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BIOTECHNOLOGY AND SUSTAINABLE AGRICULTURE—A REVEIW

Sonia Kumari* and Sanjeet K. Chaurasia

Rajendra Agricultural University, Pusa, Samastipur, Bihar-848125

**Corresponding Author (Sonia Kumari) Email : soniasinharau@yahoo.co.in*

ABSTRACT

The Science of using biological things into technology for the benefits of mans kind is known as Biotechnoly. It is a rapidly growing segment in biological sciences and has diversified applications in sustainable agriculture. Biotechnology uses all things such as such as plants, animals and Microbes.biotechnology have many applications in agriculture as bio fertilizers, bio-pesticides, bio-herbicides,and bio insecticides.They have also a role in cleaning the environment through biodegradation of waste and oil spills. This review will enlist the role of microbial biotechnology in all these application with few most advanced examples.

Key words : Genetic modified crops, bio fertilizer, bio pesticides, bioremediation biotechnology, microbial biotechnology,

Increasing population poses a great challenge to traditional agricultural systems. Old farming equipment and practices are now exhausted and their effectiveness is decreasing to meet the agricultural productivity and their by the demand of the peoples. As countries develop these pressures are multiplied by reducing farmland, rising labour costs and shortage of farm workers. Biotechnology offers modern method to improve the sustainability of existing system to produce more and better quality of our agricultural products. There are numerous application of biotechnology that includes increased crop yield, reduced use of chemical pesticides, providing resistance to the disease and pest to the crop, Processing of foods turning them to more nutritious and easy to handle and transport. Agricultural technologies ensured a 'green revolution' in the middle of 20th century but causing high ecological cost and contributing global pollution, unfavorable climate change and loss of biodiversity (1). Development of biotechnology applications was initiated in 6000 BC, but development of genetic tools and cellular and tissue engineering gave the begin in 1970s then after many the speed of biotechnological work gain momentum (**2**). Use of microbes for the above purpose is known as Microbial Biotechnology. One of the most important contribution of biotechnology in agriculture is the development of Genetically modified crops (GM) that has resistant to many pest and weeds and hence increased crop production (3)

Role of Microbes in Biotechnology

Microorganisms are the group of tiny organism that are present everywhere in soil air and in water. Human being is exploiting microbes since ancient era. At present day microbes are exploited in the biotechnology process known as Microbial biotechnology which is an important area that promotes for advances in food safety, food security, value-added products, human nutrition and functional foods, plant and animal protection, and overall fundamental research in the agricultural sciences. Microbial biotechnology, enabled by genome studies, will lead to breakthroughs such as improved vaccines and better disease-diagnostic tools, improved microbial agents for biological control of plant and animal pests, modifications of plant and animal pathogens for reduced virulence, development of new industrial catalysts and fermentation organisms, and development of new microbial agents for bioremediation of soil and water contaminated by agricultural runoff (4).

Microorganisma as Bio Fertilizers

Bio fertilizer are preparation of live or latent cell of efficient strain of nitrogen fixing, phosphate solubilizing or cellulolytic microorganism used for application of soil, or seed or mixed with compost to accelerate the process of mobilization of nutrient from the soil and thereby making them more available to the growing crops or plants. (5). Bio fertilizers are known to play a number of vital roles in soil fertility, crop productivity and production in agriculture as they are eco friendly and can replace chemical fertilizers that are indispensable for getting maximum crop yields. Some of the important functions or roles of Bio fertilizers in agriculture are :

1. They supplement chemical fertilizers for meeting the integrated nutrient demand of the crops.

2. They can at best minimize the use of chemical fertilizers.

Table-1 : List of important Microorgansims

Bio control agent	Suppressed agent	Crop	Disease /Host/Remarks
Bacteria			
Pseudomonas fluorescens	*Phytophthora infestans*	Potato	Fireblight
Erwinia herbicola	*Erwinia amylovara*	Pear, apple and other rosaceous plants	
B. subtilis	*Uromyces sp.*	Bean	Bean rust
S. griseoviridis	*Agrobacterium brasicicola*	Cruiciferae	Damping off of crucifers
P. fluorescens	*Rhizoctotnia solani P. ultimum*	Cotton	Damping off of cotton
P. fluorescens	*Pythium ultimum*	Mushroom	Brown blotch of Mushrooms
A. Radiobacter	*Agrobacterium tumefaciens*	Several crops	Crown gall
Bacillus thuringiensis	Heliothis and other Lepidoptera and Coleopteran	-	Cotton, chickpea, maize, tomato, groundnut etc.
Fungi			
Hirsutella thompsonii	Citrus mites	Citrus fruits	
Verticillium lecanii	Aphids, white, Lies		Citrus fruit
Trichoderma viride	*Macrophomina phaseolina*	Groundnut, chickpea	
Rhizoctonia solani	*Pythium ultimum*	Cotton legume	Damping off of cotton
T. viride	*F. solani*	Sisam	Sisam wilt
Viruses			
Nucleopoyhedrosis virus	Rice borer	Rice	Asiatic rice borer
Nucleopoyhedrosis virus	Cotton leaf worm	Cotton	Cotton leaf worm
Chilo Granulosis virus	*Chilo infuscatellus*	Sugarcane	
Nucleopoyhedrosis virus (NPV)	Asiatic rice borer, cabbage looper	Cotton, rice Cabbage	Commercially used in USA
Granulosis viruses (GV)	Codling moth, tuber worm rice borer	Potato, rice	
Bioherbicides			
Phytophthora citrophora	Milk weed	-	-
Colletrotrichum gloecosproioides	*Aeschynomene verginica*	-	-
Protozoa	-	-	-
Malameba locustae	*Grass hoper, Lepidoptera*	-	-

3. Application of Bio fertilizers results in increased mineral and water uptake, root development, vegetative growth and nitrogen fixation.

4. Some Biofertilizers (eg, *Rhizobium BGA, Azotobacter* sp) stimulate production of growth promoting substance like vitamin-B complex, Indole acetic acid (IAA) and Gibberellic acids etc.

5. Phosphate mobilizing or phosphorus solubilizing bio fertilizers / microorganisms (bacteria, fungi, mycorrhiza etc.)

6. Mycorrhiza or VA-mycorrhiza (VAM fungi) when used as Biofertilizers enhance uptake of P, Zn, S and water, leading to uniform crop growth and increased yield and also enhance resistance to root diseases and improve hardiness of transplant stock.

7. They liberate growth promoting substances and vitamins and help to maintain soil fertility.

8. They act as antagonists and suppress the incidence of soil borne plant pathogens and thus, help in the bio-control of diseases.

9. Nitrogen fixing, phosphate mobilizing and cellulolytic microorganisms in bio-fertilizer enhance the availability of plant nutrients in the soil and thus, sustain the agricultural production and farming system.

10. They are cheaper, pollution free and renewable energy sources.

11. They improve physical properties of soil, soil tilth and soil health in general.

12. They improve soil fertility and soil productivity.

13. Blue green algae like *Nostoc, Anabaena,* and *Scytonema* are often employed in the reclamation of alkaline soils.

14. Bio-inoculants containing cellulolytic and lignolytic microorganisms enhance the degradation/ decomposition of organic matter in soil, as well as enhance the rate of decomposition in compost pit.

15. BGA plays a vital role in the nitrogen economy of rice fields in tropical regions.

16. *Azotobacter* inoculants when applied to many non-leguminous crop plants, promote seed germination and initial vigor of plants by producing growth promoting substances.

17. *Azolla-Anabaena* grows profusely as a floating plant in the flooded rice fields and can fix 100-150 kg N/ha /year in approximately 40-60 tones of biomass produced.

18. Plays important role in the recycling of plant nutrients.

19. Bio-pesticides : The term biopesticide is used for all kind of bio control agents like microbial pesticides, microbial herbicides, while the microbes used for insect control of often called bioinsecticides and use of microbes or its secretion to kill the weeds is microbial herbicides. (6) Some of the important biopesticides are as follows :

Microbes in environmental Cleaning : Bioremediation

A variety of industrial organic chemicals are released into the environment that serves as a raw material for microbial enzymes (7). The process of cleaning up the hazardous substances into non-toxic compounds is called the Bioremediation. Depending on their behavior in the environment, organic compounds are often classified as biodegradable, persistent or recalcitrant. A biodegradable organic compound is one that undergoes a biological transformation (8,9). A persistent organic compound does not undergo biodegradation in certain environments; and a recalcitrant compound resists biodegradation in a wide variety of environments. Mineralization is a parallel term to biodegradation, referring to complete degradation to the end products of CO_2, water and other inorganic compounds (10).

CONCLUSIONS

Biotechnology play a very important role in production of crop without much application of chemical fertilizers, pesticides, herbicides etc. It also keep our environment safe and clean for the use of the future generations. It helps the organisms and the engineers to find useful ways of getting adapted to the changes in the environment and keep the environment clean and green. The benefit of environmental biotechnology helps us to avoid the use of hazardous pollutants and wastes that affect the natural resources and the environment. The development of the society should be done in such a way that it helps to protect our environment and also helps us to development it. The environmental biotechnology has a role to play in the removal of the pollutants. Also biotransformation makes possibility of producing many useful industrial enzymes and product without causing any hazardous to the natural environment. In this way microbes and biotechnology go side by side to benefits the man kinds.

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