

Biotechnology and Its Applications

- ❖ **Biotechnology:** Deals with industrial scale production of biopharmaceuticals and biologicals using GM microbes, fungi, plants and animals.
- ❖ Applications of biotechnology include:
 - + Therapeutics processed food
 - + Diagnostics bioremediation
 - + Genetically modified organisms
 - + Crops for agriculture
 - + Waste treatment
 - + Energy production

BIOTECHNOLOGICAL APPLICATIONS IN AGRICULTURE

- ❖ Made crops more tolerant to abiotic stresses (cold, drought, salt, heat).
- ❖ Reduced reliance on chemical pesticides (pest-resistant crops).
- ❖ Helped to reduce post harvest losses.
- ❖ Increased efficiency of mineral usage by plants (prevents early exhaustion of fertility of soil).
- ❖ Enhanced nutritional value of food, e.g., golden rice, i.e., Vitamin 'A' enriched rice.
- ❖ Insect resistant plants-Bt Cotton
- ❖ Pest resistant plants-Tobacco plant (By RNAi)

BIOTECHNOLOGICAL APPLICATIONS IN MEDICINE

30 recombinant therapeutics have been approved for human use the world over. In India, 12 of these are presently being marketed.

- ❖ Genetically Engineered Human Insulin (humulin) → manufactured by Eli Lilly, an American company in 1983
- ❖ Gene Therapy → First clinical gene therapy was conducted in 1990 in a 4 year old girl to treat adenosine deaminase (ADA) deficiency

MOLECULAR DIAGNOSIS METHODS

Parameters	Conventional	Modern
Early detection	Not possible	Possible
Examples	Serum and urine analysis	RDT, PCR, ELISA

TRANSGENIC ANIMALS

- ❖ Possess manipulated DNA and express foreign gene
- ❖ Transgenic rats, rabbits, pigs, sheep, cows
- ❖ 95% of transgenic animals are mice.

Uses of Transgenic Animals

- ❖ Transgenic models exist for study of diseases like cancer, cystic fibrosis, rheumatoid arthritis and Alzheimer's
- ❖ Biological products
 - + α -1 antitrypsin - Treat emphysema
 - + Similar attempts are made for treatment of PKU (Phenylketonuria) and cystic fibrosis.
 - + First transgenic cow: Rosie developed in 1997 producing human protein enriched milk (2.4 grams per litre)
- ❖ Vaccine Safety
Transgenic mice are being used to test the safety of polio vaccine to replace the use of monkey.
- ❖ Chemical safety testing
Transgenic animals are made more sensitive to toxic substances to obtain results in less time.

ETHICAL ISSUES

- ❖ GEAC (Genetic Engineering Approval Committee): Makes decisions regarding the validity of introducing GMO for public services.
- ❖ Biopiracy refers to the use of bio-resources by multinational companies and other organisations without proper authorization from the countries and people concerned without compensatory payment.
- ❖ The Indian Parliament has recently cleared the second amendment of the Indian Patents Bill.

CONTROVERSIES REGARDING PATENTS AND BIOPIRACY

- ❖ Basmati rice:
 - + 2,00,000 varieties of rice in India, 27 documented varieties of Basmati rice in India.
 - + In 1997, an American company got patent rights on Basmati rice through the US patent Trademark office.
- ❖ Turmeric and Neem
 - + Though Indian were using turmeric for hundred of years, in 1995, the patent for the use of turmeric in wound healing is given to university of Mississippi medical centre.
 - + Several traditionally herbal based medicinal products made up of turmeric and neem were also got patent.