

GENETICS & PLANT BREEDING

(Subject Code-96)

Unit 1: General Genetics and plant Breeding

Mendelian inheritance, cell division, linkage, its detection and estimation. Epistasis Gene concept, allelism and fine structure of gene., Extra chromosomal inheritance . DNA - structure, function, replication and repair. Genetic code. Gene enzyme, relationship. Replication, Transcription and Translation. Gene regulation in prokaryotes and eukaryotes. Crop Improvement. Spontaneous and induced mutations and their molecular mechanisms. Crop domestication, evolution of crops and centres of diversity. Emergence of scientific plant breeding. Objective and accomplishments in plant breeding and the role of National and International Institutes. Gametogenesis and fertilization. Modes of sexual and asexual reproduction and its relation to plant breeding methodology. Apomixes incompatibility and male sterility systems and their use in plant breeding.

Unit 2: . Crop Improvement

Origin, distribution and floral biology of cereals, wheat, rice, maize) pulses pigeonpea, chickpea, black gram, green gram, pea, lentil, oilseeds, groundnuts, sesamum, rapeseed mustard, soybean, linseed; fibers and sugar crops, fodder and green manures. Breeding methods for self pollinated, cross pollinated and clonally propagated crops Component, recombinational and transgressive breeding. Single seed descent. Populations, their improvement methods and maintenance multiline approval. Ideotype breeding. Mutation breeding.

Unit 3: Cytogenetics of Crop Plants

Chromosome structure, function and replication. Recombination and crossing over karyotype analysis. Banding techniques. *In situ* hybridization. Special types of chromosomes. Chromosomal interchanges, inversions, duplications and deletions. Polyploids, haploids aneuploids and their utility. Wide hybridization and chromosomal manipulations for alien gene transfer. Pre-and post- fertilization barriers in wide hybridization. Genome organization and cytogenetics of important crop species- wheat, maize, rice, Brassica, cotton, Vigna potato and sugarcane. Principles and procedures of genome analysis. Cytogenetic techniques for gene location and gene transfer, somatic hybridization somadonal variation.

Unit 4: Quantitative Genetics

Quantitative characters. Multiple factors inheritance Genetic control of polygenic characters. Genetic advance and types of selection and correlated response. Hardy Weinberg law. Linkage disequilibrium. Genetic load. Polymorphism. Breeding value heritability. Response to selection, correlated response. Estimates of variance components and covariance among relatives. Estimation of gene effects and combing ability. Effects of linkage and epistasis on estimation of genetic parameters. Maternal effects.

Unit 5: Biometrical genetics

Genotype environment interactions and stability of performance. Mating system and mating design diallel, line X tester, NC-1, NC-II and NC-III designs, approaches to estimate and exploit component of self and cross pollinated crops. Genotype X environment interaction and stability analysis. Generation mean analysis, concept of combing ability & gene action, QTL mapping, strategy and

statistical methods in QTL mapping.

Unit 6: Heterosis Breeding

Concept and types of heterosis, Genetic, physiological, biochemical molecular, and biometrical basis or approaches of heterosis, role of genetic engineering in heterosis breeding. Two and three lines approaches of heterosis exploitation synthetic and composite varieties.

Unit 7: Molecular Breeding

Artificial synthesis of gene. Genetic and molecular markers, generations of molecular markers and their application in genetic analyses and breeding. molecular markers in genetic diversity analysis and breeding for complex characters. Gene tagging, marker aided selection. Genome projects and utilization of sequence formation. Vectors. DNA libraries, DNA finger printing, DNA sequencing. Nuclei acid hybridization and immunochemical detection. Chromosome walking. Recombinant DNA technology. Gene editing, Gene cloning strategies. Genetic transformation and transgenic Antisense RNA, RNAI and micro RNA techniques in crop improvement.

Unit 8: Plant Breeding for Stress Resistance and Nutritional Quality

Genetic basis and breeding for resistance to diseases and insect pests. Breeding for vertical and horizontal resistance to diseases. Genetic and physiological basis of abiotic stress tolerance. Breeding for Climate resilient crops. Breeding for resistance to heat frost, flood, drought and soil stresses. Important quality parameters in various crops, their genetic basis and breeding for these traits, Role of molecular markers in stress resistance breeding : MAS, MARS and MABB. Breeding for bio-fortification.

Unit 9: Plant Genetic Resources and their Regulatory Systems; Varietal Release and Seed Production

Plant exploration, germplasm introduction, exchange, conservation, evaluation and utilization of plant genetic resources. Convention on Biological Diversity and International Treaty on Plant Genetic Resources for Food and Agriculture. Intellectual Property Rights, Biodiversity Act. Plant Variety Protection and Farmers Rights Act. System of variety release and notification. Types of seeds and seed chain. Seed production and certificate.

Unit 10: Statistical Methods and Field Plot Techniques

Frequency distribution. Measures of central tendency, probability theory and its applications in genetics. Probability distribution and tests of significance. Correlation. Linear, partial and multiple regression. Genetic divergence. Multivariate analysis. Design of experiment- basic principles, completely randomized design, randomized block and split plot design. Complete and incomplete block designs. Augmented design, Grid and honeycomb design. Hill plots, unreplicated evaluation. Data collection and interpretation.