties requires many steps and can take 10 to 25 years depending on the crop. Now, however, applications of agricultural biotechnology have considerably shortened the time it takes to bring them to market. It currently takes 7-10 years for new crop varieties to be developed. One of the tools, which make it easier and faster for scientists to select plant traits is called marker- assisted selection (MAS). The different traits and physical features of plants are encoded in the plant's genetic material, the deoxyribonucleic acid (DNA). The DNA occurs in pairs of chromosomes (strands of genetic material), one coming from each parent. The genes, which control the plant's characteristics, are specific segments of each chromosome. All of the plant's genes together make up its genome.

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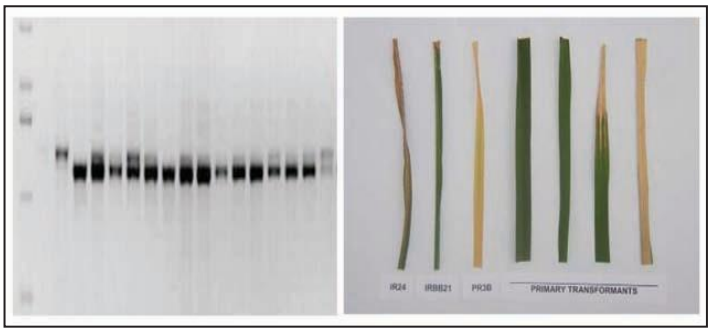

Genetic Engineering and Gm Crops

Over the last 30 years, the field of agricultural biotechnology has developed rapidly due to the greater understanding of DNA as the chemical double-helix code from which genes are made. Genetic engineering is one of the modern agricultural biotechnology tools that is based on recombinant DNA technology. The term genetic engineering, often interchanged with terms such as gene technology, genetic modification, or gene manipulation, is used to describe the process by which the genetic makeup of an organism can be altered using "recombinant DNA technology." This involves the use of laboratory tools and specific enzymes to cut out, insert, and alter pieces of DNA that contain one or more genes of interest. The ability to manipulate individual genes and to transfer genes between species that would not readily

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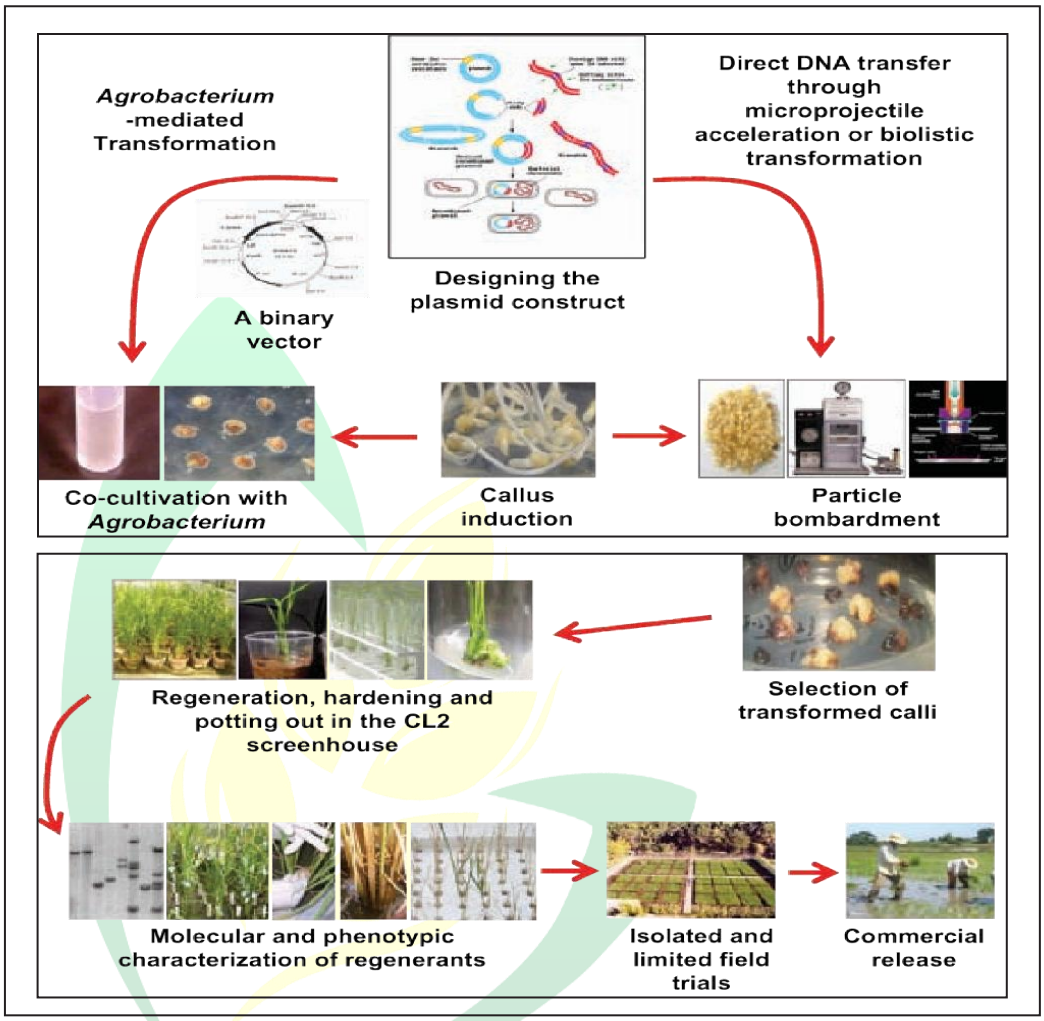
interbreed is what distinguishes genetic engineering fromtraditional plant breeding.



Conclusion

Agriculture biotechnology applications are helpful in sustained food production. Biotechnology is a complement not alternate for many areas of conventional agricultural research. It offers a variety of tools to improve our understanding and management of genetic resources for food and agriculture. As by reducing cost of production by reducing need of pesticide spray and fertilizer, development of new varieties that produce high yield and possess tolerance against abiotic stress. These transgenic crops can grow in wide range of environmental condition and possess more nutritional value, and also involve in production of vaccine and healthcare product for human population. Tissue culture technique, Micro propagation, DNA marker assisted technique are basic tools for transgenic varieties. These tools are already employed to breeding and conservation programs and to facilitating the

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diagnosis, treatment and prevention of plant and animal diseases. The application of biotechnology provides the researcher with new knowledge and tools that make the job more efficient and effective. The biotechnology also strikes the challenges of environment which affecting the agriculture directly or indirectly.