

BIOTECHNOLOGY

Cell structure and Function

Cell wall and cell membrane, intracellular transport; Structural organization and functions of cell organelles; Cell division and cell cycle.

Biomolecules and Metabolism

Structure and function of carbohydrates, lipids, proteins and nucleic acids; Synthesis of carbohydrate, glycolysis, HMP, citric acid cycle and metabolic regulation; Oxidative phosphorylation and substrate level phosphorylation; Vitamins, hormones; Functional molecules, antioxidants, nutrient precursor, HSPs, anti-viral compounds. Enzymes, multienzyme complexes, immobilized enzymes and protein engineering, Analytical tools - NMR, HPLC.

Molecular Biology and Cellular processes

Organization and structure of prokaryotic and eukaryotic of genomes; DNA structure and properties; DNA replication, repair and recombination; Transcription, protein synthesis, regulation of gene expression at transcription and translation level; Role of chromatin, chromatin remodeling, gene silencing, epigenetic regulation.

Genetics, Phylogeny and Evolution

Mendelian inheritance, codominance, incomplete dominance, gene interactions, pleiotropy, genomic imprinting, linkage and cross-over, linkage disequilibrium; sex-linked inheritance; Quantitative genetics and Polygenic inheritance; Population Genetics and Hardy-Weinberg equilibrium; Extrachromosomal inheritance; Gene concept- Allele, multiple alleles, pseudoalleles; Mutations; Structural and numerical alterations of chromosomes, - Deletion, duplication, inversion, translocation, ploidy and their genetic implications. Mutagens.

Tissue culture

Totipotency, tissue culture media, Plant regeneration pathways; tissue culture applications, commercial clonal propagation, NCS-TCP. embryo, Endosperm and Anther culture; Protoplast culture, somatic hybrids; Cell suspension culture, production of secondary metabolites, hairy roots and bioreactor technology.

Recombinant DNA Technology

Gene cloning; *In vitro* mutagenesis and deletion techniques; PCR, RT-PCR and qRT-PCR; Methods for analysis of gene expression, large scale expression, bioprocess engineering.

Molecular Breeding

Molecular markers, Gene flow in plants; Marker assisted selection, mapping populations, QTL and association mapping, Gene pyramiding; Mapping genes on specific chromosomes Tools for plant genetic engineering, RNA interference, Transcriptional gene silencing, Gene traps/ T-DNA and transposable element insertion / activation lines, genome editing. Genetic engineering for biotic and abiotic stress tolerance; Plant response to pathogens and herbivores, biochemical and molecular basis of host plant resistance, virology. Intellectual Property Rights (IPR), Biosafety regulations, PPV&FRA, legal implications.

Genomics, proteomics and bioinformatics

Genome sequencing, Taxonomic classification of organisms using molecular markers -16S rRNA typing/sequencing; Differential gene expression; Genotyping/SNP detection; Biological Databases, Computational analysis of sequences- finding genes and regulatory regions; Gene annotation; Similarity searches; Pairwise and multiple alignments; Alignment statistics; Prediction of gene function using homology, context, structures, and networks. Identification and analysis of proteins by 2D analysis; Tryptic digestion of protein and peptide fingerprinting; Mass spectrometry; tools for studying Protein-protein interactions, Protein interaction maps; Protein arrays-definition, applications- diagnostics, and expression profiling.

Research Methodology

Research Methodology, types of research designs, sampling methods; Basic statistics- Measures of central tendencies, dispersion, uses of graphs and tables, software in statistical analysis, ANOVA, probability, types of errors in statistics, tests of significance, and sample size.