ST. JOSEPH’S COLLEGE FOR WOMEN (AUTONOMOUS) VISAKHAPATNAM

III SEMESTER **AGRICULTURE AND RURAL DEVELOPMENT** Time: 3hrs/week

**GPBR 211(2) FUNDAMENTALS OF PLANT BREEDING** Marks: 100

w.e.f 22AJ 2022-2023 SYLLABUS

**OBJECTIVES:**

* To study Genetics in relation to plant breeding.
* To study identifying the characteristics of self and cross pollinated crops
* To study about determine breeding methodology for plants.
* To study about basic statistical analysis related to plant breeding.

**COURSE OUTCOMES:**

At the end of the course, students will be able to

**CO1:** Explain historical development, concepts, nature and role of plant breeding and modes of reproduction.

**CO2:** Discuss plant introduction and centres of origin/diversity.

**CO3:** List and explain the different plant breeding methods.

**CO4:** Summarize the development of resistance and tolerance mechanisms.

**THEORY**

**UNIT – I: (6hrs)**

1 Historical developments, concept, nature and role of plant breeding, major achievements and future prospects - Definition, aim, objectives, history and developments of plant breeding, scientific contributions of eminent scientists - Landmarks in plant breeding - Scope of plant breeding.

2 Modes of reproduction and apomixis - Asexual reproduction (vegetative reproduction and apomixis) and sexual reproduction - Their classification and significance in plant breeding.

3 Modes of pollination - Classification of crop species on the basis of mode of pollination– self-pollination – mechanisms promoting self-pollination – Genetic consequences of self-pollination – Cross pollination – Mechanisms promoting cross pollination – Genetic consequences of cross pollination – Often cross pollinated crops.

4 Self– incompatibility - Classification – Heteromorphic, homomorphic, gametophytic and sporophytic systems of incompatibility – Advantages and disadvantages – Utilization in crop improvement.

5 Male sterility- Genetic consequences, cultivar options - Different types – Genetic, cytoplasmic and cytoplasmic genetic male sterility – Inheritance and maintenance– utilization of male sterile lines in hybrid seed production – Their advantages and disadvantages.

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6 Domestication, acclimatization and introduction - Plant introduction – Primary introduction and secondary introduction – Plant introduction agencies in India – National Bureau of Plant Genetic Resources (NBPGR) and its activities – Procedure of plant introduction – Merits and demerits of plant introduction.

7 Centre of origin/diversity - Centres of diversity– Centres of origin – Classification – law of homologous series – Types of centres of diversity – Germplasm collections – Genetic erosion – Main reasons of genetic erosion – Extinction - Gene sanctuaries - Introgression – Gene banks – Types of gene banks.

**UNIT-II: (6hrs)**

1. Breeding methods in self pollinated crops - Modes of selection - Selection – Natural and artificial selection – Basic principles of selection – Basic characteristics and requirements of selection – Selection intensity – Selection differential, heritability (narrow and broad sense) – Genetic advance as per cent of mean.

2 Mass selection – Procedure for evolving a variety by mass selection – Modification of mass selection – Merits, demerits and achievements.

3 Pure line selection - Johannsen’s pure line theory and its concepts and significance – Origin of variation in pure lines – Characters of pure lines – Progeny test, genetic basis of pure line selection – General procedure for evolving a variety by pure line selection – Merits, demerits and achievements – Comparison between mass and pure line selection.

4 Hybridization techniques - Hybridization – Aims and objectives – Types of hybridization – Pre-requisites for hybridization – Procedure / steps involved in hybridization.

5 Handling of segregating population - Pedigree method – Procedure – Merits, demerits and achievements. 13 Bulk method – Procedure – Merits, demerits and achievements – Comparison between pedigree and bulk methods - Single seed descent method – Merits and demerits.

**UNIT-III: (6hrs)**

1 Backcross method of breeding–Its requirements and applications – Procedure for transfer of single dominant gene - Procedure for transfer of single recessive gene – Merits, demerits and achievements - comparison between pedigree and backcross method.

2 Multiline concept - Definition – Characteristics of a good multiline – Development of multiline varieties – Achievements.

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3 Concepts of population genetics and Hardy - Weinberg Law - Hardy Weinberg Law – Factors affecting equilibrium frequencies in random mating populations - Selection without progeny testing – Selection with progeny testing - Merits and demerits of progeny selection – Line breeding– achievements.

4 Recurrent selection – Different types – Detailed procedure of simple recurrent selection and other recurrent selection methods – Conclusion on the efficiency of different selection schemes.

5 Heterosis - Heterosis and hybrid vigour – Luxuriance – Heterobeltiosis – Brief history– heterosis in cross pollinated and self pollinated species – Manifestations of heterosis

6 Genetic basis of heterosis – Dominance, over dominance and epistasis hypotheses – Objections and their explanations – Comparison between dominance and overdominance hypotheses – Physiological basis of heterosis

**UNIT-IV: (6hrs)**

1 Inbreeding depression - Brief history – Effects of inbreeding – Eegrees of inbreeding depression – Procedure for development of inbred lines and their evaluation.

2 Development of inbred lines and hybrids - Exploitation of heterosis – History of hybrid varieties – Important steps in production of single and double cross hybrids – Brief idea of hybrids in maize, pearl millet, sunflower and rice.

3 Composite and synthetic varieties - Production procedures – Merits, demerits and achievements – Factors determining the performance of synthetic varieties – Comparison between synthetics and composites.

4 Breeding methods in asexually propagated crops, clonal selection and hybridization - Characteristics of asexually propagated crops – Characteristics of clones –Clonal selection – Procedure – Advantages and disadvantages – Problems in breeding asexually propagated crops – Genetic variation within a clone – Clonal degeneration – Achievements – Comparison among clones, purelines and inbreds - Breeding of annual asexually propagated species through hybridization – Interspecific hybridization.

5 Wide hybridization and pre-breeding - History – Objectives – Barriers for the production of distant hybrids– Techniques for production of distant hybrids – applications of wide hybridization in crop improvement – Sterility in distant hybrids – Limitations and achievements -use of gene pools to develop intermediate breeding material.

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6 Polyploidy in relation to plant breeding - Polyploidy – Autopolyploids – Origin and production – Morphological and cytological features– Applications in crop improvement – Limitations– Allopolyploidy – Morphological and cytological features– Applications in crop improvement – Limitations.

7 Mutation breeding - Methods and uses - Mutation breeding – Procedure of mutation breeding – Applications – Advantages, limitations and achievements.

**UNIT-V: (6hrs)**

1 Breeding for important biotic and abiotic stresses - Disease resistance – Mechanisms of disease resistance in plants (disease escape, tolerance, resistance, immunity and hypersensitivity) – Genetic basis of disease resistance – Gene for gene hypothesis – sources of disease resistance – Breeding methods for disease resistance – Achievements.

2 Insect resistance – Mechanism of insect resistance in plants (non preference, antibiosis, tolerance and avoidance) – Nature of insect resistance – Genetics of insect resistance – Horizontal and vertical resistance– Sources of insect resistance – breeding methods for insect resistance – Problems in breeding for insect resistance – Achievements.

3 Drought resistance – Mechanisms of drought resistance (drought escape, avoidance, tolerance, and resistance) – Features associated with drought resistance – Sources of drought resistance – Breeding methods for drought resistance – Limitations – achievements - Resistance to water logging – Effects of water logging - Mechanism of tolerance – Ideotype for flooded areas.

4 Salt tolerance – Response of plants to salinity – Symptoms – Mechanisms of salt tolerance – Breeding methods for salt tolerance – Problems – Achievements. Cold tolerance – Chilling resistance – Effects of chilling stress on plants – Mechanism of chilling tolerance – Sources of chilling tolerance – Selection criteria.

5 Biotechnological tools - DNA markers and marker assisted selection - Definition and classification of DNA markers and applications.

6 Participatory plant breeding - Definition – Goals – Methodology – Advantages and limitations.

**References text books**

1. Phundan Singh, 2014. Essentials of Plant Breeding. Kalyani Publishers, New Delhi.
2. Singh, B.D. 2015. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
3. Gupta, S.K. 2010. Plant Breeding Theory and Techniques.Wiley India Pvt. Ltd. New Delhi.
4. Allard, R.W. 2010. Principles of Plant Breeding. John Wiley and Sons, New York.
5. Poehlman, J.M. and Borthakur, D. 1995. Breeding of Asian Field Crops. Oxford and IBH Publishing Co., New Delhi.
6. Sharma, J.R. 1994. Principles and Practice of Plant Breeding.Tata McGraw Hill, Publishing Company Ltd., New Delhi. GPBR 311 CROP IMPRO

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