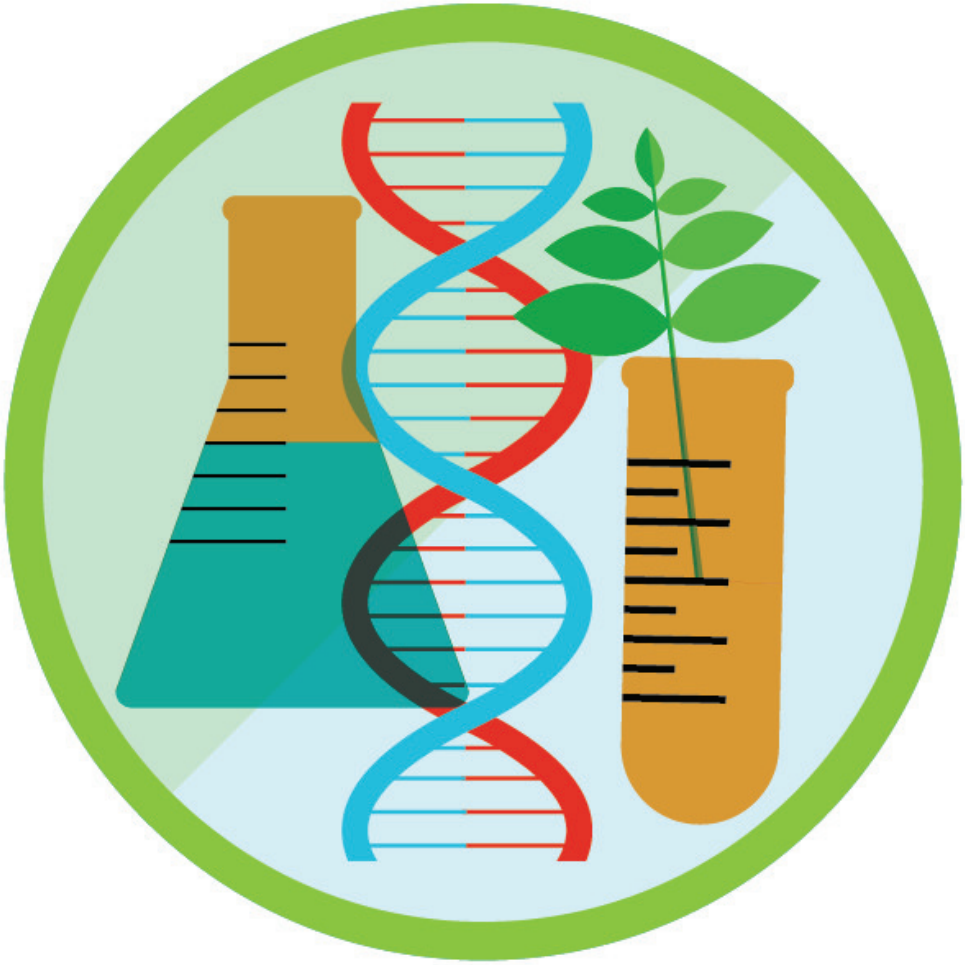
BIOTECHNOLOGY AND ITS APPLICATIONS



BIOTECHNOLOGY AND ITS APPLICATIONS

Biotechnology:

The use of biology to develop technologies and products for the welfare of human beings is known as biotechnology.

It has various applications in different fields such as therapeutics, diagnostics, processed food, waste management, energy production, genetically modified crops, etc.

Biotechnological Application in Agriculture:

- Biotechnology has different applications in agriculture.
- It can be used in agrochemicals, organic agriculture, and genetically engineered crop-based agriculture.
- To produce genetically modified organisms it can be used. Genetically modified organisms (GMO) can be obtained by alteration in their genetic material.

A different application of genetically modified organisms is:

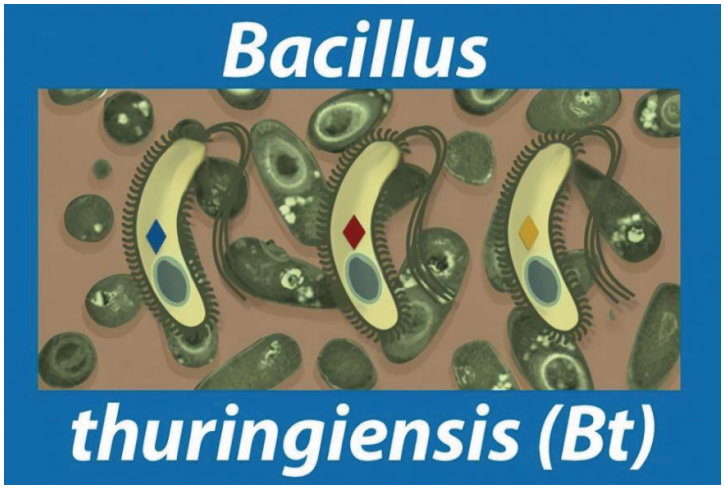
- Production of crops that are resistant to abiotic factors such as heat, cold, etc.
- Pest-resistant crops.
- Help to reduce post-harvest losses.
- Minerals can be used by the plants efficiently.
- Food with enhanced nutritional values.

Green Revolution:

The Green Revolution succeeded in tripling the food supply but yet it was not enough to feed the growing human population. Increased yields have partly been due to the use of improved crop varieties, but mainly due to the use of better management practices and use of agrochemicals (fertilisers and pesticides). for farmers in the developing world, agrochemicals are often too expensive and further increases in yield with existing varieties are not possible using conventional breeding Use of genetically modified crops is a possible solution.

Bacillus thuringiensis (Bt):

Bt toxin is produced by a bacterium called Bacillus thuringiensis (Bt for short). Bt toxin gene has been cloned from the bacteria and been expressed in plants to provide resistance to insects without the need for insecticides created a bio-pesticide Examples are Bt cotton, Bt corn, rice, tomato, potato and soyabean etc.



Bt Cotton:

Some strains of Bacillus thuringiensis produce proteins that kill certain insects such as lepidopterans (tobacco budworm, armyworm) coleopterans (beetles) and dipterans (flies, mosquitoes). B. thuringiensis forms protein crystals during a particular phase of their growth These crystals contain a toxic insecticidal protein. Bt toxin protein exist as inactive protoxins once the insect ingest the inactive toxin it is converted into an active form of toxin due to alkaline pH of gut which solubilise crystals activated toxin binds to the surface of midgut epithelial cells create pores that cause cell swelling and lysis and eventually cause death of the insect.

Cry:

Specific Bt toxin genes were isolated from Bacillus thuringiensis and incorporated into the several crop plants such as cotton as most Bt toxins are insect-group specific. The toxin is coded by a gene named cry. for example, the proteins encoded by the genes crylAc and crylIAb control the cotton bollworms, that of crylAb controls corn borer.

Pest Resistant Plants:

Various pests affect the plants which cause loss as well as a decrease in the yield of the plant.

A nematode Meloidogyne incognita infects the roots of tobacco plants and causes a decrease in the yield of the plant. To prevent this, RNA interference technology was used. This method involves silencing a specific mRNA due to a complementary dsRNA molecule. This inhibits the translation of the mRNA.

Biotechnological Applications In Medicine:

The rDNA technological processes have made immense impact in the area of healthcare by enabling mass production of safe and more effective therapeutic drugs. At present, about 30 recombinant therapeutics have been approved for human use the world over. In India, 12 of these are presently being marketed.

Genetically Engineered Insulin:

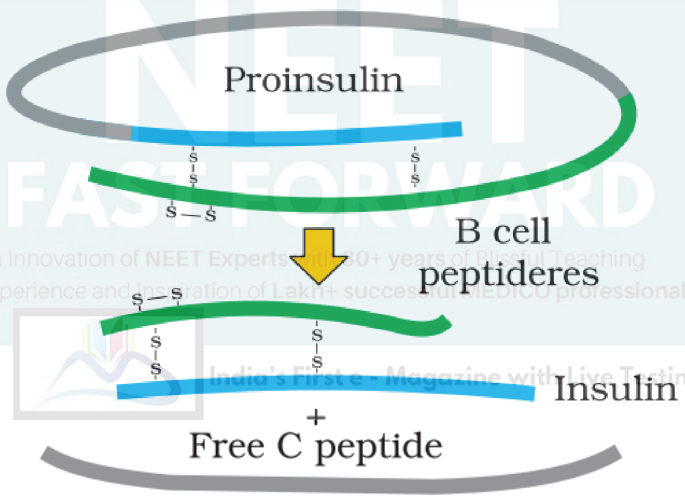
- Adult-onset diabetes can be controlled by taking insulin at regular intervals. The main source of this insulin was isolation of insulin from animals. Now a day's insulin can be obtained from bacterium using techniques of biotechnology.

- Insulin was earlier extracted from pancreas of slaughtered cattle and pigs but insulin from these sources develops allergy or other types of reactions to the foreign protein.

- Insulin consists of two short polypeptide chains- chain A and chain B, that are linked together by disulphide bridges.

- In humans, insulin is synthesized as a prohormone, which contains an extra stretch called C peptide, which is absent in mature insulin. The main challenge for production of insulin using rDNA technique was getting insulin assembled into a mature form.

- An American company, Eli Lilly in 1983 prepared two DNA sequence corresponding to A and B chain of human insulin and introduced them in plasmids of E.coli to produce insulin chain. Chain A and Chain B were produced separately, extracted and combined by creating disulphide bonds to form human insulin.



Gene Therapy:

- It is a collection of methods that allows correction of a gene defect that has been diagnosed in a child or embryo. This method is applied in a person with a hereditary disease. In this method, genes are inserted into a person's cells and tissues to treat a disease.

- The correction of gene defect involves delivery of a normal gene into the individual or embryo to take over the function of and compensate for non-functional gene.

- The first clinical gene therapy was done in 1990 to a 4 year old girl with adenosine deaminase (ADA) deficiency. This disorder is caused due to the deletion of the gene for adenosine deaminase that is essential for immune system to function. This defect can be treated by enzyme replacement

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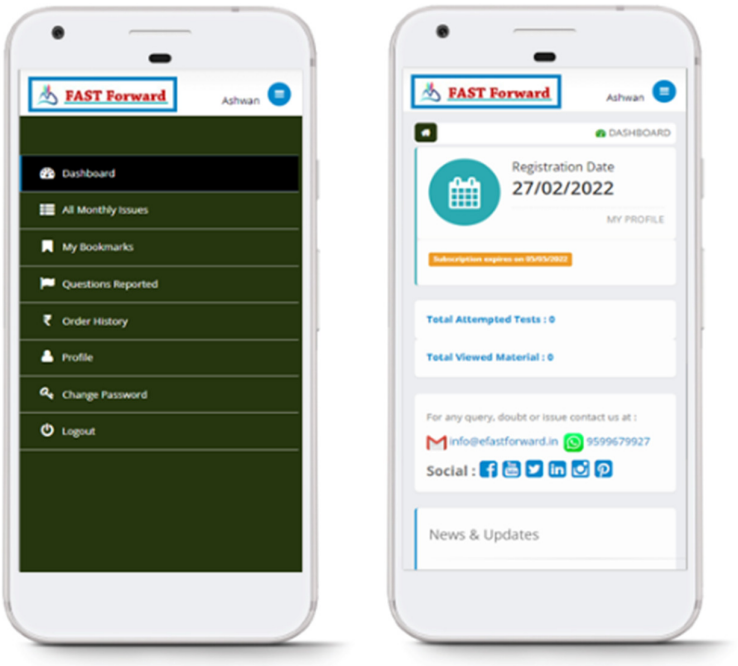

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