

**SARDAR PATEL UNIVERSITY
VALLABH VIDYANAGAR**



**Programme: MSC (CBCS)
Syllabus with effective from: 2018-19**

**BOTANY
Semester IV**

PS04CBOT21: PLANT BIOTECHNOLOGY

Unit I

Historical review and scope of plant tissue culture; Plant cell-totipotency. Aseptic techniques; Culture media: preparation and composition. Methods of sterilization, inoculation, incubation and hardening. Cell and organ differentiation; Clonal propagation or micropropagation (artificial seeds, virus free plants); Somaclonal variation; Overcoming crossing barriers : Pre fertilization and post fertilization barriers including in-vitro pollination/fertilization and embryo rescue); Endosperm, nucellus culture, anther culture and ovule culture. Germplasm storage including cryopreservation.

Unit II

Isolation of protoplasts; Purification of protoplasts; Visibility and plating density of protoplasts; Protoplast culture and regeneration of plants; Protoplast fusion and somatic hybridization (techniques of fusion, selection of fused protoplasts, chromosome status of fused protoplasts, uses of somatic hybrids); Cytoplasmic hybrids or Cybrids; Genetic modification of protoplasts.

Unit III

Vectors for gene transfer (based on Ti and Ri plasmids; co integrate, intermediate and helper plasmids; binary vectors; viruses as vectors); gene transfer techniques using Agrobacterium; selectable and scorable markers (genes); Agroinfection and gene transfer; Physical delivery methods: Biolistics and electroporation.

Unit IV

Transgenic plants for crop improvement (dicots and monocots including maize, rice, wheat, oats, etc.; resistance to herbicide, insecticide, virus and other diseases; transgenic plants for molecular farming; transgenic plants to regulated gene expression, Chloroplast and Mitochondrion engineering.

Reference Books :

- Plant biotechnology – J Hammond, *et. al.*, Springer Verlag.
- Plant cell and tissue culture for production of food ingredients – T J Fu, G Singh, *et. al.*
- Biotechnology in crop improvement – H S Chawla.
- Practical application of plant molecular biology – R J Henry, Chapman & Hall.
- Elements of biotechnology – P K Gupta.
- An introduction to plant tissue culture – M K Razdan.
- Plant propagation by tissue culture : The technology (Vols. 1 & 2) – Edwin George.
- Handbook of plant cell culture (Vols. 1 to 4) – Evans *et. al.*, Macmillan.
- Plant tissue and cell culture – H E Street, Blackwell Scientific.
- Cell culture and somatic cell genetics of plants (Vols. 1 to 3) – A K Vasil, A. Press.
- Plant cell culture technology – M M Yeoman.
- Plant tissue culture and its biotechnological applications – W Bary, *et. al.*, Springer Verlag.
- Principles of plant biotechnology : An introduction to genetic engineering in plants – S H Mantell, *et. al.*
- Advances in biochemical engineering / Biotechnology – Anderson, *et. al.*
- Applied and fundamental aspects of plant cell tissue and organ culture edited by Reinert& Bajaj Y P S, Springer Verlag.
- Plant cell and tissue culture – S Narayanswamy, Tata Mc Graw Hill Co.
- Text Books: 2.Ignacimuthu, S.J. 1997. Plant Biotechnology. Oxford and IBH Publ

PS04CBOT22: Biochemistry and Medical Botany

Unit 1:

Carbohydrates - Structural interconversions and functions. Biosynthesis and metabolism of polysaccharides, wall architecture and its components

Lipids- Biosynthesis and metabolism of lipids with reference to membrane, structural and storage lipids. Storage and mobilization of lipids.

Proteins –Biosynthesis, translocation, storage and degradation

Unit 2:

Enzymes – Major groups; distribution of plant enzymes; functional compartmentation; soluble and membrane bound enzymes; purification; localization of enzymes

Phenolic metabolism – Shikimate /arogenate pathway, Phenylamine / hydroxycinnamate pathway, Flavonoids, Lignins, Tannins and quinones

Nitrogen metabolism – Non-Biological and Biological Nitrogen fixation, Biochemistry of Nitrogen Fixation, Nitrogen fixation in Cyanobacteria.

Unit 3:

Plants as sources of drugs, pharmaceuticals and pharmaceutical aids.

Ethnomedicobotany: Basic approaches to study traditional knowledge on herbal medicine; Scope and potential applications.

Collection methods of ethnomedicobotanical data: Field methods and scrutiny of Herbarium specimens and folklore; verification of data; collection of materials for voucher specimen and for phytochemical screening; application of ethnomedicobotany.

Creating indigenous knowledge base of traditional medicines of plant origin.

Unit 4:

Pharmacognosy of drugs derived from alkaloids, glycosides, volatile oils, lipids, gums, resins, tannins and saponins. Drugs of botanical origin: Structure, physical properties, biosynthesis and chemistry of secondary metabolites: phenols, phenolic glycosides, saponins, steroids, alkaloids, vitamins and hormones and natural antibiotics.

Methods for screening natural sources for bioactive principles.

Secondary metabolites: Major pathways, structure and biosynthesis of plant pigments, alkaloids, glycosides and lignin.

References Books:

- Dey, P. M. & Harborne, J. B. (Eds.) 1997. Plant Biochemistry, Academic Press, London
- Heldt, H. 2005. Plant Biochemistry (3rd Edn.) Indian Reprint, Elsevier, New Delhi.
- Dennis, D. T., D. H. Turpin, D. D. Lefebvre and D. B. Layzell : Plant Metabolism. Addison Wesley Longman Ltd. England.
- Doby, G.: Plant Biochemistry. Inter Science Publishers, New York
- Lehninger, A. L., D. L. Nelson and M. M. Cox 2000: Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.
- Dennis, D. T., D. H. Turpin, D. D. Lefebvre and D. B. Layzell : Plant Metabolism. Addison Wesley Longman Ltd. England.
- Doby, G. : Plant Biochemistry. Inter Science Publishers, New York
- Dey, P. M. and J. B. Harborne: Plant Biochemistry. Academic Press, London.
- Lehninger, A. L., D. L. Nelson and M. M. Cox 2000: Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.
- Sadasivam, S. and A. Manickam : Biochemical Methods. 2nd edition. New Age International (P) Ltd. New Delh.
- Voet, D., J. G. Voet and C. W. Pratt : Fundamentals of Biochemistry. John Wiley & sons, Inc. New York.
- Zubay, G. : Biochemistry. Vol. 1 – 3. Wm. C. Brown Publishers, Oxford, England
- Chadwick, D.J. & Marsh, J.: Bioactive compounds from plants
- Wiley Chichester, CIBA Foundation Symposium 185: Ethnobotany and the search for new drugs
- J.B. Harborne: Phytochemical methods
- J.C. Willis: Pharmacognosy
- C.K. Kokate: Pharmacognosy
- Trease, G.E and Evans, W.C.: Pharmacognosy

Lab I: PS04CBOT23: Practicals based on PS04CBOT21 and PS04CBOT22

Lab II: PS04EBOT21: Practicals based on PS04EBOT2X and PS04EBOT2X

PSO4EBOT22: Dissertation

PSO4EBOT23: Phytoresource Utilization and conservation

Unit 1: Plant Biodiversity

Concept, status in India, utilization and concerns.

Origin, evolution, botany, cultivation and uses of:

(i) Food, forage and fodder crops, (ii) fibre crops, (iii) medicinal and aromatic plants, and (iv) oil yielding crops.

Innovations meeting for world food demands

Plants used as avenue trees for shade, pollution control and aesthetics.

Plants as sources of drugs, pharmaceuticals and pharmaceutical aids.

Unit 2: Ethnomedicobotany:

Basic approaches to study traditional knowledge on herbal medicine;

Scope and potential applications of ethnomedicobotany

Collection methods of ethnomedicobotanical data: Field methods and scrutiny of Herbarium specimens and folklore; verification of data; collection of materials for voucher specimen and for phytochemical screening;

Applications of ethnomedicobotany.

Creating indigenous knowledge base of traditional medicines of plant origin.

Unit 3: Forest products

Important timber yielding plants, timber types, identification/diagnostic features, structure & quality.

Important fire wood plants

Non Timber forest products: bamboos, rattans, fibers pulp; gums, resins, tanins, latex, fruits & tubers.

Unit 4: Phytoresource Conservation.

Principles of conservation; extinctions; environmental status of plants based on International Union for Conservation of Nature.

Strategies for conservation – *in situ* conservation : International efforts and Indian initiatives; protected areas in India – sanctuaries, national parks, biosphere reserves, wetlands, mangroves and coral reefs for conservation of wild biodiversity.

ex situ conservation : Principles and practices; botanical gardens, fields gene banks, seed banks, *in vitro* repositories, cryobanks; general account of the activities of Botanical Survey of India (BSI), National Bureau of Plant Genetic Resources (NBPGR), Indian Council of Agricultural Research (ICAR), Council of Scientific & Industrial Research (CSIR), and the Department of Biotechnology (DBT) for conservation, non-formal conservation efforts.

Reference Books :

- Anonymous. National Gene Bank: Indian Heritage on Plant Genetic Resources (Booklet). National Bureau of Plant Genetic Resources, New Delhi.

- Arora, R. K. and Nayar, E. R. Wild Relatives of Crop Plants in India. NBPGR Science Monograph.
- Baker, H. G. Plants and Civilization. C. A. Wadsworth, Belmont.
- Bole, P. V. and Vaghani, Y. Field Guide to Common Indian Trees. Oxford University Press, Mumbai.
- Chandel, K. P. S., Shukla, G. and Sharma, N. Biodiversity in Medicinal and Aromatic Plants in India : Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.
- Cristi, B. R. CRC Handbook of Plant Sciences and Agriculture. Vol. I. In-situ conservation. CRC Press, Boca Raton, Florida, USA
- Council of Scientific & Industrial Research. The Useful Plants of India. Publications and Information Directorate, CSIR, New Delhi.
- Plant Wealth of India. Special Issue of Proceedings India National Science Academy B – 63
- Rodgers, N. A. and Panwar, H. S. Planning a Wildlife Protected Area Network in India. Vol. 1. The Report Wildlife Institute of India, Dehradun.
- Sahni, K. C. The Book of India Trees, Oxford University Press, Mumbai.
- Sharma, O. P. Hill's Economic Botany. Tata McGraw Hill Co. Ltd., New Delhi.
- Swaminathan, M. S. and Kocchar, S. L. Plants and Society. Macmillan Publication Ltd., London.
- Thakur, R. S., Puri, H. S. and Husain, A Major Medicinal Plants of India. Central Institute of Medicinal and Aromatic Plants, CSIR, Lucknow. S.K. Jain: A Manual of Ethnobotany
- S.K. Jain: Glimpses of Indian Ethnobotany
- S.K.Jain, B.K. Sinha and R.C.Gupta: Notable plants in Ethnomedicine of India
- J.K. Maheswari: Dictionary of Indian Folk medicine and Ethnobotany
- S.K. Jain: Useful plants of India
- Wiley Chichester, CIBA Foundation Symposium 185: Ethnobotany and the search for new drugs

PS04EBOT24: HORTICULTURE

Unit 1:

Fundamentals of horticulture (History, nature and scope of horticulture)

Origin of Horticulture – Domestication of plants, definitions – scope and impact of horticulture (importance of horticulture in terms of economy, production and employment generation classification of horticultural crops) – pomology, olericulture, spices and planting, ornamental horticulture – climatic zones of India and Gujarat in relation to horticulture – development of horticulture in India - Divisions of horticulture and their importance (Horticultural zones of India and Gujarat) – nutritive value and nutraceutical properties of horticultural crops.

Factors influencing horticultural crop production

Growth and development – respiration – photosynthesis – seed physiology – dormancy and germination – physiology of flowering, pollination, fruitset, fruit ripening and senescence – factors influencing growth and development – soil, light, temperature, rainfall, humidity, wind.

Unit 2:

Role of plant growth regulators in seed and bud dormancy, juvenility, maturity and senescence, flowering, pollination, fruitset including parthenocarpy, fruit growth, fruit drop and fruit ripening (climacteric and non-climacteric) and fruit colour development, tuber and bulb formation and sex expression and extension of shelf life in fruits, vegetables and flowers. Role of growth regulators in plant propagation.

Nutrition of horticultural crops – assessment of nutritional requirements based on soil, tissue analysis, and field experiments. Identification of deficiency symptoms of various nutrients and methods of nutrient application. Assessment of irrigation requirements for different horticultural crops and different methods of irrigation. Pruning and training, their objectives and methods. Pollination and fruit set, problems and requirements, flower and fruit drop, stages, causes and remedial measures. Fruit thinning, objectives, advantages and disadvantages. Unfruitfulness, reasons and remedial measures.

Unit 3:

Methods of propagation of horticultural crops - Introduction, principles and classification of plant propagation methods: Propagation – definitions – seed propagation – merits and demerits – crops propagated through seeds - Factors affecting seed germination and pre-germination treatments and viability tests – vegetative propagation – merits and demerits – cutting, layering, grafting and budding rootstock influence – stock / scion relationship – specialized structures for propagation – micro-propagation, Importance of micro propagation of plants. Role of growth regulators in propagation.

Method of production and cultivation

Definition and nature of growth of fruits, vegetables, spices, plantation and flower crops – system of cultivation and planting systems including HDP for fruits, vegetables, spices and

plantation and flower crops – intercultural operations – weed, water and fertilizer management – bearing habits – crop regulatory practices for fruit crops and vegetables – training, pruning, canopy management – off season production in fruits, vegetables and flower crops – protected cultivation- Principles of protected cultivation, Structure and types of green houses, Regulation of controlled environment (RH, temperature and ventilation) and nutrient management. High-tech nursery raising technology, Production technology of high value vegetables like Tomato, Capsicum, Cucumber and flowers viz. Rose, Carnation, Gerbera, Liliium, Chrysanthemum. Soil and media, Plant protection, harvesting, grading and packaging.

Importance, scope and practicing of organic farming in horticultural crop production

Unit 4:

Pre and Post-harvest operations and Technologies of horticultural crops

Crop loading – pre-harvest operations – maturity indices – harvesting methods for climacteric and non-climacteric fruits – grading – sorting – standards for domestic and export consumption (HACCP) – packing – pre-cooling – storage – transport – quarantine and regulatory measures.

REFERENCES

1. Adams, C.R. and M. P. Early. 2004. Principles of horticulture. Butterworth – Heinemann, OxfordUniversity Press.
2. Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.
3. Chandra, R. and M. Mishra. 2003. Micropropagation of horticultural crops. International Book Distributing Co., Lucknow.
4. Chattopadhyaya, P.K.2001. A text book on Pomology (Fundamentals of fruit growing) Kalyani Publication, New Delhi
5. Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, New Delhi
6. Edmond, J.B. T.L.Senn, F.S. Andrews and P.G.Halfacre, 1975. Fundamentals of Horticulture, Tata MC. Graw Hill Publishing Co.New Delhi
7. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Hall of Indiapvt. Ltd., New Delhi.
8. Hartman, H.T. and Kester, D.E. 1986. Plant propagation – Principles and Practices – Prentice Hall of India Ltd., New Delhi.
9. Jitendra Singh. 2006. Basic Horticulture. Kalyani Publishers, New Delhi.
10. Kumar, N.1997. Introduction to Horticulture, Rajalakshmi Publication, Nagercoil.
11. Rajan, S. and B.L. Markose. 2007. Propagation of horticultural crops. New India Publishing, New Delhi.
12. Shanmugavelu, K.G., N. Kumar and K.V. Peter. 2005. Production technology of spices and plantation crops. Agrobios, Jodhpur.
13. Singh, N.P. 2005. Basic concepts of fruit science. International Book Distributing Co., Lucknow.
14. Surendra Prasad and U. Kumar. 1999. Principles of horticulture, Agro-botanica, Bikaner, India.

PSO4EBOT25: IPR and Biosafety

UNIT-I

Biotechnology and society: Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding. Social and ethical issues in biotechnology. Principles of bioethics. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.

UNIT-II

Bio- safety: Definition of bio-safety, Biotechnology and bio-safety concerns at the level of individuals, institutions, society, region, country and world.

Bio-safety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety.

Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions.

UNIT-III

IPR I: Introduction to IPR: Forms of IPR and Intellectual property protection. Concept of property with respect to intellectual creativity, Tangible and Intangible property.

WTO: agency controlling trade among nations, WTO with reference to biotechnological affairs, TRIPs. WIPO, EPO.

UNIT-IV

IPR II: Concept related to patents novelty, non-obviousness, utility, anticipation, prior art etc. Type of patents. Indian patent act and foreign patents.

Patentability, Patent application, Revocation of patent, Infringement and Litigation with case studies on patent, Commercialization and Licensing.

References:

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press. ISBN-1555811804, 9781555811808.
2. Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219
3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 075069440, 9780750694445.
4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074638602,
5. Intellectual Property Right- Wattal- Oxford Publication House.(1997) ISBN:0195905024.
6. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nd ed) ISBN-10 3527304320.
7. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.
8. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.
9. B.D. Singh. Biotechnology expanding horizons.
10. H.K.Das. Text book of biotechnology 3rd edition.