

SOLAPUR UNIVERSITY, SOLAPUR.



M.Sc. Part- II Botany

Revised Syllabus

(CBCS pattern.)

To be implemented from

June 2016

Solapur University, Solapur

M.Sc. Part- II Botany

(Semester-III and IV)

CBCS

Syllabus to be implemented from June 2016

Semester-III

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits
	Type	Name		L	T	P				
Class :→	M.Sc.- II Semester - III									
	BO-113 (CORE)	Plant Embryology and Palynology	BO-113	4	--	--	100	70	30	
	BO-114 (CORE)	Cytogenetics, Plant Breeding and Genetic Engineering	BO-114	4	--	--	100	70	30	
	BO-115 (CORE)	Advances in Plant Metabolism and	BO-115	4	--	--	100	70	30	
	BO-115 (Elective)	Horticultural Practices and Post Harvest technology	Paper-115	4	--	--	100	70	30	
	BO-116 (CORE)	Physiology of plant growth and	Paper -116	4	--	--	100	70	30	
	BO-116 (Elective)	Analytical Techniques in Plant Sciences	Paper-116	4	--	--	100	70	30	
		Total		16			400	280	120	
Practical	BO-117			4			100	70	30	
	BO-118			4			100	70	30	
Total				08	--	--	200	140	60	

*Theory Paper – 115 & 116 is offered as an elective under CBCS to the students

Semester-IV

Subject/ Core Course	Name and Type of the Paper		No. of papers/ Practical	Hrs/week			Total Marks Per Paper	UA	CA	Credits
	Type	Name		L	T	P				
Class :→	M.Sc.- II Semester - IV									
	BO-119(CORE)	Phytogeography and Conservation Biology	BO-119	4	--	--	100	70	30	
	BO-120(CORE)	Plant Tissue Culture, Green House Technology and Hydroponics	BO-120	4	--	--	100	70	30	
	BO-121 (CORE)	Environmental Plant Physiology	BO-121	4	--	--	100	70	30	
	BO-121 (Elective)	Stress Biology	BO-121	4	--	--	100	70	30	
	BO-122 (CORE)	Crop Physiology	BO-122	4	--	--	100	70	30	
	BO-122 (Elective)	Research Methodology	BO-122	4	--	--	100	70	30	
	Total			16			400	280	120	
Practical	BO123			4			100	70	30	
	BO-124			4			100	70	30	
Total				08	--	--	200	140	60	

*Theory Paper – 121 &122 is offered as an elective under CBCS to the students

Semester-III

Paper Bot. 113 (Paper-IX)

Plant Embryology and Palynology

Embryology:

Lectures-45

Unit-1 Gametophytes in Angiosperms- Brief outline of development of Male 10

and Female Gametophyte.

Ultrastructure of Male Gametophyte- Vegetative Cell, Generative Cell, Pollen

Wall, Pollen Tube; Abnormal Male Gametophytes and their Features.

Ultrastructures of Female Gametophyte- Synergids, Egg, Antipodals, Central Cell.

Pollen- Pistil Interaction and Control of Fertilization- Structure of Stigma and

Style, Pollen Tube Growth, Chemotropism, Incompatibility, Pollen Wall Proteins, Stigma

Surface Proteins, Post Pollination Events, Fertilization, Methods to Overcome

Incompatibility, Significance of Pollen Pistil Interaction.

Unit-2:-Experimental Embryology- Techniques for Anther, Ovary, Nucellus, Endosperm, and Embryo Culture and their Significance. 10

Apomixis- Diplospory, Apospory, Causes, Consequences and Significance of Apomixes.

Polyembryony- Classification, Causes, Experimental Induction and Practical importance

Palynology:

Unit 3:-Palynology- Scope and Branches with Special Reference to:- 10

Palynotaxonomy- Pollen Morphology and Plant Taxonomy with reference to Gymnosperms and Angiosperms.

Melittopalynology- Bee colony, foraging behaviour of bees, unifloral & Multifloral honey, application in crop productivity

Unit 4:- Aeropalynology- Principles, techniques, pollen analysis, pollen and spore 10

Allergy, plants causing pollen allergy, allergic properties of pollen, pollen calendar and importance

Unit: 5:-Palaeopalynology- Principles, microfossil recovery, theory and techniques, 05
Microfossils and oil exploration.

Agropalynology- Pollen storage, viability and pollen germination and their
Significance.

Practicals based On Paper Bot. 113(Paper-IX)

1. Study of Development and Ultra structure of Male Gametophyte with the help of Slides and Microphotographs.
2. Study of Development and Ultra structure of Female Gametophyte with the help of Slides and Microphotographs.
3. Study of types of styles - Solid, Hollow, Filamentous. Types of Stigmas- Dry and Wet Stigmas and their Sub types.
4. Study of new apomicts (any two) and polyembryony.
5. Study of different types of embryos (monophonic, bisporic and tetrasporic).
6. Pollen germination *in situ* condition.
7. Determination of Pollen Germination Percentage in Vitro conditions.
8. Study of Pollen Morphotypes and their Significance in Taxonomy. (At Least Six Examples)
9. Honey Analysis. (Unifloral and multifloral).
10. Study of Allergic Plants and their Pollens.
11. Study of Pollen Fertility by TTC or Acetocarmine Methods.
12. Intra –ovarian pollination ; Test tube pollination through photographs .

Reference Books:-

Embryology and Palynology

1. Bhojawani, S.S. And S.P. Bhatnagar, 1998. The Embryology of Angiosperms.
2. Johri, M.B. 1984. Embryology of Angiosperms.
3. Maheshwari, P. 1950. An Introduction to the Embryology of Angiosperms.
4. Maheshwari, P. 1963. Recent Advances in the Embryology of Vascular Plants.
5. Johri, B.M. 1963. Experimental Embryology of Vascular Plants.
6. Shivanna, K.R. And B.M.Johri, 1989. The Angiosperm Pollen; Structure and Function.
7. Stanley, R.G & F.L. Linkens, 1974. Pollen; : Biology, Biochemistry Management
8. Shivanna K.R. And N.S. Rangaswamy, 1992. Pollen Biology, a Laboratory Manual.

9. Cunningham, D.D.1873. Microscopic Examination of Air.
10. Erdtman, G. 1988. Pollen Morphology and Plant Taxonomy.
11. Fageri, K. And J. Inversen, 1964. Text Book of Pollen Analysis.
12. Gregory, P.H. 1973. Microbiology of Atmosphere.
13. Heslop-Harrison, Y.1971.Pollen Development and Physiology.
14. Moor, P.D. et.al. 1989. Pollen Analysis.
15. Nair P.K.K.1996. Essentials of Palynology.
16. Nair P.K.K. 1964 Advances In Palynology.
17. Tilak, S.T.1989. Airborne Pollen and Fungal Spores.
18. Malik C.P Physiology of sexual reproduction in flowering plants.
19. Mulcamy D.L. et.al, Biotechnology and ecology of pollen.
20. Davis, G.L Systematic embryology of angiosperms.
21. Nair, P.K. Recent advances in pollen spore research vol I, II and III.
22. Raghavan, V. Experimental embryogenesis in vascular plants.

Paper Bot -114(Paper-X)

Cytogenetics, Plant Breeding And Genetic Engineering

Lectures-45

Unit; 1:-Genome organization in prokaryotes and eukaryotes- size and structure of genome in viruses, plasmids, bacteria, yeast and higher organisms. Variation in genome size and its organization in prokaryotes, eukaryotes and organelles. Architectural differences of the genome. **15**

Organization of gene in prokaryotes and eukaryotes- structure and organization of the gene in plasmid, viruses, bacteria and eukaryotes. Gene conversion, amplification, mobile genetic elements and their significance. Gene families.

Unit 2:-Genetic Recombination and Genetic Mapping- Independent Assortment and Crossing **10**

Over, Recombination, Molecular Mechanism of Recombination, Role of Rec A and Rec B,C,D Enzymes. Proteins Involved in Eukaryotic Recombination, Recombination Nodules, Site Specific Recombination, Chromosome Mapping, Linkage Groups, Genetic Markers-Conventional and Molecular Markers Used in Construction of Molecular Maps. Correlation of Genetic and physical maps, somatic cell genetic-an alternative approach to gene mapping.

Unit 3:-Modern methods of plant breeding- Somaclonal variations, Somatic hybridization-protoplast isolation, fusion and regeneration, hybrids. Hybridoma technology . **10**

Unit 4: IPR (Intellectual property right) - concept, importance, ecological risk and ethical concerns ,application form for patenting **03**

Unit 5: -Bioinformatics : A) Introduction to Bioinformatics. Use of bioinformatics in major research areas B) Major Bioinformatics Resources on Internet: National Centre for Biotechnology Information (NCBI) i.The knowledge of various databases and bioinformatics tools available at NCBI resource ii.The major content of the NCBI databases iii.Purpose and applications in life sciences C) Protein data bank (PDB) and Nucleic acid sequence database (GenBank) D) The Basic Local Alignment Search Tool (BLAST) **07**

Reference Books:-

1. Benjamin Lewin- Genes VIII-,
2. James Darnell, Harvey Lodish and David Baltimore- Molecular Cell Biology.
3. Albert et.al.-Cell Molecular Biology.
4. C.J.Avers-Genetics.
5. Strickbergr- Genetics.
6. E.J.Gardner- Principles of Genetics.
7. J.Jahier- Techniques of Plant Cytogenetic.
8. Sharma A.K. & Sharma A – Chromosome: Theory and Practice.
9. Genetics – P.K.Gupta 2010
10. Genetics classical to modern - – P.K.Gupta 2008
11. Genetics – Verma and Agrawal -2008
12. Cytogenetics evolution biostatistics and Plant Breeding – Shukla and Chandel
13. Cell Biology ,Genetics ,Molecular biology ,evolution and ecology - – Verma and Agrawal -2008
14. The world of cell – Backer and Klein Smith (Pearson publication)/
15. Biotechnology - Satyanarayana.
16. Biotechnology –R.C.Dubey
17. Biotechnology –P.K.Gupta.

Practicals Based On Paper Bot-114(Paper-X)

1. Karyotype analysis in any two plant species.
2. Banding Studies-“O” Banding in *Allium cepa*.
3. Separation of DNA by Gel electrophoresis / Estimation of DNA
4. Meiotic Studies in Structural Hybrids.
- 5&6 Genetic Problems on Mapping of the Genes in Higher Organisms.
- 7 Study of methods of Genes transfer through photographs – physical , chemical and Biological.
- 8 Study of stpes of genetic engineering for production of BT-Cotton , Golden Rice Flaver saver Tomato through photographs .
- 9 Practical based on IPR – Procedural information about patenting .
- 10 Practical based on bioinformatics
- 11 &12 Protoplast Isolation, viability testing, Fusion, and Regeneration.

Paper Bot- 115(Paper-XI)

Advances in Plant Metabolism and Biochemistry

Lecturer-45

Unit:1	Integration of major metabolic pathways in plants, an overview	2
Unit 2:	Photosynthesis – ultrastruture of chloroplast and light harvesting complexes , Energy transduction in photosynthesis , photosynthetic electron transport , ATP synthesis , photosynthetic pathway C3 , C4 and CAM and their subgroups , C3 & C4 intermediates, regulation of Rubisco, PEP case and PCR cycle ,photorespiration and its significance.	13
Unit : 3-	Respiration – regulation of glycolysis, pentose phosphate pathway and TCA cycle, modern concept of electron transport chain in plant mitochondria, alternate oxidase, respiratory inhibitors, Gluconeogenesis. Organic acid metabolism – metabolism and role of malic acid, oxalic acid and ascorbic acid.	10
Unit : 4-	Secondary metabolism – photosynthetic carbon partitioning ,overview of Secondary metabolism and Secondary metabolites shikimic acid pathway, biosynthesis of aromatic amino acids.	10
Unit : 5	Phosphorus metabolism – Forms of phosphate in soil and plants, mechanism of P uptake, factors controlling P uptake, role of pyrophosphates in plant metabolism.Vam and P nutrition.	10
	Sulphur metabolism- Forms of Sulphur in soil and plants, sulphate uptake and reduction, biosynthesis of Sulphur containing amino acids and their role - cystein, methionine, and glutathione.	

Reference Books

1. Sinha S.K. Sane P.V. Bhargava S.C. And Agrawal P.K 1990. Proceedings of International congress of plant physiology vol I& II.
2. Smith H. 1975. Phytochrome and Photomorphogenesis.
3. Steward F.C. 1976. Growth and Organization in Plants.
4. Stumpf P.K. & Conn.E. 1980. The Biochemistry of Plants: A Comprehensive Treatise.
5. Tiaz L. And Zieger, F. 1998. Plant Physiology.
6. Wilkins M.B. 1976. Physiology of Plant Growth and Development.
7. Annual Reviews of Plant Physiology and Molecular Biology.
8. Indian Journal of Plant Physiology.
9. Journal of Experimental Botany.
10. Physiologia Plantarum Sweden.
11. Plant Physiology (Bethesda U.S.A
- 12 Bidwell R.C.S. 1979. Plant physiology.
- 13 Boner J. and Varner J. E. 1976. Plant Biochemistry.
- 14 Edwards G. Walker D.W. 1983. C3-c4 mechanism and cellular environmental regulation of photosynthesis.
- 15 Govindjee 1982. Photosynthesis vol I & II.
- 16 Hopkins W.C. 1995. Introduction to plant physiology.
- 17 Krishnmoorthy H.N. 1992. Physiology of plant growth and development.
- 18 Marschner, H.W. 1986. Mineral nutrition of higher plants.
- 19 Miller P. 1973. Phytochemistry vol I, II & III.
- 20 Moore T.C. 1974. Research experiences in plant physiology, a laboratory manual.
- 21 Mukherjee, S.P. and Ghosh A.N. 1996. Plant physiology.
- 22 Noggle G.R. & G.J. Fritz. 1990. Introductory plant physiology II Ed.
- 23 Randhir Singh & Sawhney S.K. 1988. Advances in frontier areas of Plant Biochemistry.
- 24 Sadasivan and Manikkam 1996. Plant Biochemical methods.
- 25 Salisbury F.B. & Ross C.W. 1992. Plant physiology IV Ed.

Practicals Based On Paper Bot- 115(Paper- XI)

1. and 2. Estimation of Chlorophylls and Carotenoids, Chl a/ Chl b Ratio and leaf anatomy from C3 and C4 plants.
3. Study of characteristics of CAM plants
4. Measurement of Rate of Respiration (In Germinating Seeds).
5. Study of Enzyme Glycolate Oxidase.
6. Determination of Co₂ Compensation Point.
7. Estimation of Ascorbic Acid.
8. Estimation of Polyphenols.
9. Estimation of Phosphorus in Different Plants Parts.
10. Study of VAM in plants
11. Estimation or detection of Phosphate or Sulphate in Soil
12. Detection and estimation of secondary metabolites.

Paper Bot- 116(Paper:-XII)

Physiology of plant growth and development

Lectures 45

Unit: 1-Growth and Photomorphogenesis-

Phytochrome & cryptochrome- discovery, properties, role and mechanism of action. 10

Unit: 2:-Senescence of leaves and petals- mechanism, biochemical changes and Programmed cell death. 5

Unit: 3:-A brief outline of physiology of seed development & seed germination. 10
-Post harvest physiology- ripening of fruits and its regulation, metabolism of stored seeds and leafy vegetables

Unit: 4:-Plant growth regulators- a brief idea about discovery and possible mechanism of action of triacontanol, Brassinosteroids, salicylic acid, jasmonates, polyamines & morphactins. 12

-A brief idea about role of growth retardants- CCC, Paclobutrazol, Maleic hydrazide and TIBA.

Unit: 5:-Secondary messengers and signaling in plants cells. 8

A brief idea about role of mutants in physiological studies with references to *Arabidopsis thaliana* .

Reference Books

(Bot -116):

- 1 Bidwell R.C.S. 1979. Plant physiology.
- 2 Boner J. and Varner J. E. 1976. Plant Biochemistry.
- 3 Edwards G. Walker D.W. 1983. C3-c4 mechanism and cellular environmental regulation of photosynthesis.
- 4 Govindjee 1982. Photosynthesis vol I & II.
- 5 Hopkins W.C. 1995. Introduction to plant physiology.
- 6 Krishnmoorthy H.N. 1992. Physiology of plant growth and development.
- 7 Marschner, H.W. 1986. Mineral nutrition of higher plants.
- 8 Miller P. 1973. Phytochemistry vol I, II & III.
- 9 Moore T.C. 1974. Research experiences in plant physiology, a laboratory manual.
- 10 Mukherjee, S.P. and Ghosh A.N. 1996. Plant physiology.
- 11 Noggle G.R. & G.J. Fritz. 1990. Introductory plant physiology II Ed.
12. Randhir Singh & Sawhney S.K. 1988. Advances in frontier areas of Plant Biochemistry.
13. Sadasivan and Manikkam 1996. Plant biochemical methods.
14. Salisbury F.B. & Ross C.W. 1992. Plant physiology IV Ed.
15. Sinha S.K. Sane P.V. Bhargava S.C. And Agrawal P.K 1990. Preceding Of International congress of plant physiology vol I& II.
16. Smith H. 1975. Phytochrome and Photomorphogenesis.

17. Steward F.C. 1976. Growth and Organization in Plants.
18. Stumpf P.K. & Conn.E. 1980. The Biochemistry of Plants: A Comprehensive Treatise.
19. Tiaz L. And Zieger, F. 1998. Plant Physiology.
20. Wilkins M.B. 1976. Physiology of Plant Growth and Development.
21. Annual Reviews of Plant Physiology and Molecular Biology.
22. Indian Journal of Plant Physiology.
23. Journal of Experimental Botany.

Practicals based on Paper Bot- 116 (Paper-XII)

1. Comparative growth study of etiolated and light grown seedlings and analysis of Photosynthetic pigments
2. Study of change in nitrate reductase activity during leaf senescence.
- 3&4. Hormonal and chemical regulation of leaf and Petal senescence. (Kinetin / ethephon /SA/Kcl/CaCl₂)
5. Pigment changes during ripening of fruits.
6. Study of enzyme acid phosphates during ripening of fruits.
7. Study of changes in respiration rate during ripening of fruits
8. Effect of different chemical compounds on pollen germination.
9. Effect of various PGRS on seedling growth.
10. Effect of growth retardants on plants.
11. Study of changes in starch & sugars during fruit ripening of Banana / Guava.
12. Study of changes in acidity and TSS (total soluble solids) during grape ripening.

Semester- IV

Paper Bot -119(Paper –XIII)

Phytogeography and Conservation Biology

Lectures-45

Unit 1: Phytogeography

(10 lectures)

Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation.

Unit 2:-Biodiversity -Age and area hypothesis, endemism, RET plants, hotspots, Western ghat vegetation, mangrove vegetation of India.	10
Unit 3:-Ex-situ conservation of biodiversity -concept, need and methods –polyhouse, seed banks, gene banks, cryopreservation and biotechnology.NBPGR	7
Unit 4; In situ conservation - Afforestation, Social forestry, Agroforestry, Botanical gardens, Biosphere reserves, National Parks, Sanctuaries, Sacred Groves and Sthalvrikshas .	8
Unit:5 -Intensification of agriculture and forest policies.- , biological diversity act 2002, forest conservation act, wildlife protection act with recent amendments , international conventions- Washington convention on trade of flora and fauna(1933), international biodiversity year 2010, role of NGO's in conservation of Biodiversity.	10

Reference Books

1. Nayar M.P.1996. Hot Spots of Endemic Plants of India, Nepal and Bhutan. Tropical Botanical Gardens and Research Institute, Palode, Keralal.
2. Atmedallah, M. And M.P. Nagar, 1989. Endemic Plants of The Indian Region, Vol I, Botanical Survey If India.
3. Sunge, Hugh (Ed) 1980. The Biological Aspects of Rare Plant Conservation.
4. V. P. Agarwal, 1990-Forests in India.
5. M.P. Singh, S. Chinnamani, R.N. Trivedi-1993-Social Forestry & Environment.
6. A.P. Dwivedi, 1992. Agroforestry, Principles& Practices.
7. Mishra & Singh – Flora of India Series- 4, Endemic & Threatened Flowering Plants of Maharashtra.
8. M.P. Nayar, A.P.R. Sastry (Edited By)- Red Data Book Of India Plants, Vol. 3, BSI Publication
- 9 Nayar M.P.1996. Hot Spots of Endemic Plants of India, Nepal and Bhutan. Tropical Botanical Gardens and Research Institute, Palode, Keralal.
- 10 Atmedallah, M. And M.P. Nagar, 1989. Endemic Plants of The Indian Region, Vol I, Botanical Survey If India.
- 11 Sunge, Hugh (Ed) 1980. The Biological Aspects of Rare Plant Conservation.
- 12 V. P. Agarwal, 1990-Forests in India.
- 13 M.P. Singh, S. Chinnamani, R.N. Trivedi-1993-Social Forestry & Environment.

14 A.P. Dwivedi, 1992. Agroforestry, Principles & Practices.

15 Mishra & Singh – Flora of India Series- 4, Endemic & Threatened Flowering Plants of Maharashtra.

16 M.P. Nayar, A.P.R. Sastry (Edited By)- Red Data Book Of India Plants, Vol. 3, BSI Publication

Practicals Based On Paper Bot- 119(Paper-XIII)

1. To study field vegetation with respect to stratification, canopy cover and composition.
2. To show hot spots, phytogeographical regions and distribution of endemic plants in the map of India.
3. Study of plants included in agroforestry and social forestry.
4. Study of vegetation analysis by satellite imagery.
5. Visit to NGO's working in the field of conservation.
6. Dispersal of fruits and seeds .
- 7 Dispersal of seeds .
8. Collection and storage of seeds for seed banks.
9. Mapping of trees with the help of GPS.
10. Study of density of vegetation by quadrat method –agro field.
11. Study of Quantitative estimation of plant biodiversity.
12. Study of wild species suitable for human health and industries.

Paper Bot- 120(Paper-XIV)

Plant Tissue Culture, Green House Technology and Hydroponics

Lectures-45

Unit: 1:-Plant tissue culture- Objectives and goals of plant tissue culture, laboratory design and development, operation and management. 10

-Tissue nutrition- Basic principles of in vitro culture, factors influencing morphogenesis

-Media preparation and handling- Sterilization methods, equipments And apparatus, procedures of media preparation and stock solutions.

Unit: 2:-Plant regeneration and plant propagation – Meristem culture/ axillary Bud culture, protocols and schedules of observation. 10

-Callus culture- somatic embryogeny, cell suspension culture, cell line and bioreactors

Unit: 3:-Organ culture- Anther culture, Isolation of haploids & its significance. Embryo culture. , embryo rescue. 10

-Synthetic seed- Concept method and applications.

Unit: 4:-Greenhouse technology- Construction, operation, maintenance and Management. 10

management- light, temperature, Fertilization, humidity, pest and disease control. 5

Unit: 5:-Hydroponics- Definition, technique, applications.

Reference books:

1. Dodds J.H. & Roberts L.W. (1985): Experiments in Plant Tissue Culture.
2. Camborg O.L. And Philips G.C. (1996): Plant, Tissue and Organ Culture Fundamental Methods.
3. Dixon, R.A. (1985): Plant Cell Culture. A Practical Approach.
4. Narayanaswamy S. (1997): Plant Cell and Tissue Culture.
5. Evans et. al. (1983): Hand Book of Plant Cell Culture Vol. I, II, III.
6. VASIL T.K. (1984): Cell Culture And Somatic Cell Genetics of Plant Vol. I. Laboratory Procedures And Their Applications
7. Bhojwani S.S. And Razdan N.K.(1983): Plant Tissue Culture, Theory And Practice: Elsevier Public
8. Street H.E. (1974): Tissue Culture.
9. Reinert J. And Bajaj Y.P.S. (1976): Plant Cell, Tissue And Organ Culture
10. Thorpe T.A. (1981): Plant Tissue Culture.
11. Nelson P.V. (1973) Greenhouse, Operation and Management.
12. Prasad Kumar- Greenhouse Management for Horticultural Crops.

Practicals Based On Paper Bot- 120(Paper-IV)

1. Designing of plant tissue culture laboratory.
2. a preparation of culture media.
3. Sterilization techniques.

4. Callus culture, organogenesis and suspension culture.
5. Meristem culture.
6. Somatic embryogenesis.
7. Techniques of hardening.
8. Encapsulation of embryos.
9. Green house design sketching.
10. Demonstration of watering and nutrient supply system in greenhouse.-Drip irrigation sprinklers etc.
11. & 12. Study of technique of Hydroponics.

Paper Bot- 121(Paper-XV)

Environmental Plant Physiology

Lectures-45

Unit: 1:-Introduction- Concept of stress & types of stress, plastic strain & elastic strain, stress injury, avoidance, resistance, endurance, & escape. 5

Unit :2:-Water stress- Effect of water stress on plant metabolism, drought resistance mechanisms in plants, role of prolines and other osmolites, induction of drought resistance. 15

Salt stress- Salinity and sod city, types of salinity, causes of soil salinization, a brief account of distribution of salt affected soils in India, effect of salt stress on plant

Metabolism, mechanism of salt tolerance in higher plants, reclamation of saline soils.

Water logging- Causes of water logging, nature of water logging injury, mechanism of flooding tolerance.

Unit: 3:-Ion stress- Heavy metal toxicity - iron, manganese and zinc, effects of soil acidity on plants & phytoremediation. 10

-High and low temperature stress- Effect of high and low temperatures on plants

Metabolism, mechanisms of heat and cold tolerance.

-Radiation stress- Effect of ultraviolet radiations on plants, photo inhibition and

Mechanisms of UV tolerance.

Unit: 4:-Pollution stress- Effect of air pollutants (SO₂, NO_x and Ozone) on plant metabolism. 10

-Oxygen toxicity in plants- Free radicals and their scavenging.

Effect of elevated CO₂ concentration on plant metabolism & productivity.**Unit: 5:-Biotic stress-** Effect of fungal infection on plant metabolism and mechanism of 5

Disease resistance, allelopathy- concept, plant-plant interactions, auto toxicity & allelochemicals.

Reference Books

1. Fageria N.K. 1992. Maximizing Crop Yield.
2. Gupta U.S. 1975. Physiological Aspects of Dry land Farming.
3. Kozłowski T.T. 1984. Flooding and Plant Growth.
4. Rice E.L. 1982. Allelopathy (Physiological Ecology)
5. Sharma S.K. & Gupta I.S. 1986. Physiological Aspects of Dryland Farming.
6. Turner N.C. & Kramer P.J. 1980. Adaptations of Plants to Water and High Temperature Stress.
7. Yawalkar & Agrawal, Manures and Fertilizers.
8. Evans L.T. 1972. Crop Physiology.
9. Levitt J. 1980. Responses of Plants to Environmental Stresses. Vol. 1 And 2.
10. Indian Journal of Plant Physiology. New Delhi.
11. Agros Annual Review of Plant Physiology. Jodhpur.
12. Environmental Plant Physiology.
13. Cherry J.H. 1989. Environmental Stress in Plants. Biochemical & Physiological Mechanisms.
14. Journal of Experimental Botany.
15. Environmental Plant Physiology.

Practicals Based On Paper Bot- 121(Paper-XV)

1. Measurement of relative water content and osmotic potential.
2. Determination of chlorophyll stability index.
3. Study of effects of Fe/Zn/Mn toxicity on plant growth and development.
4. Study of protein profile/ amino acid profile in plants under stress.

5. Study of effect of fungal infection on peroxidase activity.
6. Screening of germplasm for biotic and abiotic stresses
7. Effect of UV radiations on anthocyanin production.
8. Study of free radical scavenging enzymes catalase / SOD.
9. Study of free proline accumulation in plants under stress.
10. Study of effect of water logged condition on plants.
11. Study of allelopathic effect on plant growth and development (allelochemicals)
12. Study of chloride and sulphate salinity stress on plant growth and development.

Paper –Bot- 122(Paper-XVI)

Crop Physiology

Lectures-45

Unit: 1:-Crop growth- Crop growth analysis and its applications, crop productivity, harvest Index, water use efficiency and N- use efficiency, plant growth regulators in agriculture and antitranspirants 15
. Reproductive development- Photoperiodism and vernalization

Fertilizers- Types, application through soil, foliar application, organic farming and its importance.

Unit: 2:-Crop-weed interactions- Common weedicides and their mode of action. 5

Source- sink relationship- Phloem transport.-vegetative and reproductive phase and factors affecting source sink relationship.

UNIT3:-A brief idea of physiological basis of yield in sugar cane, jowar, cotton, groundnut& wheat 5

UNIT 4 - Physiology of crops with reference to following aspects- 15

- i) Mineral nutrition of groundnut.
- ii) Nitrogen fixation in chickpea.
- iii)Fruit physiology of Ber, Pomegranate, Mango, lemon and grape. [any 2]
- iv) Post harvest technology of grapes/ Ber/ and pomegranate w.r.t. market strategy- from

Unit: 5: -A brief idea of crop physiological conditions in India ICRISAT, IARIT, CIMAP Luck now, central soil salinity research lab Karnal, CAZRI Jodhpur, BARC, UAS, Bangalore.

Reference Books

- 1 Cherry J.H. 1989. Environmental Stress in Plants. Biochemical & Physiological Mechanisms.
- 2 Fageria N.K. 1992. Maximizing Crop Yield.
- 3 Gupta U.S. 1975. Physiological Aspects of Dry land Farming. 4
- Kozlowski T.T. 1984. Flooding and Plant Growth.
- 5 Rice E.L. 1982. Allelopathy (Physiological Ecology)
- 6 Sharma S.K. & Gupta I.S. 1986. Physiological Aspects of Dryland Farming.
- 7 Turner N.C. & Kramer P.J. 1980. Adaptations of Plants to Water and High Temperature Stress.
- 8 Yawalkar & Agrawal, Manures and Fertilizers.
- 10 Evans L.T. 1972. Crop Physiology.
- 11 Levitt J. 1980. Responses of Plants to Environmental Stresses. Vol. 1 And 2. 12
- Indian Journal of Plant Physiology. New Delhi.
- 13 Agros Annual Review of Plant Physiology. Jodhpur.
- 14 Environmental Plant Physiology.
- 15 Journal of Experimental Botany.
- 16 Environmental Plant Physiology.

Practicals Based On Paper Bot- 122(Paper-XVI)

1. Growth analysis of any two crop plants (RGR, NAR, LAR, LAI etc).
2. Study of the effect of antitranspirants on stomatal behavior.
3. Study of the effect of source manipulation on sink capacity in any crop plant.
4. Estimation of acid invertase during ripening of sugarcane stalk.
5. Study of allelopathic effect of weed extract on germination of crop seeds.
6. Estimation of total lipids in oil seeds.
7. Study of effect of weedicide on some aspects of weed metabolism.

8. Study of Crop varieties .
9. Visit to ware houses to study proper storage conditions for grains, seed and fruits.
10. Study of root nodules in leguminous crops.
11. Study of fertilizers (Chemical and Biofertilizers)
12. Effect of biofertilizers on growth and development of plant .

M.SC.II (SEM III) Discipline Specific Elective

**Horticultural Practices and Post-Harvest Technology
Paper XI (BO-115)**

THEORY

Lectures: 45

Unit 1: Introduction

(3 lectures)

Scope and importance, Branches of horticulture; Role in rural economy and employment generation; Importance in food and nutritional security; Urban horticulture and ecotourism.

Unit 2: Ornamental plants

(4 lectures)

Types, classification (annuals, perennials, climbers and trees); Identification and salient features of some ornamental plants [rose, marigold, gladiolus, carnations, orchids, poppies, gerberas, tuberose, sages, cacti and succulents (opuntia, agave and spurges)] Ornamental flowering trees (Indian laburnum, gulmohar, Jacaranda, Lagerstroemia, fishtail and areca palms, semul, coraltree).

Unit 3: Fruit and vegetable crops

(4 lectures)

Production, origin and distribution; Description of plants and their economic products; Management and marketing of vegetable and fruit crops; Identification of some fruits and vegetable varieties (citrus, banana, mango, chillies and cucurbits).

Unit 4: Horticultural techniques

(9 lectures)

Application of manure, fertilizers, nutrients and PGRs; Weed control; Biofertilizers, biopesticides; Irrigation methods (drip irrigation, surface irrigation, furrow and border irrigation); Hydroponics; Propagation Methods: asexual (grafting, cutting, layering, budding), sexual (seed propagation), Scope and limitations.

Unit 5: Landscaping and garden design

(5 lectures)

Planning and layout (parks and avenues); gardening traditions - Ancient Indian, European, Mughal and Japanese Gardens; Urban forestry; policies and practices.

Unit 6: Floriculture

(5 lectures)

Cut flowers, bonsai, commerce (market demand and supply); Importance of flower shows and exhibitions.

Unit 7: Post-harvest technology

(05 lectures)

Importance of post harvest technology in horticultural crops; Evaluation of quality traits; Harvesting and handling of fruits, vegetables and cut flowers; Principles, methods of preservation and processing; Methods of minimizing losses during storage and transportation; Food irradiation - advantages and disadvantages; food safety.

Unit 8: Disease control and management

(05 lectures)

Field and post-harvest diseases; Identification of deficiency symptoms; remedial measures and nutritional management practices; Crop sanitation; IPM strategies (genetic, biological and chemical methods for pest control); Quarantine practices; Identification of common diseases and pests of ornamentals, fruits and vegetable crops.

Unit 9: Horticultural crops - conservation and management

(05 lectures)

Documentation and conservation of germplasm; Role of micropropagation and tissue culture techniques; Varieties and cultivars of various horticultural crops; IPR issues; National, international and professional societies and sources of information on horticulture.

Suggested Readings

1. Singh, D. & Manivannan, S. (2009). Genetic Resources of Horticultural Crops. Ridhi International, Delhi, India.
2. Swaminathan, M.S. and Kochhar, S.L. (2007). Groves of Beauty and Plenty: An Atlas of Major Flowering Trees in India. Macmillan Publishers, India.
3. NIIR Board (2005). Cultivation of Fruits, Vegetables and Floriculture. National Institute of Industrial Research Board, Delhi.
4. Kader, A.A. (2002). Post-Harvest Technology of Horticultural Crops. UCANR Publications, USA.
5. Capon, B. (2010). Botany for Gardeners. 3rd Edition. Timber Press, Portland, Oregon.
6. Singh S.S.(1988) Crop management under irrigated and Rain fed conditions .Kalyani Publications .New Delhi.
7. Swaraj Mandal and Ajit K Basu (2014) Environmental physiology of plants .Campus

8. Dwivedi and Dwivedi(2005) Physiology of abiotic stress in plants.AGROBIOS (India)

Practicals :

1-3 .Study of ornamental plants (10 Plants from each group)

4-5.Study of fruit and vegetable crop and their varieties

6-7 – Study of biopesticides and Biofertilizers and their effect on crop plants

8-9- Artificial vegetative propagation

10- Study of cut flowers and Bonsai

11-12.Visit to Botanical garden ,nursery , polyhouse and horticultural plant preservation and processing unit.

**Analytical Techniques in Plant Sciences
Paper XII(BO-116)**

THEORY

Lectures: 45

Unit 1: Imaging and related techniques (10 lectures)

Principles of microscopy; Light microscopy; Fluorescence microscopy; Confocal microscopy; Use of fluorochromes: (a) Flow cytometry (FACS); (b) Applications of fluorescence microscopy: Chromosome banding, FISH, chromosome painting; Transmission and Scanning electron microscopy – sample preparation for electron microscopy, cryofixation, negative staining, shadow casting, freeze fracture, freeze etching.

Unit 2: Cell fractionation (05 lectures)

Centrifugation: Differential and density gradient centrifugation, sucrose density gradient, CsCl₂ gradient, analytical centrifugation, ultracentrifugation, marker enzymes.

Unit 3: Radioisotopes (4 lectures)

Use in biological research, auto-radiography, pulse chase experiment.

Unit 4: Spectrophotometry (4 lectures)

Principle and its application in biological research.

Unit 5: Chromatography (8 lectures)

Principle; Paper chromatography; Column chromatography, TLC, GLC, HPLC, Ion-exchange chromatography; Molecular sieve chromatography; Affinity chromatography.

Unit 6: Characterization of proteins and nucleic acids (4 lectures)

Mass spectrometry; X-ray diffraction; X-ray crystallography; Characterization of proteins and nucleic acids; Electrophoresis: AGE, PAGE, SDS-PAGE

Unit 7: Biostatistics (10 lectures)

Statistics, data, population, samples, parameters; Representation of Data: Tabular, Graphical; Measures of central tendency: Arithmetic mean, mode, median; Measures of dispersion: Range, mean deviation, variation, standard deviation; Chi-square test for goodness of fit.

Practical

1. Study of Blotting techniques: Southern, Northern and Western, DNA fingerprinting, DNA sequencing, PCR through photographs.
2. Demonstration of ELISA.
3. To separate nitrogenous bases by paper chromatography.
4. To separate sugars by thin layer chromatography.
5. Isolation of chloroplasts by differential centrifugation.
6. To separate chloroplast pigments by column chromatography.
7. To estimate protein concentration through Lowry's methods.
8. To separate proteins using PAGE.
9. To separation DNA (marker) using AGE.
10. Study of different microscopic techniques using photographs/micrographs (freeze fracture, freeze etching, negative staining, positive staining, fluorescence and FISH).
11. 12 .Preparation of permanent slides (double staining).

M.SC.II (SEM IV) Discipline Specific Elective

**Stress Biology
Paper XV (BO-121)**

Lectures:45

Theory

Unit 1: Defining plant stress

(2 lectures)

Acclimation and adaptation.

Unit 2: Environmental factors

(15 lectures)

Water stress; Salinity stress, High light stress; Temperature stress; Hypersensitive reaction; Pathogenesis– related (PR) proteins; Systemic acquired resistance; Mediation of insect and disease resistance by jasmonates.

Unit 3: Stress sensing mechanisms in plants

(08 lectures)

Calcium modulation, Phospholipid signaling

Unit 2: Developmental and physiological mechanisms that protect plants against environmental stress

(15 lectures)

Adaptation in plants; Changes in root: shoot ratio; Aerenchyna development; Osmotic adjustment; Compatible solute production.

Unit 3: Reactive oxygen species–Production and scavenging mechanisms.

(5 lectures)

Practical

1. Quantitative estimation of peroxidase activity in the seedlings in the absence and presence of salt stress.
2. Superoxide activity in seedlings in the absence and presence of salt stress.
3. Zymographic analysis of peroxidase.
4. Zymographic analysis of superoxide dismutase activity.
5. Quantitative estimation and zymographic analysis of catalase.
6. Quantitative estimation and zymographic analysis of glutathione reductase.
7. Estimation of superoxide anions.
8. Study of osmotic potential and water potential .
9. Estimation of proline.
10. Estimation of protein .
11. -12. Structural and physiological adaptations in stressed plants.

Suggested Readings

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.

Discipline Specific Elective

Research Methodology Paper XVI(BO-122)

Credit: Theory 4; Practical 2

Lectures: 45

Theory

Unit 1: Basic concepts of research (05 lectures)

Research-definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research.

Unit 2: General laboratory practices (10 lectures)

Common calculations in botany laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.

Unit 3: Data collection and documentation of observations (05 lectures)

Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissuespecimens and application of scale bars. The art of field photography.

Unit 4: Overview of Biological Problems (05lectures)

History; Key biology research areas, Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network.

Unit 5: Methods to study plant cell/tissue structure (05 lectures)

Whole mounts, peel mounts, squash preparations, clearing, maceration and sectioning; Tissue preparation: living vs fixed, physical vs chemical fixation, coagulating fixatives, non-coagulant fixatives; tissue dehydration using graded solvent series; Paraffin and plastic infiltration; Preparation of thin and ultrathin sections.

Unit 6: Plant microtechniques

(08 lectures)

Staining procedures, classification and chemistry of stains. Staining equipment. Reactive dyes

and fluorochromes (including genetically engineered protein labeling with GFP and other tags). Cytogenetic techniques with squashed plant materials.

Unit 7: The art of scientific writing and its presentation (07 lectures)

Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

Practicals

- 1-2.Experiments based on chemical calculations.
- 3-4.Plant microtechnique experiments.
- 5-6.The art of imaging of samples through microphotography and field photography.
- 7-8.Poster presentation on defined topics.
- 9-10.Technical writing on topics assigned.
11. Data collection ,tabulation and presentation (graphic)
12. Study of Drosophila characters and Arabidopsis thaliana culture .

Suggested Readings

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

