



**Paper 7a BIOTECHNOLOGY, TISSUE CULTURE AND
CROP IMPROVEMENT**

M.Sc. va (Candidates admitted from the academic year 2008-2009)

Core Theory

Paper 7a BIOTECHNOLOGY, TISSUE CULTURE AND CROP IMPROVEMENT

M.Sc. va (Candidates admitted from the academic year 2008-2009)

Core Theory

UNIT I

Introduction to Biotechnology : Definition, history, current demands from biological resources for food, fodder, feed, timber, oil, perfumes, pigments, biofertilizers, therapeutic agents, fermentation products etc. Bioprospecting. Ethical issues in biotechnology and safety and consumer issues of LMO/GMO.

UNIT II

Fermentation Biotechnology: Principles of fermentation, media requirements, culture, separation of products. Industrial processes for production of food, beverages, antibiotics, acid and ethanol. Fermentors and bioreactors in fermentation biotechnology. Economic aspects of fermentation.

Protein and Enzyme Biotechnology: Basic concepts, isolation, purification, production and package of enzymes. Immobilisation of enzymes, industrial enzymes, therapeutic uses of enzymes.

UNIT III

Introduction to Recombinant DNA Technology: Restriction enzymes, vectors, cloning, gene library, reverse transcription and cDNA. Artificial chromosome, DNA probes. DNA delivery systems.

UNIT IV

Tissue culture: Concept of totipotency. Media for *in vitro* culture - minerals, vitamins, natural adjuvants like coconut milk and fruit juice. Requirements for auxin, cytokinin and other growth regulators. Design of laboratory and commercial tissue culture facility. **Sterilization Procedures**: Fumigation, wet and dry sterilization, ultraviolet sterilization, ultrafiltration and surface sterilization. Maintenance of axenic cultures.

UNIT V

Callus and Suspension Culture - initiation and maintenance of callus. Micropropagation - direct and indirect morphogenesis, somatic embryogenesis and synthetic seed production. Culture systems, isolation of single and aggregate of cells and regeneration of plants. *In vitro* production of useful chemicals. Immobilization of cells and use of bioreactors.

Protoplast Culture: Isolation of protoplast, somatic cell hybridization, selecting desired hybrids and their regeneration into plants. Use of protoplast in genetic engineering.

Embryo and Anther Culture: Embryo rescue technique. Isolation of sperms and egg cells. Culture of zygote/endosperm obtained through *in vitro* fertilization. Production of haploid plants through anther and pollen culture.

UNIT VI

Tissue Culture and biotechnology in Crop Improvement: Mericlone for virus-free plants, selection of plantlets tolerant to biotic and abiotic stresses. Improvement of forest trees, cryopreservation and germplasm storage. Use of protoplasts in obtaining transgenic plants. Emerging trends using techniques of genetic engineering. Molecular markers. Introduction of desired genes from microbes, plants and animals. Transgenic plants resistant to diseases, insect pests, abiotic stress and herbicides. Improving nutritional quality of storage organs.

Suggested Reading

- AMMIRATO, P.V., D.A EVANS, W.R. SHARP., and Y.P.S. BAJAJ 1990. Hand Book of Plant Cell Culture. Vol 5. Ornamental Species. McGraw Hill Publishing Company. New York.
- BENCOCHEA, T., AND J.H. DODDS. 1986. Plant Protoplasts. A Biotechnological Tool for Plant Improvement. Chapman and Hall. London.
- BROWN, C.W., I. CAMPBELL AND F.G. PRIEST. 1987. Introduction to Biotechnology. Blackwell Scientific Publications. Oxford.
- BUTCHER, D.N., and D.S. INGRAM. 1982. Plant Tissue Culture. Oxford. IBH Publishing Company. Delhi.
- BUTENKO, R.G. 1985. Plant Cell Culture. MIR Publishers. Moscow.
- BULL, A.T., G. HOLT, AND M.D. LILLY. 1983. Biotechnology. International trends and Perspectives. Oxford and IBH Publishing co. New Delhi.
- DEBERG, P.C., AND R.H. ZIMMERMANN. 1981. Micropropagation-Technology and Application. Kluwer Academic Publishers. London.

- DIXON, R.A. 1985. Plant Cell Culture. A Practical Approach. IRL, Press. Oxford. London.
- DODDS, J.H., AND L.W. ROBERTS. 1985. Experiments in Plant Tissue Culture. Cambridge University Press. London.
- FRIEIFELDER, D. (Ed.) 1990. Molecular Biology. Narosa Publishing House. New Delhi.
- GEORGE E.F., AND P.D.SHERINGTON. 1984. Plant Propagation by Tissue Culture. Exegetics Ltd. England.
- KHUSH, G.S., AND G.H. TOENNIENSSSEN. 1991. Rice Biotechnology. The Alden Press Ltd. Oxford.
- LEWIN, B. 1994. Genes V. Oxford University Press. Oxford
- LINDSEY, K. 1992. Plant Tissue Culture Manual. Kluwer Academic Publishers.
- MARX, F.L. 1989. A Revolution in Biotechnology. Cambridge University Press. Cambridge. New York.
- MOORE, R., AND W.D. CLARK. 1995. Botany: Plant Form and Function. Vol. I. W.M.C. Brown Publishers.
- MURRAY MOO-YOUNG, (Ed.). 1992. Plant Biotechnology. Pergamon Press.
- NARAYANASWAMY, S. 1994. Plant Cell and Tissue Culture. Tata Mc Graw - Hill Publishing Company Limited. New Delhi.
- PRAVE, P., *et al.* 1987. Fundamentals of Biotechnology. FDR.
- PUROHIT, S.S., AND S.K. MATHUR. 1993. Fundamentals of Biotechnology. Agrobotanical Publishers. India.
- RAGHAVAN, V. 1977. Experimental Embryogenesis in Vascular Plants. Academic Press. London.
- RAGHAVAN, V., AND M.S. SWAMINATHAN. 1986. Embryogenesis in Angiosperms. A Developmental and Experimental Study. Cambridge University Press. Cambridge.
- REINERT, J., AND Y.P.S. BAJAJ. 1977. Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Springer-Verlag. Berlin.

REINERT, J., AND YEOMAN. 1988. Plant Cell and Tissue Culture - A Laboratory manual.

REINHARD, B.E., AND M.H. ZENK. 1977. Plant Tissue Culture and its Biotechnological Application.

SEN, S.K., AND LGIKS. 1983. Plant Cell Culture in Crop Improvement. Plenum Press. New York.

STREET, H. E. 1977. Plant Tissue and Cell Culture. Blackwell Scientific Pub. Oxford.

THOMAS, E., AND M.R.D. WYKAHAM. 1975. From Single Cell to Plants. Wykeham Publications Ltd. London.

TORRES, C.K. 1989. Tissue Culture Techniques for Horticultural Crops. Van Nostrand Reinhold. New York.

TREHAN, K. 1990. Biotechnology. Wiley Eastern Limited. New Delhi.

TREVAN, M.D., S. BOFFEY, K.J. GOULDING, AND P. STANBURG. 1977. Biotechnology: The Biological Principles. Tata McGraw Hill Publishing Company Limited. New Delhi.

YEOMAN. 1987. Plant Cell Culture Technology. Narosa Publishing House. New Delhi

MCC, Department of Botany