Chapter 12 Biotechnology and its Applications

Biotechnology is making Genetically modified organisms-microbes, plants, animals for industrial production of Bio-Pharmaceuticals and other useful products.

Applications –

i) Diagnostic & therapeutic
ii) Genetically modified crops
iii) Waste treatment
iv) Energy production
v) Food processing
vi) Bioremediation

Application in agriculture

Genetically modified organisms (GMO)-Plants, bacteria, fungi, animals.whose genes are altered by manipulation.

Transgenic crops(GMO) :-Crops contain or express one or more useful foreign genes.

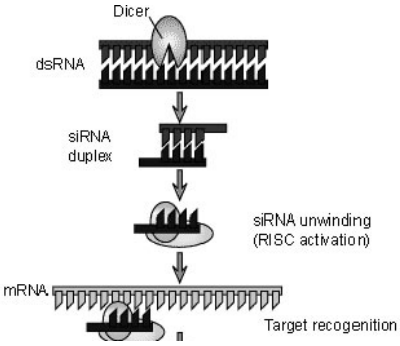
Advantages :-

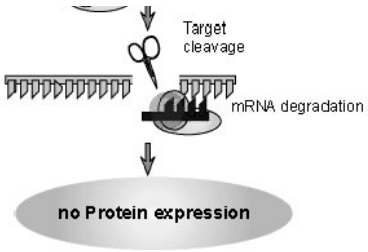
i) More tolerant to stresses (heat, cold, draught).
ii) Pest resistants GM crops, reduce the use of Chemical pesticides. Eg- BT **Cotton**
iii) Reduced post harvest losses. Eg- Flavr savr tomato.
iv) Enhance nutritional value of food. eg.- Golden Rice (Vitamin A enriched).
v) Increased efficiency of mineral use.

PEST RESISTANT PLANTS

Bt- cotton :- BT stands for Bacillus thuringiensis (Soil Bacteria). Bacterium produces proteins (Crystal Protein-cry I AC, cry II AB). A crystalliane insecticidal protein that kills the insects.Hence cry-Genes have been introduced in plants to produce crystal proteins as Protoxin (inactive toxin), which is converted to toxins in alkaline medium (i.e. in the gut of insects) and cause death of the insect larva.

Protection of plants against nematodes :-Nematode, Meloidogyne incognita infects tobacco plants & reduces yield. Specific genes (DNA) from nematodes introduced into the plants using Agrobacterium tumifecians (soil bacteria). Genes produce sense and antisense complementary RNA. Act as dsRNA and initiates RNAi (RNA interference) and silences the specific mRNA. Complementary RNA neutralizes the specific RNA of nematodes by a process called RNA Interference and parasite cannot live in transgenic host.





In medicine- genetically engineered insulin :—

rDNA technology was applied in therapeutic application by generating genetically engineered insulin for man. In 1983, Eli Lilly, an American company prepared 2 DNA sequences coding for chains A & B. Human insulin consists of two short Polypeptide chains A & B being linked by disulphide bridges.In man, Insulin secreted as Prohormone containing C peptides that is removed during maturation. In rDNA technique, insulin could be generated by preparing two separate DNA sequences of A & B chain which are incorporated into plasmids of E. coli to produce insulin chains.

Gene therapy

• Gene therapy involves correction of the gene defects in child or embryo.

• Adenosine deaminase deficiency is a kind of immuno-disorder caused by deletion of gene coding for ADA.

• It can be cured by bone marrow transplantation or enzyme replacement therapy.

• A functional ADA-cDNA(through Retrovirus) is introduced in lymphocyte culture for genetic infusion and transferred to the patient body for normal functioning.

Molecular diagnosis :-

Early & accurate detection of diseases substituting conventional diagnostic tecniques may be done by following methods: PCR (Polymerase chain reaction): Short stretches of pathogenic genome is amplified for detection of suspected AIDS, Cancer or genetic disorder. ELISA (Enzyme Linked Immunosorbent Assay) used to detect AIDS based on detection of antibodies produced against antigen of pathogen

Transgenic Animals

Animals with manipulated genes or a foreign gene to be expressed are called as transgenic animals. They are useful-

1. To know how genes contribute to development of disease.
2. To use proteins for treatment of disease.
3. To verify vaccine and chemical safety.

Biopiracy :-

Some organizations and multinational companies exploit or patent bioresources of other nations without proper authorization. Indian patent bill is there to prevent such unauthorized exploitation.

GEAC- For validity of GM research and the safety of introducing GM organism

Three mark question

1) What is the main advantage of producing genetically engineered insulin?

Ans- i) Produces only A&B peptides

ii) No C-Peptides produced

iii)No need to remove CPeptides during maturation.

2) What are the advantages of Molecular diagnosis technique?

Ans- i) Accurate

ii) disease can be detected at very early stage

iii)Can be diagnosed even if the number of pathogens is very low.

3)What are the potential risks (Three) of using GM food?

Ans – Potential risks- i)Products of transgene - allergic or toxic

ii) Cause damage to natural environment

iii) Weeds also become resistant

iv) Can endanger native species

4)What is hirudin? How do you get it?

Ans- Anti coagulant obtained from transgenic Brassica napus.

5) How does agro bacterium help to increase Tobacco production?

Ans –i) Introduction of Nematode specific gene.

ii)Production of dsRNA(Sense and anti- Sense)

iii)Silence specific mRNA.

6) Why do farmers face the problems in Agro chemical based farming?

Ans - i) Too expensive

ii) Conventional breeding procedure do not ensure increased production.

7) Why should farmers in India cultivate GM crops?

Ans - Tolerant to stress,pest resistant,less post-harvest losses, increased mineral use efficiency.

Five mark question

8)Explain the steps involved in the production of genetically engineered insulin?

Ans- i) Human insulin consists of 51 amino acids arranged in chains of A and B bearing 21 and 30 a. a respectively interconnected by disulphide bridges.