PHDGPB607: 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*			
PHDGPB607	Crop Evolution	60	00	40	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

(Dr. Santosh Dhar) Dean- Faculty of Doctoral Studies and Research, SVVV, Indore	(Dr. K. N. Guruprasad) Dean-Faculty of Agriculture, SVVV, Indore	(Dr. Shishir Jain) Controller of Examination, SVVV, Indore	(Dr. Arvind Singh) Joint Registrar, SVVV, Indore

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PHDGPB609: IPR and Regulatory Mechanism (E-Course) (1+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	Teacher's Assessment*			
PHDGPB609	IPR and Regulatory Mechanism (e-course)	60	00	40	00	00	1	0	1

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

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

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR), related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy**.**

Theory

UNIT I: Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs.

Unit II: Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection.

Unit III: Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection.

Unit IV: National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture.

Unit V: Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement

Suggested Readings

- Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
- Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.
- Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.

(Dr. Santosh Dhar) Dean- Faculty of Doctoral Studies and Research, SVVV, Indore	(Dr. K. N. Guruprasad) Dean-Faculty of Agriculture, SVVV, Indore	(Dr. Shishir Jain) Controller of Examination, SVVV, Indore	(Dr. Arvind Singh) Joint Registrar, SVVV, Indore

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PHDMBB601: PLANT MOLECULAR BIOLOGY (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*			
PHDMBB601	Plant Molecular Biology	60	00	40	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 provide in depth knowledge of recent developments of plant molecular biology and applications

• To discuss case studies and success stories in agriculture and industry

Theory

Unit I : Model Systems in Plant Biology (Arabidopsis, Rice, etc.) Forward and Reverse Genetic Approaches. Organization expression and interaction of nuclear, Mitochondrial and Chloroplast Genomes. Cytoplasmic male sterility.

Unit II: Transcriptional and Post-transcriptional Regulation of Gene Expression, Isolation of promoters and other regulatory elements, RNA interference, Transcriptional Gene Silencing, Transcript and Protein Analysis.

Unit III: Plant Developmental Processes, ABC Model of Floral Development, Role of hormones (Ethylene, Cytokinin, Auxin and ABA, SA and JA) in plant development.

Unit IV: Regulation of Flowering, Plant photoreceptors and light signal transduction, vernalization, Circadian Rhythms. Abiotic Stress Responses: Salt, Cold, Heat and Drought.

UNIT V: Biotic Stress Responses. Molecular Biology of Plant-pathogen Interactions, Molecular Biology of Rhizobium and Agrobacterium- Plant interaction. Role of programmed Cell Death in Development and Defense.

Suggested Readings

• Buchanan, B.B., Gruissem, W. and Jones R. 2015. Biochemistry and Molecular Biology of Plants, 2nd edition, Wiley and Blackwell Publications.

• Slater, A., Scott, N.W., and Fowler, M.R. 2003. The Genetic Manipulation of Plants. Plant Biotechnology Oxford, England: Oxford University Press.

• Walker, J.M., Rapley, R. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications.

(Dr. Santosh Dhar) Dean- Faculty of Doctoral Studies and Research, SVVV, Indore	(Dr. K. N. Guruprasad) Dean-Faculty of Agriculture, SVVV, Indore	(Dr. Shishir Jain) Controller of Examination, SVVV, Indore	(Dr. Arvind Singh) Joint Registrar, SVVV, Indore

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PHDMBB602: 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*			
PHDMBB602	Plant Genome Engineering	60	00	40	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.

(Dr. Santosh Dhar)	(Dr. K. N. Guruprasad)	(Dr. Shishir Jain)	(Dr. Arvind Singh)
Dean- Faculty of Doctoral Studies and Research, SVVV, Indore	Dean-Faculty of Agriculture, SVVV, Indore	Controller of Examination, SVVV, Indore	Joint Registrar, SVVV, Indore

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Course Code	Course Name	TEACHING & EVALUATION SCHEME							
		Theory			Practical		Credits		
		END SEM University Exam	Mid term exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*	L	P	Total
PHDPLPATH 604	Molecular Basis of Host-Pathogen Interaction	60	00	40	30	20	2	1	3

1. Legends: L - Lecture; P – Practical
2. *Teacher Assessment shall be based on following components: Quiz / Assignment / Project / Participation in Class.

Aim of the course:

To understand the concepts of molecular biology and biotechnology in relation to host plant-pathogen interactions.

Theory

Unit I: History of host plant resistance and importance to Agriculture. Importance and role of biotechnological tools in plant pathology. Basic concepts and principles to study host pathogen relationship. Molecular genetics, imaging and analytical chemistry tools for studying plants, microbes, and their interactions.

Unit II: Different forms of plant-microbe interactions and nature of signals/ effectors underpinning these interactions. Plant innate immunity: PAMP/ DAMP. Molecular basis of host-pathogen interaction-fungi, bacteria, viruses and nematodes; recognition system, signal transduction.

Unit III: Induction of defence responses- HR, Programmed cell death, reactive oxygen species, systemic acquired resistance, induced systemic resistance, pathogenesis related proteins, phytoalexins and virus induced gene silencing. Molecular basis of genefor-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

Unit IV: Gene for gene systems: Background, genetics, phenotypes, molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Coevolution-arms race and trench warfare models, Metapopulations, cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. natural populations, Durability of resistance, erosion of quantitative resistance. Pathogen population genetics and durability, viruses vs cellular pathogens.

Unit V: Gene deployment, cultivar mixtures. Disease emergence, host specialization. Circadian clock genes in relation to innate immunity. Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Practical: PHDPLPATHP604

• Protein, DNA and RNA isolation, plasmid extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation;
• Gene mapping and marker assisted selection;
• Development and use of molecular markers in identification and characterization of resistance to plant pathogens and their management.

Suggesting Reading

- Chet I. 1993. Biotechnology in Plant Disease Control. John Wiley & Sons, New York.
- Gurr SJ, McPohersen MJ and Bowlos DJ. (Eds.). 1992. Molecular Plant Pathology – A Practical Approach. Vols. I & II, Oxford Univ. Press, Oxford.
- Mathew JD. 2003. Molecular Plant Pathology. Bios Scientific Publ., UK.
- Ronald PC. 2007. Plant-Pathogen Interactions: Methods in Molecular Biology. Humana Press, New Jersey.
- Stacey G and Keen TN. (Eds.). 1996. Plant Microbe Interactions. Vols. I-III. Chapman & Hall, New York; Vol. IV. APS Press, St. Paul, Minnesota.

(Dr. Santosh Dhar) Dean- Faculty of Doctoral Studies and Research, SVVV, Indore	(Dr. K. N. Guruprasad) Dean-Faculty of Agriculture, SVVV, Indore	(Dr. Shishir Jain) Controller of Examination, SVVV, Indore	(Dr. Arvind Singh) Joint Registrar, SVVV, Indore

PHDSST601: HYBRID SEED PRODUCTION TECHNOLOGY (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	Teacher's Assessment*			
PHDSST 601	Hybrid Seed Production Technology	60	00	40	30	20	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 provide students a comprehensive knowledge and practical exposure on hybrid seed production techniques in agricultural and horticultural crops

Theory

UNIT I

Introduction – history – scope – importance of hybrid development – national and international scenario of seed industry – popular public sector hybrids in various crops. Heterosis – definition – expression – types – utilization of heterosis in hybrid development, hybrid vigour and seed vigour.

Unit II

Types of hybrids – intra-specific, inter-specific hybrids, single, double, three way cross, top cross hybrids – apomixes; generation system of seed multiplication in different types of hybrids. Development and maintenance of inbred lines – male sterile – maintainer lines – fertility restoration – transgenic hybrids – principles and method of development.

Unit III

Breeding tools – genetic mechanism – male sterility – types: CMS, GMS, CGMS, TGMS, PGMS – barnase and barstar system – pistillateness – self incompatibility. Manual creation of male sterility – emasculation and pollination – gametocides – mode of action, mechanism. Synchronization of flowering – problems – methods to achieve synchrony – planting ratio and supplementary pollination methods.

UNIT IV

Techniques of hybrid seed production in major agricultural crops – cereals (wheat, rice), millets (maize, sorghum, bajra), pulses (red gram), oilseeds (sunflower, castor, mustard), cotton and forage crops

UNIT V

Hybrid seed production techniques in horticultural crops – tomato, brinjal, chilli, bhendi, onion, bitter gourd, bottle gourd, ridge gourd, cucumber, melon, cabbage, cauliflower, potato, coconut and papaya

Practical: PHDSSTP601

• Characteristics features of parental lines and their hybrids;

• Floral biology of rice, maize, pearl millet, sunflower, castor and cotton;

• Study on floral biology of vegetable crops – solanaceous and other vegetables;

• Study on floral biology of cucurbitaceous crops;

• Production and maintenance of A, B and R lines;

• Practicing planting design and border rows – rice, maize, pearl millet, sunflower and red gram; brinjal and chillies;

• Practicing planting design and border rows in tomato, cotton and cucurbitaceous vegetables;

• Manipulation for synchronization – rice, sunflower, pearl millet and sorghum;

• Practicing supplementary pollination – rice and sunflower;

• Practicing field inspection in hybrid seed production plot – crops planted in ratio – sunflower, pearlmillet, sorghum, etc.;

• Practicing field inspection in hybrid seed production field – red gram, castor, cotton, cucurbits and tomato;

• Practicing roguing and identification of off-types – pollen shedders – shedding tassel – selfed fruits;

• Visit to hybrid seed production fields;

• Visit to potato seed production plots;

• Determination of cost benefit of hybrid seed production;

• Visit to seed Industry and assessing problems and perspectives in hybrid seed production.

Suggested Readings

- Agarwal RL. 2012. Seed Technology. 3rd Ed. Oxford & IBH Publishers, New Delhi.
- Basra A. 1999. Heterosis and Hybrid Seed Production in Agronomic Crops. CRC Press., Florida, United States.
- Chhabra AK. 2006. Practical Manual of Floral Biology of Crop Plants. Department of Plant Breeding, CCSHAU, Hisar.
- Dar SH. 2018. Methods of Hybrid Seed Production in Major Crops. Educreation Publishing, Chhattisgarh.
- Frankel R and Galun E. 1977. Pollination Mechanisms, Reproduction and Plant Breeding. Springer Verlag, New York.
- Hebblethwaite PD. 1980. Seed Production. Butterworth Heinemann Ltd., London, UK.
- Joshi AK and Singh BD. 2004. Seed Science and Technology. Kalyani Publishers, New Delhi.
- Krishnan M. 2012. Plant breeding and Hybrid Seed Production. Domin and Publishers & Distributors, New Delhi, India.
- Kulkarni GN. 2011. Principles of Seed Technology. Kalyani Publishers, New Delhi.
- Maiti RK, Sarkar NC and Singh VP. 2006. Principles of Post Harvest Seed Physiology and Technology. Agrobios., Jodhpur, India.
- McDonald MF and Copeland LO. 2012. Seed Production: Principles and Practices. Springer Science and Business Media, Boston, United States.
- Mondal SS, Saha M and Sengupta K. 2009. Seed Production of Field Crops. New India Publishing Agency, New Delhi.

- Sen S and Ghosh N. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.
- Singhal NC. 2003. Hybrid Seed Production. Kalyani Publishers., New Delhi, India.
- Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publications, New Delhi.
- Singhal NC. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.
- Vanangamudi K, Prabhu M, Kalaivani S, Bhaskaran M and Manonmani V. 2010. Vegetable Hybrid seed Production and Management. Agrobios., Jodhpur, India.

Suggested e-books

https://www.springer.com/in/book/9780792373223

https://www.springer.com/in/book/9780412075513

https://www.nipabooks.com/info/9788190723763/seed-production-of-field-crops

https://www.kopykitab.com/Vegetable-Hybrid-Seed-Production-And-Management

https://www.researchgate.net/publication/229432295_Hybrid_Seed_Production_and Flowers

http://www.worldcat.org/title/seed-production-principles-andractices/oclc

https://libgen.is/search.php?req=Raymond+A++T+George&column=author

https://www.researchgate.net/profile/Gulzar_S_Sanghera/publication/236865752_Advances_in_Hybrid_Rice_Technology_through_Applications_of_Novel_Technologies/links/ 0deec519b46087d815000000.pdf

Suggested websites

www.agriquest.info

www.agriinfo.in

www.seedquest.com

https://agriinfo.in/botany/18/

http://www.fao.org/3/a-e8935e.pdf

http://www.agriquest.info/seed_production.php

(Dr. Santosh Dhar) Dean- Faculty of Doctoral Studies and Research, SVVV, Indore	(Dr. K. N. Guruprasad) Dean-Faculty of Agriculture, SVVV, Indore	(Dr. Shishir Jain) Controller of Examination, SVVV, Indore	(Dr. Arvind Singh) Joint Registrar, SVVV, Indore