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A Review of Biotechnology in Agriculture

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ABSTRACT

Genetic changes in plants were first observed 10,000 years ago in Southwest Asia, where humans first bred plants by artificial selection. Over the past two decades, several transgenic plants overexpressing SPI have been genetically engineered and tested for increased resistance to pathogenic insects. This technology is cultivated by millions of farmers, including many in developing countries, and offers significant economic and environmental benefits, including: Example: Chemical use was reduced by 37%, yield increased by 22%, and agricultural profits increased.

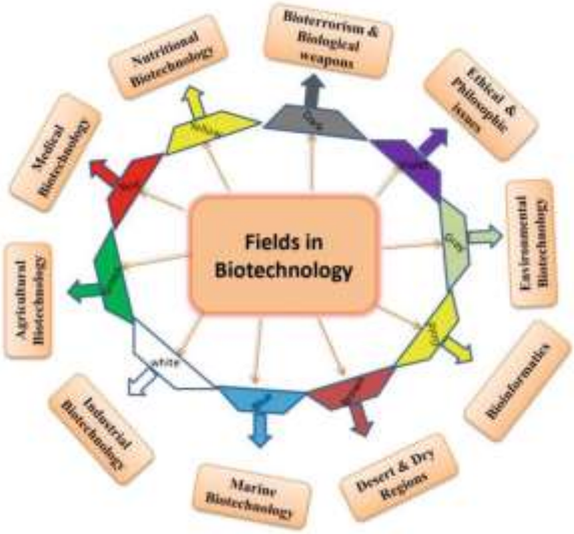
Traditional breeding cannot keep up with the demands; To achieve these goals, the gap will be closed through biotechnology and the cultivation of genetically modified (GM) crops. Conventional livestock production cannot keep up with demand; To achieve the goals, biotechnology and the production of genetically modified crops (GMOs) are filling the gap. Bio-fortified staple foods such as rice, corn and wheat are being developed to provide essential micro-nutrients that benefit the world's poor, as well as new crop varieties that can fight chronic diseases. A number of DNA-based technologies have shown great potential in improving the efficiency of plant breeding programs, conserving genetic resources, improving the quality and yield of agricultural products, and protecting the ecological environment.

Natural substances derived from microorganisms have proven benefits in the fields of nutrition, agriculture and medicine. Translational projects such as 'Efficient Nitrogen Uptake' and 'Improving Photosynthetic Efficiency' promise higher yields in the future, when more frequent and more severe droughts are likely. GM crops alone cannot solve the hunger problem, but they can be an important part of a broader food security strategy. Key factors influencing consumer attitudes are risk and reward, knowledge and trust, and perceptions of personal values. The future is very bright for GM technologies that can meet future global feed and fiber needs in a sustainable and responsible manner.

Key words : Biotechnology, agriculture, Genetic change, transgenic plants, SPI, pathogenic insect, traditional breeding, biofortified staple, DNA based techn Agricultural biotechnology is that area of biotechnology involving applications to agriculture. In the broadest sense, traditional bio-technology has been used for thousands of years, since the advent of the first agricultural practices, for the improvement of plants, animals, and microorganisms, translation project, GM

Introduction :

Biotechnology is the technology of using biological systems, organisms, or parts thereof to develop or produce various products.



Agricultural biotechnology, also known as agrotechnology, is a field of agricultural science that uses scientific tools and methods such as genetic engineering, molecular markers, molecular diagnostics, vaccines, and tissue culture to modify living organisms such as plants, animals, microorganisms.

Agricultural biotechnology is a field of biotechnology that includes agricultural applications. In its broadest sense, traditional biotechnology has been used to improve plants, animals, and microorganisms for thousands of years, since the first agricultural practices emerged. Modern biotechnology has greatly increased the precision of changing plant traits, shortened the time taken, and greatly increased the potential sources from which desired traits can be obtained.

Its purpose is to make new methods in agricultural biotechnology and related fields available to the academic community. The field of agricultural biotechnology is constantly changing and offers countless career opportunities. Apart from employing individuals for research and development. The division also serves other sectors related to agricultural biotechnology such as fisheries, poultry farming, dairy farming, floriculture, and horticulture. Agriculturally oriented biotechnology can also deepen academic expertise by linking it with postharvest, food processing, or genetic engineering technologies.

Goal: The main goals of biotechnology in agriculture are to improve seed quality, create disease-resistant varieties and increase productivity.

Increasing and stabilizing yields, increasing resistance to pests and diseases, increasing resistance to drought and cold, increasing the nutritional content of products, etc

Methodology of plants genetic modification :

1. **Simple selection:** Simple breeding is marker-assisted breeding, which uses molecular analysis to detect plants capable of expressing desired traits, such as disease resistance to one or more pathogens. specifically in the population. The successful application of marker-assisted selection allows for a faster and more efficient mechanism to identify candidate individuals likely to possess “superior traits.” . The dominant traits are those considered beneficial to humans, as well as pets eating plant-based diets; they are not necessarily beneficial to the plant in an ecological or evolutionary context. Often, traits considered beneficial to plant breeders are detrimental to the plant in terms of environmental value.

   - **Traditional cross breeding:** For thousands of years, traditional breeding has been the backbone of improving crop genetics. Typically, pollen from one plant is placed on the female part of another plant's flower, resulting in the formation of seeds that are a hybrid of the two parents. Plant breeders then select plants with desirable beneficial traits to pass on to the next generation.

   - **Hybridization between species:** Hybridization between species occurs in a variety of ways. Domesticated oats (Avena sativa) and related species such as its weedy cousin wild oats (Avena fatua) may cross-pollinate and exchange genetic information, but this is generally not the case. there is no. Under certain conditions, certain genes can also be naturally integrated into the genomes of more distant relatives. Some edible plants carry genes derived from different species and transmitted both by nature and human intervention.

   - **Embryo rescue:** a) Mature embryo culture: This is the culture of mature embryos obtained from mature seeds. This type of culture is used when embryos are not viable in vivo or remain dormant for long periods of time, or to prevent inhibition of seed germination. b) Immature embryo culture: Also called embryo rescue. This includes culturing immature embryos to rescue embryos in case of large crosses, crosses with seedless parents, or severe fruit drop at early stages of embryonic development. The main purpose of this is to prevent embryo abortion and produce viable (hybrid) plants.

   - **Mutation:** Mutations can occur randomly in the DNA of any organism. To create diversity in plants, scientists can randomly create mutations in plants. Mutagenesis uses radiation to create random mutations in the hope of achieving a desired trait.

- **Somatic cell hybridization:** A process also known as cell fusion, somatic cell hybridization typically uses the enzymes pectinases, cellulases, and hemicellulases to strip away the protective walls of cells growing in culture. These isolated cells, called protoplasts, are collected from different sources and fused using different techniques such as electric shock. When two protoplasts fuse, the resulting somatic hybrid contains genetic material from both plant sources.
- **Tissue Culture:** Tissue culture involves manipulating cells, anthers, pollen grains, or other tissues. Therefore, they survive for long periods of time under laboratory conditions or become complete living growing organisms. Genetically modified cells can be converted into genetically modified organisms through tissue culture.
- **Polyploidy:** Polyploidy is induced to change the number of chromosomes in a crop, thereby potentially affecting its reproductive potential and size. Organisms usually have two sets of chromosomes, also called diploid. However, this chromosome number can change naturally or through the use of chemicals, which can lead to changes in crop fertility and size.
- **Genetic engineering:** Genetic engineering inserts DNA segments into a cell's chromosomes, then uses tissue culture to regenerate the cell into an entire organism with a different genetic structure than the original cell. This is also known as rDNA technology; it creates transgenic organisms.
- **Microinjection:** DNA can be injected directly into anchor cells. A certain percentage of these cells will survive and integrate the injected DNA. However, this process is laborious and ineffective compared to other methods.

Career Prospects In Agricultural Biotechnology

Agricultural biotechnology is a growing global industry. With this growth comes employment opportunities in many interesting professions. People with a wide range of skills and education levels are employed by private agricultural companies as well as public (government or sponsored) agencies and institutions around the world. As the industry expands, expanding your education and experience also increases your chances of landing a job with more independence and a higher salary.

R&D (Research and Development): R&D is the process of discovering new items and manufacturing them until they are ready for market. Agricultural biotechnology continues by using these two processes to produce new products for commercial use. Research scientists are senior scientists who perform basic scientific research at universities, government laboratories, or companies. In many cases, researchers' own new product ideas are the impetus for starting a company. Research scientists bring specific expertise and deep knowledge about a particular scientific field. They are typically responsible for identifying patentable inventions and designing their own experiments.

Process Development Scientist: Your goal is to improve the performance of your production unit and implement process controls to ensure that products are manufactured in a high quality and reproducible manner.

Self-employment: Freelancers can find work in agribusinesses, produce stores, and agricultural companies.

Agricultural management: Professionals in this profession typically work in either animal, crop, or dairy production. Their responsibilities include managing human resources, organizing related operations, working on machinery, organizing agricultural administration, planning strategies/tactics for high yields, etc.

Agricultural consultants: Agricultural consultants or consultants provide advice, solutions and support to their clients, ensuring that their business or operations operate as efficiently and effectively as possible.

Product Development : These professionals are needed in manufacturing companies to control and understand the processes used to make the final product. They operate across the manufacturing industry, producing products as diverse as food, cosmetic dyes, and pharmaceuticals.

Agricultural biotechnologist: Agricultural biotechnologists are experts in the use of scientific tools, research, technology, etc. to transform living organisms such as plants and animals. Although some agricultural biotechnologists focus exclusively on crops, they are often called

Agricultural biotechnologists. As a biotechnologist, you will use methods and techniques such as genetic engineering, molecular markers, molecular diagnostics, vaccines and tissue culture. Through these techniques, desirable traits from one crop are transferred to completely different species. Thus, transgenic crops have the desired flavor, color, fruiting rate, harvest time, disease and livestock resistance, etc.

Industries: Agricultural biotechnology job opportunities are available in private companies and public (government-established or supported) organizations and agencies.

WHY ARE AGRICULTURAL BIOTECHNOLOGY PRODUCTS BEING DEVELOPED ?

New developments in agricultural biotechnology are being used to increase the productivity of crops, prima-rily by reducing the costs of production by decreasing theneeds for inputs of pesticides, mostly in crops grown intemperate zones. The application of agricultural biotech-nology can improve the quality of life by developing newstrains of plants that give higher yields with fewer inputs,can be grown in a wider range of environments, givebetter rotations to conserve natural resources, providemore nutritious harvested products that keep much longerin storage and transport, and continue low cost food sup-plies to consumers.

After two decades of intensive and expensive re-search and development in agricultural biotechnology,the commercial cultivation of transgenic plant varietieshas commenced over the past three years. In 1999, it isestimated that approximately 40 million hectares of landwere planted with transgenic varieties of over 20 plantspecies, the most commercially important of which werecotton, corn, soybean, and rapeseed (International Ser-vice for the Acquisition of Agricultural Biotechnology[ISAAA], 1999)

The benefits of these initial transgenic crops are better weedand insect control, higher productivity, and more flex-ible crop management. These benefits accrue primarilyto farmers and agribusinesses but there are also economicbenefits accruing to consumers in terms of maintainingfood production at low prices. The broader environmental and social benefits of reducing pesticide use contribute to more sustainable agriculture and improved food security. Crop/input combinations currently undergoing field trials in emerging markets include virus-resistant melon, papaya, potato, pumpkin, tomato and pepper; insect-resistant rice, soybeans and tomatoes; disease-resistant potatoes; and slow-ripening chili peppers. Work is also underway to use plants such as acorns, potatoes and bananas as mini-factories to produce vaccines and biodegradable plastics.

Further advances in biotechnology are likely to produce crops with a wider range of traits, some of which may be of more direct interest to consumers. B. Because it has properties that improve nutritional quality.

Given a chance, new developments in genetic engineering could also help solve human health, agricultural, and environmental problems in poor countries. To date, major private sector research and development efforts in biotechnology have focused on how to bring traits useful to producers to developed markets and allow life science companies to recover their investments. New means of mobilizing both public and private resources are needed to ensure that the poor are not left behind in the genetic revolution.

Green revaluation in India

The word "green revolution" was coined in 1968 by William S. Goud of the United States Agency for International Development (USAID) to introduce new technologies and policies that were implemented in developing countries with the help of developed countries between the 1940s and 1960s. Increasing the production and yield of food crops . Under the Green Revolution, many high-yielding varieties (HYVs) have been developed to improve agricultural productivity. These genetically improved wheat and rice varieties were developed by the International Maize and Wheat Improvement Center (CIMMYT), Mexico, and the International Rice Research Institute (IRRI), Philippines, respectively.

What Is the Green Revolution?

The green revolution led to high productivity of crops through acclimated measures, similar as(1) increased area under husbandry,(2) twice- cropping, which includes planting two crops rather than one, annually,(3) relinquishment of HYV of seeds,(4) largely increased use of inorganic diseases and fungicides,(5) bettered irrigation installations, and(6) bettered ranch tools and crop protection measures(Singh, 2000; Brainerd and Menon, 2014) and variations in ranch outfit. There was a high investment in crop exploration, structure, request development, and applicable policy support(Pingali, 2012). sweats were made to ameliorate the inheritable element of traditional crops A report by the Department of Agriculture, Cooperation and Farmers Welfare estimates that the food grain product in India will be279.51 million tonnes during the 2017 – 2018 crop time. Although India is tone- sufficient in food product, its food product between 1947 and 1960 was so bad that there were pitfalls for the circumstance of shortage. thus, the Green Revolution was initiated in the 1960s in order to increase food product, palliate extreme poverty and malnourishment in the country, and to feed millions.

Agrarian scientist Mankombu Sambasivan Swaminathan saved millions of people in South Asia from shortage in the 1960s and was deified in India as the father of the agrarian movement known as the green revolution. By depleting high- yielding wheat and rice kinds among poor growers in South and southeast Asia, he helped to increase agrarian tone- adequacy. For this work, he entered the first World Food Prize in 1987. He latterly called for a sustainable ' evergreen revolution ' to address the implicit environmental damages of prevalent ferociousfarming. M.S. Swaminathan(1925 – 2023), leader of India's ' green revolution '

Agrarian scientist who introduced crops to end shortage in India in the 1960s. Introduced High Yielding Variety seeds in Indian husbandry. The HYV seeds were largely effective in regions that had rich irrigation installations and were further successful with the wheat crop. thus, the Green Revolution at first concentrated on countries with better structure similar as Tamil Nadu and Punjab. During the alternate phase, the high yielding variety seeds were given to other countries, and crops other than wheat were also included in the plan. The most important demand for the high yielding variety seeds is proper irrigation. Crops grown from HYV seeds need good quantities of water force and growers couldn't depend on thunderstorm. Hence, the Green Revolution has bettered the irrigation systems around granges in India. marketable crops and cash crops similar as cotton, jute, oilseeds, etc weren't a part of the plan. Green revolution in India substantially emphasized food grains similar as wheat and rice. To enhance ranch productivity green revolution increased the vacuity and use of diseases, weedicides, and fungicides to reduce any damage or loss to the crops. It also helped in promoting marketable husbandry in the country with the preface of ministry and technology like harvesters, drills, tractors,etc.

The benefits of indigenous crops over the introduced HYVs include(1) civilization of indigenous crops can make husbandry more genetically different and sustainable,(2) consumption of domestically cultivated indigenous crops can reduce the carbon vestiges and significances,(3) the indigenous crops are largely acclimated to the climatic conditions of the land, and(4) consumption of indigenous foods contribute to food diversity and enrichment of diet with micronutrients provides health benefits due to the relations between the inherited genes and food nutrients

There may be many challenges in reviving indigenous species, which may include(1) growers ' amenability in the propagation of indigenous kinds,(2) relating the growers with traditional knowledge of crop civilization,(3) encouraging the growers with large landholdings to cultivate indigenous crops,(4) mindfulness among the consumers and stakeholders about the ecological and health benefits of indigenous kinds,(5) support of the government to the growers for the propagation of these crops in small and large scale, and(6) development of robotization suitable for recycling indigenous crops, as the being machines are designed for the HYVs, and employing the same ways for the processing of indigenous crops may lead to the loss of micronutrients and phytochemicals.

Advance research in Biotechnology

1. Cloning: Gene cloning involves assembling a large population of DNA fragments in a pure form. Gene cloning involves creating DNA and inserting it into a suitable host similar to E. coli. The host used must be plasmid-free. In some cases, bacterial cells additionally transcribe DNA molecules into messenger RNA, which in turn is translated into peptide chains. Therefore, cloning can be used not only to obtain large amounts of the deoxyribonucleic acid sequence of a single gene, but also to obtain large amounts of the gene's protein product.

2. Polymerase chain reaction (PCR):

Pathogens can be found using the polymerase chain reaction method. Polymerase chain reaction is also used for DNA sequencing, which helps doctors predict whether a patient is likely to develop diseases such as AIDS or cystic fibrosis. This method is so useful that it has become one of the most important tools in biology and medicine, helping to find cures for diseases such as cancer, AIDS, and cystic fibrosis. Polymerase Chain Reaction DNA sequences are replicated using the polymerase chain reaction. To detect infections in food or water, or to create new species like glow-in-the-dark cats, scientists introduce DNA into bacteria and watch them multiply over time. Polymerase chain reaction is another tool scientists can use on cells. For example, cells from people with Parkinson's disease can be used over time to clone cells that don't have Parkinson's disease.

3. Gel electrophoresis

Passing charge between molecules is the process of gel electrophoresis. Different parts of the molecule move at different speeds, so by running an electric current through the DNA in the gel, scientists can determine what type of molecule it is. Gels are barriers that prevent DNA from interacting with other substances and allow individual molecules to be separated. By using compounds such as silver nitrate to create film images after separation, scientists can learn more about human and animal cells.

4. DNA sequencing

Analysis of the genetic code is the process of DNA sequencing. It can be used to identify the genes a person carries, allowing doctors to predict the likelihood that a person will develop a particular genetic disease during their lifetime. DNA sequencing also helps us learn more about cells and organisms. For example, researchers found that mice with genetic abnormalities caused by obesity eat less when hungry. They discovered this by testing the DNA to see which gene was responsible for the mutation.

application:

The application of biotechnology in agriculture is still in its infancy. Most current genetically modified plant varieties are modified for only a single trait, such as herbicide tolerance or pest resistance. Rapid advances in genomics have the potential to improve plant breeding by identifying more functional genes. This could make it possible to more successfully breed complex traits such as drought and salt tolerance that are controlled by many genes. This would be of great benefit to farmers in remote areas around the world, as breeding for such traits has had limited success compared to conventional breeding of major staple crops. The application of biotechnology to agriculturally important crop species has traditionally involved the exchange of genetic material between two parent plants to produce desirable traits such as higher yields, disease resistance, and improved product quality. This has included the use of selective breeding to produce well-equipped offspring.

1 . Apple 🍎:

In recent years, new technologies for genetic improvement have emerged, including transplantation, viral vectors, and genome editing. Using these techniques, the final product will be free of foreign genes, and some of them have potential applications in apple breeding

Genetic engineering has facilitated the development of apples with resistance to fungal and bacterial diseases, apples with improved fruit quality, and rootstocks with improved root formation and dwarfing abilities. DNA markers for disease resistance (scab, powdery mildew, fire blight, Alternaria spot) and pericarp color have also been developed and marker-assisted selection (MAS) is used in breeding programs.

2. Papaya :

Papaya fruit is a rich source of potassium, magnesium, and vitamins A and C, leading to a steady increase in global production.

In the 1990s, a genetically modified papaya called "Sunup" was developed and became widely known for its resistance to papaya ringspot virus. Papayas were susceptible to papaya ringspot virus, which caused plants to become stunted and unable to produce ripe fruit, but papaya's genetic code did not have resistance.

The researchers then developed the genetically modified papaya SunUp using a technique called "particle bombardment-mediated transformation." The gold particles were coated with the virus's coat protein gene and were shot into cells of non-transgenic "Sunset" papayas using a gene gun. Therefore, SunUp contained the genetic sequence of the virus and was protected from infection.

3. Seedless grapes :

The process of growing seedless grapes uses asexual reproduction. The new plant is essentially a genetic clone of the original parent plant, which requires manual manipulation of the plant's genetic material. Seedless grapes are also very nutritious and contain phytonutrients, antioxidants and vitamins. When compared side-by-side, red grapes contain more nutrients than white grapes, providing higher amounts of vitamin C, vitamin K, flavonoids and phytonutrients.

4.**Strawberry 🍓:**

Like most fruits, they are propagated vegetatively from parts of the plant. Strawberry breeders grow plants from seeds in an active search for new and unexpected hybrids. Seed genetics are an unpredictable combination of parental genetics. Plant breeders manage these crosses by choosing specific parent plants to cross with, as they are careful to pass on the traits of each parent to their offspring. For example, one parent may be very productive but not have particularly tasty fruit, while the other parent may produce fruit. Good things Bearing fruit is fruitful, but not very productive. They want their offspring to have the best of both worlds: be highly productive and bear good fruit. Of course, it is possible to have offspring that are unproductive and bear poor fruit.

5. Pink pineapple:

Pineapples are simply engineered to produce less of the enzyme that converts the pink pigment lycopene into the yellow pigment beta-carotene, something that is already done in traditional pineapples. Their pink flesh is the result of downregulation of the gene β-LCY, which encodes the enzyme lycopene beta cyclase. Pink pineapples are so rare that they are more expensive than regular pineapples.

6. Rice :

Of course, the Fe and Zn content in rice is low. Enrichment leads to an increase in iron and zinc concentrations. Bt rice exhibits resistance to bacterial, viral and fungal diseases. Pest attacks can be minimized because Bt rice is considered a new raw material that reduces the use of pesticides and is considered friendly to aquatic life.

Golden Rice: Vitamin A deficiency can be overcome by consuming golden rice, as the concentration of β-carotene, like vitamin A, is maximum in golden rice with cowpeas. The content of minerals such as calcium, iron and zinc is higher in cowpeas.

Maize :

Production of corn varieties with increased vitamin A and carotenoids content, high mineral content in genetically modified corn varieties, biofortification of corn with β-carotenes has been reported.

Bt corn is highly resistant to the European corn borer. The development of transgenic varieties can reduce the attack of various parasitic diseases.

7. Wheat:

The first successful genetic modification of bread wheat was carried out at the University of Florida, USA [34], using biological methods and funded by a research grant from Monsanto. Monsanto scientists were also the first to report the creation of genetically modified wheat using Agrobacteria-mediated transformation. Currently, biologically and Agrobacterial-mediated gene transfer using immature embryos as models remains the main method for genetic engineering of wheat. The limited amount of zinc and iron in wheat has led to the creation of genetically modified varieties with 40-50% higher Fe and Zn content.

8. Cassava :

Cassava is biofortified with beta-carotene to increase carotene concentration, and the addition of these minerals can increase iron and zinc levels.

9. Indian Bt Cotton :

India is the second largest producer and consumer of cotton after China. In 2002 he Bt cotton was introduced to India. India has the largest area under cotton cultivation, accounting for about one-third of the world's cotton production. Advantages of Bt cotton: Good yields, high returns, less need for pesticides, good quality, suitable for early sowing. The introduction of Bt cotton has greatly benefited Indian farmers and agribusiness. Bt cotton increased profit and yield by Rs. $1877 ($38) per acre or 126 kg/acre land, 50% and 24% higher than conventional cotton profits and yields, respectively.

Disadvantages: High cost of seeds, high cost of fertilizers and irrigation.

10. GM canola (Australia):

Canola is grown as an intercrop in Australia, providing farmers with profitable alternative crops and crop rotation benefits through successive grain cropping stages and associated weed/pest mechanisms. Other benefits include controlling broadleaf weeds and grain root diseases, and promoting continued grain growth. It is primarily cultivated in Western Australia (WA), where the cultivated area ranges from 400 to 800,000 hectares, and is the most successful of the four cover crops (oat, lupine, canola, and pea). From 2002 to 2007, canola production in WA alone generated 440 million tonnes, worth A$200 million.

11. Bt brinjal :

Bt-Brinjal is a transgenic eggplant produced by inserting the soil bacterium Bacillus thuringiensis gene [cry IAc] into eggplant. Insertion of genes into young cotyledon eggplant cells was carried out via Agrobacterium-mediated vectors along with promoters, markers, etc. This is said to give eggplants resistance to lepidopteran insects such as fruit and bud borers (Leucinodes spp.). orbonalis) and fruit borer (Helicoverpa armigera). It has been reported that when an insect absorbs her Bt toxin, it can disrupt the digestive process and ultimately lead to the insect's death. Benefits of Bt Eggplant: 1) High quality eggplant fruit free of parasites and damage 2) Bt Eggplant significantly reduces the amount of pesticide residues. Farmers are expected to benefit at various levels. These include, but are not limited to: 3) Reducing the cost of pesticides and reducing labor costs by reducing the amount of spraying. 4) Increase yield per unit area by protecting fruits from damage caused by FSB.

12. In diagnosis:

Doctors can now detect many diseases and health conditions more quickly and accurately. The time required to diagnose infectious diseases has been reduced from days to minutes. Certain cancers can now be diagnosed simply by taking a blood sample, eliminating the need for invasive and costly surgeries.

13. Therapeutics: Biotechnology offers improved versions of today's treatment regimens, new treatments are being advanced, and biotechnology has enabled gene therapy, immunosuppressive therapy, and the creation of replacement tissues and organs to cure genetic diseases. It is now possible to use cell therapy, replacement therapy, etc.

14. The lactic acid bacterium Lactococcus lactis is commonly used for milk fermentation and is considered a safe host for biopharmaceutical development.

Leonard Janessi, a senior fellow at the National Center for Food and Agricultural Policy, said farmers who adopt genetically modified crops can earn more money even in tough conditions.

15. Genetically modified (GM) crops represent the fastest rate of adoption of new technology in global agriculture. The reason is that farmers directly benefit from increased yields and reduced production costs.

16. Biotechnology in Medical Sciences provides an overview of the various aspects of biotechnology and is an excellent reference book for non-scientists and those new to biotechnology. twenty one. Biotechnology is being used to produce new advanced biofuels that have similar performance to gasoline, are less fuel efficient than ethanol, and have fewer mixing problems.

17. Biotechnology is used to produce new advanced biofuels that have performance similar to gasoline, better fuel efficiency than ethanol, and fewer mixing problems.

18. Pharmaceutical companies that sell biologics are using biotechnology principles such as recombinant DNA technology to develop more effective protein-based drugs, such as erythropoietin and fast-acting insulin.

19. Recombinant DNA technology is used for large-scale protein synthesis. This involves extracting the DNA or RNA of interest from a biological sample, such as a cell or tissue, and incorporating the DNA encoding the protein of interest into an appropriate cloning vector.

20. Biotechnology can be used to improve the quality of oil and coal by removing unwanted elements/components such as sulfur, nitrogen, metals and ash and also reducing the viscosity. Biorefinery can make oil refining easier/cheaper and reduce the production of air polluting gases from oil combustion.

21. Biotechnology can be used to convert remaining hydrocarbons in depleted oil wells and coal reserves into methane, reducing the amount of CO_2 released into the atmosphere while significantly reducing the amount of CO_2 released into the atmosphere. The possibility exists to recover a large amount of energy content.

22. Used for urbanization of pharmaceuticals and biopharmaceuticals. Although there are no chemical concerns about combining these drugs, microorganisms may have grown in them. Large protein molecules are typically the raw materials for biopharmaceuticals.

23. Used in gene tablets

Conclusion :

Agriculture is a diverse endeavor, and we must embrace that diversity if we want to succeed. We have discussed the principles and methods of the most common and widely used molecular markers for crop breeding and improvement. Conventional breeding methods, especially those at the genome level, aimed at both creating and exploiting genetic variation to isolate effective alleles (variants) of genes that confer increased yield, disease resistance, pest resistance, etc. With the advent of technology, it is clearly playing a role. play a role in this effort. The nutritional benefits are likely to increase further in the future as more genetically modified crops and traits become available. GM crops have less chemical pollution around the world. Certainly, the reduction in the incidence of pesticide poisonings, which could exceed 100 million cases, is an important indicator of the benefits of genetically modified crops, but perhaps most importantly, their contribution to improving the mental health of farmers, especially in India. I'm sure you're doing it.

Reference :

1. https://pubmed.ncbi.nlm.nih.gov/26264020/
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5790416/
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4346933/
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6471620/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9090284/
6. https://www.orfonline.org/research/towards-smart-agriculture/?amp
7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3674000/
8. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576180/
9. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6173531/
10. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7216575/
11. http://whatsapp.provider.media/item/94973919-9712-42f0-bdbe-68791def1c4f
12. https://doi.org/10.20546/ijcmas.2018.706.393
13. https://www.annualreviews.org/doi/10.1146/annurev.energy.31.031405.091314
14. https://en.m.wikipedia.org/wiki/Polyploidy
15. https://www.mishicotffa.org/uploads/2/3/2/7/23271034/careers_in_biotech_reading.pdf
16. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7061863/
17. https://www.ncbi.nlm.nih.gov/books/NBK215771/
18. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5385174/
19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3781270/
20. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4955036/
21. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6431451/
22. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3525971/
23. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6153617/

24. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4741079/
25. https://journalofethnicfoods.biomedcentral.com/articles/10.1186/s42779-019-0011-9
26. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7611098/
27. https://www.slideshare.net/manojsiddartha/bt-crops-ppt
28. https://www.javatpoint.com/advantages-and-disadvantages-of-biotechnology
29. https://in.docworkspace.com/d/sIJSu_b6-Aeje3acG?sa=00&st=0t
30. https://www.slideshare.net/FyzahBashir/applications-of-biotechnology
31. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4780799/
32. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8751662/
33. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5790416/#:~:text=Canola%20in%20Australia%20is%20grown,better%20successive%20cereal%20crop%20growth
34. https://idreamcareer.com/career/agriculture-biotechnologist/#:~:text=If%20you%20are%20into%20management,the%20Indian%20Agricultural%20Research%20Institute
35. https://biotecharticles.com/Agriculture-Article/Plant-DNA-Cloning-and-its-Applications-in-Agriculture-4444.html