GPB 604: PLANT GENETIC RESOURCES, CONSERVATION AND UTILIZATION (2+0)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
GPB 604	Plant Genetic Resources, Conservation and Utilization	50	40	10	00	00	2	0	2

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on the methods of germplasm conservation and its utilization.

Theory

UNIT I

Concept of natural reserves and natural gene banks; In situ conservation of wild species in nature reserves: in situ conservation components, factors influencing conservation value, national plan for in situ conservation; in situ conservation of agro-biodiversity on-farm; scientific basis of in situ conservation on-farm, building on-farm conservation initiatives, implementation of on-farm conservation, management of in situ conserved genetic diversity on-farm, enhancing benefits for farmers from local crop diversity.

UNIT II

Ex situ conservation: components, plant genetic resources conservation in gene banks, national gene banks, gene repositories, preservation of genetic materials under natural conditions, perma-frost conservation, guidelines for seed multiplication and exchange to network of active/ working collections, orthodox, recalcitrant seeds- differences in handling, clonal repositories, genetic stability under long term storage condition.

UNIT III

In-vitro storage, maintenance of in-vitro culture under different conditions, in-vitro bank maintenance for temperate and tropical fruit crop species, spices, tubers, bulbous crops, medicinal and endangered plant species, conservation of embryos and ovules, cell/ suspension cultures, protoplast and callus cultures, pollen culture, micropropagation techniques, problems, prospects of in-vitro gene bank.

UNIT IV

Cryopreservation- procedure for handling seeds of orthodox and recalcitrant-cryoprotectants, desiccation, rapid freezing, slow freezing, vitrification techniques, encapsulation/ dehydration techniques, national facilities, achievements, application of cryopreservation in agricultural, horticultural and forestry crops. Problems and prospects; challenges ahead.

UNIT V

Concept and procedure for PGR management, germplasm characterization, evaluation and utilization; Concept of core and mini core; collections and registration of plant germplasm

Suggested Readings

- Ellis RH, Roberts EH and White Head J. 1980. A New More Economic and Accurate Approach to Monitor the Viability of Accessions During Storage in Seed Banks. FAO/ IBPGR Pl. Genet. Resources News 41-3-18.
- Frankel OH and Hawkes JG. 1975. Crop Genetic Resources for Today and Tomorrow. Cambridge University Press, Cambridge.
- Paroda RS and Arora RK.1991. Plant Genetic resource Conservation and management, NBPGR, New-Delhi. Simmonds NW. 1979. Principles of Crop Improvement, Longman.
- Westwood MN. 1986. Operation Manual for National Clonal Germplasm Repository. Processed Report. USDA-ARS and Oregon State Univ. Oregon, USA.
- Withers LA. 1980. Tissue Culture Storage for Genetic Conservation. IBPGR Tech. Rep. IBPGR, Rome, Italy.

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GPB 607: CROP EVOLUTION (2+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
GPB 607	Crop Evolution	50	40	10	00	00	3	0	3

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on crop evolutionary aspects and role of mutations, hybridizations and polyploidy in crop evolution and improvement.

Theory

UNIT I

Origin and evolution of species; Centres of diversity/ origin, diffused centres; Time and place of domestication; Patterns of evolution and domestication-examples and Case studies; Domestication and uniformity – Characteristics of early domestication and changes – Concept of gene pools and crop evolution; Selection and Genetic drift – Consequences

UNIT II

Speciation and domestication–The process of speciation, Reproductive isolation barriers; Genetic differentiation during speciation; Hybridization - speciation and extinction; Exploitation of natural variation: Early attempts to increase variation, Distant hybridization and introgression, Inter-specific, inter-generic hybridization, scope and limitations, techniques to overcome the limitations.

UNIT III

Gene transfer into cultivated species, tools and techniques; Validation of transferred genes and their expression; Controlled introgressions. Processes in crop evolution and stabilization of polyploids, cytogenetic and genetic stabilization; Genome organization – Transgenesis in crop evolution, Multifactorial genome, Intragenomic interaction, Intergenomic interaction, Genome introgression.

UNIT IV

Methods to study crop evolution - Contemporary Methods, Based on morphological features, Cytogenetic analysis, Allozyme variations and crop evolution, DNA markers, genome analysis and comparative genomics. Evolutionary significance of polyploidy, evolution of crop plants through ploidy manipulations.

UNIT V

Polyploids: methods, use of autopolyploids; haploidy and DH-method of production and use, allopolyploids; synthesis of new crops; Case studies – Cereals, Pulses, Oilseeds, vegetables, Fibre crops, Plantation crops, Forage crops, Tuber crops, Medicinal Plants.

Suggested Readings

- Hancock JF. 2004. Plant Evolution and the Origin of Crop Species. 2nd Ed. CABI.
- Ladizinsky G. 1999. Evolution and Domestication. Springer.
- Miller AJ. 2007. Crop Plants: Evolution. John Wiley & Sons.
- Smartt J and Simmonds NW. 1995. Evolution of Crop Plants. Blackwell

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MBB 602: PLANT GENOME ENGINEERING (3+0)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
MBB 602	Plant Genome Engineering	50	40	10	00	00	3	0	3

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To discuss the specialized topics and advances in field of genetic engineering and application of molecular tools in breeding of specific crops.

Theory

UNIT I

Conventional versus non-conventional methods for crop improvement; Present status and recent developments on available molecular marker, transformation and genomic tools for crop improvement. Genetic engineering for resistance against abiotic (drought, salinity, flooding, temperature, etc) and biotic (insect pests, fungal, viral and bacterial diseases, weeds, etc) stresses;

UNIT II

Genetic Engineering for increasing crop productivity by manipulation of photosynthesis, nitrogen fixation and nutrient uptake efficiency; Genetic engineering for quality improvement (protein, essential amino acids, vitamins, mineral nutrients, etc.); edible vaccines, etc.

UNIT III

Recent developments in plant transformation strategies; Role of antisense and RNAi-based gene silencing in crop improvement; Regulated and tissue-specific expression of transgenes for crop improvement

UNIT IV

Gene stacking; Pathway engineering; Marker-free transgenic development strategies; Genome editing: principles and methods, Development of genome edited plants; High throughput phenotyping of transgenic plants.

UNIT V

Field studies with transgenic crops; Environmental issues associated with transgenic crops; Food and feed safety issues associated with transgenic crops; Risk assessment of transgenic food crops.

Suggested Readings

• Christou P and Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.

• Stewart Jr, C.N. 2016. Plant Biotechnology and Genetics: Principles, Techniques, and Applications. John Wiley & Sons.

• Kirakosyan A and Kaufman PB. 2009. Recent Advances in Plant Biotechnology p. 409. Dordrecht: Springer.

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SST 604: GENETIC PURITY AND DUS TESTING (2+1)

Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		THEORY			PRACTICAL		L	P	CREDITS
		End Sem University Exam	Mid Term Exam	Teachers Assessment*	End Sem University Exam	Teachers Assessment*			
SST 604	Genetic Purity and DUS Testing	50	30	00	15	05	2	1	3

Legends: L - Lecture; **P** – Practical;

*Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class etc.

Objective

To impart knowledge on various methods of genetic purity assessment and DUS testing for protection of plant varieties.

Theory

UNIT I

Genetic purity – importance – factors influencing genetic purity; genetic/ cultivar purity test – objectives – principles – methods; laboratory tests – green house and field plot methods, grow – out test, seed and seedling growth tests; chemical and biochemical methods; anthocyanin pigmentation, secondary compounds, phenol, peroxidase and fluorescence tests – chromatography techniques.

UNIT II

Electrophoretic analysis of proteins and isozymes; DNA finger printing methods – RAPD, AFLP, SSR, SNP and other markers; computer based machine vision technique and image analysis for varietal identification.

UNIT III

Genesis of Plant Variety Protection (PVP); International Union for Protection of New Varieties of Plants (UPOV) and its functions – GATT agreement in relation to plant variety protection; Protection of Plant Varieties and Farmer's Rights (PPV and FR) Act 2001 – objectives, salient features, farmer's rights, breeder's rights, researcher's rights – PPV and FRA Rules 2003.

UNIT IV

Criteria for protection of new varieties of plants; Distinctness, Uniformity and Stability (DUS) testing – principles and procedures, guidelines, sample size, test duration, testing option; varieties of common knowledge – extant variety – essentially derived variety – collection of reference

samples – grouping of varieties – example varieties; types and categories of characters – recording observations on characteristics – colour characteristics.

UNIT V

Assessment of DUS characters of major crops based on morphological, biochemical and molecular markers – rice, maize, wheat, barley, black gram, green gram, red gram, cowpea, rajma, sunflower, groundnut, castor, mustard, tomato, brinjal, onion, potato, chilli, bhendi, cucurbits, cole crops, sugarcane, cotton, flower, fruit and tree species; statistical procedure – computer software for DUS testing; guidelines for registration of germplasm – impact of plant variety protection on seed industry growth.

Practical

• Genetic purity assessment based on seed characters;

• Genetic purity assessment based on seedling growth tests, anthocyanin pigmentation;

• Genetic purity assessment based on secondary compounds, phenol, peroxidase and fluorescence tests;

• Chromatography analysis of secondary compounds;

• Electrophoretic analysis of seed protein and isozymes;

• DNA fingerprinting using PCR techniques;

• DUS testing based on morphological descriptors of plant – rice and millets;

• DUS testing based on morphological descriptors of plant – pulses and oil seeds;

• DUS testing based on morphological descriptors of plant – vegetable crops;

• DUS testing based on morphological descriptors of plant – flower, fruit and tree species;

• Recording observations and interpretation of data;

• Tree method of classification of varieties/ cultivars;

• Chemical and biochemical test applicable for DUS testing;

• Practical exercise on recording DUS characteristics, statistical analysis and interpretation in major agricultural crops;

• Practical exercise on recording DUS characteristics, statistical analysis and interpretation in major horticultural crops;

• Visit to DUS test centers

Suggested Readings

- Anon. 2016. Manual of Seed Certification Procedures. Directorate of Seed Certification, Coimbatore, Tamil Nadu.
- Chakrabarthi SK. 2010. Seed Production and Quality Control. Kalyani Publishers, New Delhi.

- Choudhary DR. 2009. Guidelines for Storage and Maintenance of Registered Plant Varieties in the National Gene Bank. Published by Protection of Plant Varieties and Farmer's Rights Authority. Ministry of Agriculture, GoI, New Delhi, India.
- ISTA. 2010. Handbook of Variety Testing. International Seed Testing Association, Switzerland.
- Joshi AK and Singh BD. 2004. Seed Science and Technology, Kalyani Publishers, New Delhi, India.
- Maiti RK, Sarkar NC and Singh VP. 2006. Principles of Post Harvest Seed Physiology and Technology. Agrobios., Jodhpur, India.
- Mishra DK, Khare D, Bhale, MS and Koutu GK. 2011. Handbook of Seed Certification. Agrobios, Jodhpur, Rajasthan.
- Ramamoorthy K, Sivasubramaniam K and Kannan M. 2006. Seed Legislation in India. Agrobios, Jodhpur, Rajasthan.
- Trivedi PC. 2011. Seed Technology and Quality Control. Publications, Jaipur, Rajasthan.

Suggested e-books

https://books.google.co.in/books?isbn=16118603932.

https://books.google.co.in/books?isbn=81894220303.

https://books.google.co.in/books?id=2FbwZwEACAAJ

https://books.google.co.in/books?id=J5bQtgAACAAJ

https:/books.google.co.in/books?isbn=0851997392

https://www.upov.int/edocs/tgdocs/en/tg023.pdf

Suggested websites

www.seedquest.com

www.ucanr.edu

www.sasa.gov.uk

www.ppvfra.org

https://www.upov.int/test_guidelines/en/

http://plantauthority.gov.in/crop-guidelines.htm

https://www.upov.int/resource/en/dus_guidance.html

https://www.upov.int/edocs/tgpdocs/en/tgp_6_section_2.pdf

https://www.upov.int/publications/en/tg_rom/introduction.html