Applications of Biotechnology

i) Therapeutics
ii) Diagnostics
iii) Genetically modified crops for agriculture
iv) Processed food
v) Bioremediation
vi) Energy production

Increase in food production by biotechnology can be done by

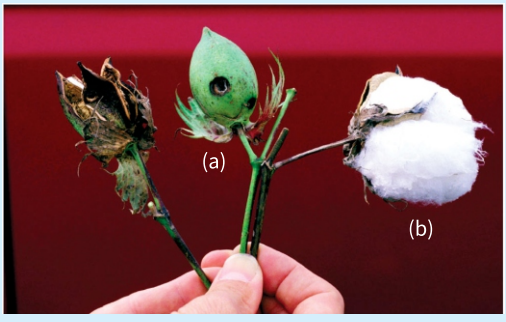
1. Agrochemical based agriculture (- using pesticide or a fertiliser)
2. Organic agriculture (- fertilisers of organic origin such as compost manure, green manure, etc.)
3. Genetically engineered crop-based agriculture

GENETICALLY MODIFIED PLANTS

- Plants whose genes have been altered by manipulation.
- It has increased tolerance levels against abiotic stresses, are pest resistant crops, efficient on minerals used by plants and has enhanced nutritional value of food.
- E.g vitamin 'A' enriched rice (golden rice).

Bt Cotton

- BT cotton is a genetically modified pest-resistant plant cotton variety, modified by the insertion of one or more genes from *Bacillus thuringiensis* (common soil bacteria) which produces an insecticide to combat bollworms.
- *Bacillus thuringiensis* produces cry proteins, which are present in BT cotton plants and these proteins are good at killing bollworm and tobacco budworm larvae – two caterpillar pests of cotton.
- Examples are Bt cotton, Bt corn, rice, tomato, potato and soyabean etc.



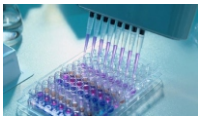
Cotton boll: (a) destroyed by bollworms; (b) a fully mature cotton boll

Pest resistant Plants (Bio – pesticides)

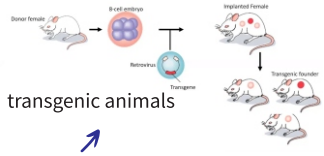
Nematode resistant in Tobacco Plants

- *Meloidogyne incognita* (nematode) intact tobacco roots
- RNA interference (RNA:) used to prevent it.
- mRNA silencing is done to inhibit translation of toxic crystal

Host plant- generated dsRNA triggers protection against nematode infestation (a) Roots of a typical control plants; (b) transgenic plant roots 5 days after deliberate infection of nematode but protected through novel mechanism.

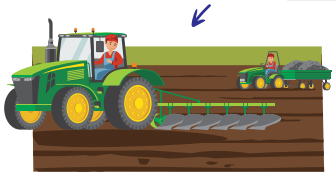


Medicine



transgenic animals

10. BIOTECHNOLOGY AND ITS APPLICATIONS



Agriculture

Food industry

MEDICINE

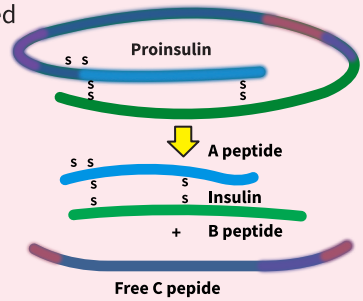
The recombinant DNA technology is used for production of therapeutic drugs which are safe and effective.

Insulin

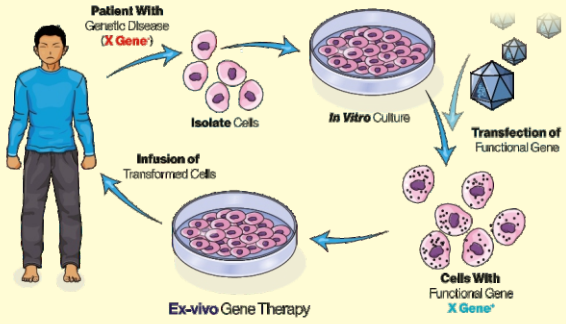
Insulin is prepared by recombinant DNA (rDNA) technology for medicinal purposes on a large scale. It was first produced in 1983 by an American Biotech company. The trademark name is Humulin® and it is licensed to Eli Lilly, the company which manufactured it for the first time.

Genes, which code for functional A and B peptides of insulin, were inserted in the plasmids of non-pathogenic *E.coli* strains.

Both the chains are produced separately and joined afterwards by disulphide linkages.



Gene Therapy



Gene therapy is a collection of methods used to correct gene defects in a child or embryo. It has been attempted on a 4-year-old girl with adenosine deaminase (ADA) deficiency, which can be cured by bone marrow transplantation and enzyme replacement therapy. Other diseases such as cystic fibrosis, hemophilia, cancer, and Parkinson's are also treated by gene therapy.

Molecular Diagnosis

- Early detection of a disease is not possible by conventional diagnosis methods.
- Some techniques used for early diagnosis are

1) Polymerase Chain Reaction (PCR)

- Amplification of desired sequence,
- Uses - HIV in AIDS identification
  -Detection of mutation in cancer patients
  -Detection of genetic disorders

2) Recombinant DNA technology uses a probe to hybridize to complementary DNA to detect mutated genes.

3) Enzyme Linked Immuno Sorbent Assay (ELISA)

- Antigen – antibody interaction principle.
- Use - Detection of pathogenic antigens

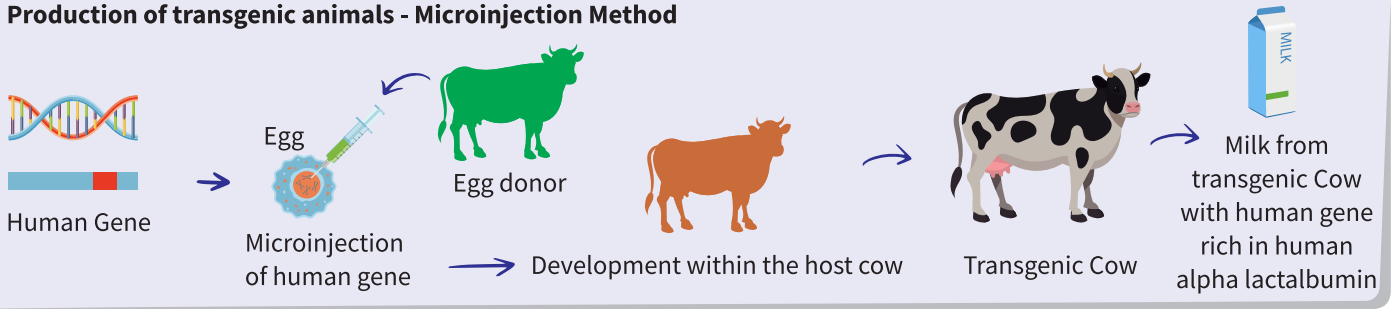
Transgenic Animals

Animals that have had their DNA manipulated to possess and express an extra (foreign) gene are known as transgenic animals. Transgenic rats, rabbits, pigs, sheep, cows and fish have been produced, although over 95% of all existing transgenic animals are mice.

Benefits of Transgenic animals

- Normal physiology & development & knowledge about gene regulation rate
- Study of diseases (eg. Transgenic models for cancer)
- Biological products. Eg. Human milk protein (α - 1 – antitrypsin) is used to treat emphysema.
- Vaccine safety (eg. Polio vaccine)

Production of transgenic animals - Microinjection Method



ETHICAL ISSUES

Genetic Engineering Approval Committee (GEAC)

Organisation established by Indian government to decide the validity of genetic engineering research and safety of GM organisms in public services.

BIOPiracy

Patent granted for biological entities and products derived from them. Eg. Basmati Rice

Indian Patents bills

Indian Parliament approved the amendment to the Indian Patents Bill, which concerns with Patent terms, emergency measures, etc.

BIOPATENT

Use of bio – resources by multinational corporations and other organization without proper permission from the governments and people involved.