KERALA AGRICULTURAL UNIVERSITY

B.Sc. Hons (Ag.) PROGRAMME

Course Catalogue and Syllabi

2007

KAU P.O., Thrissur- 680 656

CONTENTS

Syllabus B.Sc. Hons (Ag.)

Department wise courses

Sl. No.	Catalogue No.	Proposed courses	Credit hrs
I.	**Agronomy**		
1.	Agro.1101	Introductory Agriculture (Ancient Heritage, Agriculture Scenario and Gender Equity in Agriculture)	1 (1+0)
2.	Agro.1102	Principles of Agronomy	2 (1+1)
3.	Agro.1203	Irrigation and Water Management	3 (2+1)
4.	Agro.1204	Weed management	2 (1+1)
5.	Agro.2105	Field crops-I	3 (2+1)
6.	Agro.2206	Practical crop production (Rice)	1 (0+1)
7.	Agro.2207	Field crops II	2 (1+1)
8.	Agro.3108	Cropping pattern and Farming systems	2 (1+1)
9.	Agro.3209	Sustainable agriculture and organic farming	2 (1+1)
Total			**18 (10+8)**
II	**Plant breeding & Genetics**		
1	Pbgn.1101	Morphology and Systematics of crop plants	1 (0+1)
2	Pbgn.1102	Principles of Genetics & Cytogenetics	3 (2+1)
3	Pbgn.2103	Principles of Plant Breeding	3 (2+1)
4	Pbgn.3104	Breeding of Crops	3 (2+1)
5	Pbgn.3205	Principles of seed Technology	2(1+1)
Total			**12 (7+5)**
III	**Soil Science & Agricultural Chemistry**		
1	Scac.1101	Introduction to Soil Science	3 (2+1)
2	Ssac.1202	Agricultural Biochemistry	3 (2+1)
3	Ssac.2103	Organic farming and Soil Health	2 (1+1)
4	Ssac.2204	Fertilizers and Agro-chemicals	2 (1+1)
5	Ssac.3105	Soil Chemistry, soil fertility and Nutrient Management	3 (2+1)
6	Ssac.3206	Environmental Science	2 (1+1)
Total			**15(9+6)**
IV	**Agricultural Entomology**		
1	Ento.1101	Insect Morphology, Physiology and Systematics	3 (2+1)
2	Ento.1202	Insect Ecology and Integrated Pest Management	3 (2+1)
3	Ento.2203	Pest of crops and stored Grains and their Management	3 (2+1)
4	Ento.3204	Plant Parasitic Nematodes, other non insect pests and their management	2 (1+1)
Total			**11 (7+4)**
V	**Agricultural Economics**		
1	Econ.1201	Principles of Agricultural Economics	2(2+0)
2	Econ.2102	Agricultural Finance and Co- operation	2 (1+1)
3	Econ.2203	Production Economics and Farm Management	2 (1+1)
4	Econ.3104	Agricultural Marketing , Trade and Prices	2 (1+1)
5	Econ.3205	Fundamentals of Agri-Business Management (including Product Development, Appraisal and Monitoring)	2 (1+1)
Total			**10(6+4)**

VI	**Agricultural Engineering**		
1	Engg.1101	Fundamentals of Soil, Water and Conservation Engineering	2 (1+1)
2	Engg.1202	Farm Power and Machinery	2 (1+1)
3	Engg.3103	Protected Cultivation and Post –Harvest Technology	2 (1+1)
4	Engg.3204	Renewable Energy	1 (1+0)
Total			**7 (4+3)**
VII	**Plant Pathology**		
1	Path.1101	Introductory plant pathology	2 (1+1)
2	Path.2102	Principles of crop disease management	2 (1+1)
3	Path.3103	Disease of field crops and their management	3 (2+1)
4	Path.3204	Diseases of horticultural crops and their management	3 (2+1)
Total			**10(6+4)**
VIII	**Horticulture**		
1	Hort.1101	Fundamentals of Horticulture	1 (1+0)
2	Hort.1202	Plantation crops	2 (1+1)
3	Hort.2103	Landscaping and ornamental horticulture	2 (1+1)
4	Hort.2204	Vegetable Crops	3 (2+1)
5	Hort.3105	Fruit Crops	3 (2+1)
6	Hort.3206	Spices and Medicinal plants	2 (1+1)
7	Hort.3207	Post-Harvest Management and Processing of horticultural crops	3 (2+1)
Total			**16(10+6)**
IX	**Agricultural Extension**		
1	Extn.1201	Sociology and Psychology as applied to Agricultural Extension	2(2+0)
2	Extn.2102	Agricultural Extension and Rural Development	2(1+1)
3	Extn.3103	Communication and Extension Methodologies for Transfer of Agricultural Technology	2(1+1)
4	Extn.3204	Entrepreneurship Development and Extension Management	2(1+1)
5	Extn.4105	Rural Agricultural Work Experience Programme (RAWE)	20(0+20)
Total			**28(5+23)**
X	**Plant Physiology**		
1	Crps.2201	Crop Physiology	3(2+1)
Total			**3(2+1)**
XI	**Microbiology**		
1	Micr.1101	Agricultural Microbiology	3 (2+1)
Total			**3 (2+1)**
XII	**Statistics and Computer Application**		
1	Stat.1201	Basic Statistics	2 (1+1)
2	Stat.2102	Introduction to Computer Applications	2 (1+1)
3	Stat.3203	Design and Analysis of Experiments	2 (1+1)
Total			**6 (3+3)**
XIII	**Animal Husbandry**		
1	Anhs.2101	Fundamentals of Livestock Poultry Production	3 (2+1)
Total			**3 (2+1)**

XIV	**Agricultural Meteorology**		
1	Agmt.1101	Agricultural Meteorology	2 (1+1)
Total			**2 (1+1)**
XV	**Plant Biotechnology**		
1	Biot.2201	Principles of Plant Biotechnology, Bio-safety Rules and Intellectual Property Rights	3 (2+1)
Total			**3 (2+1)**
XVI	**Home Science**		
1	Hmsc.2201	Food and Nutrition	2 (1+1)
Total			**2 (1+1)**
XVII	**Non Credit Courses**		
1	Phed.1101	Physical Education	1 (0+1)
2	Stur.2201	Study tour –I	1 (0+1)
3	Stur.3202	Study tour –II	1 (0+1)
Total			**3(0+3)**
XVII		**Experiential learning**	**20**
Grand Total			**169+0+3 Non-credit**

Courses for Experiential Learning

I	**Crop production**		
1	Elcp. 4201	Seed Production Technology **(Agro & PB&G)**	3 (2+1)
2	Elcp.4202	Remote Sensing GIS and Land Use Planning **(S.S & Agrl. Chemistry)**	3 (2+1)
3	Elcp.4203	Integrated Farming System **(Agro & AH)**	3 (2+1)
4	Elcp.4204	Water Management (Watershed Micro-irrigation Problematic water)**(Agro,, Engg. & S.S & Agrl. Chem)**	4 (3+1)
5	Elcp.4205	Soil Management (Conservation, Problematic Soil, Soil Quality) **(S.S and Agrl.Chem, Engg & Agro)**	4 (3+1)
6.	Elcp.4206	Crop growth, simulation and modeling **(Agro. met agro & Physi.)**	3(2+1)
II	**Crop protection**		
1	Elpt 4201	**Integrated pest and disease management (Ento and Path)**	4 (2+2)
2	Elpt 4202	Management of Post Harvest insect pests and diseases **(Ento & Path)**	3 (1+2)
3	Elpt 4203	Non- insect pests and their Management **(Ento)**	3 (1+2)
4	Elpt 4204	Productive Insects **(Ento)**	2 (0+2)
5	Elpt.4205	Mushroom cultivation **(Path)**	2 (0+2)
6	Elpt 4206	Bio-control agents and bio-pesticides (mass production and uses) **(Micro, Path & Ento)**	3(1+2)
7	Elpt 4207	Pesticides and Plant Protection equipment **(Ento, Path & Engg)**	3(1+2)

III		**Horticulture**	
1	Elht.4201	Commercial Vegetable Production **(Oleri)**	3(1+2)
2	Elht. 4202	Commercial Floriculture **(Pomol)**	3(1+2)
3	Elht.4203	Commercial Fruit Production **(Pomol)**	3(1+2)
4	Elht. 4204	Nursery management of Horticultural crops **(Pomol, Pln crps & Oleri)**	4(1+3)
5	Elht. 4205	Protected cultivation of horticultural crops (**Oleri,Pomlogy & Engg**)	2(1 +1)
6	Elht.4206	Seed production of vegetables and flowers **(Oleri, Pomology & Pbgn)**	2(1 +1)
7	Elht.4207	Processing and value addition of horticultural crops. **(Proc & Hmsc)**	3(2+1)
8	Elht.4208	Landscape designing and Indoor Gardening Techniques **(Floriculture)**	2(1+1)
IV		**Post Harvest Technology and Value addition**	
1	Elph.4201	Post harvest Technology of Horticultural corps **(Proc)**	3(1+2)
2	Elph.4202	Unit operation for quality value addition processing and development of new products **(Proc & Engg)**	4(1+3)
3	Elph.4203	Post harvest technology of spices, plantation crops, medicinal and aromatic crops**(Proc & Pln crop)**	4(1+3)
4	Elph.4204	Integrated storage management of fruits, flowers and vegetables **(Proc, pomolo & Oleri)**	3 (1+2)
5	Elph.4205	Post harvest handling of cut flowers and dry flowers **(Pomol & Proc)**	3(1+2)
6	Elph.4206	Processing of cereals, pulses and oilseed crops including biodiesel **(HmSc, Agro & Engg)**	3(1+2)
V.		**Agri-Business Management**	
1	Elab.4201	Information & Communication Management **(Extn & Engg)**	3(1+2)
2	Elab.4202	Management of Agro-based industry **(Extn, HmSc &Engg**)	4(1+3)
3	Elab.4203	Marketing Management (Agricultural Import-Export Policy of Govt.of India & Business Laws) **(Econ)**	3(1+2)
4	Elab.4204	Financial Management of Agri-Business **(Econ)**	4(1+3)
5	Elab.4205	Natural Resources Economics and Management **(Econ)**	3(1+2)
6	Elab.4206	Project formulation, Evaluation and Monitoring **(Econ)**	3(1+2)
VI		**Social Sciences**	
1	Elss.4201	Agricultural Journalism **(Extn)**	3(1+2)
2	Elss.4202	Visuals and Graphic Communication **(Extn)**	3(1+2)
3	Elss.4203	Cyber Extension **(Extn & Engg)**	2(1+2)
4	Elss.4204	Behavioral Skills **(Extn & Hmsc)**	3(1+2)
5	Elss.4205	Livestock, Poultry and Fish Marketing **(AH & Econ)**	3(1+2)

6	Elss.4206	Farm Planning and Budgeting **(Econ)**	3(1+2)
7	Elss.4207	Government Policies and Programmes related to Agriculture **(Extn & Econ)**	3(1+2)
VII	**Biotechnology**		
1	Elbt.4201	Molecular Breeding **(PB&G. & Biotech)**	3(1+2)
2	Elbt.4202	Plant tissue culture **(Biotech & PB&G)**	4(1+3)
3	Elbt.4203	Recombinant DNA Technology **(Biotech)**	3(1+2)
4	Elbt.4204	Bio-informatics **(Biotech, PB&G & Micro& Computer science)**	3(1+2)
5	Elbt.4205	Microbial & Environmental Technology **(Micro,Biotech & Engg)**	4(1+3)
6	Elbt.4206	Molecular Diagnostics **(Biotech,Path & Pbgn)**	3(1+2)
7	Elbt.4207	Breeding for biotic and abiotic stresses **(PB&G, Ento, Path and Physio)**	2(1+1)
8	Elbt.4208	Invitro production of secondary metabolites **(Biotech, Pln Crops,Physio, and HmSc).**	2(1+1)
9	Elbt.4209	Invitro conservation of germplasm **(Biotech, & PB&G)**	2(1+1)
10	Elbt.4210	Diagnostic Physiology **(Physio)**	2(1+2)
VIII	**Commercial Agriculture**		
1	Elca.4201	Commercial Floriculture **(Pomol)**	3(0+3)
2	Elca.4202	Commercial Fruit Production **(Pomol)**	3(0+3)
3	Elca.4203	Nursery management of horticultural crops **(Pomol, Pln crps & Oleri)**	3(1+2)
4	Elca.4204	Cultivation of commercially important medicinal & aromatic plants **(Pln Crops, Agro)**	2(1+1)
5	Elca.4205	Commercial spices production **(Pln Crops)**	3(1+2)
6	Elca.4206	Production technology of economic forest plants **(Agro)**	3(1+2)
7	Elca.4207	Commercial seed production **(Agro, PB&G,& Oleri)**	3(1+2)
8	Elca.4208	Fermentation Technology **(Micro, Biotech, Processing and HmSc.)**	3(1+2)
9	Elca.4209	Agri-Eco tourism **(Extn,Agro,Hort,Econ.&A.H)**	4(1+3)

Rural Agricultural Work Experience (RAWE): Under this programme two models were suggested. RAWE Model II is recommended.

RAWE Model II	**Duration (Weeks)**
1. Orientation	1
2. Village attachment	6
3. Agri-clinics / Plant Health Clinics / Experiential leaning /Industrial Attachment	12

4	Project report preparation and examination	1
Total		20

RAWEP Attachment with Agro-based Industries: During RAWE Programme the students will undergo internship in any one of the following industries / companies / institutes for a period of twelve weeks (the list is only suggestive and need based / location specific industries may be included).

x_ Seed industries / companies
x_ Fertilizer industries
x_ Pesticides industries
x_ Biotechnological industries (Tissue Culture labs)
x_ Bio pesticides industries
x_ Commercial nurseries / landscaping units
x_ Sericulture units
x_ Food processing units
x_ Agricultural finance Institutions / Banks / Credit Societies etc.
x_ Non – Governmental organizations

Evaluation of RAWE Programme

Attendance: Minimum attendance for this programmme - 85%.

Semester wise distribution of courses

Sl. No	CatalogueNo.	Title of the Course	Credit
		I Semester	
1	Agro.1101	Introductory Agriculture	1+0
2	Agro. 1102	Principles of Agronomy	1+1
3	Agmt. 1101	Agricultural Meteorology	1+1
4	Pbgn.1101	Morphology and Systematics of crop plants	0+1
5	Pbgn.1102	Principles of Genetics & Cytogenetics	2+1
6	Ssac. 1101	Introduction to Soil Science	2+1
7	Micr.1101	Agricultural Microbiology	2+1
8	Engg.1101	Fundamentals of Soil, Water and Conservation Engineering	1+1
9	Hort.1101	Fundamentals of Horticulture	1+0
10	Ento.1101	Insect Morphology, Physiology and Systematics	2+1
11	Path.1101	Introductory plant pathology	1+1
12	Phed.1101	Physical Education	0+1 **(Non-credit)**
Total			**14+9=23**
		II Semester	
1	Agro 1203	Irrigation and Water Management	2+1
2	Agro.1204	Weed management	1+1
3	Ssac.1202	Agricultural Biochemistry	2+1
4	Econ..1201	Principles of Agricultural Economics	2+0
5	Ento.1202	Insect Ecology and Integrated Pest Management including Beneficial Insects	2+1
6	Extn.1201	Sociology and Psychology as applied to Agricultural Extension	2+0
7	Engg.1202	Farm Power and Machinery	1+1
8	Hort.1202	Plantation crops	1+1
9	Stat.1201	Basic Statistics	1+1
Total			**14+7 =21**
		III Semester	
1	Agro.2105	Field crops-I	2+1
2	Pbgn.2103	Principles of Plant Breeding	2+1
3	Ssac. 2103	Organic farming and Soil Health	1+1
4	Econ..2102	Agricultural Finance and Co- operation	1+1
5	Path.2102	Principles of crop disease management	1+1
6	Hort.2103	Landscaping and ornamental horticulture	1+1
7	Extn.2102	Agricultural Extension and Rural Development	1+1
9	Stat.2102	Introduction to Computer Applications	1+1
10	Anhs.2101	Livestock Production and Management	2+1
Total			**12+9 =21**

IV Semester

1	Agro.2206	Practical crop production (Rice)	0+1
2	Agro.2207	Field crops II	1+1
3	Crps.2201	Crop Physiology	2+1
4	Ssac.2204	Fertilizers and Agro-chemicals	1+1
5	Ento.2203	Pests of crops and stored Grain and their Management	2+1
6	Econ..2203	Production Economics and Farm Management	1+1
7	Hort.2204	Vegetable Crops	2+1
8	Biot.2201	Principles of Plant Biotechnology, Bio-safety Rules and Intellectual Property Rights	2+1
9	Hmsc.2201	Food and Nutrition	1+1
10	Stur.2201	Study tour –I (Non credit)	0+1(Non-credit)
Total			**12+9=21**

V Semester

1	Agro.3108	Cropping pattern and Farming systems	1+1
2	Pbgn.3104	Breeding of Crops	2+1
3	Ssac.3105	Soil Chemistry, soil fertility and Nutrient Management	2+1
4	Econ..3104	Agricultural Marketing , Trade and Prices	1+1
5	Engg.3103	Protected Cultivation and Post –Harvest Technology	1+1
6	Path.3103	Disease of field crops and their management	2+1
7	Hort.3105	Fruit Crops	2+1
8	Extn.3103	Communication and Extension Methodologies for Transfer of Agricultural Technology	1+1
Total			**12+8 =20**

VI Semester

1	Agro.3209	Sustainable agriculture and Organic farming	1+1
2	Ssac.3206	Environmental Science	1+1
	Pbgn.3205	Principles of Seed Technology	1+1
3	Ento.3204	Plant Parasitic Nematodes, other non insect pests and their management	1+1
4	Econ..3205	Fundamentals of Agri-Business Management (including Product Development, Appraisal and Monitoring)	1+1
5	Engg..3204	Renewable Energy	1+0
6	Path.3204	Diseases of Horticultural Crops and their management	2+1
7	Hort.3206	Spices and Medicinal plants	1+1
8	Hort.3207	Post-Harvest Management and Processing of horticultural crops	2+1
9	Extn.3204	Entrepreneurship Development and Extension Management	1+1
10	Stat.3203	Design and Analysis of Experiments	1+1
11	Stur.3202	Study tour –II (Non credit)	0+1(Non-credit)
Total			**13+10= 23**

VII Semester

	Extn.4105	Rural Agricultural Work Experience	**20**
Total			**20**

VIII Semester

		Experiential Learning	**20**
Grand Total			**169**

Distribution of credits – Semester-wise.

Year	Semester	Credits	Physical Education	Study Tour	Total
I	**I**	14+9 =23	0+1 (Non-credit)		23
	II	14+7 =21			21
II	**III**	12+9 =21			21
	IV	12+9=21		0+1(Non-credit)	21
III	**V**	12+8=20			20
	VI	13+10=23		0+1(Non-credit)	23
IV	**VII**	20			20
	VIII	20			20
Total		**169**	**1**	**2**	**169**

I. AGRONOMY

1. Agro.1101. Introductory agriculture (1+0)

(Ancient heritage, Agricultural scenario and Gender equity in agriculture)

Agriculture as an art, science and business of crop production - Branches of agriculture - Origin of agriculture- Diffusion of crops- Subsistence and commercial agriculture- agriculture- Hunger and food security- Agriculture systems in the world - Basic elements of crop production; Factors affecting crop production; Agricultural seasons in India and Kerala-History of agricultural development – Ancient India- Agriculture in civilization era- Chronology of agricultural technology development in India- Green revolution- Indian agriculture-balance sheet, liabilities; Assets and Contrasting trends (DATA), Agricultural growth, contrasting food chains- Diversity in physiography- Agriculture in Kerala- Major farming systems- Physiographic features. Economic ecology, Rainfed and irrigated agriculture- Farming Systems approach- value addition- requirements in new technology; Women in Agriculture-multifaceted roles and tasks- Understanding gender- Gender roles in agriculture systems-Work stress factors, nutritional and rural life standards, role in house hold decision making- Drudgery reduction for farm women- Women friendly agricultural technology and empowerment of women: Group dynamics for farm women and rural women

Lecture schedule

1. Importance of agriculture in India- Agriculture as an art, science and business of crop production –Branches of agriculture and their relationships.
2. Origin of agriculture- Hearths of domestication- Diffusion of crops during the pre-historic period, medieval period, and the modern period-Columbian exchange
3. Subsistence agriculture-commercial agriculture. Extensive and intensive agriculture-Agribusiness- Peasant farming-Urban agriculture-Hunger and food security.
4. Agriculture systems in the world: hunting and gathering- shifting cultivation, settled agriculture, intensive subsistence agriculture, plantation agriculture, Mediterranean agriculture, homestead agriculture, market gardening/ truck gardening, large-scale grain farming (sidewalk and suitcase farming), recessional farming, pastoral nomadism , livestock ranching, commercial livestock fattening, commercial dairying, etc.
5. Basic elements of crop production; Factors affecting crop production - Agricultural seasons in India and Kerala
6. History of Agricultural Development – Agriculture in ancient India – Natural calamities and famines
7. Agriculture in civilization era-Chronology of agricultural technology development in India-Second world war and its effects on food production-Grow More Food Campaign and its effects.
8. Green revolution-Genesis-Basic elements-Criticisms- Lifeboat ethics and carrying capacity
9. Indian Agriculture-balance sheet, liabilities, assets and contrasting trends (with supporting data). Agricultural growth and contrasting food chains

10. India- Diversity in physiography- Agriculture in Kerala- Major farming systems- Physiographic features.
11. Economic ecology- Rainfed and irrigated agriculture
12. Farming Systems approach- value addition, requirements in new technology
13. Women in Agriculture-multifaceted roles and tasks- Understanding gender concepts
14. Gender roles in agriculture systems- gender, poverty and livelihoods- biodiversity and food security
15. Occupational health hazards- Work stress factors, nutritional and rural life standards, role in house hold decision making
16. Women labour in agriculture and issues- Drudgery reduction for farm women, Women friendly agricultural technology- Ergonomical approaches- Technological options
17. Empowerment of rural women- Participation and Governance
18. Access to farm resources-Group dynamics for farm women and rural women

Suggested Readings

Ahmed, I. (ed.) 1985. *Technology and Rural Women: Conceptual and Empirical Issues*, ILO, London

Ahmed, S. 2004. *Gender Issues in Agricultural and Rural Livelihoods*-Vol. I M.S. Swaminathan Research Foundation, Chennai and Kerala Agricultural University, Thrissur.

Commonwealth Secretariat.1996. *Women and Natural Resource Management: A Manual for the Asian Region*. Gender and Youth Affairs Division, London.

Cox, G.W and Atkins, M.D. 1979. *Agricultural Ecology : An Analysis of World Food Production Systems.* W.H. Freeman and Company, San Francisco.

FAO [Food and Agriculture Organization of the United Nations]. 2001. Field Level Handbook, SEAGA Socio–Economic and Gender Analysis Programme. FAO, Rome (Available: http://www.fao.org/sd/seaga/downloads/En/fieldEn.pdf).

Grigg, D.B. 1974. *The Agricultural Systems of the World: An Evolutionary Approach*. Cambridge University Press, Cambridge.

Harlan, J.R. 1992. *Crops and Man*. American Society of Agronomy& Crop Science Society of America, Madison, WI.

Husain, M. 1996. *Systematic Agricultural Geography*. Rawat Publications, Jaipur

Janick, J., Schery, R.W., Woods, F.W., and Ruttan, V.W. 1974. *Plant Science: An Introduction to World Crops*. W.H. Freeman and Company, San Francisco.

Noor Mohammed.1992. Origin, diffusion and development of agriculture. In: Noor Mohammed (ed.), *New Dimensions in agricultural geography: Vol.1.Historical Dimensions of agriculture*. Concept publishing Co., New Delhi. pp29-75.

Pandey, H. 2002. *Women in Agriculture*. National Research Centre for Women in Agriculture (ICAR), Bhubanewar.

Purseglove, J.W. 1974. *Tropical Crops: Dicotyledons*. The English Language Book Society and Longman, London

Randhawa, M.S. 1980-1986. *A History of Agriculture in India* Vol.I to IV Indian Council of Agricultural Research, New Delhi.

Samantha R.K (ed.). 1995. *Women in Agriculture-Perspectives, Issues and Experiences*. M.D.Publishes, New Delhi.

2. Agro. 1102. Principles of agronomy (1+1)

Meaning, definition and scope of agronomy. Relationship with other disciplines-divisions of agronomy- Classification of crop plants based on the intensity of cultivation, uses, life span, growth habit, and climatic response and/or habitat. Agronomic classification of crops-Botanical classification- Category of cultivars- classification of crops based on special purpose – Growth- definition - factors affecting growth -Crop yield contributing characters-harvest index- Seed – definition - characteristics of good quality seed – vegetative propagation in field crops- setts, slips, tubers, and rhizomes- methods of sowing/planting – planting geometry and its effect on growth and yield.– Tillage-definition- objectives – types of tillage- tillage implements – tilth - characteristics of good tilth - Soil productivity and fertility- Crop nutrition – nutrients –classification – Nutrient sources- organic manures –fertilizers – biofertilizers- Integrated Nutrient Management

Practical

Visit to crop museum and identification of crops- Study of tillage implements - ploughs, harrows and cultivators- Practice of ploughing; Practice of puddling; Study of seeding equipments. Different methods of sowing crops-direct seeding: broadcasting, dibbling and drilling-transplanting- Identification of manures and fertilizers-organic manures: bulky and concentrated-fertilizers: Straight, complex and mixed fertilizers- - Fertilizer recommendation and calculation of doses for rice, coconut, cassava, banana and cowpea-Methods of application of fertilizers broadcasting, placement, foliar application and fertigation- Visit to experimental plots to study design and layout - yield estimation of crops.

Lecture Schedule

1 Meaning, definition and scope of agronomy- divisions of agronomy- Relationship with other disciplines
2 Classification of crops based on the intensity of cultivation, uses, ontogeny/ life span, growth habit, and climatic response and/or habitat- Agronomic classification of crops-
3 Botanical classification- Category of cultivars- classification based on special purpose
4 Growth, definition - factors affecting growth - Crop yield contributing characters-biological and economic yield- harvest index
5 Plant population and yield –optimum plant population- planting time
6 Planting geometry and its effect on growth and yield.–
7 Seed – definition - characteristics of good quality seed
8 Vegetative propagation in field crops- setts, slips, tubers, and rhizomes
9 Methods of sowing/planting- direct seeding: broadcasting, dibbling and drilling-transplanting-
10 Tillage- definition- objectives – types of tillage- conservation tillage
11&12. Tillage implements-ploughs, harrows, cultivators, hoes and special purpose implements
13 Tilth - characteristics of good tilth –

14 Soil productivity and fertility- Crop nutrition – classification of nutrients
15 Nutrient recycling through manures and fertilizers – organic manures
16 Fertilizers and fertilizer use- Management of fertilizers
17 Biological nitrogen fixation - biofertilizers-
18 Integrated Nutrient Management

Practical schedule

1. Visit to crop museum and identification of crops
2. Study of tillage implements. country plough, mouldboard plough, Bose plough and disc plough
3. Practice of ploughing and puddling;
4. Study of intercultivation implements (cultivators, harrows) and practices
5. Hoes: broad blade chopping hoe (*Mammatty)*, digging hoe or pick (*Thoomba*), spade, digging fork, hand fork, conoweeder, etc.
6. Study of seeding equipments.
7. Different methods of sowing; direct seeding: broadcasting, dibbling and drilling- transplanting-
8. Identification of manures and fertilizers-organic manures: bulky and concentrated-
9. Fertilizers: Straight, complex and mixed fertilizers
10. Fertilizer recommendation and calculation for rice, coconut, cassava, banana and cowpea-
11. Green manure crops and cover crops
12. Computation of seed rate for various crops
13. Practice of methods of fertilizer applications- broadcasting, placement, foliar application and fertigation;
14. Visit to experimental plots to study design and layout
15. Yield estimation of crops.

16-18. Preparation of planting materials of cassava, land preparation and making mounds and planting (each student will be allotted a minimum of 40m^2 area)

Suggested Readings

Balasubramaniyan, P and Palaniappan, S.P.. 2001. *Principles and Practices of Agronomy*. AgroBios(India)Ltd., Jodhpur.

Brady, N.C. and Well, R.R. 2002. *The Nature and Properties of Soils* (13th ed.). Pearson Education, Delhi.

De, G.C.1989. *Fundamentals of Agronomy*. Oxford & IBH Publishing Co., New Delhi.

Havlin, J. L., Beaton, J. D., Tisdale, S.L., and Nelson, W.L. 2006. *Soil Fertility and Fertilizers: An Introduction to Nutrient Management* (7thed.). Pearson Education, Delhi.

ICAR.2006. *Hand book of Agriculture*, ICAR, New Delhi.

Reddy. T.Y and Reddy, G.H.S.1995. *Principles of Agronomy*, Kalyani Publishers, Ludhiana.

Reddy.S.R.1999. *Principles of Agronomy*, Kalyani Publishers, Ludhiana.

Sankaran, S. and Subbiah Mudaliar, V.T. 1991.*Principles of Agronomy*. The Bangalore Printing & Publishing Co., Bangalore

3. Agro. 1203. Irrigation and water management (2+1)

Irrigation: definition and objectives. Role of water in soil and plants- Irrigated agriculture vs. Rainfed agriculture, dry farming and dryland farming- Water resources and irrigation development in India and Kerala. Soil–plant-water-relationships. Soil moisture

constants. Evapo-transpiration, potential evapo-transpiration and consumptive use, Reference crop evapo-transpiration (ETo)- Crop co-efficient (Kc)- Kc values for different crops. Main empirical methods of calculation of ETo- Effective rainfall, Water requirement of crops- Factors affecting water requirement of crops- Methods of determining water requirement-effective rainfall- Scheduling irrigation based on soil moisture status-physiological stages of crop, meteorological data- Methods of irrigation-surface irrigation, subsurface and micro irrigations including sprinkler, drip and bubbler irrigation. Irrigation efficiency- Agronomic techniques to improve water use efficiency-factors affecting water use efficiency-conjunctive use of water- irrigation water quality criteria and its management. Water management of different crops like rice, wheat, banana, coconut, sugarcane, cowpea, sesame, groundnut, and vegetables. Agricultural drainage-causes of water logging and types of drainage.

Soil erosion- nature and extent of erosion; types- soil erosion by water- different forms- Soil conservation vs. water conservation -tolerable soil loss- Universal soil loss equation- methods of soil conservation- agronomic measures- mechanical measures- Control of gully erosion- Role of grasses and pastures in soil conservations; Wind breaks and shelter belts- Land capability classification and its utility- Water harvesting techniques - *in situ* and *ex situ* water harvesting methods - Farm ponds, percolation ponds or wells, check basin, minor irrigation tanks

Watershed management- concept- watershed and command area development approach, objectives- divisions- watershed and command area- Characteristics of watersheds – Stream order and delineation of watershed –Planning process- Steps and components of watershed management programmes- Agro techniques for efficient management of rainfed crops- Alternate land use systems for rainfed lands- Watershed Development programmes in India- NWDPRA, Hariyali.

Practical

Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Measurement of irrigation water through flumes and weirs; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Determination of EC, pH, carbonates, bicarbonates, Ca++ and Mg++ in irrigation water (quality parameters)

Studies of different soil conservation measures. Determination of slope using simple devices such as Abeney level and line level, Laying contour lines using A-frame, line level and water tube level

Lecture schedule

1 Irrigation: definition and objectives-water management and watershed management. Role of water in soil and plants- Irrigated agriculture vs. Rainfed agriculture. Rainfed farming, dry farming and dryland farming- Water resources of India–development of irrigation in India and Kerala

2,3	Soil moisture and its characteristics- soil moisture tension and soil water potential-Components of soil water potential- Soil moisture constants.
4	Soil – plant – water relationships- Availability of water to plants- infiltration, percolation, seepage, interflow- soil moisture movement.
5	Evapo-transpiration and consumptive use- Potential evapo-transpiration(ETp) and Reference crop evapo-transpiration (ETo)- Crop co-efficient (Kc), Kc values for different crops.
6	Pan evaporimeter- crop factor- Main empirical methods of calculation of ETo
7	Water requirement of crops- factors affecting water requirement of crops, methods of determining water requirement-effective rainfall,
8,9	Scheduling irrigation based on soil moisture status – physiological stages of crop, meteorological data
10,11	Methods of irrigation- surface irrigation, flooding, furrow, border and basin irrigation, sub irrigation.
12,13	Micro irrigation- Drip irrigation- Sprinkler irrigation, surge and bubbler irrigation
14	Irrigation efficiency- water use efficiency -Agronomic techniques to improve water use efficiency-factors affecting water use efficiency- Conjunctive use of water
15	Irrigation water quality criteria and its management
16,17	Water management of principal crops, critical stages of crop, depth and schedule of irrigation – rice, wheat, rice, wheat, banana, coconut, sugarcane, cowpea, sesame, groundnut, and vegetables.
18	Agricultural drainage-causes of water logging and types of drainage.
19	Soil erosion- definition, nature and extent of erosion; types of erosion, factors affecting erosion
20	Soil erosion by water- different forms- splash, sheet, rill, gully, stream bank, landslides
21	Tolerable soil loss- Universal soil loss equation
22,23	Soil conservation vs. water conservation- methods of soil conservation- agronomic measures, contour cultivation, strip cropping, cover crops, vegetative barrier; improved dry farming practices;
24,25	Mechanical measures -bunding, bench terraces, convertible bench terraces (Puertorican, Californian, etc.), intermittent terraces, conservation terraces, contour stone walls, hill side ditches, etc.
26	Management of drainage lines- revetments, bank armoring and retaining walls- Control of gully erosion: check dams and vegetation lined waterways.
27	Role of grasses and pastures in soil conservations; wind breaks and shelter belts;
28	Land capability classification and its utility
29	Water harvesting techniques - *in situ* and *ex situ* water harvesting methods
30	Farm ponds, percolation ponds or wells, check basin, minor irrigation tanks
31,32	Watershed management- concept, watershed and command area development approaches- Divisions and characteristics of watersheds- Objectives of watershed management-limitations
33	Stream order and delineation of watershed- Large and small watersheds – Resource inventory-Peoples participation
34	Watershed planning process- Steps in watershed management, components of watershed management programmes- Watershed development plan

35 Agrotechniques for efficient management of rainfed crops-land preparation, seeding, crop density, selection of efficient crops and varieties-Efficient cropping- Alternate land use systems for rainfed lands-

36 Watershed Development programmes in India-NWDPRA, Hariyali- Features-Common Guidelines

Practical schedule

1 Basic calculations for water management
2 Bulk density, porosity and infiltration rate
3 Determination of soil moisture by thermo-gravimetric method and volumetric methods
4 Determination of soil moisture by tensiometer
5 Electrical resistance blocks, Neutron moisture meter
6 Field capacity
7 Permanent wilting point
8,9 Measurement of irrigation water and efficiency of different methods- Orifices, weirs, Parshall flumes, and calculating the rate of discharge.
10 Use of Open Pan Evaporimeter for scheduling irrigation to crops.
11 Computation of irrigation requirement of crops, irrigation interval and irrigation efficiency.
12 Methods of irrigation – border strip, check basin, ring, corrugation furrow
13 Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability
14 Cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals;
15 Determination of EC, pH, carbonates, biocarbonates, Ca++ and Mg++ in irrigation water (quality parameters)
16 Studies of different soil conservation measures
17 Determination of slope using Abney level, Smithy's hypsometer
18 Marking contour lines using Abney level, 'A' frame, and water tube level
19 Visit to a water management research station

Suggested Readings

Dhruvanarayana, V.V. 1993. *Soil and Water Conservation Research in India*. ICAR, New Delhi.

Gurmel Singh, C. Venkataraman, G., Sastry,B. and Joshi, P. 1990. *Manual of Soil and Water Conservation Practices*. Oxford and IBH Publishing Co., New Delhi.

Hansen, V.E., Israelsen, O.W., and Stringham, G.E. 1979. *Irrigation Principles and Practices* (4th ed.). John Wiley and Sons, New York

IARI [Indian Agricultural Research Institute]. 1977. *Water Requirement and Irrigation Management of Crops in India*, IARI Monograph No.4, Water Technology Centre, IARI, New-Delhi.

Lenka, D. 2001. *Irrigation and Drainage*. Kalyani Publishers, New-Delhi.

Mal, B. C.2002. *Introduction to Soil and Water Conservation Engineering*, Kalyani Publishers, New-Delhi.

Michael, A.M and Ojha, T.P. 2005. *Principles of Agricultural Engineering*–Vol.II. Jain Brothers, New Delhi.

Michael, A.M. 1988. *Irrigation Theory and Practice*. Vikas Publishing House Pvt. Ltd., New Delhi.

Mishra, R.D. and Ahamed, M. 1993. *Manual of Irrigation Agronomy*. Oxford and IBH Publishing Company Pvt. Ltd.
Prihar, S.S. and Sandhu, B.S. 1987. *Irrigation of Field crops – Principles and Practices* – ICAR, New-Delhi.
Sankara Reddi, G.H. and Yellamanda Reddy, T. .2003 *Efficient Use of Irrigation Water.* Kalyani Publishing House, New Delhi.
Tideman, E.M. 1996. *Watershed Management*: *Guidelines for Indian Conditions*. Omega Scientific Publishers, New Delhi.

4. Agro. 1204 . Weed management (1+1)

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy .Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management (IWM); Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in rice, banana, pineapple, cowpea, coconut, rubber, tea, coffee, cardamom, vegetables, shift of weed flora in cropping systems, aquatic and problematic weeds and their control.

Practical

Identification of weeds; Survey of weeds in crop fields and other habitats; Preparation of herbarium of weeds; hand weeding, hoeing, use of cono weeder, Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Economics of weed control practices; Visits to areas with problem weeds.

Lecture schedule

1	Weeds-introduction, definition- characteristics of weeds- harmful and beneficial effects –uses
2	Classification of weeds — propagation and dissemination– geographical distribution – factors affecting distribution
3	Ecology of weeds – weed succession on uncultivated areas
4	Crop weed association- crop weed competition- critical period of weed competition- Allelopathy
5	Concepts of weed prevention, eradication, and control.
6,7	Weed control methods: Physical, cultural, biological, chemical and integrated weed management (IWM)
8-10	Introduction to herbicides: advantages and limitation of herbicides- Herbicide usage in India- classification- important herbicides
11	Herbicide formulations- methods of application
12	Introduction to Adjuvants and their use in herbicides-herbicide safeners
13	Introduction to selectivity of herbicides – fate of herbicides in the plant: Compatibility of herbicides with other agrochemicals;
15	Shift of weed flora in cropping systems
16-17	Weed management in rice, banana, pineapple, cowpea, coconut, rubber, tea, coffee, cardamom, vegetables,
18	Aquatic weeds and their control - Parasitic weeds and their control.

Practical schedule

1	Techniques of weed collection and preservation
2-6	Survey of weeds in crop fields and other habitats- Identification and preparation of herbarium of weeds
7	Herbicide formulation and identification- Herbicide label information
8-9	Study of herbicide application equipment and calibration
10	Computation of herbicide doses
11	Field practice of spraying herbicides in the field
13-14	Recording observations on the effect of herbicides on crops and weeds- Phytotoxicity symptoms of herbicides in different crops - Calculations on weed control efficiency and weed index
15	Hand weeding and hoeing using conoweeder in rice
16	Hoeing and after cultivation in cassava plots
17	Economics of weed control practices
18	Visit to areas with problem weeds.

Suggested Readings

Aldrich, R.J. and Kramer, R.J. 1997. *Principles in Weed Management*. Panama Publications, New Delhi.

Alstrom, S. 1990. *Fundamentals of Weed Management in Hot Climate Peasant Agriculture*. Department of Crop Production Science, Swedish University of Agricultural Sciences, Uppasala.

Anderson, P.W. 1983. *Weed Science – Principles*. West Publishing Co. New York

Ashton, P.M. and Crafts, A.S. 1981. *Mode of Action of Herbicides* (2nd ed.) Wiley- Inter Science, New York.

Gupta, O.P. 2000. *Weed Management - Principles and Practices*. Agrobios (India) Ltd., Jodhpur

King, L.J. 1974. *Weeds of the world – Biology and control*. Wiley Eastern, New Delhi

Radosevich, S. R. and Holt, J.S. 1984. *Weed Ecology; Implications for Vegetation Management*. John Wiley & Sons Inc., New York

Rao, V.S. 2000. *Principles of Weed science* (2nd ed.). Oxford & IBH Publishing Co. New Delhi.

Reddy, S.R. 1999. *Principles of Agronomy*. Kalyani Publishers, Ludhiana.

Thomas, C. G. and Abraham, C.T. 1998. *Common Weeds of Rice Ecosystem and their Management*. Kerala Agricultural University, Thrissur

Thomas, C.G. and Abraham, C.T. 2007. *Methods in Weed Science*. Kerala Agricultural University, Thrissur

Zimdahl, R.L. 1999. *Fundamentals of Weed Science* (2nd ed.). Academic Press, New York.

5. Agro.2105. Field crops – I (2+1)

Origin, geographic distribution, economic importance, soil and climatic requirement , varieties, cultural practices , harvest and post harvest handling, and value addition of major cereals and millets, tubers and forage crops.

Cereals: Rice, wheat, maize, sorghum, barley, oats, pearl millet, finger millet, minor millets.

Tuber crops: Cassava, potato, sweet potato, yams, aroids, minor tuber crops.

Forage crops : Guinea grass, hybrid Napier, para grass, congo signal, setaria, fodder maize, fodder sorghum, fodder bajra , fodder cowpea, stylo, berseem, lucerne, subabul, agathi, and hedge lucerne. Grasslands and pastures – grazing systems - Hay and silage making .

Practical

Identification and familiarisation of cereals and millets, tuber crops and fodder crops – Preparation of wet, dry and mat nurseries for rice –Calculations on seed rate, fertilizer requirements - Preparation of planting material of major crops - Seed treatment – Land preparation and planting – After cultivation operations – Growth and yield measurements – Harvesting – Computation of cost of cultivation.

Lecture schedule

1	Importance and distribution of cereals and millets, differences between cereals and millets, important tropical and temperate crops.
2-7	Rice - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, special systems of cultivation, harvesting and processing
8-10	Wheat - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting and processing
11	Maize - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
12	Sorghum - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
13	Barley, oats, pearl millet, finger millet and other minor millets – Economic importance and general cultivation aspects
14	History, importance and distribution of tuber crops, important major and minor tuber crops
15-18	Tapioca - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting and processing
19-21	Potato - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
22	Sweet potato - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
23-24	Yams - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
25-26	Aroids (Elephant foot yam, Colocasia and Xanthosoma) - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
27	Minor tuber crops – economic importance
28	Agrostology – Important terms and definitions – Importance in live stock nutrition – classification of fodder crops
29	Guinea grass - Economic importance, soil and climatic requirements, varieties, cultural practices, harvesting and yield

30 Hybrid Napier - Economic importance, soil and climatic requirements, varieties, cultural practices, harvesting and yield
31 Congo signal, Gamba grass, Setaria - Economic importance and general cultivation aspects
32 Cereal fodders - fodder maize, fodder sorghum, fodder bajra - Economic importance and general cultivation aspects
33 Ground legumes – stylo, berseem, lucerne and fodder cowpea - Economic importance and general cultivation aspects
34 Tree legumes - subabul, hedge lucerne, agathi - Economic importance and general cultivation aspects
35 Pastures - Natural and artificial – pasture management – grazing systems – grazing capacity – stocking rate
36 Forage preservation – Hay and silage making

Practical schedule

1 Identification and familiarisation of cereals and millets
2 Identification and familiarisation of tuber crops
3 Identification and familiarisation of forage crops
4 Familiarisation of different silos, silage making
5 Hay making
6 Problems on seed rate and fertilizer requirements of major crops
7 Preparation of planting materials of major crops - Seed treatment
8-9 Land preparation and planting of major crops
10 Preparation of wet, dry and mat nurseries for rice
11-12 After cultivation operations of major crops
13-14 Growth and yield measurements
14-15 Harvesting in cassava and preparation of white chips, parboiled chips, etc.
16 Comparison of cooking qualities of different varieties of tuber crops
17 Computation of cost of cultivation
18 Visit to a major paddy growing tract/fodder farm

Suggested Readings

Baekema, H.P. and Zaag, D.E.V.D 1990. *Introduction to Potato Production.* Pudoc, Wageningen

Chatterjee, B.N. 1989. *Forage Crop Production- Principles & Practices*. Oxford & IBH . New Delhi.

Chatterjee, B.N. and Maiti, S.1985. *Principles and Practices of Rice Growing.* Oxford & IBH Publishing Co., New Delhi.

Chidda Singh, Prem Singh and Rajbir Singh. 2003. *Modern Techniques of Raising Field Crops* (2nd ed.). Oxford & IBH , New Delhi.

De Datta, S.K. 1981. *Principles and Practices of Rice Production.* John Wiley & Sons, New York.

Gutteridge, R.C and Shelton, H.M. (eds.).1998 *Forage Tree Legumes in Tropical Agriculture*. Tropical Grassland Society of Australia Inc.

ICAR [Indian Council of Agricultural Research].2006. *Hand Book of Agriculture*. ICAR, New Delhi

KAU [Kerala Agricultural University].2007. *Package of Practices Recommendations – Crops*. Directorate of Extension, Kerala Agricultural University, Thrissur

Mohankumar, C.R., Nair, G.M. James George, Raveendran. C.S. and Ravi. V. 2000. *Production Technology of Tuber Crops*. C.T.C.R.I, Trivandrum

Narayanan, T.R. and Dobadghao, P.M. 1972. *Forage Crops of India*, ICAR, New Delhi.

Onwueme, I. C. and Charles. W.D . 1994. *Tropical Root and Tuber Crops – Production, Perspective and Future Prospects*. F.A.O. Production and Protection Paper-126, Rome.
Pal, M., Deka, J., and Rai, R.K. 1996. *Fundamentals of Cereal Crop Production*. Tata McGraw Hill Pub., New Delhi
Prasad, R. (ed.). 1999. *A Text Book of Rice Agronomy*, Jain Brothers, New Delhi,
Prasad, R. (ed.). 2001. *Field Crop Production*. ICAR, New Delhi
Purseglove, J.W. 1974. *Tropical Crops: Dicotyledons*. The English Language Book Society and Longman, London
Purseglove, J.W. 1975. *Tropical Crops: Monocotyledons.* The English Language Book Society and Longman, London
Skerman P.J. and Riveros F. 1990 *Tropical Grasses*. FAO Plant Production and Protection Series 23. Food and Agriculture Organization of the United Nations, Rome
Skerman P.J., Cameron D.G. and Riveros, F.1988 *Tropical Forage Legumes*. (2nd ed.). FAO (Food and Agriculture Organization of the United Nations), Rome
Thomas, C. G. 2003. *Forage Crop Production in the Tropics.* Kalyani Publishers, Ludhiana
Whiteman, P.C. 1980. *Tropical Pastures*. Oxford University Press, Oxford.

6. Agro. 2106. Practical Crop Production (Rice) (0+1)

Rice-crop planning, Nursery raising: Land preparation, seed treatment, sowing, water management, nutrient management, and plant protection

Main field preparation, transplanting, nutrient management, water management, Identification of weeds and weed management, Identification of insect pests and diseases and plant protection, harvesting, post harvest handling of produce, storage and marketing of produce. Growth analysis- Determination of LAI, LAD, LAR, NAR, RGR, etc. using destructive samples at three growth stages- Harvest Index- Preparation of balance sheet including cost: benefit ratio (A minimum of 200m^2 land (5cents) will be allotted to each student).

Practical schedule

1	Rice-Crop planning-Selection of site for nursery and main field
2	Nursery raising-land preparation, seed treatment, sowing
3	Water management, nutrient management and plant protection in the nursery.
4-5	Preparation of main field- strengthening bunds- ploughing- puddling
6-7	Organic manure application, basal dose of fertilizers and transplanting
8-9	Top dressing of fertilizers, water management
10	Identification of weeds in the field, Number of weeds per unit area
11	Weed management
12-13	Identification of pests and diseases, plant protection
14-16	Growth analysis- collection of destructive samples and determination of leaf area (three times)
17	Harvesting, post harvest handling of produce, storage and marketing of produce
18	Preparation of balance sheet-Cost benefit analysis

Note: In addition to practical hours, for certain time bound operations; the students will complete the work after the regular class hours.

7. Agro. 2207. Field crops – II (1+1)

Origin, geographic distribution, economic importance, soil and climatic requirement , varieties, cultural practices , harvesting and post harvest handling of pulses,

oilseeds, and commercial crops (sugar crops, fibre crops, narcotics, and medicinal and aromatic plants)

***Pulses*:** Chick pea, cowpea, black gram, green gram, red gram, horse gram, lentil, french bean, peas, other minor pulses

***Oilseeds*:** Groundnut, sesamum, soya bean, rapeseed and mustard, sunflower, safflower, linseed, other minor oilseeds

Sugar crops: Sugarcane and sugar beet

***Fibre crops*:** Cotton, jute, other minor fibre crops

Narcotics: Tobacco, betel vine

***Medicinal plants*:** Commercially grown medicinal plants of Kerala

Practical

Identification and familiarisation of pulses, oilseeds, sugar crops, fibre crops, narcotics and commercial medicinal plants – Problems on seed rate, fertilizer requirements - Preparation of planting material of major crops - Seed treatment – Land preparation and planting – After cultivation operations – Growth and yield measurements – Harvesting – Computation of cost of cultivation- Field and factory visits

Lecture schedule

1	Importance of pulses in human nutrition- Chick pea - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting
2	Cowpea - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
3	Red gram, black gram and green gram –economic importance and general cultivation aspects
4	Horse gram, lentil, French bean, peas, other minor pulses (Rajmash, Kesari dhal, faba bean, moth bean, rice bean, etc.) – economic importance
5	Importance of oil seeds- Groundnut - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting.
6	Sesame - Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting
7	Rapeseed and mustard, soybean, sunflower, safflower, linseed, other minor oilseeds – economic importance
8	Important sugar yielding crops- sugar beet-economic importance
9-11	Sugarcane - Origin, geographic distribution, botany and growth phases, soil and climatic requirements, varieties, cultural practices, ratooning, harvesting-quality parameters-processing- by-products
12-13	Cotton- Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting- quality parameters
14	Jute- Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting
15-16	Tobacco- Origin, geographic distribution, economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices,

harvesting, curing and drying

17 Betel vine – economic importance, botany and growth phases, soil and climatic requirements, varieties, cultural practices, harvesting

18 Commercially grown medicinal and aromatic plants of Kerala – Lemon grass, palmarosa, vetiver, *Kaempferia galanga*, *Piper longum*, *Indigofera tinctoria*, *Asparagus racemosus*, *Holostemma adakodiyen*, *Plumbago roseus* – Economic importance and General cultivation practices

Practical schedule

1 Identification and familiarisation of pulse crops
2 Identification and familiarisation of oilseeds
3 Identification and familiarisation of sugar crops
4 Identification and familiarisation of fibre crops, tobacco, betel vine
5 Identification and familiarisation of important medicinal plants
6 Problems on seed rate and fertilizer requirements of major crops
7 Preparation of planting material of major crops - Seed treatment – *Rhizobium* inoculation of leguminous crops
8-10 Land preparation and planting of major crops
11-12 After cultivation operations of major crops
13-14 Growth and yield measurements
15 Quality assessment in sugarcane
16 Quality assessment in cotton
17 Computation of cost of cultivation
18 Visit to cotton and sugarcane producing areas/mills

Suggested Readings

Agarwal, P.C. 1990. *Oilseeds in India*. Oxford and IBH, New Delhi

Balasuramaniyan, P. and Palaniappan, SP. 2003. *Principles and Practices of Agronomy*. Agrobios(India)

Barnes, A.C. 1964. *The Sugarcane*. Interscience Publishers, New Delhi

Chidda Singh, Prem Singh and Rajbir Singh.2003. *Modern Techniques of Raising Field Crops* (2nd ed.). Oxford & IBH , New Delhi.

Das, P.C. 1997. *Oilseed Crops of India*, Kalyani Publishers., New Delhi.

ICAR [Indian Council of Agricultural Research].2006. *Hand Book of Agriculture*. ICAR, New Delhi

KAU [Kerala Agricultural University].2007. *Package of Practices Recommendations – Crops*. Directorate of Extension, Kerala Agricultural University, Thrissur

Lekshmikantan, M. 1983. *Technology in Sugarcane Growing.* Oxford & IBH Publishing Co., Pvt. Ltd., New Delhi

Prasad, R. (ed.). 2001. *Field Crop Production*. ICAR, New Delhi

Purseglove, J.W. 1974. *Tropical Crops: Dicotyledons*. The English Language Book Society and Longman, London

Purseglove, J.W. 1975. *Tropical Crops: Monocotyledons.* The English Language Book Society and Longman, London

Thomas, J., Joy, P.P., Mathew, S., Skaria, B.P., Duethi, P.P. and Joseph, T.S. 2000. *Agronomic Practices for Aromatic and Medicinal Plants*. Directorate of Arecanut and Spices Development, Kozhikode.

Yadav, D.S. 1992. *Pulse Crops*. Kalyani Publishers., New Delhi.

8. Agro. 3108. Cropping patterns and farming systems (1+1)

Introduction-importance of system approach in crop production, different cropping systems- Terms and definition- Cropping pattern - Multiple cropping and various forms- advantages and disadvantages- Intercropping- ecological basis of intercropping systems- types- sequential cropping and crop rotation-planned crop rotation- Mixed farming and farming systems.

Plant interactions- Allelopathy, Annidation-Competition- Measures to minimize competition-Criteria for assessment of yield advantage, land use efficiency and monitory advantage-LER, RYT, LEC, Relative Crowding Coefficient-Aggressivity, Competition Index, Crop Equivalent Yield, Multiple Cropping Index.

Cropping systems prevalent in Kerala-Rice based cropping system- Coconut based multi-tier cropping system- crop cafeteria for multiple cropping- Tapioca based cropping system-Homestead farming in Kerala, Agro forestry – Silviculture, Agrisilviculture, Agrihorticulture, Agrisilvopastural system, Alley cropping, Taungya cultivation and Social forestry- Organic recycling in cropping systems. Important cropping systems in India-Wheat based-Maize based-Sorghum based-Red gram based-Cotton based. Crop planning, crop calendar and cropping scheme preparation-factors affecting cropping schemes.

Farming systems- components- Livestock- poultry- aquaculture- apiculture -sericulture etc.-Integrated farming system (IFS) models for uplands and low lands for sustainable agriculture- Evaluation of farming systems.

Practical

Preparation of cropping scheme for irrigated situations. Preparation of cropping scheme for dry land situations. Study of existing farming systems in nearby villages. Preparation of integrated farming system models for wet lands. Preparation of integrated farming system models for dry lands. Visit to research station and farmers field to familiarize with various cropping and farming systems. Evaluation of farming systems.

Lecture schedule

1. Introduction-importance of system approach in crop production.
2. Different cropping systems-terms and definitions
3. Multiple cropping and various forms- Inter cropping- ecological basis of intercropping systems- types- (Mixed intercropping, row intercropping, relay intercropping and strip cropping)-
4. Sequential cropping and crop rotation – Planned crop rotation- parallel cropping – companion cropping- -live-mulch farming- trap cropping-catch cropping-contingency cropping-cover cropping.
5. Plant interactions-Allelopathy, annidation-competition.
6. Competition for solar radiation- nutrients and water- effect- measures to minimize competition.

7-8. Criteria for assessment of yield advantage- LER, RYT, LEC, Relative Crowding Coefficient-Aggressivity, Competition Index, Crop Equivalent Yield, Multiple Cropping Index.

9. Cropping systems in various parts of Kerala-Coconut based multi-tier cropping system- crop cafeteria for multiple cropping in coconut
10. Rice based cropping system-Tapioca based cropping system-Homestead farming in Kerala.

11. Important cropping systems in India - Wheat based-Maize based-Sorghum based-red gram based-cotton based cropping systems.
12. Agroforestry –definition- Major agro forestry practices- Silviculture, Agri-silviculture, Agri-horticulture, Silvo-pastoral , Agri-silvopasture- Systems and subsystems- Alley cropping, Taungya cultivation, Social forestry.
13. Multipurpose trees - selection of tree species- trees in home gardens- agroforestry potential of common tree crops-
14. Organic recycling in rice, coconut and other important plantation crops.
15. Crop planning, crop calendar- cropping scheme preparation.
16. Farming systems, definition - components-Live stock- poultry-aqua culture etc.
17. Integrated farming system models for uplands and low lands.
18. Precision farming- Evaluation of farming systems.

Practical schedule

1. Study of agroclimatic classification of India and Kerala.
2. Visit to Instructional Farm for familiarization with coconut based farming systems.
3. Visit to a rice research station for familiarization with rice based farming systems.
4. Familiarization with agroforestry systems.
5. Identification of tree species suitable for agroforestry systems
6. Familiarization with shade tolerant crops in tree based cropping systems.
7. Study of litter decomposition and organic recycling.
8. Preparation of cropping scheme for irrigated situations.
9. Preparation of cropping scheme for dry land situations.
10. Study of existing farming systems in nearby villages.
11. Preparation of integrated farming system models for wet lands.
12. Preparation of integrated farming system models for dry lands.
13. Preparation of integrated farming system models for homesteads.
14. -17. Visit to research stations, central nursery and farmer's fields to familiarize with various cropping and farming systems.
18. Evaluation of cropping systems.

Suggested Readings

Balasubramaniyan, P. and Palaniappan, S.P. 2001. *Principles and Practices of Agronomy*. Agrobios Publishers, Jodhpur

Chatterjee, B.N., Maiti, S. and Mandal, B.K. 1989. *Cropping Systems - Theory and Practice*. Oxford and IBH Publication, New Delhi

Francis, C.A. 1986. *Multiple Cropping Systems*. Macmillan Publication

Francis, C.A. 1989. Biological efficiencies in multiple cropping systems. *Advances in Agronomy*, 42.1-42.

Gomez, A.A. and Gomez, K.A. 1983. *Multiple Cropping in the Humid Tropics of Asia*. International Development Centre (IDRC),Ottawa.

Karlen, D.l., Varvel, G.E., Bullock, D.G. and Cruse, R.M. 1994 Crop rotations for the 21st century. *Advances in Agronomy*, 53.1-45.

Nair, P.K..R. 1993. *An Introduction to Agroforestry*. Kluwer, Netherlands.

Palaniappan, S.P. and Sivaraman, K. 1996. *Cropping Systems in the Tropics: Principles and Management*. New Age India (P) Ltd.,

Panda, S.C. 2003. *Cropping and Farming Systems*. Agrobios Publishers, Jodhpur

Papendick, R. I., Sanchez, P.A. and Triplett, G.B. *(eds).* 1976 *Multiple cropping*. American Society of Agronomy Special Publication No.27.Madison, Wisconsin.

Pathak, PS. and Roy M.M. 1994. *Agroforestry Systems for Degraded Lands.* Oxford& IBH Publishing, New Delhi.

Raman, K.V. and Balaguru, T. 1992. *Farming systems Research in India: Strategies for Implementation*. Pragati Art Printers, Hyderabad, India.

Rangasamy, A.K. Annadurai, Subbiyan, P. and Jayanthi, C. 2002. *Farming System in the Tropics.* Kalyani Publishers, Ludhiana

Tejwani, K.G. 1994. *Agroforestry in India*, Oxford & IBH Pub., New Delhi.

9. Agro. 3209. Sustainable agriculture and organic farming (1 +1)

The concept of sustainability and sustainable development-emerging issues- Sustainable agriculture- concept themes- differences between conventional, sustainable, and alternate agriculture- Various alternate agricultural systems-limitations- Modernization of agriculture and its relation to sustainability. Factors affecting ecological balance and ameliorative measures- Indian agriculture in terms of availability of natural resources and their carrying capacity- Strategies for realizing sustainable agriculture- low vs. high external input agriculture (LEIA vs. HEIA) -Natural resource management as a part of sustainable resource management –crop production practices- animal production practices- Basic ecological principles of LEISA – promising LEISA techniques and practices – improved manure handling – crop residue management – strategic use of chemical fertilizers and pesticides – use of traps, repellants and biological control – water conservation measures – water harvesting – ITK and farmer centered techniques and practices

Organic agriculture-history-concepts- philosophy- objectives, opportunities and priorities- Criticisms- Organic farming and food security-Principles of organic farming- Tools and practices of organic farming: Planned crop rotation, Green manures and cover crops, Manuring and composting, Multiple cropping, Intercropping in relation to maintenance of soil productivity, Biological pest control, Biological agents and pheromones ,Control of weeds, diseases and insect pests, Sanitation, Tillage and cultivation, Mulching, Fire, Supplemental fertilization, Biorational pesticides, Foliar fertilization, Buffers and barriers- Shelterzones- Record keeping- Socio-economic impacts; Marketing and export potential - Current status of organic farming -Initiatives in India and Kerala- National Programme for Organic Production (NPOP) –Operational structure of NPOP-Accreditation agencies- Certification Agencies – National Standards for Organic Products (NSOP)-inspection and certification procedures

Practical

Preparation of enriched farm yard manure; Bangalore method of composting- Coir pith composting- - Preparation of Vermicompost; Study on biofertilizers. Raising green manure crops and cover crops- Plant protection through bio-agents and pheromones Visit to urban waste recycling unit; Study of profitable utilization of agricultural wastes; Visit to poultry and dairy units to study resource allocation, utilization and economics; Visit to an organic farm to study various components and utilization; Study of degraded lands. Raising of vegetable crops organically through nutrient, diseases and pest management;
and ornamental nursery raising; macro quality analysis, grading, packaging, post harvest management.

Lecture schedule

1. The concept of sustainability and sustainable development-emerging issues
2. Sustainable agriculture- concept themes-environmental health, economic profitability, and social and economic equity. Conventional, sustainable, and alternate agriculture- Alternate agricultural systems- biodynamic farming, natural farming, organic farming, permaculture, homa farming, and other forms-limitations.
3. Modernization of agriculture and its relation to sustainability. Factors affecting ecological balance and ameliorative measures-pesticide use concerns- Indian agriculture in terms of availability of natural resources and their carrying capacity-
4. Strategies for realizing sustainable agriculture- Natural resource management as a part of sustainable resource management –crop production practices- animal production practices-
5. Low vs. high external input agriculture (LEIA vs. HEIA) - Basic ecological principles of LEISA – promising LEISA techniques and practices–
6. Improved manure handling – crop residue management – strategic use of chemical fertilizers and pesticides –
7. Biological control of crops, weeds and diseases- Use of traps, repellants and other non-chemical methods
8. Water conservation and water harvesting as a part of sustainable agriculture – ITK and farmer centered techniques and practices
9. Good Agricultural Practices(GAP)- GAP certification- EUREPGAP
10. Organic agriculture-history- concepts- philosophy- objectives- Opportunities and priorities- constraints. Implications of organic farming on food security-
11. Principles of organic farming-biodiversity, diversification and integration of enterprises, sustainability, natural plant nutrition, natural pest management, and integrity.
12. Tools and practices of organic farming: planned crop rotation, green manures and cover crops, manuring and composting, multiple cropping, intercropping in relation to maintenance of soil productivity,
13. Biological pest control, biological agents and pheromones ,control of weeds, diseases and insect pests, sanitation, tillage and cultivation, mulching, fire, supplemental fertilization,
14. Biorational pesticides, foliar fertilization, buffers and barriers- shelterzones-record keeping-
15. Socio-economic impacts; Marketing and export potential –
16. Current status of organic farming -Initiatives in India and Kerala- National Programme for Organic Production (NPOP) –
17. Operational structure of NPOP-Accreditation agencies- Certification Agencies –
18. National Standards for Organic Products (NSOP)-inspection and certification procedures

Practical schedule

1. Preparation of enriched farm yard manure
2. Bangalore method of composting
3. Coir pith composting
4. Preparation of vermicompost
5. Studies on biofertilizers.
6. Raising green manure crops and cover crops
7. Plant protection through bio-agents

8. Use of traps and pheromones
9. Visit to a biological control laboratory
10. Visit to urban waste recycling unit;
11. Visit to poultry and dairy units to study resource allocation, utilization and economics
12. Visit to an organic farm to study various components and utilization;
13. to 16. Raising of vegetable crops organically through nutrient, diseases and pest management

17 Ornamental nursery raising;

18 Grading, packaging, post harvest management

Suggested Readings

Ananthakrishnan, T.N. (ed.) 1992. *Emerging Trends in Biological Control of Phytophagous insects.* Oxford & IBH, New Delhi.

Chhonkar, P.K. and Dwivedi, B.S. 2004. Organic farming and its implications on India's food security. *Fertil. News* 49(11): 15-18,21-28,31&38.

Gaur, A.C. 1982. *A Manual of Rural Composting*. FAO/UNDP Regional Project Document, FAO, Rome.

Howard, A. 1940. *An Agricultural Testament*. Oxford University, London.

Lampin, N. 1990. *Organic Farming*. Farming Press Books, Ipswitch, U.K.

Palaniappan, S.P and Anandurai, K. 1999. *Organic Farming- Theory and Practice*, Scientific Pub., Jodhpur.

Reddy, M.V. (ed.) 1995. *Soil organism and Litter decomposition in the Tropics*. Oxford & IBH, New Delhi.

Singh, S.P. (ed.) 1994. *Technology for Production of Natural Enemies*, Project Directorate of Biological Control, Bangalore.

Trewavas, A. 2004. A critical assessment of organic farming and food assertions with particular respect to UK and the potential environmental benefits of no-till agriculture.*Crop Prot.* 23:757-781.

Trivedi, R.N. 1993. *A Text Book of Environmental Sciences*, Anmol Pub., New Delhi.

Veeresh, G.K., Shivashankar, K. and Singlachar, M.A. 1997. *Organic Farming and Sustainable Agriculture*, Association for Promotion of Organic Farming, Bangalore.

Woomer, PL. and Swift, M.J. 1994. *The Biological Management of Tropical Soil Fertility*,.S.B.F. & Wiley.

II. PLANT BREEDING AND GENETICS

1. Pbgn. 1101. Morphology and systematics of crop plants (0+1)

Classification of plants different systems of classification – General features of important families – morphology of roots, stem, leaves, flowers, fruits and seeds.
Introduction to field crops – Classification of field crops. Botany and economic importance of crops like Rice, Maize, Ragi, Cowpea, Black gram, Green gram, Red gram, Bittergourd, Snakegourd, Ashgourd, Pumpkin, Cucumber, Brinjal, Chilli, Tomato, Soyabean, Groundnut, Gingelly, Castor, Tapioca, Cotton, Sweet potato, Rubber, Eucalyptus, Mango, Cashew, Pepper, Papaya and Banana

Practical Schedule

1. Classification of plants and species
2. Systems of classification
3. Artificial system by Hutchinson and Engler,
4. Use of flora in identifying plants by utilizing key to plant kingdom
5. Division, sub-division, class, sub-class, series, order
6. Family, genus and species.
7. Introduction to field crops
8. Agricultural classification of field crops.
9. Observing general morphology of roots, stem and leaves
10. Observing general morphology of inflorescence
11. Dlowers stems and pistils
12. Family characters and Botany and economic parts of the crop plants
13. Rice, Maize, Ragi, Cowpea, Blackgram,
14. Green gram, Red Gram, Bittergourd, Snakegourd, Ash gourd,
15. Pumpkin, Cucumber, Brinjal, Chilli, Tomato, Soyabean,
16. Groundnut, Gingelly, Castor, Tapioca, Cotton, Sweet potato,
17. Rubber, Eucalyptus, Mango,
18. Cashew, Pepper, Papaya and Banana.
19. Practical Examination

Suggested Readings

Albert F-Hill and O.P. Sharma, 1996. Economic Botany. Tata Mc Graw – Hill Publishing Company Ltd., New Delhi
Chalam, G.V., J. Venkateswarlu. 1966. Agricultural Botany in India-Vol. 1. Asia pulishing house, Bombay, New Delhi
Daniel Sundararaj, D and G. Thulasidas, 1993. Botany of field crops. Macmillan India Ltd., New Delhi
Kochar, S.L. 1988. Economic Botany in the tropics, Macmillan India Ltd., New Delhi

2. Pbgn. 1102. Principles of genetics and cytogenetics (2+1)

Mendel's laws of inheritance and exceptions to the laws, Types of gene action, Multiple alleles, Pleiotropism, Penetrance and expressivity; Quantitative traits and Qualitative traits; Multiple factor hypothesis: Cytoplasmic inheritance – important features and difference from chromosomal inheritance; Mutation and it's features; Methods of inducing mutations and CIB technique. Fine Structure of Gene; Gene expression regulation and differential gene activation; Ultra structure of cell and cell organelles and their functions; Study of chromosome structure, morphology, number and and types, Karyotype and Idiogram; Mitosis and meiosis, their significance and differences between them; DNA its structure and function – types of DNA – modes of replication and repair. RNA its structure, function and types; Transcription, Translation, Genetic code and outline of protein synthesis; Linkage and crossing Types of linkage, over estimation of linkage; Numerical chromosomal aberrations (Polyploidy) and evolution of different crop species like Cotton, Wheat, Tobacco, Triticale and Brassicas – Structural chromosomal aberrations.

Practical

Microscopy Preparation and use of fixatives and stains for light microscopy; Preparation of micro slides and identification of various stages of mitosis and meiosis; Monohybrid ratio and its modifications; Dihybrid ratio and its modifications; Trihybrid ratio; Chi-square analysis, Interaction of factors; Epistatic factors, Supplementary factors and Duplicate factors; Complementary factors. Additive factors and Inhibitory factors;

Linkage – Two point test cross; Linkage – Three point test cross; Induction of polyploidy using colchicines; Induction of chromosomal aberrations using chemicals.

Lecture Schedule

1-2. History and development of Genetics.
3. Pre- mendelism,Mendelian and post mendelian periods-modern Genetics.
4. Mendelism-background of Mendel and Mendel's experiments.
5-6. Mendel's laws of inheritance and exceptions to the laws
7. Types of gene action, Multiple alleles
8. Pleiotropism, Penetrance and expressivity
9-10. Quantitative traits, Qualitative traits and differences between them
11. Multiple factor hypothesis
12-13.Cytoplasmic inheritance it'scharacteristic features and difference between chromosomal
and cytoplasmic inheritance
14-15. Mutation and it's characteristic features
16. Methods of inducing mutations and CIB technique
17. Gene expression and differential gene activation
18. Lac operon and Fine structure of Gene
19. Ultra structure of cell and cell organelles and their functions
20. Study of chromosome structure,
21. Morphology, number and types, Karyotype and Idiogram
22. Midterm Examination
23-24. Mitosis and meiosis, their significance and differences between them

25-26. DNA and it's structure, function, types, modes of replication and repair.
27. RNA and its structure, function and types
28-29. Transcription, Translation, Genetic code and outline of protein synthesis
30. Crossing over and factors affecting it
31. Mechanism of crossing over and Cytological proof of crossing over
32-33. Linkage, Types of linkage and estimation of linkage
34. Numerical chromosomal aberrations (Polyploidy) and evolution of different crop specieslike Cotton, Wheat, Tobacco, Triticale and Brassicas
35. Structural chromosomal aberrations.
36. Final Examination

Practical Schedule

1. Microscopy (Light microscopes and electron microscopes)
2. Preparation and use of fixatives and stains for light microscopy
3. Preparation of micro slides and identification of various stages of mitosis
4. Preparation of micro slides and identification of various stages of meiosis
5. Monohybrid ratio and its modifications
6. Dihybrid ratio and its modifications
7. Trihybrid ratio
8. Chi-square analysis and Interaction of factors
9. Epistatic factors, Supplementary factors
10. Duplicate factors; Complementary factors
11. Additive factors and Inhibitory factors
12. Linkage – Two point test cross;
13. Linkage – Three point test cross
14. Induction of polyploidy using colchicines
15, 16, 17. Induction of chromosomal aberrations using chemicals.
18. Practical Examination

Suggested Readings

Gupta P K 1999 Cytogenetics Rastogi Publishers, Meerut
Lewin, B2005 Genes IX Oxford University Press, New York
Phundan Singh 1995Elements of genetics Kalyani Publishers, Ludhiana
Prasad, G. 1989 Introduction to Cytogenetics Kalyani Publishers, Ludhiana
Strickberger, M.W. 1996. Genetics(3rd edn.). Mac Millan Publishing Co., New Delhi
Swanson, C.P., Merz, T. and Young, J.1975 Cytogenetics Prentice Hall of India Private Limited, New Delhi
Winchester A M 1967 Genetics (3 rd edn)Oxford and IBH Publishing Co New Delhi

3. Pbgn. 2103. Principles of plant breeding (2+1)

Aims, objectives and importance of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apromixis and their classification; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Methods of breeding – introduction and acclimatization. Selection, Mass selection, Johannson's pure line theory, genetic basis, pure line selection; Hybridization, Aims and objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and various modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis, inbreeding depression.

Various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; synthetics and composites; Population improvement programmes – recurrent selection, Methods of breeding for vegetatively propagated crops; Clonal selection; Mutation breeding; Ploidy breeding; Wide hybridization and significance in crop improvement.

Practical

Microsporogenesis; Fertilization and life cycle of an angiospermic plant; Plant Breeder's kit; Hybridization techniques and precautions to be taken; Handling of segregating generations, pedigree methods- bulk methods- back cross methods; Field lay out of experiments; Field trials, maintenance of records and registers; Estimation of Heterosis and inbreeding depression; Estimation of Heritability, GCA and SCA; Estimation of variability parameters;; Problems on Hardy, Weinberg Law; Study of male sterility and incompatibility in field plots.

Lecture Schedule

1. Floral biology, Emasculation and Pollination techniques in crop plants
2. Aims and objectives of Plant Breeding
3. Modes of reproduction, Sexual, Asexual,
4. Apomixis and their classification
5. Significance of plant breeding - Achievements
6. Modes of pollination, genetic consequences,
7. Differences between self and cross pollinated crops
8. Methods of breeding – introduction and acclimatization
9. Selection, Mass selection
10. Johannson' s pure line theory, genetic basis
11. Pure line selection
12. Hybridization, Aims and objectives, types of hybridization
13. Methods of handling of segregating generations,
14. Pedigree method
15. Bulk method
16. Back cross method and various modified methods
17. Incompatibility – different types
18. Applications of self incompatibility in crop improvement
19. Male sterility – different types
20. Utilization of male sterility in crop improvement
21. Midterm Examination
22. Heterosis, inbreeding depression, estimation of heterosis
23. Various theories of Heterosis
24. Exploitation of hybrid vigour, development of inbred lines
25. Production of Single cross and double cross hybrids
26. Population improvement programmes, recurrent selection
27. Synthetics and composites
28. Methods of breeding for vegetatively propagated crops, Clonal selection
29. Mutation breeding, types, nature, classification
30. Mutagens- physical and chemical mutagens
31. Handling of mutated populations- problems and prospects
32. Poliploidy breeding-origin and classification
33. Auto and allopolyploids
34. Role of polyploidy in evolution of crop plants
35. Wide hybridization, significance in crop improvement.

36. Recent approaches in crop breeding.

Practical Schedule

1. Botanical description and floral biology
2. Study of megasporogenesis and microsporogenesis
3. Fertilization and life cycle of an angiospermic plant
4. Plant Breeder' s kit; Hybridization techniques and precautions to be taken
5. Floral morphology, selfing, emasculation and crossing techniques
6. Study of male sterility and incompatibility in field plots
7. Rice and Sorghum; Maize and Wheat
8. Bajra and ragi; Sugarcane and coconut
9. Groundnut, Castor, Safflower
10. Sesamum; Redgram, Bengalgram
11. Greengram; Soybean and blackgram
12. Chillies, Brinjal and Tomato
13. Bhindi, Onion, Bottle gourd and Ridge gourd
14. Cotton and Mesta; Jute and Sunhemp.
15. Practical Examination

Suggested Readings

Allard, R.W. 1960. Principles of Plant Breeding. John Wiley & Sons INC. USA. Toppan Co. Ltd. Japan

Choudhari, T.C. 1982. Introduction to Plant Breeding. Oxford A& IBH Publishing Co., New Delhi

Elliot. 1958. Plant Breeding & Cytogenetics. Mc Grow Hill. New York

Hayward, M.D., Bosemark, N.O and Romagosa (eds) 1993 Plant breeding- principles and prospects Chapman and Hall, London

Kuckuck, H. Kobabe, G. and Wenzel, G. 1996 Fundamentals of plant breeding Narosa Publishing House

Phundan Singh 1996 Essentials of plant breeding Kalyani Publishers. New Delhi/ Ludhiana.

Sharma, J.R. 1989. Principles and Practice of Plant Breeding. Tata Mc Graw - Hill Publishing Company Limited, New Delhi.

Singh, B.D. 2001. Fundamentals of Genetics. Kalyani Publishers. New Delhi. Ludhiana

Singh, B.D. 2003. Plant Breeding Principles and Methods. Kalyani Publishers. New Delhi/ Ludhiana.

4. Pbgn. 3104. Breeding of crops and intellectual property rights (2+1)

Breeding objectives and concepts of breeding in self pollinated , cross pollinated and vegetatively propagated crops. Origin and distribution of species, wild relatives and forms. Breeding of Cereals (rice, wheat, maize, sorghum, bajra). Pulses (cow pea, red gram, green gram, black gram). Oil seeds (ground nut, sesame). Fibers (cotton), Vegetables (Tomato , bhindi, chilly, cucurbitaceous).Medicinal plants (thippali, plumbago) Flower crops (anthurium, orchid,). Fruit crops (mango, banana,). Plantation crops (Coconut, cashew, rubber, pepper, arecanut, cardamom, cocoa) . Breeding procedures for development of hybrids, / varieties of various crops. Idiotype concept and resistance breeding (biotic and abiotic) . Mechanism of resistance in plants. Plant genetic resources- conservation and utilization. Biodiversity Act and its implications – Exchange

of germplasm, Material Transfer Agreement International treaties on plant genetic resources. IPR – definition, concepts, and components. - plant breeders rights and farmers rights. UPOV , PPV and FR act. Plant variety registration, DUS testing, Benefit sharing . Concept of Geographical Indications

Practical

Floral morphology, selfing and crossing techniques; Parentage of released varieties/hybrids Rice and Sorghum; Maize and Wheat; Bajra and ragi; Sugarcane and coconut; Groundnut, Castor, Safflower and Sesamum; Redgram, Bengalgram and Greengram; Soybean and blackgram; Chillies, Brinjal and Tomato; Bhendi, Onion, Bottle gourd and Ridge gourd; Cotton and Mesta; Jute and Sunhemp. Study of quality certification plots; Visit to AICRP trials and programmes; Visit to grow out test plots; Visit to various research stations; Visit to other institutions.

Lecture Schedule

1. Breeding objectives and important concepts of breeding self pollinated crops
2. Cross pollinated and vegetatively propagated crops
3. Hardy-Weinberg Law
4-5 Definition of biometrics, assessment of variability i.e., additive, dominance and epistasis .
6. Genotype x Environment interaction and influence on yield/performance
7. Study in respect of origin
8. Distribution of species, Wild relatives and forms.
9-10. Breeding methods of Cereals- rice
11-12 Breeding methods of wheat, maize, sorghum, bajra,
13. Breeding methods of Pulses -cowpea, redgram, greengram, blackgram
14. Breeding methods of Oilseeds- Groundnut, sesame, castor etc.
15. Breeding methods of Fibers - Cotton etc.
16. Breeding methods of Vegetables -Tomato, bhindi, chilli, cucumbers
17. Breeding methods of Flowers crops -Anthurium, orchid, heliconia, gladiolus & gerbera, marigold
18. Breeding methods of Fruit crops -mango, banana, papaya
19-20. Breeding methods of Plantation crops –coconut
21. Breeding methods of cashew
22 .Breeding methods of rubber
23. Breeding methods of pepper
24. Major breeding procedures for development of hybrids / varieties of various crops
25. Plant Genetic Resources their conservation and utilization in crop improvement
26. Mid term Examination
27. Ideotype concept in crop improvement
28-29.Breeding for resistance to biotic and abiotic stresses variability in pathogens and pests
30. Mechanisms of resistance in plant to pathogens and pests.
31. Genetic basis of adaptability to unfavourable environments .
32. IPR- definition,concepts and components.
33-34.IPR policies and issues in Indian scenario
35. Case studies of IPR issues.
36. Final Examination.

Practical Schedule

1. Emasculation and Hybridization techniques
2. Handling of segregating generations, pedigree methods
3. Handling of segregating generations, bulk methods
4. Handling of segregating generations, back cross methods
5. Field lay out of experiments
6. Field trials, maintenance of records and registers
7. Estimation of Heterosis and inbreeding depression
8. Estimation of Heritability, GCA and SCA
9. Estimation of variability parameters
10. Parentage of released varieties/hybrids
11. Problems on Hardy, Weinberg Law
12. Study of quality characters
13. Sources of donors for different characters
14. Visit to seed production and certification plots
15. Visit to AICRP trials and programmes
16. Visit to grow out test plots
17. Visit to various research stations
18. Visit to other institutions.
19. Practical Examination

Suggested Readings

Banga S S and Banga S K 1996 Hybrid Cultivar Development Narosa Publishing House
Chahal, G.S. and Gosal, S.S. 2002. Principles and Procedures of Plant Breeding. Narosa Publishing House, New Delhi
Fehr, W.R. 1987. Principles of Cultivar Development (2 Volumes). Macmillan Publishing Co. New York
Hancock, J.F. 1989Plant evolution and the origin of crop species Prentice Hall, Englewood Cliffs, New Jersey
Ram, H.H. and Singh, H.G.1986 Crop breeding and geneticsKalyani Publishers, Ludhiana
Singh, B.D. 2002. Plant Breeding. Principles and methods. Kalyani Publishers, New Delhi/Ludhiana
Neal C. Stoskopf, Dwight T. Tomes and B.R. Christie. 2006. Plant Breeding Theory and Practice. Scientific Publishers (India). Jodhpur
Purseglove, J.W. 1978. Tropical Crops Monocotyledons. Vol-1 & Vol-2 New Art Printing Co Pte Ltd.
Purseglove, J.W. 1978. Tropical Crops Dicotyledons. Vol-1 & Vol-2 New Art Printing Co Pte Ltd.
Sharma, J.R. 1989. Principles and Practice of Plant Breeding Tata Mc Graw – Hill Publishing Company Limited, New Delhi
Intellectual property laws containing acts and rules .2005 P 947.Universal law publishing company
Elsy, C.R. , Jessy Thomas , K , and Mohandas ,M. 2006 Primer on IPR in Agriculture. P. 36. Kerala Agricultural University

5. Pbgn. 3205. Principles of seed technology (1+1)

Introduction to Seed Production, Importance of Seed Production, Deterioration of crop varieties, Factors affecting deterioration and their control; Maintenance of genetic purity during seed production, Seed quality; Definition, Characters of good quality seed, Different classes of seed, Production of nucleus & breeder's seed, Foundation and certified seed production in maize (varieties, hybrids); Foundation and certified seed production of rice (varieties & hybrids); Foundation and certified seed production of tomato, brinjal, chilli and bhindi; Seed certification, procedure for seed certification, field inspection and field counts etc.; Seed Act and Seed Act enforcement, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories; Duties and powers of seed inspectors, offences and penalties; Seed control order Seed Control Order 1983, Seed Act 2000 and other issues related to seed quality regulation. Intellectual Property Rights, Patenting, WTO, Plant Breeders Rights, Seed Drying: Forced air seed drying, principle, properties of air and their effect on seed drying, moisture equilibrium between seed and air, Heated air drying, types of air distribution systems for seed drying, Seed processing: air screen machine and its working principle. Different upgrading equipments and their use, Establishing a seed testing laboratory; Seed testing procedures for quality assessment, Seed treatment, Importance of seed treatment, types of seed treatment, equipment used for seed treatment, Seed packing and seed storage, factors affecting seed longevity during storage and conditions required for good storage, General principles of seed storage, measures for pest and disease control, temperature control, Seed marketing, marketing structure, marketing organization; Factors affecting seed marketing.

Practical

Seed sampling principles and procedures; Physical analysis of Field and Horticultural crops; Germination analysis of Field and Horticultural crops; Moisture tests of Field and Horticultural crops; Viability test of Field and Horticultural crops; Seed health test of Field and Horticultural crops; Vigour tests of Field and Horticultural crops; Seed dormancy and breaking methods; Grow out tests for varietal identification; Visit to Seed production plots of Rice; Chillies and Vegetables. Visit to Seed processing plants; Visit to Seed testing laboratories; Varietal identification in seed production plots; planting ratios, isolation distance, rouging etc.

Lecture Schedule

1. Introduction to seed production, importance of seed production.
2. Deterioration of crop varieties,factors affecting deterioration and their control.
3. Seed quality; definition , characters of good quality seed, different classes of seed, maintenance of genetic purity during seed production,
4. Production of nucleus & breeder's seed, foundation and certified seed
5. Seed Production in maize (varieties, hybrids); Foundation and certified seed production of rice (varieties &hybrids)
6. Foundation and certified seed production of tomato, brinjal, chilli and bhindi
7. Seed certification, procedure for seed certification, field inspection and field counts
8. Seed Act and Seed Act enforcement, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories
9. Duties and powers of seed inspectors, offences and penalties

10. Seed control order: Seed Control Order 1983, Seed Act 2000 and other issues related to seed quality regulation.
11. Intellectual Property Rights, Patenting, WTO, Plant Breeders Rights
12. Midterm Examination
13. Seed Drying: forced air seed drying, principle, properties of air and their effect on seed drying, moisture equilibrium between seed and air.
14. Heated air drying, types of air distribution systems for seed drying
15. Seed processing: air screen machine and its working principle, different upgrading equipments and their use.
16. Establishing a seed testing laboratory and seed testing procedures for quality assessment
17. Seed treatment, importance of seed treatment, types of seed treatment, equipments used for seed treatment

18.Seed packing and seed storage, general principles of seed storage, factors affecting seed longevity during storage and conditions required for good storage, measures for pest and disease control, temperature control

19. Seed marketing, marketing structure, marketing organizations, factors affecting seed marketing.

Practical Schedule

1. Seed sampling principles and procedures
2. Physical purity analysis of field and horticultural crops
3. Germination analysis of field and horticultural crops
4. Moisture tests of field and horticultural crops
5. Viability test of field and horticultural crops
6. Seed health test of field and horticultural crops
7. Vigour tests of field and horticultural crops
8. Seed dormancy and breaking methods
9. Grow out tests for varietal identification
10. Visit to seed production plots of rice, chilli and vegetables
11. Visit to seed processing plants
12. Visit to seed testing laboratories
13. Varietal identification in seed production plots
14. Planting ratios,isolation distance, roguing etc
15. Practical Examination

Suggested Readings

Agrawal, P.K. 1994. Principles of Seed Technology Kalyani Publishers, Ludhiana
Agrawal, R.L. 1990. Seed Technology Kalyani Publishers, Ludhiana
Agrawal, P.K. and N. Dadlani 1995. Techniques in Seed Science and Technology
Neal C. Stoskopf, Dwight T. Tomes and B.R. Christie. 2006. Plant Breeding Theory and Practice. Scientific Publishers (India), Jodhpur.
Dahiya, B.S.; Rai, K.N. 1995 Seed Technology Kalyani Publishers, Ludhiana
Nema, N.P. 1999 Principles of Seed Certification and Testing Allied Publishers Pvt. Ltd., New Delhi.

III. SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

1. Ssac. 1101. Introduction to soil science (2+1)

Soil-Pedological and edaphological concepts -origin of the earth - earth's crust - composition. Rocks and minerals. Weathering - soil formation - factors and processes - components of soils -soil profile. Soil physical properties - soil texture - textural classes - particle size analysis. Soil structure Classification - soil aggregates – significance. Soil consistency - soil crusting. Bulk density and particle density of soils and porosity - their significance and manipulation. Soil compaction - soil Colour. Elementary knowledge of soil classification. Soils of India - geological formations – characterization of soils of Kerala.

Soil water - retention and potentials - soil moisture constants - movement of soil water – infiltration – percolation – permeability – drainage - methods of determination of soil moisture. Thermal properties of soils - soil temperature - soil air - gaseous exchange - influence of soil temperature and air on plant growth.

Soil colloids – properties – nature - types and significance. Layer silicate clays - their genesis and sources of charges. Adsorption of ions - ion exchange - CEC and AEC - factors influencing ion exchange and its significance. Concept of pH - soil acidity - brief overview of saline, sodic and calcareous soils. Soil organic matter – composition – decomposability – humus - fractionation of organic matter. Carbon cycle - C: N ratio. Soil biology – biomass - soil organisms and their beneficial and harmful roles.

Practical

Determination of bulk density and particle density - aggregate analysis - soil strength. Soil moisture determination - soil moisture constants – field capacity - infiltration rate - water holding capacity. Soil texture and mechanical analysis. Soil temperature. Analytical chemistry – basic concepts - techniques and calculations. Collection and processing of soil for analysis – organic carbon, pH, EC, - Study of a soil profile – Identification of rocks and minerals. Total elemental analysis of soils. Estimation of CEC.

Lecture Schedule

1. Soil – definition – earth -origin -earth crust, composition, pedological and edaphological approach
2. Rocks – different kinds of rocks, formation and classification
3. Soil forming minerals – primary, secondary, accessory minerals - classification
4. Weathering of rocks and minerals- types of weathering, factors affecting weathering
5. Soil formation – factors and processes of soil formation, soil development
6. Profile development and differentiation, horizons, factors influencing the profile development
7. Podzolization and laterization
8. Soil physical properties – soil texture, importance of soil texture, textural classification of soils
9. Particle size analysis -Stokes law – limitations and assumptions
10. Different methods of particle size analysis and textural group identification.

Quiz

11. Soil structure – definition, classification
12. Aggregation of soil particles – factors controlling them
13. Soil consistency - Soil crusting
14. Particle density – bulk density and porosity – their importance of soil fertility, factors affecting them and manipulation
15. Soil compaction -Soil air – importance – composition – comparison with atmospheric air, factors affecting the composition of soil air – dynamics – importance
16. Soil temperature, heat flow- amount – and equations- factors controlling the soil temperature- soil colour
17. Soil classification, need for classification, comparison of different systems of classification
18. Soil taxonomy and its characteristics
19. Soils of India – Geological formation and soils of Kerala - characterization
20. Soil water-forms of soil water, energy concepts- retention dynamics and availability.
21. Soil moisture constants – Movement of soil water- saturated unsaturated
22. Infiltration – percolation - permeability – drainage – capillary movement.
23. Methods for determination of soil moisture
24. Soil colloids, properties of colloids, different kinds of colloids, role of colloids in soil fertility -flocculation, de-flocculation, conditions favoring flocculation and de-flocculation
25. Layer silicate clays – their genesis and source of charge.
26. Clay minerals- amorphous material – organic colloids- clay humus complexes source of charges Adsorption of ions
27. CEC – its importance – CEC and nutrient availability
28. AEC – Factors influencing ion exchange and its significance
29. pH Concept, soil acidity reason for soil acidity, reserve acidity, active acidity - liming

Mid term Examination

30. Saline soils, reasons for salinity, characterisation of saline soils, reclamation of saline soils
31. Saline alkali soils and non-saline alkali soils – characterisation, amendments and reclamation
32. Soil organic matter – composition properties Decomposability , influence on soil properties.
33. Humus fractions of soil Organic matter – carbon cycle
34. Transformation of organic matter – C:N ratio- soil biology
35. Biomass – soil organisms- their beneficial and harmful roles
36. Role of organic matter in maintaining the physical and chemical properties of soils – importance in plant nutrition.

Practical Schedule

1. Determination of particle density, Determination of bulk density and porosity
2. Aggregate analysis
3. Soil strength - Modulus of rupture
4. Soil moisture determination by different methods
5. Determination of Soil moisture constants Field capacity PWP

6. Determination of water holing capacity
7. Particle size analysis of soils
8. Particle size analysis of soils textural identification
9. Measurement of soil temperature variations
10. Brief introduction to Analytical chemistry, Basic concepts and calculations
11. Familiarization of Various titrimetric analysis
12. Collection and preparation of soil samples
13. Determination of Organic C
14. Determination of soil pH, and electrical conductivity of soil
15. Hypothetical soil profile and examination of soil profile.
16. Total elemental analysis -Determination of total N
17. Determination of total P ,K
18. Determination of CEC of soils
19. Identification of rocks and minerals

Suggested Readings

Biswas, T.D. and Mukherjee, S.K. 1987. *Text Book of Soil Science*. Tata McGraw Hill Publishing Co., New Delhi

Brady, N.C. 1990. *Nature and Properties of Soils*. 10th Edn, Macmillian Publishing Co. Inc., New York

Das.D.K, 1997. *Introductory Soil Science*. Kalyani Publishers, New Delhi.

Foth, H.D. and Turk, L. M. 1972. *Fundamental of Soil Science*. 5th Edn. Wiley Eastern Pvt. Ltd., New Delhi

Gupta, P.K. 2007. Soil, Plant, Water and Fertilizer Analysis. Published by AGROBIOS (India), Jodpur

ISSS, 2002. *Fundamentals of Soil Science*. Published by Indian Society of Soil Science, IARI, New Delhi

Jaiswal, P.C. 2006. *Soil, Plantand Water Analysis*. 2nd Edn. Kalyani Publishers, ludhiyana

Samuel L.Tisdale, Werner.L. Nelson, James D.Beaton and John L. Havlin. 1995. *Soil Fertility and Fertilisers*. 5th Edn. Macmillan publishing company, USA.

2. Ssac. 1202. Biochemistry (2+1)

Biochemistry – Introduction and importance. Plant cell, cell wall and its role in live stock, food and paper industries. Bio-molecules – Structure, properties & applications: Amino acids, peptides and proteins –Plant proteins and their quality. Enzymes –Factors affecting the activity, classification, Immobilistion and other industrial applications. Lipids –Acyl lipids, Their industrial application in soaps, detergents, paints, Varnishes, lubricants, adhesives, plastics, nylon, Bio-diesel, Biodegradable plastics etc. Carbohydrates; Nucleotides and Nucleic acids. Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation. General reactions of amino acid degradation. Biosynthesis – carbohydrates, Lipids, Proteins and Nucleic acids. Metabolic regulation. Secondary metabolites, Terpenoids, Alkaloids, Phenolics and their applications in food and pharmaceutical industries.

Practical

Amino acid models (atomic); Paper electrophoresis for the separation of plant pigments; Protein denaturation – heat, pH, precipitation of proteins with heavy metals, Protein estimation by Lowry method; Enzyme kinetics, competitive inhibition, enzyme

immobilization; Extraction of nucleic acids, column chromatography of RNA hydrolysate; Characterization of lipids by T.L.C.; Extraction of oil from oil seeds; Estimation of fatty acids by G.L.C.; Models of sugars, sucrose & starch; Quantitative determination of sugars; Paper chromatography for the separation of sugars; Determination of phenols.

Lecture Schedule

1. Review of Biochemistry – introduction and importance
2. Plant cell – structure, constituents, functions –cell membrane – role of livestock feed and paper industry
3. Biomolecules – general groups – importance
4. Amino acids – classification – properties – general reactions – biological functions.
5. Contd… Amino acids – classification – properties – general reactions – biological functions
6. Peptides and proteins – classification and significance
7. Plant proteins – properties, quality and function
8. Enzymes –chemistry- nomenclature, classification, functions, properties – mechanism of action
9. Enzymes – factors affecting the activity, immobilization and industrial application
   Quiz
10. Lipids- chemistry – classification – properties
11. Cont.. Lipids- chemistry – classification – properties
12. Analysis of fats – physical and chemical tests
13. Simple lipids and complex lipids of natural occurrence and agricultural significance
14. Lipids –industrial application in soaps, detergents, paints, lubricants, varnishes, adhesives
15. Plastics, nylon, bio diesel, biodegradable plastics – chemistry and nomenclature
16. Carbohydrates- classification – important sugars- structure, properties and stereochemistry
17. Cond… Carbohydrates- classification – important sugars- structure, properties and stereochemistry
18. Sugars- chemical reactions- disaccharide – properties and reactions
19. Sugars- chemical reactions- disaccharide – properties and reactions
    Mid term Examination
20. Polysaccharides – storage and structural groups – sugar derivatives and their biological significance
21. Nucleotides and nucleic acids – chemistry and biological significance
22. Metabolism – basic concepts – principles- metabolic energy –and its generalization – central metabolic pathway
23. Metabolism of carbohydrates – glycolysis and alcoholic fermentation- glucogenesis
24. Respiration – citric acid cycle – pentose phosphate pathway, utilization of other monosaccharides and polysaccharides – energetics
25. Electron transport and oxidative phosphorylation
26. Metabolism of lipids – utilization of odd numbers and even numbers of fatty acids
27. Beta-oxidation of fatty acids and amino acid degradation
28. Glyoxylate cycle - integration of carbohydrate and lipid catabolism in oil seed crops

29. Metabolic regulations integration of intermediary metabolism of carbohydrate – lipids – amino acids
30. Biosynthesis of carbohydrates – photosynthesis – pigments – concepts of light and dark reactions – photophosphorylation – fixation of CO_2 – events in Calvin Cycle
31. Formation of glucose, sucrose and starch – C_3, C_4 and CAM plants
32. Regulation of photosynthesis – photorespiration – balance sheet of carbon transformation
33. Biosynthesis of lipids, proteins and nucleic acids
34. Secondary metabolites – chemistry – classification – importance – Terpenoids
35. Alkaloids – classification – properties and uses
36. Phenolics – applications in food and pharmaceutical industries

Practical Schedule

1. Preparation of amino acid models – separation of plant pigments by paper electrophoresis
2. Cond..Preparation of amino acid models – separation of plant pigments by paper electrophoresis
3. Denaturation of proteins – heat, pH, precipitation of protein with heavy metals
4. Estimation of protein by Lowry method
5. Enzymes kinetics – effect of temperature
6. Enzyme inhibition – competitive and immobilization
7. Extraction of nucleic acid – DNA
8. Extraction of nucleic acid – RNA
9. Column chromatography of RNA hydrolysate
10. Characterization of lipids by TLC
11. Cond.. Characterization of lipids by TLC
12. Extraction of oils from oil seeds
13. Cond… Extraction of oils from oil seeds
14. Estimation of fatty acids by GLC
15. Qualitative and quantitative tests for reducing and non reducing sugars
16. Preparation of models for sugars, sucrose and starch - Estimation of glucose and sucrose
17. Paper chromatography for the separation of sugars
18. Estimation of phenols

Suggested Readings

Conn, E.E and Stumpf, P.K. 1989. *Outline of Biochemistry*. Wiley Eastern Ltd. New Delhi.

Frank M. Mallette, Paul M. Althouse and Carl O. Glagett. 1960. *Biochemistry of Plants and Animals*. Published by Wiley Wastern Pvt Ltd., New Delhi

Jain, J.L. 2001. *Fundamentals of Biochemistry*. 5th Edn. Published by S.Chand & Company, New Delhi

Lehninger, A. 1984. *Principles of Biochemistry*. Published by CBS Publishers and Distributers, New Delhi

Mazur, A and Harrows, B. 1971. *Textbook of Biochemistry*. W.B. Sanders Publications, New Delhi

Metha, S.L, Lodha, M.L and Sane, P.V. 1993. *Recent Advances in Plant Biochemistry*. Published by ICAR, New Delhi

Milton,T. 1920. *Basic Chemistry of Life*. 2nd Edn. Published by Appleton-Century-Crofts, New York
Rameshwar, A. 1993. *Outlines of Plant Biochemistry*. Published by Maya Prakash 206 Bidhan Sarani, Calcutta
Robert M. Devlin Francis M. Witham. 1986. *Plant Physiology*. Published by CBS Publishers and Distributers, New Delhi
Veerakumari, 2004. *Biochemistry*. MJP Publishers, Chennai
White, A and Handler, P. 1978. *Principles of Biochemistry*. McGraw Hill Publications, New Delhi

3. Sssc. 2103. Organic farming and soil health (1+1)

Organic farming – Concepts, and practices – management. Components- Organic farming for sustainable agriculture- Manures – bulky and concentrated – FYM – Compost – rural, urban, vermicompost, coirpith etc. Enrichment of organic manures. Sewage and sludge, green manures – potentials and limitations. Quality parameters of organic manures and specifications. Recycling of organic residue. Industrial effluents and heavy metal contamination – bioremediation and phyto remediation. Biofertilizers. Soil micro flora – nutrient transformations. Soil health – concept and assessment – Soil Health Card. Soil enzymes – biological tests –harmful effect of non judicious chemical fertilization. Role of microorganisms in degradation of pesticides. Integrated Nutrient Management (INM) and Integrated Plant Nutrient Supply System (IPNS). NPOP, organic produce quality considerations, certification, labeling, accreditation process and marketing**.**

Practical

Sampling of manure materials - moisture determination,bulk density,pH, E.C, estimation of organic carbon , total nitrogen, C:N ratio, phosphorus and potassium in manures/ compost. Estimation of heavy metals. Preparation of soil samples for chemical and biological tests - Estimation of organic carbon and available nitrogen in soil. Determination of soil biological activity by monitoring dehydrogenase activity. Determination of urease activity in soil - Assay of acid and alkaline phosphomonoesterase in soil. Study of cellulose decomposition and CO_2 evolution. Nitrate reductase activity in soils. Bio assay of available K. Soil fertility evaluation by Neubauer technique. Preparation of vermicompost and other manures -preparation of enriched manures.

Lecture schedule

1. Organic farming – Concepts, practices, management and components. Organic manures – Bulky organic manures, farmyard manure – types – nutritional importance and methods of handling
2. Compost - farm and town refuse compost – aerobic and anaerobic methods - preservation and composition -Sewage sludge and night soil- composition and limitations – quality parameters of organic manures.
3. Role of earthworms – preparation, nutrient composition and use of vermicompost – enrichment techniques – nutrient recycling
4. Heavy metal contamination – source, permissible limit –bio remediation and phyto remediation

Quiz

5. Concentrated organic manures – non-edible and edible of cakes, blood meal, meat meal and fish manure
6. Biofertilizers, forms, uses and advantages – nitrogen and phosphorus
7. Soil micro flora – beneficial and harmful – role in soil fertility –bacteria, fungi and actinomycetes
8. Nutrient cycles in soils – carbon, CO_2 fixation, soil organic matter in plants and animal residues and degradation of organic matter by microbes.
9. Cont…Nutrient cycles in soils – Nitrogen – ammonification nitrification and denitrification
10. Cont… Nutrient cycles in soils – Phosphorus and sulphur

Mid term Examination

11. Use of microbes for plant growth – development of inoculants – Research and Industry
12. Soil health – Concepts – assessment and Soil Health Card
13. Soil enzymes – role in soil fertility - biological test
14. Chemical fertilizers – harmful effect of non judicious chemical fertilization
15. Microorganisms – role in degradation of pesticides
16. Integrated Nutrient Management and Integrated Plant Nutrient Supply System
17. NPOP- regulations for organic production - quality consideration of farm produce – accreditation process -certification –labeling, and marketing.

Practical Schedule

1. Sampling of manure materials. Moisture determination
2. Nitrogen estimation in oil cake, bone meal.
3. Estimation of phosphorus in bone meal
4. Estimation of acid soluble P_2O_5 in bone meal
5. Estimation of acid soluble P_2O_5 in bone meal (continued)
6. Preparation of soil samples for analysis – for chemical and biological tests
7. Estimation of organic carbon by Walkley and black method
8. Determination of available nitrogen in soil
9. Determination of soil biological activity by monitoring dehydrogenase activity.
10. Determination of urease activity in soil
11. Assay of acid and alkaline phosphomonoesterase in soil.
12. Study of cellulose decomposition and CO_2 evolution
13. Nitrate reductase activity in soils
14. Bio assay of available K
15. Soil fertility evaluation by Neubauer technique.
16. Preparation of vermicompost and other manures

17-18. Preparation of enriched manures.

Suggested Readings

Allan Wild, 1988. *Russel's Soil Conditions and Plant Growth*. Longman group U.K.
Burges, A and Raw, F. 1967. *Soil Biology*. Acad. Press, New York

Dahama,A.K. 2007. Organic Farming for Sustainable Agriculture. 2nd Edn. Published by AGROBIOS (India) Jodhpur
Das, P.C. 1993. *Manures and Fertilizers*. Kalyani Publishers, New Delhi.
Department of Commerce, Ministry of Commerce and Industry, Govt. of India. 2000. *National the standards Programme for Organic containing Production for the organic products*
Gehlot, D. 2005. Organic Farming: Standards, Accreditation, Certification anfd Inseption. Published by AGROBIOS (India) Jodhpur Published by AGROBIOS (India) Jodhpur
Gupta, P.K. 2006. Vermicomposting for Sustainable Agriculture. Published by AGROBIOS (India) Jodhpur
Gupta, P.K. 2007. *Soil. Plant, Water and Fertilizer Analysis*. Published by AGOBIOS (India), Jodpur
Lampkin, N.H. and Padel, S. 1994. *The Economics of Organic Farming*. Biddles (UK) Ltd.pp 468
Palaniappan, SP and Annadurai, K. 1999. *Organic Farming - Theory and Practice*. Scientific Publishers (India) Ltd. pp 257
Sadasivam, S. and Manickam, A. 1992. *Biochemical Methods for Agricultural Sciences*. Wiley Eastern Limited and Tamil Nadu Agricultural University,Coimbatore. pp96-144.
Sharma, A.K. 2006. A Hand Book of Organic Farming. Published by AGROBIOS (India) Jodhpur
Sharma, A.K. 2005. *Biofertilizers for Sustainable Agriculture*. Published by AGROBIOS (India) Jodhpur
Tandon, H.L.S. 1992. *Fertilizers, Organic Manures, Recyclable Wastes and Biofertilizers* Fertilizer Development and Consultation Organisation. pp148
Tandon, H.L.S. 1993. *Methods of Analysis of Soils, Plants, Waters and Fertilizers.* Fertilizer Development and Consultation Organisation. pp143
Thampan, P.K. 1993. *Organics in Soil Health and Crop Production*. Peekay tree crops development foundation, India. pp252
Yawalkar, K.S., J.P. Agarwal and Bokde,S. 1981. *Manures and Fertilizers*. Agri-Horticultural Publishing House, Nagpur, India. pp398

4. Ssac. 2204. Fertilizers and agro-chemicals (1+1)

Fertilizers – classifications - manufacturing processes and properties of major nitrogenous (ammonium sulphate, urea, calcium ammonium nitrate, ammonium nitrate, ammonium sulphate nitrate) - phosphatic (single super phosphate, enriched super phosphate, diammonium phosphate, ammonium poly phosphate) - potassic and complex fertilizers - their fate and reactions in the soil. Secondary and micronutrients fertilizers - amendments. Fertilizer Control Order - fertilizer storage.

Organic chemistry as prelude to agro chemicals - diverse types of agrochemicals - botanical insecticides (Neem), Pyrethrum, Synthetic pyrethroids. Synthetic organic insecticides - Major classes - properties and uses of some important insecticides under each class. Herbicides – major classes – properties and uses of 2, 4-D, atrazine, glyphosate, butachlor benthiocarb - new classes of compounds - sulfonyl ureas etc. Fungicides – major classes – properties and uses of carbendazim, carboxin, captan, tridemorph and copper oxychloride – Insecticides Act. Plant growth regulators - mode of action - metabolism and detoxification of agrochemicals in plant, soil and animal systems. Compatibility of agrochemicals.

Practical

Estimation of Ammoniacal and nitrate nitrogen – water soluble P2O5, potassium, calcium, sulphur and zinc contents of fertilizers. Adulteration in fertilizer. Argentimetric and iodometric titrations – their use in the analysis of lindane metasystox, endosulfan, malathion, copper and sulphur fungicides, bleaching powder – Compatibility of fertilizers with pesticides.

Lecture Schedule

1. Fertiliser materials - classification, basic principles – sources -properties and uses
2. Nitrogenous fertilisers – Urea , Ammonium sulphate - manufacturing process, properties and use
3. Nitrogenous fertilisers -Sodium nitrate, ammonium chloride, calcium ammonium nitrate, ammonium nitrate, ammonium sulfate nitrate manufacturing process, properties and use Suitability of different nitrogenous fertilisers for different soils and crops.
4. Phosphatic fertilisers – classification, manufacturing process, property and use of single super phosphate, triple super phosphate and bone-meal
5. Phosphatic fertilisers – basic slag, rock phosphate, dicalcium phosphate manufacture, properties and use. Behaviour of phosphatic fertilisers in different soil types and comparative fertiliser value of various phosphatic fertilizers
6. Principles of manufacture of potassic fertilisers, physical and chemical properties in relation to their use in various soils
   Quiz
7. Straight vs complex fertilisers. Manufacturing process, efficiency, properties and use of the recent complex fertilisers. Unit value and evaluation of fertilizers. Materials supplying secondary nutrients and micronutrients and chelating compounds. Fertiliser control order and specifications of fertilizersAmendments - Soil acidity –liming materials and its reaction in acidic soils. Liming materials – methods for evaluating the efficiency and the lime requirement. Saline and alkali soils – amendments for reclamation and soil conditioners
8. Organic chemistry as a prelude to agrochemicals AND 10. Types of agrochemicals organic, inorganic, botanicals and synthetic botanicals

11. Naturally occurring insecticides Botanicals – Neem, Purethrum, rotenoids and other alkaloids and their synthetic analogues
12. Important classes of chemical insecticides - classification of herbicides – pre-emergence and post emergence, selective and non-selective
    Mid term Examination
13. Herbicides - Important chemical classes - 2,4-D, atrazine, glyphosate, butachlor, benthicarb, Neww classes of compounds Sulfonyl ureas etc.
14. Herbicides – pyridines and pyrinium salts, triazines and urea derivatives
15. Classification of fungicides – copper, sulphur, dithiocarbamates - Fungicides – copper compounds, dithiocarbamates, sulphur and its compounds – preparation, toxicity, mechanism of action and use
16. Fungicides – nitro derivatives of phenol, misc. groups, systemic fungicides, toxicity and use .
17. Plant growth regulators – compatibility of fertilizers and other agrochemicals.
18. Behavior of pesticide in the air, water and soil -Metabolism. Detoxification and bio degradation of pesticides in soil, plant and animal systems
19. Management of pollution. -Insecticide act and regulations

Practical Schedule

1. FCO regulations for sampling and analysis and sampling of fertilisers
2. Estimation of nitrogen in ammonium sulfate and urea
3. Estimation of nitrogen in urea (continued).
4. Estimation of ammoniacal nitrogen and nitrate N in ammonium nitrate –
5. Estimation of water soluble P_2O_5 in super phosphate, Estimation of K_2O in muriate of potash
6. Estimation of water soluble P_2O_5 in super phosphate (continued) Estimation of K_2O content in muriate of potash (continued)
7. Analysis of complex fertilisers – estimation of nitrogen and water soluble P_2O_5 in ammonium phosphate.
8. Estimation of neutralising value of liming material
9. Analysis of Zinc content of fertilizers.
10. Rapid tests to detect adulteration in fertilizers
11. Safe handling and sampling of pesticides for analysis.
12. Introduction to Argentometric and iodometric titrations and their use in pesticide analysis.
13. Estimation of active chorine in Bleaching powder.
14. Estimation of active ingredient in chlorinated hydrocarbon – Lindane and endosulfan.
15. Estimation of active ingredient in – malathion and Metasystox.
16. Estimation of copper content in in copper sulphate and Phytolan .
17. Estimation of sulphur content in Sulphur Dust and in wettable Powder.
18. Use of compatibility charge and guide lines for mixing fertilizers and pesticides

Suggested Readings

Buchel, K. H. (1977). *Chemistry of Pesticides*. Johnwiley and Sons Publications, New York

Gupta,P.K, 1999. *Hand book of Soil, Fertilizer and Manure*. Agro Botanica, Bikaner.

Gupta, A.K. 2007. Methods in Environmental Analysis Water, Soil and Air. 2nd Edn. Published by AGROBIOS(India) Jodpur

Mishra, P.C. 1989. Soil *Pollution and Soil Organisms*. Ashish Publishing House, New Delhi.

Petreezzelli, D & Hefferich, F.G. 1993. *Migration and Fate of Pollutants in Soils and Subsoils*. Verlag, New york.

Purohit,S.S. 2006. *Environmental Pollution Causes, Effects and Control*. Published by AGROBIOS(India) Jodpur

Salt, D.E, Smith, R.D. and Ruskin, I. 1998. *Phyto Remediation.* Annu Rev. Plant Physical. Plant Mol. Biol. 49 : 643 - 68.

Shilpa, S, Varma, H.N and Bhargava, S.K. 2006. *Air Pollution and its Impacts on Plant growth* Published by New India Publishing Agency, New Delhi

Singh, S.S, 1999. *Soil Fertility and Nutrient Management*. Kalyani Publishers, New Delhi

Sreeramalu, U.S. (1979). *Chemistry of Insecticides and Fungicides.* Oxford & IBH publishing Co., New Delhi.

Stevens, R.W. (1977). *Pesticides in the Environment* Vol. Part 1. Marcel Dekker, Inc. New York

Tandon, H.L.S.1992. *Fertilisers, Organic Manures, Recycleable Wastes and Biofertilisers.* FDCO, New Delhi

Tisdale, S.L.,W.L. Nelson Beaton J.D and Havlin J.L (1997). *Soil Fertility and*

Fertilisers. 5th Edn Printice Hall of India New Delhi.
Ulysses, R. and Johnes, S. 1987. *Fertilisers and Soil Fertility*. Premtice Hall of India Pvt. Ltd., New Delhi
Yawalkar, K.S., Agarwal, J.P. and Bokdi, S. 1984. *Manures and Fertilisers*. Agrl. Horti. Publishing House, Nagpur

5. Ssac. 3105. Soil chemistry, soil fertility and nutrient management (2+1)

Soil as a source of plant nutrients - essential and beneficial elements - criteria of essentiality - forms of nutrients in soil - mechanisms of nutrient transport to plants- factors affecting nutrient availability to plants. Nutrient uptake mechanisms. Metabolic functions - deficiency and toxicities of nutrients - measures to overcome deficiencies and toxicities. Problem soils – acid, salt affected and calcareous soils, characteristics, nutrient availabilities. Reclamation – mechanical, chemical and biological methods. Fertilizer and insecticides and their effect on soil water and air. Irrigations water – quality of irrigation water and its appraisal - Indian standards for water quality. Use of saline water for agriculture.

Soil fertility – Different approaches for soil fertility evaluation. Methods - Soil testing – Chemical methods - critical levels of different nutrients in soil. Plant analysis – DRIS methods - critical levels in plants - rapid tissue tests - Indicator plants - biological method of soil fertility evaluation.

Soil test based fertilizer recommendations to crops. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers. Nutrient cycles, N, P, K and S. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions.

Practical

Principles of analytical Instruments and their calibration and applications, Colorimetry and flame photometry. Estimation of available N, P, K, S, and Zn in oils, pH,

EC, Exchangeable cations and anions in soil. Lime requirement and gypsum requirement of problem soils. Estimation of N, P and K in plants.

Lecture schedule

1. Soil as a source and storehouse of nutrients.
2. History and development of soil fertility studies
3. Arnon's criteria and different forms of nutrients
4. Essential and beneficial elements in plant nutrition.
5. Forms of nutrient in soil and factors affecting availability of nutrients
6. Mechanism of nutrient transport to plant roots – ion uptake and ionic status of plants nutrient absorption – Carrier theory
7. Ion pumps - Active and passive transport - ion antagonism and synergism
8. Metabolic functions of elements in plants
9. Metabolic functions – Continued -
10. Deficiency and toxicity symptoms of elements in plants
11. Measures to overcome deficiency and toxicity and regulations by plants.
    Quiz
12. Problem soils – a broad perspective - distribution - Problems in nutrient

availability

13. Acid soils – sources, factors affecting, active acidity and potential acidity- Acid sulfate soils – genesis – formation
14. Reclamation - mechanical chemical and biological. - Liming materials – neutralising value, limestone reactions in soil, and lime requirement
15. Saline, saline sodic soils and calcareous – characteristics –
16. Reclamation of saline soils and sodic soils - mechanical - chemical and biological
17. Gypsum requirement of sodic soil and leaching requirement of saline soils
18. Management of saline sodic soils and reclamation of calcareous soil
19. Fertilizers and pesticides – effect on soil water and air quality.
    Mid term Examination
20. Quality of irrigation water and its appraisal- undesirable problems in water due to the accumulation of salts
21. Parameters for assigning the quality of irrigation water – SAR, RC, ESP, RSC.
22. Indian Standards for water quality - use of saline water for agriculture – conjunctive use.
23. Soil fertility – different approaches for soil fertility evaluation
24. Chemical methods –Soil testing -Critical level of nutrients in soils
25. Tracer techniques and EUF for soil fertility evaluation
26. Soil test based fertilizer recommendation to crops
27. Chemical methods –plant analysis – DRIS -Critical levels in plants - Rapid tissue tests – Indicator plants - Leaf colour chart - SPAD meter
28. Biological methods and recent trends in soil fertility evaluation
29. Nutrient use efficiency (NUE) – Concepts–factors influencing NUE in respect of N, P,K, S, Fe and Zn fertilizers.
30. Role of soil organic matter in maintenance of soil fertility.
31. Nutrient cycles in soils – Nitrogen cycle – atmospheric N, plant and animal organic N, ammonification, nitrification and denitrification
32. Nitrogen fixation, non symbiotic and symbiotic-Role of blue green and azolla Nitrogen fixation – Major reactions involved in n fixation
33. Phosphorus cycle – organic and inorganic forms of P – rock phosphate sediments, release of P in soil.
34. Dynamics of Potassium in soil.
35. Sulphur cycle – organically bound sulphur, oxidation under aerobic conditions, role of chemitrophic bacteria.
36. Chemical and biochemical implications of different nutrient cycles in soil fertility
37. Sources, method and scheduling of nutrient for different soils and crops grown under rainfed and irrigated condition.
38. Integrated nutrient management

Practical schedule

1. Introduction to Analytical Instruments.
2. Principles of pH meter Conductivity meter colorimeter and flame photometers (AES and AAS)
3. Principles Preparation of soil samples for analysis
4. Determination of pH and electrical conductivity in soil
5. Estimation of organic carbon by Walkley and black method
6. Determination of available nitrogen in soil
7. Determination of available phosphorus in soil
8. Determination of available potassium in soil

9. Determination of available Sulphur in soil
10. Determination of available Zinc in soil
11. Determination of exchangeable cations
12. Estimation of CEC by sum of cations
13. Determination of AEC
14. Determination of Lime requirement and Gypsum requirement
15. Collection and preparation of plant samples for analysis
16. Dry ashing of plant material and Wet digestion of plant material
17. Determination of N in plant sample
18. Determination of P in the plant material
19. Determination of K in the plant material

Suggested Readings

Burges, A, and Raw, F. 1967. Soil Biology. Acad.Press, New York

Donahu, L. R., Miller, W. R. and Shickuluna, 1977. Soils. Prentice Hall of India Pvt. Ltd., New Delhi

KAU, 1994. A Glimpse to Problem Soils of Kerala (ed. Padmaja, et al.) Kerala Agricultural University, Vellanikkara

Mengel, K.J. and Kirkby, A. 1978. Principles of Plant Nutrition. International Potash Institute, Switzerland

Nyle.C. Brady 1995. The Nature and Properties of Soils. 10th Edn. Printice Hall India pvt. Ltd. New Delhi

Raymond W Miller and Roy L. Donahue. 1992. Soils and Introduction to Soils and Plant Growth. 6th edn. Printice Hall India pvt. Ltd. New Delhi

Robert .M. Devlin and Francis H. Witham 1986. Plant Physiology. 4th Edn. CBS Publishers and Distributors New Delhi.

Samuel L.Tisdale, Werner.L. Nelson, James D.Beaton and John L. Havlin. 1995. Soil Fertility and Fertilisers. 5th Edn. Macmillan publishing company, USA.

Fundamentals of Soil Science. Published by Indian Society of Soil Science, IARI New Delhi, 2002

Wild, A. 1988. Russel's Soil Conditions and Plant Growth. ELBS Publications

6. Ssac. 3206. Environmental science (1+1)

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Forest, Water, Food, energy and land resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation. Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Causes, effects and management of soil nuclear hazards and industrial wastes. Disaster management, Floods, earthquakes, cyclones and land slides. Social issues and the environment, unsustainable to sustainable development. The Environment Protection Act, The Air Act, The water Act, The Wildlife Protection. Act and Forest Conservation Act. Woman and child welfare, HIV/AIDS and Role of information technology on environment and human health.

Practical

Collection, processing and storage of effluent samples; Physical, chemical and biological analysis of soil and water samples : Determination of Bio- Chemical oxygen demand (BOD) in effluent sample; Determination of chemical oxygen demand (COD) in effluent sample; Estimation of dissolved oxygen in effluent samples; Determination of sound level by using sound level meter; Estimation of respirable and non respirable dust in the air by using portable dust sampler; Determination of total dissolved solids (TDS) in effluent samples; Estimation of species abundance of plants; Estimation of nitrate contamination in ground water; Analysis of temporary and total hardness of water sample by titration; Estimation of pesticide / heavy metal contamination in Agro-Ecosystem; Visit to Social Service Organisation / Environmental Education Centre; Crop adaptation to environmental variables, soils conditions; Study of transpiration and water balance in plants; Visit to a local polluted site. Observations and remedial measures; Assessment of chlorophyll content of fresh water / sea water ecosystem.

Lecture Schedule

1. Environmental studies- scope and importance
2. Renewable and nonrenewable recourses – forest, water, food energy and land resources
3. Cont… Renewable recourses – forest, water, food energy and land resources
4. Ecosystems – definition, concept, structure and functions
5. Ecosystems- types, energy flow - producers, consumers and decomposers
6. Biodiversity – definition and classification
7. Biodiversity – threats to biodiversity and its conservation
   Quiz
8. Environmental pollution – causes and effects – air and water
9. Environmental pollution – soil, thermal noise and marine
10. Cont.. Environmental pollution – soil, thermal noise and marine
11. Soil nuclear hazards and industrial waste – causes, effects and management
12. Cont… Environmental pollution – soil, thermal noise and marine
    Midterm
13. Disaster management – floods, earthquakes, cyclones and landslides
14. Cont…. Disaster management – floods, earthquakes, cyclones and landslides
15. Social issues and environment, unsustainable to sustainable development
16. Environmental Protection Act – The Air Act and The Water Act
17. Wild Life Protection Act and Forest conservation Act
18. Women and Child welfare, HIV/AIDS, role of information technology on environment and human health

Practical Schedule

1. Visit to a local polluted site -Collection, processing and storage of effluent – soil and water samples
2. Demonstration of methane emission from various agro- industrial wastes.
3. Determination of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), dissolved oxygen in effluent samples
4. Allelopathic studies in agro- ecosystems- bioassay using root exudates of *Cyperus Rotundus*
5. Determination of sound level by using Sound Level Meter and Estimation of respirable and non respirable dust in the air by using Portable Dust Sampler
6. Determination of total dissolved solids (TDS) in effluent samples

7. Estimation of nitrate content in ground water and determination of the temporary and total hardness of water samples
8. Pesticide residue analysis - collection of samples for monitoring of pesticides
9. Extraction and clean-up *of* pesticide residues from various substrates- crop and soil samples.
10. Estimation of pesticide residues by gas-liquid chromatography
11. Thin layer chromatography and paper chromatography for the detection of some Pesticides
12. Interpretation of residue data for estimation of safety intervals
13. Extraction and estimation of heavy metals in the soil and water samples collected from the polluted area and interpretation of data
14. Visit to Social Service Organization / Environmental Education Centre, Crop adaptation to environmental variations and soil conditions
15. Identification of plant species in an ecosystem
16. Plant adaptations- hydrophytes and xerophytes- morphological and anatomical features and special adaptations
17. Estimation of transpiration and water balance in plants and Assessment of chlorophyll content of fresh water/ sea water ecosystem
18. Visit to Social Service Organization / Environmental Education Centre, Crop adaptation to environmental variations and soil conditions

Suggested Readings

Alloway, A.J. 1990. *Heavy metals in soils*. John Wiley & Sons, New York.

Banjerji, S.K. 1993. *Environmental Chemistry*. Prentice Hall of India Pvt. Ltd, New Delhi

Briggs, D and Courtney, F. 1993. *Agriculture and Environment. The Physical Geography of Temperate Agriculture System*. Longman, London

Filter, A.H. and Hay, R.K.M. 1987. *Environmental Physiology of Plants*. 2nd Edn. Academic Press, London

Hodges, L.1973. *Environmental Pollution*. 2nd Edn. Holt,, Rinehart and Winston, USA

Gupta, A.K. 2007. Methods in Environmental Analysis Water, Soil and Air. 2nd Edn. Published by AGROBIOS(India) Jodpur

Katyal, K. and Satake, M. 1990. *Environmental Pollution*. 2nd Edn. Anmol Publishers, New Delhi

Larcher, W. 1980. *Physiological Plant Ecology*. Springer- Verlag, New York

Loomis, R.S and Corner, D.J. 1992. *Crop Ecology, Productivity and Management in Agricultural Systems*. Cambridge University Press

Mishra, P.C. 1989. Soil *Pollution and Soil Organisms*. Ashish Publishing House, New Delhi.

Petreezzelli, D & Hefferich, F.G. 1993. *Migration and Fate of Pollutants in Soils and Subsoils*. Verlag, New york.

Purohit,S.S. 2006. *Environmental Pollution Causes, Effects and Control*. Published by AGROBIOS(India) Jodpur

Salt, D.E, Smith, R.D. and Ruskin, I. 1998. *Phyto Remediation.* Annu Rev. Plant Physical. Plant Mol. Biol. 49 : 643 - 68.

Sehgal, J.L. & Absol, I.P. 1994. *Soil Degradation in India, Status and Impact*. Oxford and IBH publishing Co., New Delhi.

Shilpa, S, Varma, H.N and Bhargava, S.K. 2006. *Air Pollution and its Impacts on Plant growth* Published by New India Publishing Agency, New Delhi

Sukla, R.S. and Chandel, P.S. 1994. Plant Ecology and Soil Science. S. Chand and Co. Ltd., New Delhi

Wild, A. 1994. *Soils and the Environment*: An Introduction. Cambridge University Press

IV. AGRICULTURAL ENTOMOLOGY

1. Ento.1101. Insect morphology, physiology and systematics (2+1)

History of Entomology. Classification of phylum Arthropoda. Relationship of class Insecta with other classes of Arthropoda. Insects in relation to man. Abundance and success of insects. Morphology- structure and function of insect cuticle. Body segmentation. Structure of head, thorax and abdomen. Structure and modifications of insect antennae, mouth parts and legs. Wings- venation, modifications , wing coupling and articulation. Structure of male and female genetalia. Sense organs. Metamorphosis and diapause. Types of larvae and pupae. Structure and functions of digestive, circulatory, excretory, respiratory, nervous, secretory (Endocrine) and reproductive system. Types of reproduction in insects. Embryology and development. Systematics. Classification – importance, history, development and binomial nomenclature. Type concept- hierarchical classification of taxonomic categories. Methods of collection and preservation of insects. Classification – Orders: Odonata- Zygoptera, Anisoptera. Orthoptera – Tettigonidae, Gryllidae Gryllotalpidae, Acrididae. Dictyoptera- Mantidae, Blattidae. Isoptera- Termitidae, Thysanoptera- Thripidae. Hemiptera- Delphacidae, Fulgoridae, Cercopidae, Cicadidae, Membracidae, Cicadellidae, Aleyrodidae, Aphididae, Coccidae, Pseudococcidae, Tingidae, Reduvidae, Miridae, Lygaeidae, Pyrrhocoridae, Coreidae, Pentatomidae, Gerridae, Belostomatodae, Nepidae. Neuroptera- Chrysopidae, Hemerobidae, Mantispidae. Coleoptera- Scarabaeidae, Buprestidae, Elateridae, Coccinellidae, Chrysomelidae, Cerambycidae, Curculionidae, Bruchidae. Diptera- Cecidomyiidae, Syrphidae, Tachinidae, Culicidae, Muscidae, Tabanidae, Asilidae, Tephritidae. Lepidoptera- Psychidae, Cochlididae, Pyralidae, Papilionidae, Nymphalidae, Lycaenidae, Pieridae, Hesperidae, Geometridae, Sphingidae, Arctiidae, Noctuidae, Lymantridae. Hymenoptera - Tenthridinidae, Ichneumonidae, Braconidae, Evanidae, Chalcididae, Trichogrammatidae, Formicidae, Apidae.

Practical

Methods of collection and preservation of insects including immature stages. External features of grasshopper/cockroach. Types of insect antennae, mouthparts and legs.Wing venation, types of wings and wing coupling apparatus. Types of insect larvae and pupae. Dissection of digestive systems (grasshopper/ cockroach). Dissection of male and female reproductive systems (grasshopper/ cockroach/ honey bees/ predatory bug). Study of characters of orders Odonata , Orthoptera, Dictyoptera, , Isoptera, Thysanoptera, Hemiptera, Neuroptera, Coleoptera, Diptera, Lepidoptera, Hymenoptera, and their families of agricultural importance.

Lecture schedule

1. History of Entomology. Classification of phylum Arthropoda. Relationship of class Insecta with other classes of Arthropoda.
2. Insects in relation to man - Factors for insect abundance and success.
3. Morphology - structure and functions of insect cuticle . Moulting.
4. Body segmentation.Structure of Head
5. Structure of thorax .
6. Structure of abdomen.

7. Structure and modifications of insect antennae.
8. Structure and modifications of insect mouth parts.
9. Structure and modifications of insect legs.
10. Wing venation.
11. Modifications of wing , wing coupling and articulation.
12. Structure of male and female genetalia.
13. Sense organs.
14. Metamorphosis and diapause in insects.
15. Types of larvae and pupae.
16. Structure and functions of digestive system
17. Structure and functions of circulatory and excretory systems.
18. Structure and functions of respiratory and nervous systems.
19. Structure and functions of secretory (Endocrine) system.
20. Structure and functions of reproductive system
21. Special modes of reproduction.
22. Embryology and development of insects
23. Systematics- classification and its importance.
24. History and development of taxonomy and binomial nomenclature.
25. Type concept- Hierarchical classification of taxonomic categories.
26. Classification- Orders. Odonata, Zygoptera, Anisoptera . Orthoptera – Tettigonidae, Gryllidae Gryllotalpidae, Acrididae.
27. Dictyoptera- Mantidae, Blattidae. Isoptera- Termitidae, Thysanoptera- Thripidae
28. Hemiptera- Delphacidae, Cercopidae, Cicadidae, Membracidae, Cicadellidae, Aleurodidae, Aphididae, Coccidae, Pseudococcidae,
29. Tingidae, Reduvidae, Miridae, Lygaeidae, Pyrrhocoridae, Coreidae Pentatomidae. Gerridae, Belostomatodae, Nepidae
30. Neuroptera- Chrysopidae, Hemerobidae, Mantispidae.
31. Coleoptera- Scarabaeidae, Buprestidae, Elateridae, Coccinellidae,
32. Chrysomelidae, Cerambycidae, Bruchidae, Curculionidae.
33. Diptera- Cecidomyiidae, Syrphidae, Culicidae, Muscidae, Tabanidae, Asilidae, Tephritidae, , Tachinidae.
34. Lepidoptera- Psychidae, Cochlididae, Pyralidae, Papilionidae, Nymphalidae, Lycaenidae, Pieridae,
35. Hesperidae, Geometridae, Sphingidae, Arctiidae, Noctuidae, Lymantridae.
36. Hymenoptera- Tenthridinidae, Ichneumonidae, Braconidae, Evanidae, Chalcididae, Trichogrammatidae, Formicidae, Apidae.

Practical schedule

1. Collection and preservation of insects and immature stages.
2. External features of Grasshopper/Cockroach.
3. Types of insect antennae.
4. Types of insect mouthparts.
5. Types of insect legs.
6. Wing venation, Types of wings and wing coupling apparatus.
7. Types of insect larvae and pupae.
8. Dissection of digestive system in insects (Grasshopper/ Cockroach).
9. Dissection of male and female reproductive systems in insects (Grasshopper/ Cockroach).
10. Study of characters of order Odonata , Orthoptera, Dictyoptera.
11. Study of characters of order Isoptera , Thysanoptera.
12. Study of characters of order Hemiptera- sub order Homoptera
13. Study of characters of order Hemiptera- sub order Heteroptera
14. Study of characters of order Neuroptera
15. Study of characters of order Coleoptera.
16. Study of characters of order Diptera
17. Study of characters of order Lepidoptera.
18. Study of characters of order Hymenoptera.

Suggested Readings

Chapman, R. F. 1981. *The Insects: Structure and Function*. Edward Arnold Publishing Limited , London. 919 p.
Mani, M. S. 1968. *General Entomology*. Oxford and IBH Publishing Company, New Delhi. 912 p.
Nayar, K. K., Ananthakrishnan T. N. and David. B.V. 1976. *General and Applied Entomology*, Tata McGraw Hill Publishing Company Limited, New Delhi, 589p.
Pedigo, L. P. 1999. *Entomology and Pest Management.* Third Edition. Prentice Hall, New Jersey, USA, 691p.
Richards, O.W. and Davies, R. G. 1977. *Imm's General Text Book of Entomology,* Vol.1&2, Chapman and Hall Publication, London, 1345p.
Srivastava, P. D. and Singh, R. P. 1997. *An Introduction to Entomology*, Concept Publishing Company, New Delhi, 269p.

2. Ento.1202. Insect ecology and integrated pest management (2+1)

Insect Ecology- introduction, importance. Environment and its components. Effect of abiotic factors- temperature, moisture, humidity, rainfall, light, atmospheric pressure and air currents. Effect of biotic factors – food, natural enemies. Concepts of balance of life in nature, biotic potential and environmental resistance. Life table. Pests in agro-ecosystem- status, causes for outbreak . Categories of pests. Pest surveillance and pest

forecasting. Assessment of pest population and damage. IPM- introduction, importance, concepts, principles. Tools of IPM - host plant resistance, cultural, mechanical, physical, legislative, biological methods – biocontrol agents- parasites and predators – types of parasitism, mass multiplication techniques. Important groups of microorganisms used in pest control - bacteria, viruses, entomopathogenic nematodes and fungi - mass multiplication techniques. Chemical control – importance, hazards and limitations. Classification of insecticides. Ttoxicity of insecticides and formulations of insecticides. Study of important insecticides. Botanical insecticides – neem based products. Synthetic insecticides - cyclodienes, organophosphates, carbamates, synthetic pyrethroids. Novel insecticides - nicotinyl insecticides, phenyl pyrazoles, avermectins, macrocyclic lactones, oxadiazimes, thiourea derivaties, pyridine azomethines, pyrroles, pyrozoles etc. Nematicides, rodenticides, acaricides and fumigants. Insecticides Act 1968 – important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes. Plant protection equipment. Recent methods of pest control- repellents, antifeedants, hormones, attractants, Pheromones, Chitin synthesis inhibitors, irradiation and genetic control. Practices, scope and limitations of IPM. Biotechnology in pest management

Practical

Study of a selected agro ecosystem and distribution pattern of insects. Identification of different types of insect damages on crop plants. Sampling techniques for the estimation of insect population and damage. Pest surveillance through light traps, pheromone traps and field incidence. Practicable IPM practices- mechanical , physical , cultural and biological methods. Preparation of botanical pesticides. Familiarization with insecticides and their formulations. Calculation of doses/concentrations of insecticides. Plant protection equipments- parts and working.

Lecture schedule

1. Insect Ecology- introduction. Environment and its components.
2 - 3 Population dynamics- effect of abiotic factors- temperature, moisture, humidity, Rainfall, light, atmospheric pressure and air currents.
4. Effect of biotic factors – food, natural enemies.
5. Concepts of Balance of life in nature, biotic potential and environmental resistance. Life table.
6. Pests – definition, categories of pests, causes for outbreak .
7. Losses caused by pests
8. Pest monitoring - Pest surveillance and pest forecasting.
9. Assessment of pest population and damage.
10 IPM- introduction, importance, concepts, principles .
11-12 Tools of IPM- Host plant resistance, definition , mechanisms of resistance, compatibility with other pest management practices – merits and demerits
13 Cultural methods
14 Mechanical methods
15 Physical and Legislative methods
16 Biological methods- definition, methods, advantages, limitations
17-18 Natural enemies- parasites , predators and microorganisms used in pest control- definition, types of parasites and predators

19 Important groups of microorganisms- bacteria, viruses and fungi used in pest control
20 Mass multiplication techniques of important biocontrol agents
21 Chemical control – importance, hazards and limitations.
22 Classification of insecticides based on mode of entry, action and chemical nature
23 Formulations of insecticides.
24 Study of important insecticides- botanical insecticides – neem based products,
25 Synthetic insecticides - cyclodiens, organophosphates, carbamates, synthetic pyrethroids.
26 Novel insecticides - nicotinyl insecticides, phenyl pyrazoles, avermectins, macrocyclic lactones, oxadiazimes, thiourea derivaties, pyridine azomethines, pyrroles.
27 Nematicides, Rodenticides, Acaricides and fumigants.
28 Insecticides Act 1968 – Important provisions. Application techniques of spray fluids. Phytotoxicity of insecticides. Symptoms of poisoning, first aid and antidotes.
29-30 Plant protection equipments – Classification- and working principles- parts of sprayers, dusters and uses.
31 Recent methods of pest control- repellents, antifeedants, attractants
32 Insect growth regulators
33 Pheromones, Chitin synthesis inhibitors,
34 Gamma radiation and genetic control.
35 Practices, scope and limitations of IPM.
36 Biotechnology in pest management

Practical schedule

1. Study of a selected agro ecosystem and distribution pattern of insects.
2. Identification of different types of insect damages on crop plants.
3. Sampling techniques for the estimation of insect population in selected crops
4. Estimation of insect damage in selected crops
5. Pest monitoring through light traps, pheromone traps and field incidence
6. Familiarization with Mechanical methods of pest control
7. Familiarization with cultural methods of pest control
8. Identification of predators
9. Identification of parasitoids
10 Identification of microbial agents
11. Familiarization with different formulations of insecticides
12. Familiarization with different insecticides
13. Calculation of doses/concentrations of insecticides.
14. Preparation of spray fluid for field application

15&18 Familiarization with Plant protection equipment.

Suggested Readings

Atwal, A. S and Bains, S. S. 1989. *Applied Animal Ecology*. Kalyani Publishers. New Delhi. 245p

David, B.V. and Kumaraswami, T. 1996 *Elements of Economic Entomology*. Popular Book Depot, Madras. 536 p.

Dhaliwal, G. S. and Ramesh Arora. 1998. *Principles of Insect Pest Management* . Kalyani Publishers, New Delhi. 297 p.

Dhaliwal, G. S. and Singh, B. 1998. *Pesticides – The ecological Impact in Developing Countries* . Commonwealth Publishers, New Delhi. 256p.
Metcalf, C. K. and Flint, W. P. 1970. *Destructive and Useful Insects : Their Habits and Control* . Tata McGraw Hill Publishing Company. New Delhi. 1074p.
Odum, E.P. 1996. Fundamentals of Ecology. Nataraj Publishers. Dehra-Dun. 574 p.
Pedigo, L. P. 2002. *Entomology and Pest Management*. Fourth Edition. Prentice Hall.New Delhi. India . 742p.
Srivastava, K. P. 2003. *A Text Book of Applied Entomology*. Vol. II. Kalyani Publishers, Ludhiana. 497p.

3. Ento. 2203. Pests of crops and stored grains and their management (2+1)

Distribution, biology, nature and symptoms of damage and management strategies of insect pests of rice, wheat, maize, sorghum, ragi, coconut, arecanut, oil palm , rubber, cashew, mango, banana, pomegranate, guava, sapota, citrus, grapevine, apple, sugarcane, cotton, pulses, groundnut, castor, gingelly, sunflower, brinjal, bhindi, tomato, moringa, amaranthus, chillies, curry leaf, cruciferous and cucurbitaceous vegetables, tapioca, potato, sweet potato, colacasia, pepper, cardamom, ginger, turmeric, vanilla, onion, coffee, tea and ornamental and medicinal plants.
Stored grain pests – Introduction. Causes of storage losses. Coleopteran and lepidopteran pests- biology and damage. Preventive and curative methods of management .

Practical

Identification of pests, damage symptoms and management of rice, coconut, arecanut, oil palm , rubber, cashew, mango, banana, pomegranate, guava, sapota, citrus, apple, sugarcane, cotton, pulses, groundnut, castor, gingelly, sunflower, brinjal, bhindi, tomato, moringa, amaranthus, chillies, curry leaf, cruciferous and cucurbitaceous vegetables, tapioca, potato, sweet potato, colacasia, , pepper, cardamom, ginger, turmeric, vanilla, coffee, tea ,ornamental and medicinal plants. Coleopteran and lepidopteran pests of stored products and their biology and damage.

Lecture schedule

Distribution, host-range, bionomics, symptoms of damage and management practices for major pests of the following crops.

1-2. .Pests of rice – sap feeders, borers and foliage feeders
3. Pests of wheat and maize.
4. Pests of sorghum and ragi
5. Pests of coconut – borers and tissue feeders
6. Pests of coconut – sap feeders
7. Pests of arecanut
8. Pests of cashew
9-10. Pests of sugarcane – borers and root feeders, foliage and sap feeders
11. Pests of cotton – sap feeders and foliage feeders
12. Pests of cotton – bollworms and stem weevil
13-14. Pests of pulses – sap feeders , foliage pests, pod and stem borers and leaf miners.
15-16 Pests of oilseeds - groundnut , sunflower. gingelly and castor
17. Pests of mango

18. Pests of citrus
19. Pests of banana
20. Pests of guava, pomegranate and sapota
21. Pests of apple and grapevine
22. Pests of Brinjal, tomato and chillies
23. Pests of bhendi and cucurbits
24. Pests of cruciferous vegetables
25. Pests of amaranthus and moringa
26. Pests of tapioca, potato and sweet potato
27. Pests of onion, ginger and turmeric
28. Pests of pepper and cardamom
29- 30. Pests of Coffee and tea
31. Pests of ornamental and medicinal plants
32. Pests of stored products- introduction, causes of storage losses
33. Coleopteran pets of stored products
34. Lepidopteran pests of stored products
35. Management of stored product pests – preventive
36 Management of stored product pests – curative

Practical schedule

Identification of pests, symptoms of damage, collection and preservation of

1. Pests of rice
2. Pests of wheat, maize, sorghum and ragi
3. Pests of coconut
4. Pests of arecanut and cashew
5. Pests of sugarcane,
6. Pests of cotton
7. Pests of pulses
8 Pests of groundnut , sunflower, gingelly and castor
9. Pests of mango and citrus
10. Pests of banana guava, pomegranate and sapota
11. Pests of Brinjal, tomato and chillies, bhendi and cucurbits
12. Pests of cruciferous vegetables, amaranthus and moringa
13. Pests of potato, sweet potato and tapioca,
14. Pests of onion, ginger and turmeric
15. Pests of pepper and cardamom, Coffee and tea
16. Pests of ornamentals and medicinal plants
17. Pests of stored products - Lepidoptera
18. Pests of stored products - Coleoptera

Suggested Readings

Atwal, A. S. 1991. *Agricultural Pests of India and South – East Asia*. Kalyani Publishers, New Delhi. 529p.

David, B. V. 2001. *Elements of Economic Entomology*. Popular Book Depot, Madras, 536p.

Ghosh, S. K. Durbey, S. L. 2003. *Integrated Management of Stored Grain Pests*. International Book Distributing Company. 263p.
Nair, M. R. G. K. 1986. *Insects and Mites of Crops in India*. Indian Council of Agricultural Research, New Delhi. 267p.
Nair, M. R. G. K. 1999. *Monograph on Crop Pests of Kerala and Their Management*. Kerala Agricultural University. Thrissur. 227p.
Pradhan, S. 1983. *Agricultural Entomology and Pest Control*. Indian Council of Agricultural Research, New Delhi. 267p.
Rao, P. A., Mathur, K. C and Pasalu. L. C. 1987. *Rice Storage and Insect Pest Management.* B.R publishers. New Delhi. 187p.

4.Ento. 3204. Plant parasitic nematodes, other non insect pests and their management (1+1)

Plant parasitic nematodes- morphology, anatomy , physiology and classification. Nature and symptoms of damage in crops. Biology and management of important nematode pests of crops. Mites- biology, nature and symptoms of damage on crops. Management of important mite pests of crops. Rodents - general characters of important species , biology, habits and management. Snails and slugs- biology, habits, economic importance and management. Rodenticides, nematicides, acaricides and molluscicides- formulations and applications.

Practical

Collection of soil and plant samples and extraction of nematodes. Identification of important plant parasitic nematodes and their symptoms of damage. Identification of important mite species. and their symptoms of damage. Identification of important rodent species. Identification of snails, slugs, birds and other vertebrate pests and the symptoms of damage caused by them.

Lecture schedule

1. Introduction to Nematology – Economic importance of nematodes and classification.
2. General morphology and anatomy of nematodes.
3. Taxonomy of nematodes with special reference to plant parasitic nematodes. Role of nematodes in complex diseases. Nature of damage caused by nematodes.
4. General principles of controlling plant parasitic nematodes – Nematicides.
5. Biology, nature of damage and control of plant parasitic nematodes of cereals, pulses, vegetables.
6. Biology, nature of damage and control of plant parasitic nematodes of fruit crops, sugarcane, coconut and arecanut.
7. Introduction to acarology – Role of acarines in agriculture .
8. Biology, external morphology and general characters of plant parasitic mites.

9-10 Important phytophagous mites infesting crops in Kerala and their nature and symptoms of damage

11 Mite transmission of plant diseases. Management of plant feeding mites

12 Snails and slugs- habits and habitats, economic importance and management.

13 Rodents – general features – squirrels and porcupines.

14 Rats and mice – general features- identifying characters of rats and mice of agricultural importance, their habits and habitats.

15 Rodent management - principles and methods of control-physical, biological and mechanical methods.

16 Rodenticides - acute poisons, chronic poisons, fumigants. Fumigation, baits, baiting and rat proofing

17 Rodent control campaign – rodent eradication programmes, organisation and implementation.

18 Vertebrate pests-birds and mammals injurious to agriculture, nature of damage and control.

Practical Schedule

1.	Collection of soil and root samples for the extraction of nematodes.
2 -3	Extraction of nematodes by Cobb's sieving techniques from soil samples.
4	Extraction of nematodes from root samples.
5-6	Counting and estimation of nematodes from soil samples
7-8	Counting and estimation of nematodes from root samples.
9-10	Identification of plant parasitic nematodes and symptoms of attack
11-12	Identification of important phytophagous mites and symptoms of attack on crops
13.	Identification of snail and slug pests of crops
14-15	Identification of important rodent spp.
16-18	Aquiantance with acaricides, rodenticides, nematicides and molluscides.

Suggested Readings

David, B. V. and Kumaraswamy, T. 1996. *Elements of Economic Entomology*. Popular Book Depot, Madras.536p.

Gopal Swarup and Dasgupta D. R. 1986. *Plant Parasitic Nematodes of India Problems and Progress*. Indian Agricultural Research Institute, New Delhi

Haq, M. A. and Ramani, N. 1992. *Mites and Environment.* Anjengo Publications, Kerala. 171p.

Jeppson, L. R., Keifer, H. H. and Baker, E.W. 1975. *Mite Iinjurious to Economic Plants*. University of California Press. California. 614p.

Prakash, I and Mathur, R. P. 1987. *Management of Rodent Pests.* Indian Council of Agricultural Research, New Delhi 133 p.

V. AGRICULTURAL ECONOMICS

1, Econ.1201. Principles of agricultural economics (2+0)

Economics- Meaning, definition, subject matter- Divisions of economics - Importance of economics- Agricultural economics- Meaning, definition- Basic concepts - Goods, service, utility, value, price, wealth, welfare- Wants- Meaning, characteristics, classifications of wants, importance. Theory of consumption- Law of diminishing marginal utility, meaning, definition, assumption, illustration, limitations, law of equi-marginal utility-Importance- Consumer surplus- Meaning, definition, importance. Demand- Meaning, definition, kinds of demand, demand schedule, demand curve, law of Demand, extension and contraction vs increase and decrease in demand. Elasticity of demand- Types of elasticity of demand, degrees of price elasticity of demand, methods of measuring elasticity, factors influencing elasticity of demand, importance of elasticity of demand – supply- meaning,supply function-Law of supply- factors influencing – Production- Meaning, factors of production- land, labour, capital, organization, entrepreneurship- Distribution- rent, wages, interest, profit- National Income -definition and concepts -. Public finance- meaning- Public resource- Meaning- sources- Taxation- types- Public expenditure- meaning, Principles- Money- meaning- evolution- Inflation: definition, types of inflation- Welfare economics- Meaning and basic concepts

Lecture Schedule:

1	Economics-meaning-Definition-wealth-welfare-scarcity and growth approaches-subject matter-Divisions-micro and macro-importance.
2	Agricultural Economics – meaning - definition- subject matter – importance-relationship with other disciplines
3-5	Basic terms and concepts – goods , services, Utility-types, value-attributes, price, wealth-attributes, welfare- goods- types- circular flow of money
6	Human wants-meaning-characteristics-classification of wants-importance
7	Theory of consumption – Meaning- Importance-Standard of Living-Engel's Law of Family Expenditure
8	Law of Diminishing Marginal Utility-Meaning-Definition-Illustrations-Assumptions-Limitations
9	Law of Equi- Marginal Utility-Meaning-Definition- Limitations-Importance
10-12	Consumer Surplus-meaning-definition-importance-Demand-meaning-definition-types of demand-law of demand-Extension Vs Contraction-Increase and decrease in demand-demand schedule-shift in demand-exceptions to demand-factors influencing demand- Supply- meaning-supply function-law of supply- factors influencing
13-15	Elasticity of demand-definition-meaning-types –price-income-cross-degree of elasticity-measurements of elasticity-factors influencing elasticity of demand-Supply-definition-types-law of supply-factors
16	Production-meaning-factors of production-Land-meaning-importance-peculiarities
17-18	Labour-meaning-importance-classification-peculiarities-efficiency-labour mobility-types of mobility and importance- division of labour
19	Capital-meaning-types-fixed and variable-characteristics-functions and importance
20	Capital formation-steps in capital formation-reasons for low capital formation-capital formation in agriculture
21	Organization-meaning and importance-functions-Entrepreneurship-definition and importance
22-23	Distribution-rent-meaniong-types-wages-meaning-types-interest-meaning-gross and

	net-interest- profit-meaning-types-net and gross profit
24	National Income- definition and concepts-GNP-GDP-NNP-NDP-Personal Income-Disposable Income
25	Public Finance-meaning-importance-sources of public resource
26-27	Taxation-types-direct-indirect-service tax-meaning-basic concepts
28	Public expenditure-meaning-need-principles-basic concepts
29	Money-meaning-evolution-kinds-functions
30	Inflation -definition-causes-types-demand pull and cost push inflation
31	Related forms of inflation-deflation-stagflation
32	Welfare Economics-meaning and definition -basic concepts

Suggested Readings

Dewett, K.K. 2005. *Modern Economic Theory*. S. Chand, New Delhi.
Dewett,K.K.,Verma. 2004 *Elementary Economic Theory*, S.Chand, New Delhi
Jhingam,M.L.2001. *Micro Economic Theory*. Konark publishers, New Delhi
Kenneth, E.B.1941. *Economic Analysis*. Harper and Row, New York.
Reddy,S., Raghuram,P., Neelakantan,T.V.,Bhavani D. I. 2004. *Agricultural Economics*.Oxford and IBH Publishers, New Delhi.

2. Econ.2102. Agricultural finance and co-operation (1+1)

Agricultural finance- nature and scope -. Agricultural credit: meaning, definition, need, classification. Credit analysis - 4R' s 5C' s and 7 P' s of credit -repayment plans- History of financing agriculture in India - Sources of agricultural credit – non institutional sources-money lenders-indigenous bankers -Institutional sources - Commercial banks, social control- nationalization of commercial banks -Lead bank scheme- Service area approach - Regional rural banks -NABARD-Establishment- Role and functions . Higher financing agencies, RBI, AFC, Asian development bank, World bank, Insurance and credit guarantee corporation of India. Crop insurance programme in India. Agricultural cooperation: philosophy and principles. History of Indian cooperative movement, cooperative credit structure: PACS, FSS- DCCB-SCB-PCARDB-SCARDB.

Practical

Factors governing use of Capital and identification of credit needs; Estimations of credit needs and comparison with scale of finance and unit costs; Preparations and analysis of loan proposals; Types of repayment plans; Study of financial institutions: PACS, DCCB, Apex Banks, RRBs, CBs, NABARD.

Lecture Schedule:

1	Agricultural Finance – Introduction-Scope and Definition
2	Agricultural Credit-meaning-definition-need
3	Classification of Agricultural Credit – source-period-security-liquidity-purpose
4	Credit Analysis – 4 Rs – 5 Cs – 7 Ps – Repayment Plans – Diminishing and Even payments
5-6	History of Agricultural Financing in India – Taccavi loans – Co-operative Credit Act – RBI Act – Social Control –Nationalization –Formation of RRBs.
7	Sources of Agricultural credit – non institutional sources-money lenders-indigenous bankers- merits and demerits
8-9	Institutional sources-Commercial Banks-Lead Bank Scheme-Service Area Approach-RBI-Stipulation in Agricultural lending
10	Regional Rural Banks-Genesis-structure-functions

11	NABARD-Establishment-Role and Functions
12	RBI and Agricultural Credit – A brief exposition to Asian Development Bank-World Bank-DICGC
13	Crop Insurance Schemes in India
14	Co-operation-Definition-Principles of Co-operation-History of Indian Co-operative Movement
15-16	Co-operative credit structure-short, medium and long term-PACS, PSS, DCCB, SCB, PCARDB, SCARDB

Practical schedule

1	Documentation of Basic Statistics on Agricultural Finance
2	Procedural formalities in the sanctioning of farm loans
3 - 4	Estimation of credit needs – Farm level survey
5 -7	Presentation and discussion in the class – comparison with scale of finance and unit cost
8-10	Preparation and analysis of loan proposals
11	Preparation of Repayment plans
12-16	Visit to co-operative credit institutions, Lead Bank, NABARD

Suggested Readings

Kahlon,A.S., Singh, Karam. *Managing Agricultural Finance*. Allied Publishers, New Delhi

Reddy,S., Raghuram,P., Neelakantan,T.V and Bhavani D.I.2004. *Agricultural Economics*.Oxford and IBH Publishers, New Delhi.

Reddy,S., and Ram,P.R. *Agricultural Finance and Management*. Oxford and IBH, New Delhi

3. Econ.2203. Production economics and farm management (1+1)

Production economics- Meaning, definition, nature and scope of agricultural production Economics- Basic concepts and terms- technical units-farm firm- plant. resources and resource services- fixed and variable resources- flow and stock resources- product- production. production period- production function- continuous and discrete function -short and long term production function- choice indicator, slope of a curve- concepts of production. Production functions: Meaning, definition, types. laws of returns- Increasing, Constant and decreasing. Factor product relationship. Determination of optimum input and output. Factor factor relationship- Product product relationship. Enterprise relationships- Returns to scale- Meaning, definition, importance. farm management. Economic principles applied to the organizations of farm business- Time comparison principle- capital productivity analysis- Farm inventory –Methods of valuation of farm assets- depreciation-meaning - methods of computation -Types and systems of farming- Farm planning and budgeting.. Farm budgeting.

Practical

Computation of cost concepts; Methods of computation of depreciation; Analysis of net worth statement; Farm inventory analysis; Preparation of farm plans and budgets;Types of farm records and accounts; Preparation of profit and loss account;Break, Evenanalysis; Economics analysis of different crop and livestock enterprises; application of Farm management Principles.

Lecture schedule

1-2	Production Economics – meaning and scope- relation to farm management- farm management and other sciences-definition of farm management- Basic terms and concepts of Production Economics and farm management.
3-4	Basic production relationships-factor-product relationship, factor-factor relationship, product- product relationship Factor-product relationship- Increasing, constant and decreasing returns. Law of diminishing returns-Total product-Average Product –Marginal product-Product curves-stages of production –Determination of profit maximization- illustration –Elasticity of production- Return to scale- Types-limitations of the law of diminishing returns.
5-6	Cost curves- meaning of costs- types of costs- cost function-stages of cost function-Relationship between cost and revenue function, cost of cultivation, cost of production, principle of profit maximization and loss minimization
7	Principle of Equi marginal returns-Importance –definition-illustration-comparison with law of diminishing returns
8- 9	Factor- factor relationship - marginal rate of substitution- constant, increasing and diminishing rate of substitution - isoqaunt- iso-cost lines- properties - principle of resource substitution- least cost combination - iso-clines, expansion path and ridge line
10-11	Product product relationships –independent enterprises-joint products-complementary- supplementary -competitive relationships- Marginal rate of product substitution -constant , increasing and diminishing rate of substitution –production possibility curve- iso revenue line-properties- Principle of enterprise combination –optimum product combination- isocline- Expansion path and ridge line
12-13	Time comparison principle-importance, explanation, compounding and discounting method- Capital productivity analysis- pay back period – Net Present Worth – Benefit Cost ratio – Internal Rate of Return
14	Tools of farm management analysis-farm planning-objectives of farm planning, characteristics of a good farm plan, techniques of farm planning, budgeting-enterprise budgeting-partial budgeting and complete budgeting- steps in farm planning and budgeting.
15-16	Farm inventory –Methods of valuation of farm assets-cost minus depreciation-current market price- net selling price - replacement cost minus depreciation and income capitalization method- Depreciation-meaning - methods of computation-straight line method - sum of the years digit method - and declining balance method
17-18	Classification of farming –systems of farming- peasant farming- state farming, capitalistic farming - collective farming - and co-operative farming- Types of farming – specialized farming- diversified farming- mixed farming - dry farming and ranching,

Practical schedule

1-6	Computation of cost concepts- study the cost of cultivation of major crops in Kerala namely rice, banana and coconut-preparation of interview schedule- data collection – discussion - presentation
7-9	Exercise on problems related to farm management principles viz. principles of diminishing returns, principle of resource substitution, cost principles, time comparison principle, and computation of depreciation
10-13	Exercise on the preparation of farm inventory, farm planning and budgeting (A tentative production plan at the cultivator level will be prepared.)
14	Computation of depreciation using different methods
15-16	Exercise on project analysis to study the computation of pay back period, internal rate of return, net present worth etc.

Suggested Readings

Johl,S.S.,Kapur,T.R. 2000. *Fundamentals of Farm Business Management*. Kalyani Publishers, New Delhi

Kahion,A.S.,Singh,K.1992.*Economics of Farm Management in India.*Theory of Practice,Allied Publishers.

Dhondyal,S.P.1987.*Farm Management: an Economic Analysis*. Friends Publications, Meerut.

Gittinger,J.P.1973. *Economic Analysis of Agricultural Projects*. The Johns Hopkins University Press, Baltimore.

Reddy,S.S.,Ram,P.R.,Sastry,T.V.N.,Devi,J.B.2004. *Agricultural Economics*. Oxford & IBH publishing Co. New Delhi.

4.Econ. 3104. Agricultural marketing, trade and prices (1+1)

Agricultural marketing: concepts and definition-Scope and subject matter-Market andmarketing-meaning-definitions-elements of a market-classification-agricultural

marketing- Approaches-functional (exchange, institutional and commodity)- Producer's surplus- meaning-types of producers surplus-marketable surplus-marketed surplus-importance, factors affecting marketable surplus. Marketing channels: Meaning-definition-channels for different products-marketing efficiency: Meaning-definition-marketing costs-margins and price spread-factors affecting the cost of marketing-Measures to improve marketing efficiency and tools for risk management- cooperative marketing-futures trading-contract farming- International trade domestic trade vs. International trade- Theories of international trade - Globalization and liberalization-WTO and AoA- Market access-domestic support-Export subsidies- EXIM-Policy & ministerial conferences - Agricultural price policy in India- objectives – role of CACP- administered prices.

Practical

Basic statistics related to agricultural marketing- Temporal behavior of agricultural Prices-Visit to local agricultural markets- Visit to cooperative marketing institutions- Visit to CWC/SWC- Visit to central/ state agmark lab- Price spread analysis- Marketing of

organic produce- Innovative approaches to agricultural marketing- Visit to commodity exchanges.

Lecture Schedule:

1	Agricultural Marketing – concepts and definitions – scope – subject matter
2	Market and Marketing-meaning-definition-elements of a market
3-4	Classification of market-based on commodity, location, volume of business, time, competition
5-7	Agricultural Marketing-approaches-functional (Exchange function, physical marketing function, facilitating functions)-institutional (agencies, channels)-commodity
8	Producer's surplus-meaning-types-marketable and marketed surplus-importance-factors affecting
9-11	Marketing efficiency-meaning-definition-estimation of marketing costs/margins for farm commodities-measures to improve marketing efficiency and tools for risk management-co-operative marketing-futures trading-contract farming
12	International trade-Domestic Vs International trade-theories of international trade-theory of absolute advantage
13	Theory of comparative advantage-Leonteif's paradox
14	Globalization and Liberalization-WTO-AOA (market access, domestic support, export subsidies)
15	EXIM Policy 2007-with special emphasis on AEZ.
16	Agricultural price policy in India-objectives-role of CACP in agricultural price policy-Administered prices (support price, procurement price, levy price, statutory minimum price, issue price)

Practical schedule

1	Basic information and statistics related to agricultural marketing
2	Temporal behavior of prices of important agricultural commodities in Kerala
3-5	Visit to local agricultural markets and evaluation of their functioning-orientation-finalization of proforma-collection of data and presentations
6	Visit to co-operative marketing institutions and evaluation of the functioning
7	Visit to CWC/SWC and evaluation of the functioning
8	Visit to Central/State Agmark Laboratory and evaluation of the functioning
9-11	Price spread Analysis
12	Marketing of organic produce – Case studies, field visits and evaluation
13	Agricultural exports from Kerala – Visit to institution/agencies
14-15	Innovative approaches to Agricultural Marketing – VFPCK-Contract Farming-SHGs – evaluation and discussion of alternative marketing strategies
16	Visit to Commodity Exchanges and evaluation of their functioning

Suggested Readings

Acharya, S.S., Agarwal, N.L.1987. *Agricultural Marketing in India*. Oxford and IBH, New Delhi.

Acharya, S.S., Agarwal, N.L.1994. *Agricultural Prices and Policy*. Oxford and IBH, New Delhi.

Philip,K.2004. *Principles of Marketing*. Prentice Hall, New Delhi.

5.Econ.3205. Fundamentals of agri business management (1+1)

Agribusiness: Meaning, definition, structure of agribusiness, (Input, farm, product sectors)- Management- definition, types of management- Tactical-Strategic and operational level management- Agribusiness management- Distinctive features- Management functions: meaning- definitions- Planning, organizing, direction, coordinating, controlling :Agro based industries- Importance and need-Types of agro-based industries-Financial management-Importance-Balance sheet, Net worth analysis, cash flow analysis-Marketing management- Meaning, definitions, marketing management functions- 5Ps of marketing-Market segmentation- Meaning and need- Pricing policy - Meaning and methods- Project-definitions- project cycle-Identification-formulation-implementation-monitoring-appraisal and evaluation techniques-PBP-BCR-NPW-IRR

Practical

Preparation of projects in agriculture and allied sectors –

Agro processing- Orientation- Survey and presentation- Documentation of input supply agencies in agriculture-Orientation on product development and diversification in agri business-Visit to agro based units, preparation and presentation of project reports-

Visit to NABARD/Lead bank/RRBs/ and interactive session on procedures and formalities of starting agri business projects

Lecture Schedule

1	Agribusiness- Meaning- Definition- Importance in Indian Economy
2-3	Structure of Agribusiness- Input, Farm and Product sectors. Management- Definitions- Types of Management- Tactical- Strategic and Operational management. Agribusiness Management- Distinctive features- Management process- definition and role.
4 - 6	Management functions- Meaning- definitions- Planning, Organizing, Direction, Coordinating, Controlling Planning-Types of Planning- Steps in Planning Organizing- Types of Business Organizations- Single partnership, Partnership, Joint stock companies, Co-operatives, Public, State, Private, incorporations Directing- Meaning- Definition- Principles of Direction - Co-ordination- Meaning- Definition- Principles- Types- Methods Controlling- Meaning and Importance
7	Agro based industries- Importance and need- Types of Agro based industries
8	Institutional and Technological support for Agro based industries
9	Financial Management- Importance and need- Balance sheet, Net Worth Analysis, Cash Flow Analysis
10-12	Marketing Management- Meaning- definition- Marketing management process- Market opportunity analysis- Market penetration- Market development- Product development- Product diversification- product life cycle-Marketing mix- 5 Ps of Marketing- Product- Place-Product life cycles, Price- Promotion- People/Perception
13	Market segmentation- Meaning and need- basis of segmentation
14	Pricing Policy- meaning- methods- pricing strategies
15 -16	Project- Definition- Project cycle- Identification- Planning- Implementation- Monitoring- Evaluation
167-18	Appraisal and Evaluation bankable projects- Pay back Period-Benefit Cost Ratio- Net Present Worth and Internal Rate of Returns

Practical schedule

1-6. Preparation of Projects in Agriculture and Allied sectors -Agro processing- Orientation- Survey and Presentation

7-8 Documentation of Input Supply Agencies in Agriculture

9-10 Orientation on product development and diversification in agri business

11-12 Visit to Agro based units, Preparation and Presentation of project reports

13-16 Visit to NABARD/Lead Bank/RRBs/ and interactive session on procedures and formalities of starting agri business projects

Suggested Readings

Downey,W.D., Troche, J. K.1981.*Agribusiness Management*. Mc Graw Hill Inc.,New Delhi

Gittinger,J.P.1982. *Economic Analysis of Agricultural Projects*. The Johns Hopkins University Press, Baltimore

Alagumani ,T., Chinnaiyan, P.,Elangovan, S.1998. *Agricultural Management* . Publishers K9 International, Madurai.

Philip,K. 2004. *Marketing Management*. Prentice Hall, New Delhi.

VI. AGRICULTURAL ENGINEERING

1. Engg.1101. Fundamentals of soil, water and conservation engineering (1+1)

Surveying: survey equipment, chain survey, cross staff survey, plotting procedure, calculations of area of regular and irregular fields. Levelling – levelling equipment, terminology, methods of calculation of reduced levels, types of levelling, contouring. Irrigation, classification of projects, flow irrigation and lift irrigation.. Irrigation water measurement – weirs, flumes and orifices and methods of water measurement and instruments. Water conveyance systems, open channel and underground pipeline. Irrigation methods – drip and sprinkle irrigation systems. Soil and water conservation – soil erosion, types and engineering control measures.

Practical

Acquaintance with chain survey equipment; Ranging and measurement of offsets; Chain triangulation; Cross staff survey; Plotting of chain triangulation; Plotting of cross staff survey; Levelling equipment – dumpy level, levelling staff, temporary adjustments and staff reading; Differential leveling; Profile leveling; Contour survey – grid method; Plotting of contours. Irrigation water measuring devices; Study of different components of sprinkler irrigation systems; Study of different components of drip and sprinkler irrigation systems; Uniformity of water application in drip and sprinkler systems; Study of soil and water conservation measures.

Lecture Schedule

1. Surveying-definition-classification-unit measurement-measurement of distance by pacing and chaining
2. Chain, tapes, arrows, pegs, poles and ranging rods, brief description and uses, methods of ranging lines.
3. Chain triangulation or chain surveying- baseline, check line etc
4. Setting out right angles to survey lines with chain or tape. Cross staff and optical square
5. Cross staff survey and chain traversing, plotting and sample calculation of areas measured in the field.
6. Compass surveying-closed and open traverse. Designation of bearing of lines- WCB and Quadrantal bearing systems
7. Prismatic compass-description-traversing with prismatic compass and plotting
8. Local attraction and its corrections-examples- Dip of magnetic needle-magnetic declineation.
9. Plane table surveying- plane table and its accessories-advantages and disadvantages
10. Methods of plane tabling, radiation, intersection and traversing.
11. Levelling-definition of terms-different types of levels and leveling staff
12. Dumpy level, its adjustments and uses, different types of leveling
13. Differential leveling, field book and recording levels
14. Determination of reduced levels by height of collimation and rise and fall method, computation of earth work
15. Irrigation, classification and different methods of irrigation
16. Irrigation water measurement methods and instruments
17. Drip and sprinkler irrigation, components, design aspects
18. Engineering measures of soil conservation

Practical Schedule

1. Acquaintance with chain survey equipments
2. Chain surveying
3. Compass surveying
4. Plotting and Area calculation
5. Plane table surveying
6. Dumpy leveling
7. Differential leveling and Profile leveling
8. Contour surveying – Grid method
9. Plotting of contours
10. Irrigation water measuring devices - Weirs
11. Irrigation water measuring devices – Flumes and Orifices
12. Design of open channels
13. Design of underground pipe line system
14. Design of surface irrigation methods-furrow, basin and check basin
15. Sprinkler irrigation system
16. Drip Irrigation system
17. Engineering structures for soil conservation-contour bund and graded bund
18. Practical Examination

Suggested Readings

Kanetkar, Kulkarni. *Surveying and leveling*, AVG Prakasan, 23RD edition . Jan. 2005
Ojha, T.P. and A.M.Michael. *Principles of Agricultural Engineering*, Vol.II. Jain Brothers New Delhi.3rd edition 2001.
Singhal, O.P. *Agricultural Engineering*, 1997

2. Engg.1202. Farm power and machinery (1+1)

Status of farm power in India and Kerala- sources of farm power – merits and demerits of different forms of power. Farm mechanization-scope of farm mechanization-present status of mechanization-limiting factors and suggestions of farm mechanization. Thermodynamic cycle. Principle of working of internal combustion engines. Terminology connected with engine power. Fuel system, lubrication system and cooling system of IC engines. Farm tractor –classification-components and selection. Power transmission system of a tractor- clutch-governor-differential. Hydraulic control system of tractor. Tractor testing-performance characteristics of tractor engines. Power tiller-components of power tiller. Principles of operation of electric motor-types-components-care and maintenance

Tillage. Plough-classification-types-components-adjustments and repairs of mould board plough and disc plough. Plough accessories like coulter, jointer, scraper, land wheel and gauge wheels. Terminology connected with ploughs-advantages and disadvantages of different ploughs. Other ploughs like chisel plough, subsoiler and rotary plough etc. Harrows, Cultivators, Puddlers, Bund former, Ridger etc. Seed drill and seed cum fertilizer drill- components-types-calibration. Planter–functions-components. Plant protection equipments-sprayer-duster-types-components-care and maintenance.Harvesting

equipment-types- components-principle-registration and alignment. Equipments for land development and soil conservation

Practical

Study of different components of I.C. Engine; Study of working of four stroke engine; Study of working of two stroke engine; Study of M.B. plough, measurement of plough size, different parts, horizontal and vertical suction, determination of line of pull etc.; Study of disc plough; Study of seed–cum-fertilizer drills-furrow opener, metering mechanism, and calibration; Study, maintenance and operation of tractor; Learning of tractor driving; Study, maintenance and operation of power tiller; Study of different parts, registration, alignment and operation of mower. Study of different inter cultivation equipment in terms of efficiency, field capacity; Repairs and adjustments and operation of sprayers; Repairs and adjustments and operation of dusters; Study of paddy transplanters.

Lecture Schedule

1. Status of farm power in India and Kerala- sources of farm power – merits and demerits of different forms of power. Farm mechanization-scope of farm mechanization-present status of mechanization-limiting factors and suggestions of farm mechanization.
2. Thermodynamic cycle-Otto cycle-diesel cycle-problems. Principle of working of internal combustion engines- four stroke cycle engine-two stroke cycle engine.
3. Terminology connected with engine power-swept volume-compression ration-indicated horse power-brake horse power-problems.
4. Fuel system, lubrication system and cooling systems of IC engines
5. Farm tractor-classification-tractor components-selection of tractor
6. Power transmission system of a tractor-clutch-differential. Hydraulic system of tractor-basic components and types of hydraulic system.
7. Estimating the cost of tractor power-problems. Mechanics of tractor chasis. Tractor testing-types of tests-use of tractor testing. Performance characteristics of tractor engines- relation of engine speed with torque and BHP.
8. Study of farm / homestead friendly implements - Power tiller-components of power tiller-power transmission in power tiller.
9. Principles of operation of electric motors-single phase and three phase motors
10. Tillage-objectives of tillage-classification and types of tillage. Tractor drawn implements, trailed, semi-mounted and mounted type. Plough –types of plough-indigenous plough-mould board plough
11. Types of share-types of mould board-plough accessories Jointer and Coulter, Gauge wheel and Land wheel. Adjustments of mould board plough-vertical suction, horizontal suction and throat clearance.
12. Centre of power-centre of resistance-pull-draft, unit draft-theoretical and effective field capacity-field efficiency-problems-forces acting upon a tillage implement.
13. Disc plough-advantage and disadvantages-types of disc plough-standard and vertical disc plough-disc angle-tilt angle. Adjustments and repairs of ploughs-chisel plough-subsoiler-rotary plough.
14. Ploughing of land-furrow, furrow slice, furrow wall, crown. Back furrow. Dead furrow, methods of ploughing, gathering and casting. Harrows-Disc harrow- types, components and other harrows
15. Cultivator-tractor drawn cultivator-cultivator with rigid and spring loaded tynes. Puddler-bund former- ridger and paddy weeder.
16. Seed drill and seed cum fertilizer drill-seed metering mechanism-components and types. Calibration of seed drill. Planter functions-seed metering devices in a planter.

17. Plant protection equipment-sprayers-types of spray-components of power sprayer. care of power sprayers, different type of sprayers
18. Duster-types of duster-care and maintenance of dusters. Harvesting equipment-Vertical conveyor reaper

Practical Schedule

1. Study of tools and equipments in a farm machinery workshop
2. Study of different components of an IC engine
3. Study of four stroke cycle engine and injector
4. Study of two stroke cycle engine and carburetor
5. Study of different components , operation and maintenance of power tiller
6. Study of farm / homestead friendly equipment and implements
7. Study of different components of tractor
8. Study of operation and maintenance of tractor
9. Study of Mould Board plough and its adjustments
10. Study of disc plough and its adjustments
11. Study of cultivators and its adjustment
12. Study of Harrows and it adjustments
13. Study of paddy transplanter
14. Study of seed drill and its calibration
15. Study of planters and different metering mechanisms
16. Study of sprayers and dusters and its calibration
17. Study of Harvester, Mower, registration and alignment
18. Practical Examination

Suggested Readings

Ojha, T.P. and A.M.Michael. *Principles of Agricultural Engineering*, Vol.I. Jain Brothers New Delhi.3rd edition 2001.
Sahay, Jagdiswar. *Elements of Agricultural Engineering*. Agro book Agencies1977
Singhal, O.P. *Agricultural Engineering,* 1977

3. Engg.3103. Protected cultivation and post harvest technology (1+1)

Green house technology, Introduction, Types of Green Houses; Plant response to Green house environment, Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes. Green house equipment, materials of construction for traditional and low cost green houses. Passive solar green house, green house drying. Threshing, threshers for different crops- working principles. Winnowing, Cleaning, Different cleaners – working principles, Drying, grain drying, types of drying, types of dryers. Storage, grain storage, types of storage structures. Fruits and vegetables-cleaning and grading, methods of grading, equipment for grading of fruits and vegetables, storage of fruits and vegetables. Size reduction. equipment for size reduction. Food quality, measurements, principles, and quality standards.

Practical

Study of different types of green houses based on shape, construction and cladding materials; Calculation of air rate exchange in an active summer winter cooling system;

Estimation of drying rate of agricultural products inside green house; The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization/ sterilization; Visit to commercial green houses; Study of threshers, their components, operation and adjustments; Winnowers their components, operation and adjustments; Study of cleaners & graders. Study of dryers; Study of improved grain storage structure.

Lecture Schedule

1. Green house technology: introduction, concept & principles- Types of Green Houses; classification of green house.
2. Plant response to green house environment, Temperature and relative humidity control. Ventilation and light control.
3. Planning and design of greenhouses, Design criteria of greenhouse for cooling and heating purposes.
4. Green house equipment, materials of construction for traditional and low cost green houses.
5. Passive solar green house, green house drying- methods & applications.
6. Threshing: threshers for different crops- working principles.
7. Winnowing- working principle, Cleaning- principles & properties, effectiveness of cleaning,
8. Different cleaners and separators- length separator, cyclone separator, specific gravity separator, colour sorter, separators based on surface texture, working principles,
9. Drying, principles, classification- conduction, convection and radiation driers, moisture contents, theory of grain drying.
10. Drying- Constant and falling rate of drying, Calculation on water evaporated from material, efficiency of drying.
11. Types of dryers- mechanical dryers, batch, continuous, mixing and non mixing dryers- working principles.
12. Storage, grain storage, types of storage structures- traditional, improved and modern storage structures.
13. Fruits and vegetables- cleaning and grading, methods of grading, equipment for grading of fruits and vegetables.
14. Storage of fruits and vegetables- Effect of temperature, Relative humidity and gas composition, traditional storages, Modified and Controlled atmosphere storage structures.
15. Size reduction- Principles and equipment for size reduction.
16. Food quality, measurements- destructive and non destructive methods- principles.
17. HACCP, GAP, GMP, and quality standards.G74G

Practical schedule

1. Study of different types of green houses based on shape, construction and cladding materials.
2. Calculation of air rate exchange in an active summer winter cooling system.
3. Estimation of drying rate of agricultural products inside green house.
4. Design of green house
5. Study of Irrigation methods under green houses

6. The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization/ sterilization.
7. Visit to commercial green houses.
8. Study of threshers, their components, operation and adjustments.
9. Study of winnowers their components, operation and adjustments.
10. Study of cleaners their components, operation and adjustments.
11. Study of graders their components, operation and adjustments.
12. Study of dryers their components, operation and adjustments.
13. Drying rate and drying efficiency calculations
14. Study of improved grain storage structure.
15. Visit to cold storage structure
16. Visit to grain processing centre
17. Practical examination.

Suggested Readings

Chakraverty, A. and D.S.De. 1981. *Post harvest technology of cereals and pulses.* Oxford and IBH Publishing Co., Calcutta. P. 323.
Mohsenin, N.N. 1970. *Physical properties of plant and animal materials,* Gordon and Breach publishers, New York.p.1206.
Pande, P.H.1994. *Principles of agricultural processing*, Kalyani Publishers, Ludhiana, p.278.
Sahay, K.M. and K.K. Singh. 1994. *Unit operations in agricultural Processing*, Vikas Publishing House Pvt. Ltd., New Delhi, p.340.

4. Engg.3204. Renewable energy (1+0)

Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, constructional details, Biogas production and its utilization, Agricultural wastes, Principles of combustion, pyrolysis and gasification, Types of gasifiers, Producer gas and its utilization. Briquettes, Types of Briquetting machines, uses of Briquettes, Shredders. Solar energy, Solar flat plate and focussing plate collectors, Solar air heaters, Solar space heating and cooling, Solar energy applications / Solar energy gadgets, Solar cookers, Solar water heating systems, solar grain dryers, Solar Refrigeration system, Solar ponds, Solar photo voltaic systems, solar lantern, Solar street lights, solar fencing, Solar pumping systems. Wind energy, Types of wind mills, Constructional details & application of wind mills. Liquid Bio fuels, Bio diesel and Ethanol from agricultural produce, its production & uses.

Lecture Schedule

1. Sources of energy, Classification, energy from Biomass
2. Properties of different types of renewable energy sources
3. Types of biogas plants, constructional details, biogas production and it utilization-problems
4. Agricultural wastes, principles of combustion, pyrolysis and gasification
5. Types of gasifiers, producer gas and its utilization.
6. Briquettes, types of Briquetting, uses of briquettes, shredders.
7. Solar energy, solar flat plate and focussing plate collectors
8. solar air heaters, solar space heating and cooling
9. solar energy applications/solar energy gadgets, solar cookers, solar water heating systems

10. solar grain dryers, solar refrigeration system, solar ponds
11. Solar photovoltaic systems, solar lantern, solar street lights, solar fencing
12. Solar pumping systems
13. wind energy, types of wind mills
14. Construction details and application of wind mills
15. Liquid bio fuels, types
16. Bio diesel and ethanol from agricultural produce
17. Production of bio diesel
18. Applied use of different types of renewable energy sources from the practical stand point

Suggested Readings

Ojha, T.P. and A.M.Michael. *Principles of Agricultural Engineering*, Vol.I. Jain Brothers New Delhi.3rd Edition 2001
Ojha, T.P. and A.M.Michael. *Principles of Agricultural Engineering*, Vol.II. Jain Brothers New Delhi 3rd Edition 2001
Sahay, Jagdiswar. *Elements of Agricultural Engineering*. Agro book Agencies, 1977
Singhal, O.P. *Agricultural Engineering* 1977

VII. PLANT PATHOLOGY

1. Path. 1101. Introductory plant pathology (1+1)

Introduction, Definition and objectives of Plant Pathology. History -Terms and concepts -Important plant pathogenic organisms, different groups, fungi, bacteria,fastidious vesicular bacteria, phytoplasma, spiroplasma, viruses, viroids, algae, protozoa and phanerogamic parasites with examples of diseases caused by them. Survival and Dispersal of Plant Pathogens. Phenomenon of infection – pre-penetration, penetration and post penetration. Pathogenesis – Role of enzymes, toxins, growth regulators and polysaccharides. Prokaryotes: classification of prokaryotes according to Bergey's Manual of Systematic Bacteriology. General Characters of fungi, Definition of fungus, somatic structures, types and modifications of fungal thalli, fungal tissues, reproduction in fungi (asexual and sexual).Nomenclature, Binomial system of nomenclature, rules of nomenclature, Classification of fungi. Key to divisions and sub-divisions.

Practical

Acquaintance to plant pathology laboratory and equipments; Preparation of culturemedia for fungi and bacteria; Isolation techniques, preservation of disease samples; Study of Pythium, Phytophthora and Albugo; Study of Sclerospora, Peronosclerospora,Pseudoperonospora, Peronospora, Plasmopara and Bremia; Study of genera Mucor and Rhizopus. Study of Oidium, Oidiopsis, Ovulariopsis, Erysiphe, Phyllactinia, Uncinula and Podosphaera; Study of Puccinia (different stages), Uromyces, Hemiliea; Study of Sphacelotheca, Ustilago and Tolyposporium; Study of Agaricus, Pleurotus and Ganoderma;**s**Study of Septoria, Colletotrichum, Pestalotiopsis and Pyricularia; Study of Aspergillus,Penicillium, Trichoderma, and Fusarium; Study of Helminthosporium, Drechslera,Alternaria, Stemphylium, Cercospora, Phaeoisariopsis, Rhizoctonia and Sclerotium.

Theory Schedule

1. Plant Pathology – introduction – definitions of terminology – bacteria, fungi, viruses, viroids, phytoplasmas, fastidious vascular bacteria, parasites, pathogens, biotrophs hemibiotrophs, necrotrophs.
2. Pathogenicity, pathogenesis, virulence, infection, inoculum, invasion, colonisation, inoculum potential, symptoms, incubation period. Survival and dispersal of plant pathogens.
3. Phenomenon of infection – pre-penetration, penetration and post penetration-. pathogenesis. Role of enzymes, toxins, growth regulators and polysaccharides
4. Disease cycle, disease syndrome, monocyclic diseases, polycyclic diseases, alternate host, collateral host. Predisposition, physiological race, biotype, symbiosis, mutualism antagonism.
5. General characters of fungi, classification of fungi, methods of reproduction.
6. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of the Division Myxomycota – *Plasmodiophora, Spongospora.*
7. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of S.D.Mastigomycotina. of *Pythium* &

Phytophthora

8. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance General characters, taxonomy, somatic structures, reproduction , life cycle and plant pathological significance of *Albugo, Sclerophthora, Peronosclerospora, Peronospora & Plasmopara.*
9. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of S.D.Zygomycotina. *Rhizopus* and *Mucor.*
10. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of S.D. Ascomycotina – *Taphrina.&* yeasts
11. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of *Erysiphe, Aspergillus, Penicillium*
12. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of *Claviceps, Chaetomium, Ascobolus, Sclerotinia*.
13. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of S.D.Basidiomycotina. *Puccinia, Melampsora Uromyces*.
14. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of *Ustilago, Tilletia, Neovossia, Sphacelotheca Tolyposporium Agaricus,Pleurotus ,Ganoderma.*
15. General characters, taxonomy, somatic structures, reproduction, life cycle and plant pathological significance of S.D. Deuteromycotina *Colletotrictum, Alternaria, Cercospora, Pestalotia, Botryodiplodia,& Diplodia. Corticium, Fusarium, Helminthosporium, Pyricularia, Sclerotium Rhizoctonia, Phyllosticta, Phoma, Trichoderma,&Verticillium.*
16. General characters of bacteria- taxonomy, structure, reproduction and plant pathological significance - Characters and classification of phytopathogenic bacteria- symptoms of bacterial diseases, mode of entry and spread.
17. General characters of Virus – definition- nature, properties, classification,virus – vector relationships-common symptoms of virus, viroid and phytoplasmal diseases of crops
18. Characters of algal and phanerogamic plant parasites – symptoms.

Practical schedule

1. Common symptoms of plant diseases caused by fungi.
2. Symptomatology of viral diseases
3. Symptomatology of bacterial & phytoplasmal diseases.
4. Transmission studies for viral disease symptom expression.
5. Common laboratory techniques in mycology , preservation of plant disease specimens.
6. Isolation of plant pathogenic fungi
7. Microscopic slide culture, common media and mountants used in mycology.
8. Study of symptoms, host parasite relationships and systematic position of fungi belonging to Division Myxomycota.
9. Study of symptoms, host parasite relationships and systematic position of fungi belonging to S. D. Mastigomycotina - *Pythium & Phytophthora.*
10. Study of symptoms, host parasite relationships and systematic position of fungi belonging to White Rust – *Albugo*
11. Study of symptoms, host parasite relationships and systematic position of fungi belonging to Downy mildews – *Plasmopara & Peronospora*
12. Study of symptoms, host parasite relationships and systematic position of fungi

belonging to S.D. Zygomycotina - *Rhizopus*

13. Study of symptoms, host parasite relationships and systematic position of fungi belonging to S.D. Ascomycotina - *Aspergillus Penicillum Saccharomyces & Taphrina*
14. Study of symptoms, host parasite relationships and systematic position of fungi belonging to Powdery mildew fungi
15. Study of symptoms, host parasite relationships and systematic position of fungi belonging to Rust Fungi
16. Study of symptoms, host parasite relationships and systematic position of fungi belonging to Smut fungi
17. Study of economic importance, cultivation, and systematic position of *Agaricus*, *Pleurotus* and *Ganoderma*
18. Study of symptoms, host parasite relationships and systematic position of fungi belonging to S. D.Deuteromycotina

Suggested Readings

Alexopoulos, C.J. and Mims, C.W. 1989. Introductory Mycology. Wiley Ltd. New Delhi.
Verma, J. P. 1987. The Bacteria. Malhotra Publishing House. N. Delhi.
Walkey, D.G.A. 1985. Applied Plant Virology. Heinemann, London.
Webster, J. 1989. Introduction to Fungi. Cambridge University Press.. Agrios, G.N. 1994.
Agrios ,G.N.1994. Plant Pathology Academy Press. New York.

2. Path.2102. Principles of crop disease management (1+1)

Plant Disease Epidemiology. Forecasting – Remote sensing – General principles of plant diseases management – Importance – Avoidance, exclusion , protection – Plant Quarantine and Inspection – Quarantine Rules and Regulations .Cultural methods – Roguing , eradication of alternate and collateral hosts, crop rotation, manure and fertilizer management, mixed cropping, sanitation, hot weather ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage. Role and mechanisms of biological control and PGPR. Physical Methods – Heat and Chemical methods – Methods of application of fungicides. Host plant resistance – Defense mechanism in plants – Structural and Bio-chemical (pre and post-infection). Application of biotechnology in plant disease management –Development of disease resistant transgenic plants through gene cloning. Integrated plant disease management (IDM) – Concept, advantages and importance.

Practical

Demonstration of Koch's postulates; Study of different groups of fungicides and antibiotics; Preparation of fungicides – Bordeaux mixture, Bordeaux paste, Cheshunt compound; Methods of application of fungicides – seed, soil and foliar; Bio-assay of fungicides – poisoned food technique, inhibition zone technique and spore germination technique; Bio-control of plant pathogens – dual culture technique; Visit to quarantine station and remote sensing laboratory.

Theory Schedule

1. Introduction - importance and history of crop disease management.
2. Epidemiology of crop diseases – weather factors and their role – temperature, rainfall, relative humidity etc.
3. Disease assessment –forecasting – disease modelling
4. Principles of crop disease management – Importance, general Principles – Avoidance – Exclusion – protection
5. Plant Quarantine and Inspection –Rules and Regulations.
6. Cultural control-Roguing, eradication of alternate and collateral hosts, crop rotation, mixed cropping manure and fertilizer management. Sanitation, hot weather ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage.
8. Biological control - Role and mechanisms of biocontrol agents and PGPR.
9. Physical Methods – soil solarisation , heat treatment etc.
10-14. Chemical methods –Fungicides –classification – chemical groups of fungicides – inorganic, organic, systemic, antibiotic etc., Methods of application of fungicides – seed, soil, foliar spray, post harvest treatment, root feeding etc Fungicide formulations –
Characteristics of an ideal fungicide. Compatibility and phytotoxicity of fungicides
15,16. Plant disease resistance – types of resistance – vertical and horizontal – Defense mechanism in plants – Structural and Bio- chemical (pre and post- infection) cross-protection
17. Biotechnological approach in plant disease management – tissue culture – somaclonal variation, transgenic plants etc.
18. Integrated plant disease management (IDM) – Concepts, advantages and importance.

Practical schedule

1. Proving Koch's postulates
2. Familiarization with different groups of fungicides.
3. Preparation of Bordeaux mixture, Bordeaux paste and cheshunt compound phytotoxicity of fungicides
4. Preparation of fungicidal spray solutions- methods of application of fungicides – spraying and soil drenching.
5. Seed treatment with systemic and contact fungicides.
6. Root feeding, post harvest treatment.
7. Bio-assay of fungicides – poisoned food technique, inhibition zone technique and slide germination technique
8. Bio-control of plant pathogens – dual culture technique and *in- vitro* testing
9. Methods of mass multiplication of *Trichoderma* sp and *Pseudomonas* sp.
10. Solarisation for management of soil borne pathogens.
11. Demonstration of physical methods for crop disease management
12. Preparation and application of botanicals
13. Assessment of diseases – grading, score chart – disease index.
14. Screening of varieties for resistance to plant disease
15. Disease indexing for early detection of virus diseases.
16. Familiarization with plant protection equipments.
17. Visit to Plant Quarantine Station.
18. Visit to Remote sensing laboratory and Tissue culture laboratory

Suggested Readings

Agrios, G.N. 2003.. *Plant Pathology* Academy Press. New York.
Dasgupta, M.K. 1998. *Principles of Plant Pathology*. Allied Publishers Pvt. Ltd. Bangalore
Maloy. O.C. 1993. *Plant Disease control. Principles and Practice*. John Wiley and Sons.Inc. New York
Mehrotra,R.S. 1980. *Plant Pathology* Tata Mc. Graw Till Publ.Co., , New Delhi.
Nene,Y.L. and Thapliyal,P.N. 1998. *Fungicides in Plant Disease Control*. Oxford and IBH New Delhi
Prakasam,V. Reguchander,T. and Prabakar,K. 1998. *Plant diseases management*. A.E. Publication, Coimbatore.
Singh. R.S 2002. *Introduction to Principles of Plant Pathology*. Oxford and IBH Publishing, New Delhi.

3. Path. 3103. Diseases of field crops and their management (2+1)

Economic importance, symptoms, cause, epidemiology,disease cycle and integrated management of diseases of rice, sorghum, bajra, maize, wheat, sugarcane, tobacco,groundnut, sesamum, sunflower, cotton, redgram, bengalgram, blackgram, greengram,castor, soybean., solanaceous vegetables , Tuber crops, bhindi, crucifers, cucurbits, onion etc.

Practical

Study of symptoms, etiology, host-parasite relationship and specific control measures of the following crop diseases. Presentation of disease samples; survey and collection of diseases of rice, sorghum; Diseases of wheat, bajra & maize; Diseases of sugarcane, tobacco; Diseases of groundnut, castor,soyabean & sunflower; Diseases of sesamum & cotton; Diseases of redgram, greengram, blackgram, bengalgram & beans; Diseases of Solanaceous vegetables, bhendi, crucifers, onion , cucurbits ,leafy vegetables etc. Field visits at appropriate time during the semester

Note: Students should submit 50 pressed, well mounted diseased specimens in three installments during the semester.

Theory Schedule

1. Introduction to the study of crop diseases – economic importance of crop diseases- symptoms- causal agents - disease cycle – management.
2. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of rice- blast, sheath blight, sheath rot.
3. Economic importance, symptoms, causal organisms, epidemiology and management of other diseases of rice - brown spot, false smut, udbatta , foot rot etc.
4. Bacterial diseases of rice – BLB and bacterial leaf streak; Viral and phytoplasmal diseases - tungro, grassy stunt, yellow dwarf and ragged stunt ; mineral deficiency diseases

5. Economic importance, symptoms, causal organisms, epidemiology and management of wheat rusts
6. Economic importance, symptoms, causal organisms, epidemiology and management of smuts and bunts, powdery mildew, Alternaria leaf blight, and tundu of wheat.
7. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of millets - sorghum- rusts, smuts, downy mildew, sugary disease, charcoal rot, anthracnose, blight, leaf spot and striga.
8. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of maize- smuts, downy mildew, rust, stalk rot and leaf spot
9. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of bajra- rusts, smuts, downy mildew and ergot
10. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of minor millets
11. Diseases of legumes -economic importance, symptoms, causal organisms, epidemiology and management of diseases of pigeon pea – Phytophthora blight, wilt, sterility mosaic and dry root rot
12. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of black and green gram - Dry root rot, rust and mosaic; gram – wilt, grey mold and Ascochyta blight; lentil – rust and wilt.
13. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of oil seeds - groundnut- early and late leaf spot, rust, Sclerotium stem rot, aflaroot disease,
14. Economic importance, symptoms, causal organisms, epidemiology and management of crown rot, seedling rot, seedling blight, pod rot and viral diseases.
15. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of sunflower – Sclerotium stem rot, rust, Alternaria blight and head rot
16. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of sesamum - leaf spots and leaf blights, powdery mildew and phyllody.
17. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of castor – seedling blight; mustard – white rust, downy mildew, Sclerotium stem rot, Alternaria blight and bacterial rot.
18. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of soybean- Rhizoctonia blight, pod blight, seed rot, bacterial pustule, seedling blight and mosaic.
19. Economic importance, symptoms, causal organisms, epidemiology and management of fungal diseases of sugarcane – red rot, whip smut, wilt and pineapple disease.
20. Economic importance, symptoms, causal organisms, epidemiology and management of ratoon stunting, grassy shoot, gummosis and other bacterial diseases.
21. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of cotton - wilt, root rot, anthracnose, grey mildew, black arm and leaf curl:
22. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of Tobacco – damping off, black shank, frog eye spot and wild fire.

23. Economic importance, symptoms, causal organisms, epidemiology and management of fungal diseases of potato – late blight, early blight, wart, black scurf etc.
24. Economic importance, symptoms, causal organisms, epidemiology and management of brown rot and other bacterial diseases of potato.
25. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of viral diseases of potato.
26. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of Brinjal - Phomopsis blight and fruit rot, Sclerotinia blight, bacterial wilt, and phyllody.
27. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of chillies – anthracnose, damping off, bacterial and viral diseases.
28. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of bhindi – leaf spot, powdery mildew and yellow vein mosaic.
29. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of tomato- damping off, late blight, early blight, fruit rot, fungal and bacterial wilt, viral and phytoplasmal diseases.
30. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of cucurbits – damping off, downy mildew, powdery mildew, anthracnose, and fruit rot, wilt, viral and phytoplasmal diseases.
31. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of cowpea and beans – collar rot and web blight, Fusarium wilt, rust, powdery mildew, anthracnose and Sclerotium blight;
32. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of crucifers - damping off, downy mildew, black leg, black rot, head rot and leaf blight
33. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of onion- smut, smudge, Alternaria blight, anthracnose.
34. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of leafy vegetables like amaranthus –white rust and Rhizoctonia leaf blight
35. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of tuber crops – cassava – mosaic, bacterial wilt, leaf spots, sett rot, tuber rot
36. Economic importance, symptoms, causal organisms, epidemiology and management of diseases of sweet potato – wilt and viral disease complex.

Practical schedule

1. Field visits, survey and collection of disease samples
2 Preservation of disease specimens
3-4 Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of rice
5. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of wheat
6. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of sorghum and maize.
7. Study of symptoms, etiology, host-parasite relationship and specific control

measuresof diseases of bajra and other millets.

8. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of groundnut, sunflower and sesamum.
9. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of castor, mustard and soybean.
10. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of Redgram, greengram, blackgram, bengalgram, beans and vegetable cowpea.
11. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of Cotton
12. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of tobacco
13. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of potato
14. Study of symptoms, etiology, host-parasite relationship and specific control measures f diseases of solanaceous vegetables
15. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of. bhendi and amaranthus
16. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of crucifers
17. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of cucurbits
18. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of tuber crops

Note:- 1. Record in proper form should be maintained for the practical.
2. Exercise should be completed in the practical class itself and should be approved by the course teacher on the same day .
3. Each student should submit at the time of final examination a herbarium consisting of **50 (fifty)** well preserved specimen in three instalments during the semester.

Suggested Readings

Singh. R.S 2001. *Plant Disease management,* Oxford and IBH N. Delhi. Mehrotra. R. S. Plant Pathology. TATA Mechgrow Hill Pub. Co. N. Delhi. Nair, M.C. and Menon. M. R. 1985. Diseases of Crop plants in KAU.

Prakasam. V Valluvaparidasan. V., Raguchander, T., Prabhakar, K and Thiruvudainambi. S 1997. Field Crop Diseases, A.E publication, Coimbatore.

Ramakrishnan, T. S. 1971. Diseases of Millets. ICAR.

Reghunath, P., Gokulapalan, Cand Umamaheswaran, K. 2001. Integrated pest and disease management of crop plant. State Institute of Languages Kerala, Thiruvananthapuram.

Sharma, P. D. 2001. Plant Pathology, Rastogi publications, shivaji Road, Meerut.

Singh, R. S. 1995. Diseases of Vegetables Crops. Oxford and IBH Publishing Co.

4. Path.3204. Diseases of Horticultural Crops and Their Management (2+1)

Economic Importance, symptoms, cause, disease cycle and integrated management of diseases of: citrus, mango, banana, grapevine, pineapple, papaya, guava, sapota, cashew, jack, apple, coconut, arecanut, cocoa, black pepper, ginger, cardamom, vanilla, tree spices, oil palm, betelvine, mulberry, coffee, tea, rubber, rose, chrysanthemum and jasmine, orchids, anthurium and other cut flowers.

Practical

Diseases of citrus, mango, guava, & sapota; Diseases of papaya, banana, pomegranate & ber; Diseases of grapes & apple, pomegranate , ber , betelvine, Diseases of oil palm, coconut, tea, coffee & mulberry; Diseases of rose, chrysanthemum and jasmine,orchids, anthurium and other cut flowers.. Field visits at appropriate time during the semester.

Note: Students should submit 50 pressed, well mounted diseased specimens in three instalments during the semester.

Lecture Schedule

1. Introduction to the study of diseases of horticultural crops – economic importance - symptoms- causal agents - disease cycle – management.
2. Diseases of coconut – Root (wilt) disease – economic importance, distribution and symptoms on crown and roots - etiology, disease cycle and integrated management of Root (wilt) disease of coconut
3. Economic importance, symptoms, cause, disease cycle and integrated management of bud rot- leaf rot - grey leaf blight of coconut .
4. Economic importance, symptoms, cause, disease cycle and integrated management of Foot rot and stem bleeding- cadang – cadang disease - lethal yellowing and other diseases of unknown etiology of coconut.
5. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of arecanut – Mahali- foot rot - Stem bleeding -inflorescence die back .
6. Economic importance, symptoms, cause, disease cycle and integrated management of yellow leaf disease of arecanut – nursery diseases- stem breaking.
7. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of oil palm – nursery diseases – crown diseases- root and trunk diseases - bud rot – sudden wilt and other diseases of oil palm.
8. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of cocoa – black pod rot – Monilia pod rot – Botryodiplodia pod rot – other pod rot diseases.
9. Economic importance, symptoms, cause, disease cycle and integrated management of – Cushion gall disease – witches broom, wilts -root disease -cherelle wilt - Swollen shoot of cocoa.
10. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of rubber – Abnormal leaf fall - powdery mildew –Stem diseases – root diseases.
11. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of tea-Blister blight – grey blight – stem and root diseases .
12. Economic importance, symptoms, cause, disease cycle and integrated management of

Thread blight – brown blight – birds eye spot etc of tea..

13. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of coffee – foliar diseases -rust and leaf spots
14. Economic importance, symptoms, cause, disease cycle and integrated management of coffee berry diseases —root stem and die back.
15. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of cardamom – azhukal/ capsule rot and clump rot.
16. Economic importance, symptoms, cause, disease cycle, transmission and integrated management of Katte and other viral disease – other foliar diseases– Nursery diseases.
17. Economic importance, symptoms, cause, disease cycle and integrated management of diseases ofblack pepper – foot rot and slow wilt.
18. Economic importance, symptoms, cause, disease cycle and integrated management of Pollu disease –bacterial leaf spot – viral and phytoplasmal diseases.
19. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of betelvine- foot rot, anthracnose, bacterial leaf spot.
20. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of ginger – soft rot- leaf spot - thread blight and bacterial wilt.
21. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of turmeric – leaf blotch, leaf spot, and Rhizome rot and root-rot.
22. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of clove- slow decline - root diseases - leaf blight, die- black, leaf spot diseases- leaf blotch symptoms.
23. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of cinnamon – leaf blight, leaf spot, leaf blotch and die-back symptoms, root diseases.
24. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of nutmeg and vanilla– leaf spots, fruit rot and root diseases .
25. Economic importance, symptoms, cause, disease cycle and integrated management of wilt diseases of banana -Panama wilt-Moko wilt ; Viral diseases-Bunchy top, Mosaic, heart rot ,infectious chlorosis and Kokkan.
26. Economic importance, symptoms, cause, disease cycle and integrated management of post -harvest diseases- Anthracnose- crown rot-black spot, pitting diseases- cigar end rot and pink mould rot.
27. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of mango- mango malformation, anthracnose, powdery mildew, die back, pink disease, sooty mould, red rust, black tip; deficiency diseases; post -harvest diseases- Diplodia stem end rot, anthracnose, soft rot, Black mould rot and Alternaria rot.
28. Economic importance, symptoms, cause, disease cycle and integrated management of.diseases of cashew, powdery mildew, anthracnose, damping off, pink disease, sooty mould and inflorescence blight.
29. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of grapevine- downy mildew , powdery mildew, anthracnose, black rot foot rot , dead arm- rust –bacterial viral and phytoplasmal diseases
30. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of citrus – gummosis- leaf fall and fruit rot –scab-pink disease-powdery mildew- root rot - felt disease- sooty mould- citrus canker- tristeza-greening and exocortis-post- harvest diseases.
31. Economic importance, symptoms, cause, disease cycle and integrated management of

diseases of pineapple- fruit rot/ basal rot/heart rot, wilt and leaf spot; diseases of jack- pink disease, immature fruit rot and post-harvest diseases.

32. Economic importance, symptoms, cause, disease cycle and integrated management of diseases of papaya- stem/foot rot- leaf spot- mosaic- leaf curl-post- harvest diseases. Diseases of pomegranate and ber-foliage,stem fruit and root diseases.
33. Economic importance, symptoms, cause, disease cycle and integrated management of diseases sapota- leaf spot, flat limb, fruit rot ; diseases of guava –wilt, canker, dry rot, leaf spot, seedling blight-post-harvest diseases.
34. Diseases of mulberry-foliar diseases,stem and root diseases . Economic importance, symptoms, cause, disease cycle and integrated management of diseases of apple-scab, powdery mildew, root rot, collar rot, black rot, fire blight, mosaic, post-harvest and non-parasitic diseases.
35. Diseases of rose – black spot, powdery mildew, rust, dieback, blight, leaf spot, anthracnose, bacterial leaf spot and viral diseases.
36. Diseases of orchids and anthurium.Economic importance, symptoms, cause, disease cycle and integrated management of diseases of dahlia, chrysanthemum & jasmine

Practical schedule

1. Field visits, survey and collection of disease samples
2. Preservation of disease specimens

3-4 .Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of coconut

5. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of arecanut and oil palm
6. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of cocoa
7. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of rubber
8. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of tea and coffee
9. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of cardamom,
10. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of black pepper, betelvine
11. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of ginger , turmeric,
12. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of tree spices and vanilla.
13. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of Banana
14. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of mango and cashew
15. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of. sapota jack, pomegranate and ber.
16. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of grapevine and citrus
17. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of pineapple-papaya, apple and mulberry.

18. Study of symptoms, etiology, host-parasite relationship and specific control measures of diseases of rose orchids and anthurium, dahlia, chrysanthemum & jasmine

Note:- 1. Record in proper form should be maintained for the practical.
2. Exercise should be completed in the practical class itself and should be approved by the course teacher on the same day .
3. Each student should submit at the time of final examination a herbarium consisting of **50 (fifty)** well preserved specimen in three instalments during the semester.

Suggested Readings

Bavappa. K.V.A., Nair M. K., and Premkumar, T. 1978. The Arecanut palm, CPCRI, Kasargod.
Menon and Pandalai. 1960. The Coconut Palm – A Monograph, Indian Central Coconut Committee.
Nair, M. C and Menon, M. R. 1983. Disease of crop plants of Kerala, KAU.
Nybe, E. V (ed) 2001. Three decades of spice research at KAU publication.
Sharma, Y. R and Premkumar, T. 1991. Diseases of black pepper NRC for spices, Calicut.
Santhakumari, P (ed) 2004. Advances in the diseases of plantation crops and spices, IDB Co., Lucknow.

.

VIII. HORTICULTURE

1. Hort. 1101. Fundamentals of horticulture (1+0)

Horticulture - definition, evolution, art, science, vocation, hobby, etc - importance, divisions, classification of crops; Commercial orchards, garden and plantations - selection of site for crops - climate, soil, socio-economic factors; Orchard planning, layout, peg marking, planting systems, spacing, digging pits, age of planting materials, after care, inter cropping, mixed cropping, etc; Tree forms and functions training and pruning in horticultural crops, principles and methods. Techniques of training and pruning - root pruning, girdling, ringing, notching, smudging, and bending, thinning - chemical and mechanical; Phases of growth and development - vegetative/ reproductive balance; flowering, bearing habit and its classification; Fruit set - carbon nitrogen relation, structure and process in relation to set and drop, factors affecting and measures to overcome drop; Problems of unfruitfulness - internal factors, external factors - measures to overcome; seedlessness in horticultural crops - significance and induction; Plant growth regulators in horticulture - natural and synthetic regulators - preparation and methods of application;

Plant propagation - definition and basic concepts, types - advantages and disadvantages, Potting and repotting - objectives and uses, containers and potting media/ mixture - kinds, qualities, pre-planting treatments; Propagation by seed - seed qualities, seed testing, seed germination - types of seed dormancy, pre-sowing treatments - factors affecting germination. Asexual propagation - apomixis, polyembryony, plant modifications for vegetative propagation - bud sports, chimeras; Propagation by cuttings - types of cuttings - factors affecting rooting of cuttings; Propagation by layering - advantages and disadvantages -types of layering; Propagation by grafting - advantages and disadvantages, stock - scion relationships, incompatibility; Grafting and budding - methods - advantages and disadvantages - separation and after care; Plant propagating structures - green house/ glass house, hot bed, cold frame, lath house, net house, mist chamber; Nursery - site selection, lay-out, components, progeny orchards, sales unit, display area, management, maintenance, commercial propagation of selected horticultural plants; Micro propagation of horticultural plants - definition, principles, methods, advantages and disadvantages, field of application in horticultural crops.

Lecture Schedule

1-2	Horticulture - definition, importance, division and classification of horticultural crops. Importance of horticulture in India and Kerala.
3	Commercial orchards, garden and plantations - selection of site for perennial horticultural crops - climate, soil, socio economic factors.
4	Orchard planning, layout, planting systems - management practices - methods, intercropping, mixed cropping etc.
5	Tree forms and functions - Training and pruning in horticultural crops - principles and methods, techniques of training and pruning, fruit thinning.
6	Phases of growth and development, vegetative reproductive balance.
7	Flowering in plants - bearing habit and its classification- factors associated with flowering and fruit set.

8	Fruit set and development - structure and process concerned with setting. Fruit drop - factors affecting and control measures - unfruitfulness - internal and external factors.
9	Seedlessness in horticultural crops; significance and induction.
10-11	Bioregulators- Natural and synthetic regulators - Role of bioregulators in horticultural crops - preparation and methods of application.
12	Plant propagation-definition and basic concepts- types of propagation-advantages and disadvantages, media, containers, potting, repotting pre planting treatments.
13	Propagation by seed - seed germination - dormancy and presowing treatments of seeds, seed viability and quality seed testing.
14	Asexual propagation - propagation by apomictic embryos, bud sports, chimeras. Plant modifications suitable for vegetative method of propagation - propagation by cuttings, types of cuttings, factors affecting rooting of cuttings.
15	Propagation by layering - advantages, disadvantages - types of layering.
16	Propagation by grafting - advantages and disadvantages - methods of grafting - development of graft unions, separation and after care.
17	Stock-scion relationship - Graft incompatibility - factors affecting incompatibility.
18	Propagation by budding, advantages and disadvantages, methods of budding - A comparative study between grafting and budding.
19	Nursery - site selection, layout - components of a nursery - production unit, sales unit, display area, management and maintenance, propagation unit - close planted progeny orchards.
20	Plant propagating structures-.greenhouse, glasshouse, hot bed, cold frame, lath house, net house, mist chamber, classification of nursery plants-commercial propagation of selected horticultural plants.
21-22	Micro propagation of horticultural plants - definition, principles - methods - advantages and disadvantages; potential application of plant cell, tissue and organ culture in horticulture crops

Suggested Readings

Bose, TK., Mitra, SK. and Sadhu, K. 1986. *Propagation of tropical and subtropical horticultural crops*. Naya Prokash, Calcutta.

Christepher, EP. 1958. *Introductory Horticulture*. Mc Graw Hill, New Delhi.

Denixon, RI. 1979. *Principles of Horticulture*. Mac Millan, New York.

Edmond, JB., Sen, TD, Andrews, TS and Halfacre, RG. 1977. *Fundamentals of Horticulture.* Tata Mc Graw Hill, New Delhi.

Halfacre, RG. and Barden, JA. 1979. *Horticulture.* Mc Graw Hill, New Delhi.

Hartmann, HT. and Kester, DE.1986. *Plant propagation - Principles and practices*. Prentice-Hall, New Delhi.

Janick, J. 1963. *Horticultural Science*. W.H. Freeman, Sanfrancisco.

Kumar, N. 1990. *Introduction to Horticulture*, Rajalekshmi Publication, Nagercoil.

Leopold, A.C. and Kriedeman, P.E. 1975. *Plant Growth and Development.* Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.

Thorpe, T.A. 1981. *Plant Tissue Culture: Methods and Application in Agriculture.* Academic Press, New York.

2. Hort. 1202. Plantation crops (1+1)

Plantation crops - introduction - importance – area, production – origin, distribution – botany, varieties – climate, soil, site selection – propagation, production of quality planting materials and hybrids – nursery management – layout, planting, aftercare – irrigation, manuring – stage of harvest, harvesting, yield and uses of coconut, arecanut, oil palm, rubber, cashew, tea, coffee and cocoa.

Practical

Morphology, floral biology – nursery techniques. Production of quality planting materials and hybrids. Seedling selection. Familiarization with varieties, Moisture conservation methods in plantations. Layout and planting, care and management of plantations. Tapping systems in rubber. Training and pruning in tea, coffee and cocoa.

Lecture schedule

1. Coconut: Importance, origin, distribution area and production – botany – varieties – selection of mother palm and production and selection of seedling.
2. Coconut: Climate and soil – site selection – lay out and planting. Care and management of young and adult palms – manuring, irrigation.
3. Coconut: moisture conservation – intercropping – coconut based cropping system, harvesting ,yield, -tapping.
4. Arecanut: Importance – origin – distribution – area, production botany and varieties, climate and soil – mother palm selection - nursery technique - selection of seedlings.
5. Arecanut : Site selection -land preparation – layout and planting -management of palms – arecanut based cropping systems- harvesting- yield.
6. Oil palm: Importance - origin – distribution – area – production -botany and varieties. Seed germination and other nursery techniques
7. Oil palm: Climate and soil - site selection – layout - planting, management of palms. Harvesting, yield.
8. Rubber: Importance – origin - distribution – area, production, botany varieties – clones – nursery techniques
9. Rubber: Climate and soil – site selection- layout and planting - management of plantation.
10. Rubber : Management of trees before and after commencement of tapping– cover cropping – intercropping – systems of tapping – latex stimulation - plugging mechanism – tapping tools - tapping rest – slaughter tapping-controlled upward tapping.
11. Cashew: Importance – origin – distribution – area – production botany and varieties- nursery technique-climate and soil.
12. Cashew: Site selection – layout – planting - high density planting-cultural practices – intercropping - harvesting , yield– problems and prospects.
13. Tea: Importance – origin – distribution - area – production - botany - clones. Climate and soil – nursery techniques. Site selection – land preparation – layout and planting.
14. Tea : Shade regulation- climate and soil –cultural practices – systems of training and pruning – harvesting , yield.

15. Coffee: Importance – origin and distribution –area, production -botany and varieties – Nursery techniques – climate and soil –
16. Coffee: Layout and planting- management -training and pruning – manuring – irrigation, flowering and harvesting, yield.
17. Cocoa: Importance – origin – distribution – area- production, botany and varieties - climate and soil – nursery techniques.
18. Cocoa: Layout-land preparation, planting, manuring and other management – training and pruning – harvesting and yield.

Practical schedule

1. Coconut : Morphology & Floral biology – techniques of selfing and crossing.
2. Coconut: Mother palm and seedling selection – planting.
3. Coconut: Husk burial – varietal characters.
4. Arecanut: Morphology & Floral biology, identification of varieties .
5. Arecanut: Sowing – seedling selection – planting.
6. Oil palm: Floral biology – identification of varieties ..
7. Rubber: Morphology & Floral biology .
8. Rubber: Nursery techniques and planting, tapping.
9. Cashew: Floral biology, identification of varieties.
10. Cashew: Propagation techniques.
11. Tea: Morphology – training and pruning.
12. Coffee: Morphology & Floral biology – identification of species and varieties.
13. Coffee: Propagation – training and pruning.
14. Cocoa: Morphology & Floral biology – identification of varieties – selfing and crossing.
15. Cocoa: Propagation – seed and vegetative methods – planting.
16. Layout and planting under different systems of planting.
17: Field visits.
18. Practical examination

Suggested Readings

Banerjee.B, 1993. Tea Production and Processing. Oxford & IBH Publishing Co. Pvt. Ltd.

Balasimha, D and Rajagopal, V. 2004. Arecanut, CPCRI, Kasargod, Kerala.

Bhaskara Rao.E.V. Nambiar.K.K..N. Nambiar.M.C. and Nair.M.K. (Eds) 1979. Monograph on Plantation crops I. Cashew (Anacardium occidentale) CPCRI, Kasargod.

Chadha, K.L.2001. Hand Book of Horticulture,ICAR, New Delhi.

CPCRI, 2003. Coffee guide, Central Coffee Research Institute, Coffee Board, Chickamangalur, Karnataka.

Child .R, 1994. Coconuts (Ed. II), Longman, London.

Corley, R.H.V. Hardon.J.J. and Wood.B.J. 1976, Oilpalm Research Elsevier Pub. Coy.

Kumar.N, Abdul Khader.J.B.M. Rangaswami.P. and Irulappan., 1993. Introduction to spices – Plantation crops, Medicinal and Aromatic plants, Rajalekshmi Pub, Nagercoil.

Menon.K.P.V. and Pandalai.K.M. 1960. The coconut Palm – a monograph. Indian Central Coconut Committee, Ernakulam.

Nampoothiri,K. U. K and Singh, H. P. 2000 Trends in Coconut Research and Development in India, Coconut Development Board, Kochi.
Ohler.J.G. 1979. Cashew. Kininkligk Institute Voor de Tropess, Amsterdam.
Peter, K.V. 2002 Plantation Crops, National Book Trust, India
Purseglove. 1978. Tropical Crops. Monocots (Vol. I & II combined)
Sethuraj.M.N. and Mathew.N.M. 1992. Natural Rubber, Biology, cultivation and Technololgy. Elsevier, Amsterdam.
Thampan.P.K. 1976. The coconut palm and its products Green Villa Pub. House, Cochin.
Thampan.P.K. 1981. Handbook on coconut Palm, Oxford & IBH, New Delhi.
Webster.C.C. and Banoknill.W.J. 1989 Rubber. John Wiley, London.
Wellman.F.L. 1961. Coffee, Leopard Hill (Books) Ltd., London..Wood.G.A.R. 1975. Cocoa. Tropical Agriculture Series. Longman, London.
Wrigley.G. 1988. Coffee Tropical agriculture Series, Longman, London.

3. Hort. 2103. Landscaping and ornamental horticulture (1+1)

Introduction to landscaping and gardening - components of landscapes and gardens -description and functional uses. Garden enclosures - roads and paths - surfacing materials - enrichment items and uses - establishment and maintenance. History of gardening – gardening trends in India - types of gardens -. Characteristics and components of English gardens - Mughal, Japanese, Persian, French and Italian gardens - Styles in gardening. Principles of landscaping – designing and preparation of landscape and garden plans – considerations for different situations – application of the outdoor room concept. Lawns - types of lawn grasses - methods of establishing lawns - land preparation – planting – mowing – rolling - application of manures and fertilizers – irrigation - weed control and plant protection – rejuvenation of lawns. Annuals and herbaceous perennials – their use in gardens – selection - colour schemes - planting designs - season and methods of planting - Cultural practices. Shrubs and trees - types – uses of shrubs in gardens - trees for landscapes - avenue planting - group planting and specimen planting – selection – planting – pruning - maintenance and rejuvenation of shrubs and trees. Climbers and Creepers – Cacti and succulents - Ferns and palms - definition and classification - special requirements - functional uses – planting - aftercare and cultural practices. Specialized gardening techniques - rock gardening - water gardening – Bonsai - Roof gardens - terrace garden - sunken garden etc. - their special requirements - establishment and maintenance. Indoor gardening – function - selection and types of indoor plants - environmental requirements - containers and media - methods of growing - special care for indoor plants – types of indoor display - vertical garden - tray garden - terrarium etc. Introduction to commercial floriculture - present status of the cut flower industry in India and abroad - area under flower crops - problems and prospects of commercial floriculture in India with special reference to Kerala. Rose - importance and uses - origin and distribution - classification and varieties - soil and climate – propagation - planting and aftercare – pruning – nutrition – irrigation - plant protection - harvesting and marketing of loose flowers - cut flowers and perfumery roses – protected cultivation for export. Orchids - Importance - classification, varieties grown, environmental requirements, cultivation methods - propagation - media and containers - planting and aftercare – management – nutrition - plant protection - harvesting and marketing of flowers. Anthurium – importance – classification - species and varieties - environmental requirements - cultivation methods – propagation - containers and media - planting and aftercare – management – nutrition - harvesting

and marketing of flowers. Jasmine and Chrysanthemum – importance and uses, classification and varieties, soil and climate, propagation, planting, special cultural techniques, nutrition, plant protection, harvesting and marketing. Bulbous Plants – classification, uses, propagation, soil and climate, planting, aftercare, harvesting and storage of planting materials of gladiolus, tube rose, heliconia, dahlia, amaryllis, ornamental gingers etc.). Minor commercial flowers – marigold, crossandra, gomphrena, *gerbera*, aster, celosia, etc. – Uses, classification, propagation, soil and climate, planting, aftercare, harvesting and marketing. Principles of flower arrangement – styles and designs – tools, containers and accessories, collection and preparation of flowers and foliage, vase solutions for fresh flowers, preservation of dry flowers and foliage, judging of flowers, flower arrangements and flowering and foliage plants in shows and exhibitions.

Practical

Classification of ornamental plants and identification of ornamental shrubs and trees. Preparation of landscape plans. Visit to gardens, commercial farms and markets.

LectureSchedule

1 History and types of gardens
2 Principles of landscape design, preparation of landscape plan
3 Components of a garden and functional uses
4 Lawn- preparation and management
5 Annuals and herbaceous plants
6 Shrubs and trees
7 Climbers and creepers, cacti, succulents, ferns and palms
8 Non living components, garden adornments
9 Specialised gardening techniques
10 Indoor plants-function, selection and management
11 Introduction to commercial floriculture
12 Rose
13 Orchids
14 Anthurium
15 Jasmine and Crossandra
16-17 Carnation, Chrysanthemum. Other commercial flowers- marigold, *Gomphrena*, *Gerbera*, aster, *Celosia*, *Gladiolus*, tuberose, *Alpinia*, *Heliconia*, *Dahlia*, *Amaryllus*, cut foliage
18 Value addition. Principles of flower arranging and judging

Practical schedule

1: Identification of ornamental plants
2: Identification of ornamental plants (continued)
3: Identification of ornamental plants (continued)
4: Identification of ornamental plants (continued)
5: Visit to public and private gardens
6: Visit to public and private gardens (continued)
7: Symbols, tools etc in landscaping and maintenance
8: Preparation of landscape plans
9: Preparation of landscape plans (continued)

10: Preparation of lawn
11: Orchid and anthurium
12: Cultural operation for major commercial flowers
13: Controlled conditions for propagation and growing
14: Flower arranging and judging
15: Visit to flower markets
16: Visit to commercial flower growers
17: Visit to flower shows
18: Value addition in floriculture

Suggested Readings

Bhandari, K. and Prakash, J. 1994. *Floriculture: Technology Trades, Trends*. Oxford & IBH Publishing Company, New Delhi

Bland, J. and Davidson, W. 2004. *Houseplant – Survival Manual*. Quantum Books Ltd., London.

Bose, T.K and Yadav, L.P. ed. 2003. *Commercial Flowers*. Naya Prakash, Calcutta, India

Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. ed. 1999. *Floriculture and Landscaping*. Naya Prokash, Culcutta, India.

Carpenter, P.L., Walker, T.D and Lanphear, F.O. 1975. *Plants in the Landscape*. W.H. Feeman and Co., San Francisco

Chadha, K.L. 2001. *Hand book of Horticulture.* ICAR, New Delhi.

Chadha, K.L. and Chowdhury, B, 1992. *Ornamental Horticulture in India*. ICAR New Delhi

Desai, B.L. 1979. *Planning and Planting of Home Gardens*. Indian Council of Agricultural Research, New Delhi.

Joiner, J.N. 1981. *Foliage Plant Production*. Prentice Hall Inc. London

Nambisan, K.M.P. 1991. *Design elements of landscape gardening*. Oxford & IBH Publishers Pvt. Ltd Calcutta

Pal, B.P. 1972. *The Rose in India*. Indian Council of Agricultural Research, New Delhi

Rajeevan, P.K. Singh, K.P. and Valsalakumari P.K. 2003 ed. *Bulbous Flowers.* Indian Society of Ornamental Horticulture Division of Floriculture & Landscaping, IARI, New Delhi.

Rajeevan, P.K., Sobhana, A., Jyothi Bhasker, Swapna,S. and S.K. Bhattacharjee. 2003. *Orchids.* Technical Bulletin. ICAR

Rajeevan, P.K., Valsalakumari, P.K. and Geetha, C.K. 1999. *Pookrishi:, Sastravum Prayogavum*. (Malayalam) Kerala Agricultural University, Mannuthy, Trichur

Rajeevan, P.K., Valsalakumari, P.K. and Geetha, C.K., Leena Ravidas and S.K.Bhattacharjee. 2002. *Anthurium.* Technical Bulletin. ICAR

Randhawa, G.S. and Mukhopadhyay, A. 1986. *Floriculture in India*. Allied publishers New Delhi

Rogers, J. 1974. *Flower arranging*. Hamlyn, London

Schery, R.W. 1976. *Lawn Keeping*. Prentice Hall Inc., New Jersey

Sessler, G.J. 1978. *Orchids and how to grow them*. Prentice Hall Inc., New Jersey

Swarup, V. 1993. *Indoor Gardening*. ICAR, New Delhi

Trivedi, P.P. 1983. *Home Gardening*. Indian Council of Agricultural research, New Delhi

4. Hort. 2204. Vegetable crop (2+1)

Importance and scope of vegetable crops in India with special reference to Kerala; Area, production, productivity of important vegetable crops of Kerala; Nutritive value of Vegetables; Economic importance and scope of various vegetables in Kerala. Classification - botanical; cultural; thermo- classification; Classification based on parts used; based on soil acidity; duration. Types of vegetable farming- kitchen garden; market garden; truck garden; vegetable forcing; vegetable garden for processing; vegetable garden for seed production. Systems of vegetable cultivation- traditional and specialized systems; Low-cost and high-tech-systems, Nutrition garden, Riverbed system, Glasshouse cultivation and other protected systems. Cropping systems and patterns- Vegetables in rice based and coconut based cropping systems; mixed cropping, intercropping, relay cropping. Factors affecting vegetable production- temperature, light, moisture, soil, Nutrients. Basic principles in vegetable production- nursery, sowing and transplanting, care and management –Irrigation- surface, sub-surface and spray irrigations – Nutrition - essential nutrients, deficiency symptoms; Methods of application. Growth regulators- important growth regulators and their effects; Methods of application. Plant protection- special precautions in vegetables-methods of control, rotation, resistant varieties, seed treatments. Vegetable seed production- general principles, breeding system, isolation distance, roguing, cultural operations, seed standards, packing and storage; Seed production in cool season vegetables, post harvest handling- losses; causes and measures to reduce losses; Packing and transport . Marketing of vegetables.

Production technology of warm season vegetable- Importance, origin, taxonomy, varieties, cultivation, problems and prospects for Solanaceous crops- tomato, brinjal and chilli- Cucurbits- bitter gourd, snake gourd, cucumber, melons, pumpkins, ash gourd, bottle gourd, ridge gourd, smooth gourd, watermelon, ivy gourd and Other perennials. Leguminous crops- vegetable cow pea, winged bean and other minor crops, okra, Leafy vegetables- amaranthus, basella, chekkurmanis Tropical root vegetables- tapioca, sweet potato, yams and other minor tubers.

Production Technology of cool season vegetables- Importance, origin, taxonomy, Varieties, cultivation, problems and prospects of potato, cole crops- cabbage & cauliflower, brussels sprout, broccoli, knol-khol; Root crops- carrot, radish, beet and turnip; bulb crops- onion, garlic and leek; peas and beans, Salad and Leafy vegetables.

Practical

Familiarization of different vegetable crops- through field visits and slide show- familiarization of seeds of vegetable crops; preparation of nursery bed, sowing and aftercare- Layout of nutrition garden and preparation of crop calendar; Main field preparation and planting of solanaceous vegetables, cucurbits, amaranthus, legumes and okra; Floral biology and varieties of solanaceous vegetables, cucurbits, amaranthus, legumes and okra; Calculation of fertilizer requirement, application by different methods- Preparation of growth regulator solutions and application; Maturity indices and harvesting of vegetables for vegetable purpose and seed purpose – seed extraction methods,

processing and storage; Economics of vegetable cultivation; Visit to the farmer's fields in the vegetable growing areas to study the field problems faced by the farmer.

Lecture schedule

1	Introduction to the course, importance of vegetable growing in India and Kerala in particular, area, production, productivity and distribution, average nutritive value of vegetables, economic importance and scope of various vegetables in Kerala
2	Classification of vegetables – types of classification and their bases – Botanical, cultural, thermo classification, classification based on parts used, based on soil acidity &duration
3	Factors affecting vegetable production- soil, climate, water, nutrients, Basic principles of vegetable production
4	Vegetable nursery, seed and seedlings production, transplanting, care and management, irrigation requirements of vegetables – surface and sub surface irrigation, spray irrigation
5	Nutrition, essential nutrients, deficiency symptoms, methods of application
6	Types of vegetable gardens, nutrition garden, market garden, truck garden, vegetable forcing, vegetable garden for special purpose and processing, veg. gardens for seed production, Hydroponics, aeroponics, Riverbed system, Terrace Garden etc
7	Problems in vegetable production; role of growth regulators in vegetable production and methods of application
8	Plant protection, special, precautions in vegetables, methods of control, rotation, resistant vegetables, seed treatments, etc.
9	General principles of seed production in vegetables- roguing, isolation distance, seed purity, seed standards, – breeder seed, foundation seed, certified seed – packaging and seed storage, moisture and temperature
10	Export of vegetables
11	Cropping systems and patterns of vegetable based cropping system, vegetables in rice based and coconut based cropping system, intercropping, mixed cropping, relay cropping, multiple cropping, etc.- Review of the topics covered.
12	Organic farming in vegetables
13	Importance, origin, taxonomy, varieties, cultivation, problems and prospects of Tomato
14	Chilli
15	Brinjal
16	Importance, origin, taxonomy, varieties, cultivation, problems and prospects of cucurbits
17	Bittergourd, snake gourd
18	Cucumber, Melons, muskmelons
19	Pumpkins, ashgourd,
20	Bottle gourd, Ridge gourd, smooth gourd , Watermelon, Ivy gourd
21	Perennial and other cucurbits
22	Importance, origin, taxonomy, varieties, cultivation, seed production problems and prospects of legumes and minor legumes
23	Importance, origin, taxonomy, varieties, cultivation, Seed production, problems and prospects of bhindi
24	Importance, origin, taxonomy, varieties, cultivation, problems and prospects of annual summer leafy vegetables – amaranth & others

25 Importance, origin, taxonomy, varieties, cultivation, problems and prospects of perennial cool season vegetables.
26 Importance, origin, taxonomy, varieties, cultivation, problems and prospectsof perennial summer vegetables Research organizations working exclusively on vegetables. Review of topics covered
27 Importance, origin, taxonomy, varieties, cultivation, problems and prospects of cool season vegetables-Cole crops-Cabbage & cauliflower
28 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of Brussels sprout, broccoli
29 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of knolkhol
30 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of cool season root vegetables Carrot & radish
31 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of cool season vegetables-Beet & turnip
32 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of Bulb Crops-onion,
33 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of Bulb Crops- garlic,& leek
34 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of Peas & beans

35 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of cool season Salad vegetables
36 Importance, origin, taxonomy, varieties, cultivation, Seed production problems and prospects of cool season Leafy vegetables
37 Glasshouse and other protected systems, Systems of vegetable cultivation, traditional and specialized systems, Low cost and high tech. systems
38 Post harvest losses, phases of loss and measures to reduce the losses, post harvest handling, respiration and storage preservation and preservatives used in cool season vegetables
39 Importance, origin, taxonomy, varieties, cultivation, problems and prospects of Tuber crops - Review of topics covered

Practical Schedule

1 Familiarization of different vegetable crops- through field visits and slide show
2 Main field preparation and planting of crops as per the list
3 Main field preparation and planting of crops as per the list
4 Preparation of nursery bed, sowing and aftercare
5 Familiarization of seeds of vegetable crops
6 Layout of nutrition garden and preparation of crop calendar
7 Floral biology and varieties of amaranthus
8 Calculation of fertilizer requirement, application by different methods
9 After care and management of crops as per the list
10 After care and management of crops as per the list
11 Biological pest control measures
12 Preparation & application of organic manures
13 Organic farming practices
14 Floral biology and varieties of solanaceous vegetables
15 Floral biology and varieties of cucurbits

16 Floral biology and varieties of legumes
17 Floral biology and varieties of okra
18 Preparation of growth regulator solutions and application
19 Maturity indices and harvesting of vegetables for vegetable purpose and seed purpose
20 Management, harvesting & taking observation of crops as per the list
21 Seed extraction methods
22 Seed processing and storage
23 Identification and familiarization of cool season vegetables
24 Main field preparation and planting of cool season vegetables
25 Economics of vegetable cultivation
26 Visit to the farmer's fields in the vegetable growing areas to study the field problems faced by the farmer.

Suggested Readings

Bose, T. K. and Som, M. G. 1990. Vegetable crops in India. Naya Prokash, Calcutta.
Chadha, K. L. 2003. Handbook of Horticulture, ICAR, New Delhi.
Choudhury, B.1983. Vegetables. National Book Trust, New Delhi.
Das, P. C.1993. Vegetable crops in India. Kalyani Publishers
Gopalakrishnan, T. R. 2007. Vegetable Crops. New India Publishing Agency, New Delhi.
Hazra, P. and Som, M. G. 1999. Technology for vegetable Production and Improvement. Naya Prokash, Calcutta
Kallo, G. Tomato. Allied Publishers Pvt. Ltd.
Peter, K. V. 1998. Genetics and Breeding of vegetables. ICAR, New Delhi.
Thamburaj, S. and Singh, N. 2005. Vegetables, tuber crops and spices. ICAR, New Delhi.

5. Hort. 3105. Fruit crops (2+1)

Importance and scope of fruit crop industry in India, with special reference to Kerala. Classification of fruits. Cultivation practices of important tropical, subtropical and temperate fruit crops with reference to their origin, soil and climatic requirements, botany, important cultivars, plant propagation practices, planting, after care and management in respect of irrigation, nutrition and other cultural operations. Training and pruning. Nutrient deficiencies of fruit plants and their correction, intercropping, major cultivation problems and their control measures, harvesting, yield, storage and marketing. Introduction to high - tech innovative practices in fruit production – biotechnology, high density planting, fertigation, protected culture, organic farming, application of bioregulators. Management of major pests and diseases.

Fruits covered – banana, mango, pineapple, papaya, sapota, guava, pomegranate. Moraceous and Annonaceous fruits, dates, citrus, grapes, mangosteen, avocado, litchi, apple, pear, peach, plum, strawberry, cherry, minor fruits.

Practical

Fruit plants – general introduction - botanical position, vegetative and floral characters of individual fruit crops, identification of varieties and varietal grouping, planting material production and nursery maintenance. Planting and post planting practices, use of bioregulators, harvesting. Visit to commercial orchards and fruit research station.

Lecture schedule

1	Importance of fruit growing - area, production and productivity– commercial importance - classification of fruits based on climatic requirements - nutritive value of fruits – south Indian fruit zones.
2	Mango – origin, distribution – area and production – composition and uses – botany, classification of varieties – climatic and soil requirements.
3	Propagation methods – major pre-planting and post-planting operations – manurial requirements.
4	Flowering – factors affecting flowering fruit set and fruit drop – use of growth regulators. Harvest indices , grading, packing, storing and transporting.
5	Major physiological disorders - problems encountered in mango production.
6	Banana – origin and distribution – area and production – composition and uses – botany.
7	Genomic classification – taxonomic scoring – important varieties.
8	Climate and soil requirements – propagation, selection of suckers – plant population in commercial plantations.
9	Manuring, irrigation and other post-planting operations – flowering and factors affecting flowering – harvest indices. Harvesting, grading, packing – ratooning.
10	Crop improvement – peculiarities and problems of banana cultivation in Kerala.
11:	Pineapple – origin and distribution – area, production – composition and uses – botany, classification and varieties – general plant description – flowering and fruit characters.
12	Climate and soil – propagation – systems of planting – population density – manuring and intercultural operations.
13	Flowering – manipulation of flowering through bioregulator application – harvest indices – yield – ratooning – staggering production - physiological disorders – major pests and diseases.
14	Papaya – origin and distribution – seed treatment – climate & soil – spacing – planting – intercultural operations – manuring.
15	Floral biology – sex expression - inheritance of sex – fruit growth and development – harvesting and yield – papain extraction – factors affecting papain yield – important pests and diseases.
16	Guava – origin and distribution – area and production – composition and uses – botany – species and varieties – propagation – spacing – planting and aftercare – manuring – pollarding - flowering, fruiting and fruit growth – yield – important pests and diseases
17	Sapota – origin and distribution – area and production – composition and uses – botany, species and cultivars – propagation – planting and aftercare – manuring – flowering, fruit growth and development – harvesting and yield – important pests and diseases.
18	Mid-Semester examination

19 Grapes – origin and distribution – area and production – composition and uses – botany, species – climatic and soil requirements – peculiarities of South Indian Viticulture.

20 Varieties – commercial classification – propagation – rootstocks – planting.

21 Training – objectives, important systems, pruning methods and season – types and season.

22 Manuring – techniques for improving quality of fruit – physiological disorders – harvesting – major pests and diseases.

23 Citrus – origin and distribution – area and production – composition and uses – botany, species and varieties.

24 Botanical and horticultural classification – chemotaxonomy, propagation - rootstocks.

25 Climate and soil – cultivation aspects – flowering, fruit set and development - harvesting – yield – storage and ripening.

26 Physiological disorders – pests and diseases – virus indexing – cross protection.

27 Moraceous fruits – fig – origin and distribution – area and production – composition and uses – species and varieties – climate and soil- propagation – cultivation – flowering , pollination and fruit set – fruit growth and development - harvesting and yield – major problems.

28 Jack – origin, distribution – area and production – composition and uses – species and varieties – climate and soil – propagation - cultivation - flowering, fruit set and yield - ripening and storage. Bread fruit and mulberry – general aspects of production.

29 Avocado – origin and distribution – composition and uses – species, races and varieties – propagation – climate and soil – cultivation – flowering, floral biology, fruit maturity, harvest and yield, pests and diseases.

30 Mangosteen and pomegranate – origin and distribution– composition and uses – botany, species and varieties – propagation – climate and soil – cultivation aspects – training and pruning - flowering, fruit set and yield - important pests and diseases.

31 Under-exploited and unexploited minor tropical and sub-tropical fruits – annonas, aonla, rose apple, jamun, west indian cherry, kodumpuli, tamarind, passion fruit, litchi, rambutan etc – general aspects of cultivation.

32 Major temperate fruits – apple, pear - varieties – training and pruning – propagation and root stocks – high density planting

33 Peach, plum, cherries – varieties – training and pruning – propagation and root stocks.

34 Strawberry – prospects for commercial cultivation in the South Indian hill zones – protected cultivation technique - other berries – general aspects.

35 Minor sub tropical and temperate fruits – general aspects

36 Introduction to high - tech innovative practices in fruit production – application of *in vitro* methods in planting material production, high density planting, fertigation, protected culture, prospects of organic farming.

Practical Schedule

1 Visit to College orchard and acquainting with orchard layout systems and fruit plants
2 Studies on propagation of fruit crops – cutting , layering
3 Studies on propagation of fruit crops – budding
4 Studies on propagation of fruit crops – grafting
5 Mango – botany, floral characters and identification of varieties
6 Field visit and study of cultural practices of mango
7 Banana - botany, floral characters and identification of varieties
8 Field visit, taxonomic scoring and study of cultural practices of banana
9 Pineapple - botany, floral characters and identification of varieties
10 Field visit and study of cultural practices of pineapple and papaya
11 Papaya - identification of sex forms and varieties
12 Guava and sapota – identification of varieties
13 Moraceous and Annonaceous fruits - identification of species and varieties
14 Grapes - botany, floral characters and identification of varieties
15 Citrus - botany, floral characters and identification of species
16 Identification of minor fruits
17 Identification of sub-tropical and temperate fruits
18 Visit to fruit research stations/ commercial orchards

Suggested Readings

Amar Singh, 1986. Fruit Physiology and Production. Kalyani Publishers, New Delhi.

Bose, T.K, Mitra,S.K. and Sanyal, D. 2002. Fruits: Tropical and Subtropical. Vol. I & II, Nayaprakash publications, Calcutta.

Chadha,K.L, Reddy,B.M.C and Sikhamony,S.D. 1998. Pineapple. ICAR, New Delhi.

Collins,J.L. 1968. The Pineapple. Leonard Hill, London.

Davies,F.S and Albrigo,L.G. 1994. Citrus. CAB International, UK.

Galletta, G.J. and Himlrick, D.G.1989. Small Fruit Crop Management. Prentice Hall, New Jersey.

Hayes,W.B. 1957. Fruit Growing in India. Kitabitan, Allahabad.

Kumar, N. 1997 (6^{th} Edition). Introduction to Horticulture. Rajhalakshmi Publications, Nagercoil

Mitra,S.K, Bose,T.K and Rathore, D.S. 1991. Temperate Fruits. Horticulture and Allied Publishers , Calcutta.

Naik,K.C. 1949. South Indian Fruits and Their Culture. Varadachari Co., Madras.

Pandey, R.M and Pandey,S.N. 1996. The Grape in India. ICAR, New Delhi.

Randhava,,G.S and Srivastava,K.C. Citriculture in India. Hindustan Publishing Co., New Delhi.

Samson, J.A. 1980. Tropical Fruits. Longman group, London.

Shanmughavelu,K.G, Aravindakshan,K and Satiamoorthy,S. 1992. Banana. Metropolitan Book Co. Pvt. Ltd. , New Delhi.

Singh, I.D. 1990. Papaya. Oxford & IBH Publishing Co. Ltd. , New Delhi.

Singh, L.B.1960. The Mango. Leonard Hill (Books), London.

Singh, R.,N.1990. Mango. ICAR, New Delhi.

Singh, R.1960. Fruits. National Book Trust, India.

Stover, R.H and Simmonds, N.W. 1987. Bananas. Longman scientific and Technical Publications, New York.

Veera Raghava Thataham, Jawaharlal,M. , Jeeva,S and R.Rabindran.1996. Scientific Fruit Culture. Suri Associates, Coimbatore-2.

Westwood, M.N. 1978. Temperate zone Pomology. Freeman & Co. , Sanfransisco.

Winkler,A.J, Cook, J.A , Kliewer, W.M and Lider,L.A. 1962. General Viticulture. University of California Press, Berkely- Los Angeles- London.

6. Hort.3206. Spices and medicinal plants (1+1)

Definition – classification – importance to the state. Origin – distribution – area, production – botany, varieties – climate, soil – propagation, nursery management – site selection, layout, planting – crop management including manuring, irrigation, shade regulation, harvesting, yield of the following crops: Pepper, cardamom, ginger, turmeric, cinnamon, nutmeg, clove, vanilla and allspice. List of seed and herbal spices and minor essential oil yielding plants.

Brief study of the history, importance and scope of medicinal and aromatic plants, management of nurseries, soil and climatic requirement, land preparation, intercultural practices and harvesting of the following medicinal and aromatic plants:

Medicinal plants : *Rauvolfia, Catharanthus*, opium, digitalis, dioscorea, solanum, acorus,senna,neem, cinchona, *Kaempferia*, long pepper, *Plumbago, Indigofera* and ocimum

Aromatic plants (essential oil yielding crops)

History, importance, problems and scope of cultivating aromatic crops, cultivation, active principles and uses of the following plants: Mints, aromatic grasses (lemon grass, palmarosa, citronella, vetiver), jasmin, tuberose, rose, geranium, patchouli, eucalyptus, sandalwood and other minor essential oil yielding crops.

Practical

Morphology, floral biology, nursery techniques, planting in main field, cultural operations, harvesting of pepper, cardamom, ginger, turmeric, tree spices and vanilla. Hand pollination in vanilla Identification of important medicinal and aromatic plants, preparation of herbarium, techniques of propagation, nursery raising and planting. Visit to research stations or pharmaceutical industries involved in the cultivation and /or processing of medicinal and aromatic plants.

Lecture schedule

1. Introduction: Spices, condiments and culinary herbs-definition – classification – importance with special reference to Kerala.
2. Pepper: Origin – distribution – area – production – export- botany and varieties. Climate and soil – propagation and nursery management – site selection, layout and planting of standards and pepper. Crop management including manuring – irrigation – shade regulation – harvesting.

3. Ginger : Origin – distribution – area, production – botany – varieties – climate & soil.
4. Ginger : Site selection – land preparation – planting – cultural and manurial practices harvesting – seed rhizome storage.
5. Turmeric: Origin – distribution – area - production - botany- varieties – climate and soil. Site selection – land preparation – planting – cultural and manurial practices – harvesting – seed rhizome storage – curing.
6. Cardamom: Origin –distribution – area – production – botany – varieties. Climate – soil – propagation – nursery techniques planting. Manuring - weeding – trashing – mulching – irrigation – shade regulation - harvesting.
7. Nutmeg & Clove: Origin – distribution – area – production - botany – propagation – climate and soil – planting and aftercare – harvesting.
8. Cinnamon : Origin – distribution – area – production – botany -propagation – climate and soil - planting - training & pruning – cultural practices – harvesting.
9. Vanilla: Origin – distribution – area – production – botany- propagation – climate and soil - planting of standard and vanilla - crop management - flower induction- hand pollination – harvesting and processing.
10. All spice & minor spices: Origin - distribution – botany – propagation – climate soil – planting and aftercare – harvesting.
11. History, importance and scope of medicinal plants. Valuable active principles in them. Botany, varieties, cultivation, post-harvest handling, active principles and uses of :Rauvolfia, Catharanthus, Dioscorea, Costus, Solanum.
12. Opium, Digitalis, Atropa, Cinchona, Senna, Acorus.
13. Neem, Kaempferia, Indigofera, Long pepper, Plumbago and Ocimum.
14. History, importance, problems and prospects of aromatic plant cultivation. Botany, varieties, planting, management and harvesting of the following crops: Lemon grass, Palmarosa, Citronella, Vetiver
15. Mint, Eucalyptus, Jasmine, Tuberose
16. Geranium, Patchouli
17. Sandalwood and Rose
18. Other minor medicinal and essential oil yielding plants.

Practical schedule

1. Pepper : Floral biology and identification of varieties
2. Pepper : Propagation
3. Ginger :Floral biology and identification of varieties
4. Turmeric:Floral biology and identification of varieties
5. Ginger & turmeric: Land preparation and planting of ginger and turmeric.
6. Cardamom:Morphology – floral biology – identification of varieties.
7. Nutmeg & clove: Morphology – floral biology – identification of varieties.
8. Cinnamon & all spice :Morphology and floral biology.
9. Vanilla:Morphology and floral biology – hand pollination.
10. Identification of minor spices.
11. Visit to spice gardens.
12. Preparation of herbarium of medicinal and aromatic plants.

13. Visit to herbal garden(s) for identification of important medicinal and aromatic plants.

14. Identification of important medicinal and aromatic plants using herbarium specimens.

15. Study of morphological and botanical features of major medicinal and aromatic plants.

16. Techniques of propagation and nursery raising of major medicinal and aromatic plants.

17. Extraction of essential oil from plants.

18. Visit to Ayurveda research centre and other important stations.

Suggested Readings

Chadha.K.L. and Rethinam.P.(Eds.) 1994. Advances in Horticulture. Vol. 9 Plantation and Spice Crops. Malhotra Publishing House, N. Delhi, India.

Chadha, K.L.2001. Hand book of Horticulture, ICAR, New Delhi.

Edison.S. Johney.A.K. Nirmal Babu.K. and Ramadasan.A. 1991. Spice varieties. Indian Institute of Spices Research (IISR), Calicut, India.

Nybe, E.V, Mini Raj,N and Peter, K.V.2007. Spices. New India Publishing Agency, New Delhi.

Purseglove. J.W., Brown, E.G.Green, C.L. and Robbins, S.R.G.1981.SpicesVol-I & II.

Pruthi.J.S. 1993. Major Spices of India, Crop Management – Post Harvest Technology, ICAR, New Delhi.

Pruthi, J.S.2001 Minor Spices and Condiments-Crop Management and Post Harvest Technology, ICAR, New Delhi, India.

Aiyar.N. and Kolammal.M 1962. Pharmacognosy of ayurvedic drugs of Kerala, Kerala University, Thiruvananthapuram.

Atal.C.K. and Kapur.B.M. 1982. Cultivation and utilization of medicinal plants. RRL, CSIR, Jammu.Tawi.

Atal.C.K. and Kapur.B.M. 1982. Cultivation and utilization of aromatic plants. RRL, CSIR, Jammu.Tawi.

Cains.J. F. 1986. Medicinal and poisonous plants of India. Scientific Publishers, Jodhpur.

Chadha. K.L. and Gupta. R. 1995. Advance in Horticulture Vol. 11 Medicinal & Aromatic plants. Malhotra Pub. House., New Delhi.

CSIR. 1971. The Wealth of India. Vol. A-Z. CSIR, New Delhi.

Dastur.J.F. 1977. Medicinal plants of India and Pakistan. Taraporevala sons & Co. Pvt. Ltd., Bombay.

Farooqui, A.A., Khan, M.M. and Sreeramu, B.S. 1997. Cultivation of medicinal and aromatic crops in India. Naya Prakash, Kolkatta.

Guenther.E. 1975. The essential oils. Robert K. Krieger Pub. Co., New York.

Jain.S.K. 1979. Medicinal Plants. National Book Trust of India, New Delhi.

Kaushik.P. 1988. Indigenous medicinal plants including microbes and fungi. Today and Tomorow's Printers and Pub., New Delhi.

Kirthikar.K.R. and Basu.B.D. 1993. Indian Medicinal plants, Vol. 1-4. Lalit Mohan Basu, Allahabad.Morton.J.P. 1971. Major medicinal plants –Botanic culture and uses. Charles. C. Thomas Pub., Ilnois, USA.
Kurian, A and Sankar, M.A.2007. Medicinal Plants. New India Publishing Agency, New Delhi.
Nesamony.S. 1988 & 1999. Oushadha Sasyangal (Vol. 1 & 2). State Institute of Languages, Kerala, Thiruvananthapuram.
Sivarajan, V.V. and Balachandran, I. 1994. Ayurvedic drugs and their plant sources. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.

Warrier.P.K. Nambiar, V.P.K. and Ramankutty.C. 1993 - 1996. Indian medicinal plants – a compendium. Vol. 1-5. Orient Longman Ltd., New Delhi.

Weiss. E.A. 1996. Essential oil crops.CAB International U.K.

7. Hort. 3207. Food technology and postharvest management of horticultural crops (2+1)

Importance of postharvest management of fruits, vegetables and other horticultural produce. Postharvest losses of fruits and vegetables physiology of maturity, ripening and senescence. Postharvest management techniques for fruits and vegetables, storage of fruits and vegetables ambient low temperature and controlled atmosphere storage systems, packaging of fresh and processed products.

General principles and methods of preservation. Principles of preservation by dehydration, thermal processing, chemical preservatives, fermentation, ionizing, radiation, government policies, regulations and specifications for fresh and processed products, export promotion agencies and their role in export of fresh and processed products. Postharvest technology of coconut, area nut, rubber, oilpalm. Postharvest technology of major spices, postharvest management of cut flowers.

Practical

General guidelines for establishment of a home scale processing unit, preparation of jam, jelly, pickles, sauce, preserve, dehydrated products, beverages. Quality analysis of fresh produce and processed products. Preparation of important products of spices and plantation crops. Visit to processing unit of fruits, vegetables, spices, plantation crops.

Lecture schedule

1. Fruits and vegetables their chemical composition
2. Physiology of maturity, ripening and senescence in fruits and vegetables
3. Postharvest losses – Pre and postharvest factors causing loss and spoilage of fruits and vegetables
4. Classification of preservation methods – recent advances in food preservation techniques.
5. Storage of fruits and vegetables – storage requirements.
6. Storage system

7- 8 Principles of preservation by removal of water (drying) sundrying, dehydration – pretreatments – blanching – important driers and its mode of operations.

9-11 Principles of preservation by application of heat (Thermal processing) – pasteurization – sterilization, techniques of canning and spoilage of canned products.

12. Principles of preservation by ionizing radiations
13. Principles of preservation by chemical methods – Role of sugar, brine, acid and other chemical preservatives, other food additives.

14 -15 Principles of preservation by fermentation Alcoholic, acetic and lactic fermentation processes.

16 Packaging technology – wholesale and retail packaging – packaging – packaging materials – consumer packaging.

17-19 Postharvest technology of coconut

20 Postharvest technology of Area nut.

21 Postharvest technology of Oil palm

22 - 23 Postharvest technology of Rubber

24 - 25 Postharvest technology of Tea

26 -27 Postharvest technology of Coffee

28. Postharvest technology of Cocoa
29. Postharvest technology of spices general aspects

30 Postharvest technology of pepper

31. Postharvest technology of cardamom
32. Postharvest technology of ginger, turmeric & chilies
33. Postharvest technology of Tree spices
34. Postharvest technology of essential oil yielding crops
35. Postharvest technology of cut flowers
36. Industrial waste utilization

Practical schedule

1. State of Indian fruit and vegetable processing industry. General guidelines for setting up of a small scale fruit and vegetable processing unit.

2 - 6 Analytical methods in evaluation of raw material and product quality
(a) Acidity (b) reducing sugars (c) Total and non-reducing sugars
(d) Ascorbic acid (e) SO_2 estimation (Total , free and combined)

7 - 10 Preparation of important fruit products – squashes, jams, jellies, pickles, candies, preserves, RTS beverages, sauces etc. working out there economics.

11. Preparation of coconut products and their storage
12. Estimation of moisture and oil in copra
13. Fermentation studies in cocoa and extraction of cocoa butter
14. Processing of pepper, estimation of oils and oleoresins in pepper.
15. Processing of turmeric and ginger. Estimation of oils / oleoresins in ginger, turmeric, chili.
16. Familiarization with different grades of tea and coffee. Flavour profile analysis.

Filed trips

1. Rubber processing unit
2. Arrant processing unit
3. Coconut processing unit
4. Coffee processing unit
5. Fruit and vegetable processing unit

Suggested Readings

Cruses, W.V. 1958. Commercial Fruit and Vegetable products. IV (ed) The Mc. Graw – Hill Book Company, London.

Mitra, S. K. 1997. Postharvest Physiology and Storage of Tropical Fruits CAB International UK.

Panastico, B.M 1975. Postharvest physiology, handling and utilization of Tropical and sub-tropical Fruits and Vegetables. The AVI Publishing Company, INC

Purseglove, J.W. et al 1981. Spices, Longman, New York (2 vols).

Ranganna, S. 1977. Manual of analysis of fruits and vegetables products. Tata Mc. Graw Hill Publishing Company, New Delhi.

Roger, C Griffin, J.R and Stanley Sacharow 1972. Principles of package development. The AVI Publishing Company INC, Westport, USA.

IX. AGRICULTURAL EXTENSION

1. Extn. 1201. Sociology and psychology as applied to agricultural extension (2+0)

Sociology and Rural Sociology, Meaning, Definition, Scope, Importance of Rural Sociology in Agricultural Extension and Interrelationship between Rural Sociology & Agricultural Extension. Indian Rural Society, Important characteristics, Differences and Relationship between Rural and Urban societies. Social Structure. Social Groups – Meaning, Definition, Classification, Factors considered in formation and organization of groups, Motivation in group formation and Role of Social groups in Agricultural Extension. Social Stratification – Meaning, Definition, Functions, Basis for stratification, Forms of Social stratification – Characteristics and – Differences between Class & Caste System. Cultural concepts – Culture, Customs, Folkways, Mores, Taboos, Rituals and Traditions – Meaning, Definition and their Role in Agricultural Extension. Social Values and Attitudes – Meaning, Definition, Types and Role of Social Values and Attitudes in Agricultural Extension. Social Institutions – Meaning, Definition, Major institutions in Rural society, Functions and their Role in Agricultural Extension. Social Organizations – Meaning, Definition, Types of organizations and Role of Social organizations in Agricultural Extension. Social Control – Meaning, Definition, Need of social control and Means of Social control. Social change – Meaning, Definition, Nature of Social change, Dimensions of social change and factors of social change. Social problems. Leadership – Meaning, Definition, Classification, Roles of a leader, Different methods of Selection of Professional and Lay leaders. Training of Leaders – Meaning, Definition, Methods of training, Advantages and Limitations in use of local leaders in Agricultural Extension. Concept of gender and Gender analysis. Psychology and Educational Psychology – Meaning, Definition, Scope and Importance of Educational Psychology in Agricultural Extension. Motivation. Attitude. Feelings. Emotions. Intelligence – Meaning, Definition, Types, Factors affecting intelligence and Importance of intelligence in Agricultural Extension. Personality – Meaning, Definition, Types, Factors influencing the Personality and Role of personality in Agricultural Extension. Teaching – Learning process – Meaning and Definition of Teaching, Learning, Learning experience and Learning situation, Elements of learning situation and its characteristics. Principles of adult learning and their implications for teaching.

Lecture schedule

1. Sociology – meaning, nature, definition, importance, scope and fields of sociology. Sociology and other sciences.
2. Rural sociology – meanings, definition, nature, scope and importance in agricultural extension. Interrelationship between Rural sociology and Agricultural Extension
3. Indian Rural Society – Important characteristics – Differences and relationship between Rural and Urban societies
4. Rural social structure – physical and social community, neighbourhood, association
5. Rural social institutions – meaning & definition – major institutions – family, religion, government etc – functions and their role in agricultural extension
6. Social process – forms in interaction- co-operation, competition, conflict, accommodation, assimilation – conjunctive and disjunctive process.
7. Social groups – meaning, definition, classification – factors considered in formation and organization of groups, motivation and role of social groups in agricultural extension.

8. Rural social stratification – meaning, definition, functions and basis for stratification. Forms of social stratification and characteristics, differences between class and caste system
9. Cultural concepts – culture, customs, folkways, mores, taboos, rituals and traditions – meaning, definition and their role in agricultural extension.
10. Social organizations – meaning, definition, types of organizations and role of social organizations in Agricultural Extension.
11. Social values and attitudes – meaning, definition types and their role in agricultural extension
12. Social control – meaning, definition, need and means of social control
13. Social change – meaning, definition, nature, dimensions and factors of social change.
14. Rural Leadership – meaning, definition, classification, roles and qualities.
15. Identification and selection of professional and lay leaders, Training of Leaders – meaning, definition and methods. Advantages and limitations of use of local leader in agricultural extension.
16. Gender concept and gender analysis, Gender in rural society as related to agricultural extension.
17. Social problem – meaning and causes – poverty, unemployment, crime, war – methods of solving social problems
18. Social planning – aims and peculiarities. Difficulties in social planning in India – decentralized planning.
19. Psychology as a science, definition, importance and scope of psychology, scope and importance of educational psychology in Agricultural Extension
20. Fields of psychology and schools of psychology
21. Growth, development and maturation, Individual differences
22. Sensation attention and perception
23. Motivation – its role in extension – types of motives
24. Attitude – importance and attitudinal change
25. Feelings and emotions theories of emotion – types of emotions
26. Personality and role of personality in Agricultural Extension – Personality theories and types of personality
27. Intelligence – meaning –definition and types
28. Factors affecting intelligence and importance of intelligence in agricultural extension
29. Teaching – learning process –Meaning and definition of teaching, learning – learning experience and learning situation
30. Elements of learning situation and characteristics
31. Learning theories – elements of learning situation and its characteristics
32. Principles of adult learning and its implication in teaching.
33. Principles of adult learning as applied to extension education.
34. Defence mechanism – types and methods
35. Transactional analysis – ego stages and structural analysis – life positions, strokes stamps, script and rituals
36. New areas in psychology
37. Final examination

Suggested Readings

Bhatia II.R. (1968). General Psychology. Oxford and IBII Publishing Company, New Delhi.

Chitambar, J.B. (1977). Introductory Rural Sociology Wilcy Eastern Ltd., New Delhi.
Desai A.R. (2003). Rural Sociology in India. Popular Prakasan, Bombay.
Maslow A.II. (1970). Human personality. Harper and Row Publishers, New York.
Reddy. A.A. (1987). Extension Education. Sree Lakshmi Press. Bapatla.
Plotnik, R. And Mollenauer S. (1986). Introduction to Psychology. Random House, New York
Sachdeva, D.R. and Bhushan, V. (1974). An introduction to sociology. Kitab Mahal S.D. Pvt. Ltd., Allahabad.
Samanta. R.K. and Arora, S.K. (Eds) (1997). An introduction to sociology. Kitab Mahal S.D. Pvt. Ltd., Allahabad.
Samanta. R.K. and Arora, S.K. (Eds) (1997). Management of Agricultural Extension in global Perspectives. B.R. Publishing Corporation. New Delhi.
Sharma. R.N. (1975). Introductory Sociology. Rajhans Prakashan mandir, Meerut.
Woliman, B.B. (1973). Hand book of general psychology. Prentice Hall, Englewood, New Jersey.

2. Extn. 2102. Agricultural extension and rural development (1+1)

Education – Meaning, Definition, Types – Formal, Informal and Non-formal education and their Characteristics. Extension Education and Agricultural Extension – Meaning, Definition, Concepts, Objectives and Principles. Rural development – Meaning, Definition, Concepts, Objectives, Importance and Problems in rural development. Developmental programmes of pre-independence era –Development programmes of post-independence era, Community Development Programme – Meaning, Definition, Concepts, Philosophy, Principles, Objectives, Differences between Community Development and Extension Education, National Extension service. Panchayat Raj system – Meaning of Democratic – Decentralization and Panchayat Raj, Three tiers of Panchayat Raj system, Powers, Functions and Organizational setup. Agricultural Development Programmes with reference to year of start, objectives & sailent features – Intensive Agricultural District Programme (IADP), High Yielding Varieties Programme (HYVP), Institution Village Linkage Programme (IVLP), Watershed Development Programme (WDP), Hariyali, National Agricultural Technology Project (NATP), ATMA, ATIC. Social Justice and Poverty alleviation programmes – Integrated Tribal Development Agency (ITDA), Integrated Rural Development Programme (IRDP), Swarna Jayanthi Gram Swarojgar Yojana (SGSY), Prime Minister's Employment Yojana (PMEY). New trends in extension, privatization. Women Development programmes – Development of Women and Children in Rural Areas (DWCRA), Rashtriya Mahila Kosh (RMK), Integrated Child Development Scheme (ICDS) and Mahila Samriddi Yojana (MSY). Women in Agriculture. Reorganized extension system (T&V System) – Salient features, Fort night Meetings, Monthly workshops, Linkages, Merits and Demerits. Krishi Bhavan Approach. Emergence of Broad Based Extension (BBE).

Practical

Visits to a village and kisan mandal to study the ongoing development programmes. Visits to Panchayat Raj Institutions to study the functioning of Gram Panchayat (GP) & Zilla Praja Parishad (ZPP). Visit and study the District Rural Development Agency (DRDA). Participation in monthly workshops of Training and Visit (T & V) System. Visit to Watershed Development Project area. Visit to a village to study the Self Help Groups (SHGs) of DWCRA. Visit to a voluntary organization to study the developmental activities. Organizing PRA techniques in a village to identify the agricultural problems.

Lecture schedule

1. Education – Meaning, definition – types – formal, informal and non –formal education and their characteristics.
2. Extension education & Agricultural Extension – Meaning – definition – concepts – objectives and principles
3. Rural development – meaning, definitions, concepts, objectives, importance & problems in rural development
4. Development programmes of pre – independence era – Sriniketan, Marthandam, Gurgaon experiment and Gandhian constructive programme development programmes of post independence era, Firka development – Etawah pilot project - & Nilokheri experiment.

5-6 Community development programme – meaning - definition – concepts – philosophy – principles – objectives -differences between Community Development and Extension Education – National Extension service.

7. Panjayat Raj system – meaning of democratic decentralization & Panchayat Raj
8. Three tiers of Panchayat Raj system – powers, functions and organisational set up

9. Agrficultural Development Programmes with reference to year of start, objectives and salient features. Intensive Agricultural District Programme (IADP), High Yielding Varieties Programme (HYVP), Institutional Village Linkage Programme (IVLP) Watershed Development Programme (WDP)

10. National Agricultural Technology Project (NATP) Agricultural Technology & Management Agency (ATMA) Agricultural Technology Information Centre (ATIC)

11. Social justice & Poverty alleviation Programmes – Integrated Tribal Development Agency (ITDA) Integrated Rural Development Programme (IRDP)

12. Swarnajayanthi Gram Swarojgar Yojana (SGSY) Prime Ministers Employment Yojana (PMEY)

13. New trends in extension, privatization

14. Women Development Programmes – Development of women & Children in rural areas (DWCRA) Rashtriya Mahila Kosh (RMK) Integrated Child Development Scheme (ICDS) Mahila Samriddi Yojana (MSY)

15. Women in Agriculture

16. Recognized extension system (T&V system) Salient features , fortnightly meetings monthly workshops, linkages – merits and demerits

17. Krishi Bhavan Approaches – Emergence of Broad Based Extension
18. Participatory Approaches

Practical Schedule

1-3 Visit to Panchayat Raj Institutuons to study the functioning of Grama Panchayat Block & Zilla Panchayat.
4. Visit to Watershed Development areas
5-6 Visit to voluntary organizations to study their activities
7. Visit to DWCRA unit
8-9 Visit to conduct case studies of SHG's
10-11Visit to Kudumabasree units
12 Visit to KISSAN
13. Visit to SIRD & ETC
14-16 Organising PRA technichques in a village to identify agricultural problems
17. Organizing one days seminars in the village based on the identified problems.

Suggested Readings

Dharma, O.P. and Bhatnagar, O.P (2003). Education and Commnication for Development Oxford, IBH, New Delhi
Desai, A.R. (2003). Rural Sociology in India. Popular Prakashan, Bombay
Khana, B.S. (1991). Rural Development in South Asia-India. Deep and Deep Publication, New Delhi.
Kthari, G.R. (1991). Rural Development Vo. I & II. Marak Publications Pvt. Ltd., Delhi.
Mollett, S.M. (1984). Planning for Agl. development. Martin Press, London.
National commission on Agriculture. (1976). Scientific technical report Part XIV. Ministry of Agriculture and Cooperation, New Delhi.
Mondal, S. and Ray G.L (2007) A Text book of Rural Development. Kalyani Publishers, Chennai
Pitale, R.L. (1982). Project appraisal technique. Oxford and IBH Pub. Co., New Delhi.
Ray G.L(2007)Extension Communication and Management .Kalyani Publishers, Chennai
Readdy. A.A. (1987). Extension Education. Sreelekshmy Press, Bapatta.
Van den Ban, A.W. and Hawkins, H.S. (1988). Agricultural Extension. Longman Publishing Company, New York.
Samanta, R.B.(1991) Agricultural Extension in Changing World perspective.UDH publishing,New Delhi
Stephen R R and David D(1997) Fundamentals of Management. Pearson Prentice Hall,New Delihi

3. Extn.3103. Communication and extension methodologies for transfer of agricultural technology (1+1)

Communication – Meaning, Definition, Models, Elements and their Characteristics, Types and Barriers in communication. Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking. Extension Teaching methods – Meaning, Definition, Functions and Classification. Individual contact methods – Farm and Home visit, Result Demonstration, Field trials – Meaning, Objectives, Steps, Merits and

Demerits. Group contact methods – Group discussion, Method demonstration, Field Trips – Meaning, Objectives, Steps, Merits and Demerits. Small group discussion techniques – Lecture, Symposium, Panel, Debate, Forum, Buzz group, Workshop, Brain Storming, Seminar and Conference. Mass contact Methods – Campaign, Exhibition, Kisan Mela, Radio & Television – Meaning, Importance, Steps, Merits & Demerits. Factors influencing selection of Extension Teaching Methods and Combination (Media Mix) of Teaching methods. Innovative Information sources – Internet, Cyber Cafes, Video and Tele conferences, Kisan call centers, Consultancy clinics. Agricultural Journalism – Meaning, Scope and Importance, Sources of news, Types, Merits and Limitations. TOT through distance education mode. Diffusion and Adoption of Innovations – Meaning, Definition, Models of adoption Process, Innovation – Decision Process – Elements, Adopter categories and their characteristics, Factors influencing adoption process. Capacity building of Extension Personnel and Farmers – Meaning, Definition, Types of training, Training to farmers, farm women and Rural youth – FTC and KVK. Gender concerns and TOT approaches. Extension Programme Planning – Meaning, Definitions of Planning, programme, Project, Importance, Principles and Steps in Programme Development Process, Monitoring and Evaluation of Extension Programmes.

Practical

Simulated exercises on communication. Audio Visual aids – Meaning, Importance and Classification. Selection, Planning, Preparation, Evaluation and Presentation of visual aids. Planning & Preparation of visual aids – Charts, Posters, Over Head Projector, (OHP) Transparencies, Power Point Slides. Planning and Preparation of Agricultural Information materials – Leaflet, Folder, Pamphlet, News Stories, Agrl. features. Handling of Public Address Equipment (PAE) System, Still camera, Video Camera and Multimedia Projections. Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations. Organization of Group discussion and Method demonstration. Visit to KVK / FTC. Planning and Writing of scripts for Radio and Television. Identifying the Problems, Fixing the Priorities and selecting a most important problem for preparation of a project. Developing a project based on identified problems in a selected village and implement them.

Lecture schedule

1. Introduction to course content, and orientation
2. Communication –meaning, definition, concept, importance and special features of agricultural communication
3. levels of communication – interpersonal, intrapersonal, group, mass communication, organisational communication – elements of communication source, message, chanel, receiver – feed back – an analysis of models of Berlo, Leagans, Shannon and Weever and others.
4. Barriers in communication – defensiveness in communication- overcoming Barriers. communication skill – verbal and non verbal communication.
5. Listerning skills, writing skills, oral presentation skills
6. Field diary and lab record, indexing, foot note, bibliographic procedure. Reading and comprehension of general and technical articles – press writing, summarising abstracting.
7. Public speaking – types – purpose- methods of presentation

8. Extension teaching methods – meaning, definition, functions and classification – Individual contact methods – farm and home visit, result demonstration, field trials, objectives, steps, merits and demerits.

9. Group contact methods – method demonstration, field trips, small group discussions, lecture, symposium, panel, debate, forum, buzz group workshop, brain storming, seminar and conference – objectives steps, merits and demerits

10. Mass contact methods – compaign, exhibition, Kisan mela, Radio and television – meaning, objectives, steps, merits and demerits.

11. Factors influencing selection of extension teaching methods and combination of (media mix) of teaching methods

12. Innovative Information sources – Internet, cyber cafes, video and Tele conferences, Kisan call centres, consultancy clinics.

13. Agricultural Journalism – meaning, scope and importance, sources of news, types, merits and limitations, ToT through distance education mode.

14. Communication in social system – Diffusion and adoption – communication flow models – Key communication and their role in communication

15. Adopter categories, characteristics of adopter categories and rate of adoption. models of adoption process and factors influencing adoption

16. Capacity building of Extension personnel and farmers- meaning, definition, types of training – training to farmers, farm women, rural youth – FTC and KVK

17. Gender concern and TOT approaches – Extension programme planning – meaning, definition of programme planning, plan, project and its importance – principles of programme planning.

18. Steps in programme Development process, monitoring and evaluation of extension programmes.

Practical schedule

1-2 Audio visual aids – meaning, importance and classification and familiarisation of aids.
3-4 General principles, procedures and preparation of poster, charts and graphs,
5-6 Projected visual aids, slides, film strip, overhead projector, opaque projection, episcope, visualiser, LCD, projector, planning, preparation and presentation
7. Practice in oral communication, power point presentation and multi media use, handling of PA system, LCD etc.
8. Practice session in listening skills, role taking, writing skills, indexing, bibliographic procedures.
9-10 Presentation of a topic, oral communication – using ICT
11-12 Organising group discussion and method demonstration
13. Writing script for radio and television
14-15 Collection of basic information from selected Panchayath and conduct of PRA – presentation of report.

16. Problem identification, prioritization and finding solution – preparing plan of work and calendar of operation
17-18 Execution of the plan in the area

Suggested Readings

Alexander Lewis. (1990) Beyond the facts, A guide to the art of feature writing. Delhi, Surjeet Publication
Applebaum. R.L., Anatol, K.W.E., Hays, E.R., Jensan, O.O., Porla, R.E. mandel, J.E. (1973). Fundamental concepts in human communication. Harper & Row, New Yorl.
Berlo, D.K. (1960). The process of communication. holt, Rinehart and Winston, New york.
Blun, A. (1996). Teaching and Learning in Agriculture – A Guide for agricultural education, FAO, Rome,
Chandrakantan, K and Palaniswamy, (2000). Advances in communication Technology, Indian PublishersRaydu, C.S., (1993). Media and Communication Management Himalaya Publishing House, Mumbai.
Dahama, O.P. and Bhatnagar, O.P. (2003). Education and Communication for Development. Oxford, IBH, New Delhi.
Flesche, R. (1997). How to write, speak and think more effectively. Happer & Row, New York.
Ray, G.L. (1991). Extension Communication and Management. Naya Prokash, Calcutta.
Rogers, E.M. (1983). Diffusion of Innovations. Free Press, New York.
Rogers, E.M. and Shoemarker, F.F. (1971). Communication of Inovations. A Cross cultural Approach, Free Press, New York.

4. Extn.3204. Entrepreneurship development and extension management (1+1)

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalisation and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; entrepreneurial motivation, enterprise launching and management; Entrepreneurship development programmes for women. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of agri inputs industry. Social Responsibility of Business. Social auditing. Project Preparation and Appraisal. CB ratio NPV and IRR. Nature, scope, principles of management and administration with special reference to agriculture. POSDCoRB, MBO, Result Based Management(RBM), Six zigma, TQM, Decision making process, MIS, PERT/CPM.

Practical

Exercises on self appraisal techniques, creativity, Projective techniques, Project preparation, launching, marketing, need analysis and demand analysis. Entreprise visit, case analysis of successful enterprises. Exercises on management skills, simulation games.

Lecture schedule

1. Concept and Theory of development – need, scope and prospects of Entrepreneurship Development

2. Entrepreneurship development process. Enterprise management and social responsibility
3. Enterprise meaning, definition, characteristics and types of enterprise.
4. Concept of entrepreneurship, entrepreneurial and managerial characteristics.
5. Entrepreneurial motivation, enterprise launching and management, entrepreneurial decision, overviewof social, political and economic system
6. Psychological, and sociological theories of entrepreneurship
7. Entrepreneurship programme- government schemes – incentives for promotion. Public private partnership – agri input industry
8. Project preparation and appraisal – cost benefit ratio – NPV, IRR, PBP
9. Extension Management – nature, scope, public administration vs Extension – management process – POSD CoRB functions and roles
10. Decision making tools – types of decision making – decision tree- limitation – DSS
11. MBO and MIS Objectives – procedure, problems and limitations
12. Result based management (RBM) TQM – concept features and principles
13. Network analysis – PERT / CPM – Float – slack – events and activities
14. Management of Stress – types of stress – coping strategies – stress antidotes – and relaxation techniques
15. Team building process – organization climate – importance – Time management – need and importance and techniques
16. Performance management – PDCA approach – quality circle –(QCC) – balance score card (BSC) concept and its importance –
17. Six sigma – concept, strategy, steps in tactics – DMAIC methodology – tools for six sigma – CTQ process map – Pareto chart – fish bone analysis – run chart

Practical schedule

1-3. Simulation games and motivation exercises for developing entrepreneurial abilities
4-6. Development of business plan, project planning, financial management, NPV and IRR
7-11. Interface with successful entrepreneur
12-13. Exercise on professional managers – roles and styles
14-16. Simulation games on team building
17-18. Exercise on management games – time management – stress management – personality inventory

Suggested Readings

Akhodri. N.M.P. etl (1989). Trainers Manual on Developing entrepreneurial motivation. NIES Bud. New Delhi.

ED. Institute of India. (1987). Developing New entrepreneurs. EDII. Ahmedabad. NISIET. libraries . 338.93/EDI.

Rao. T.V. (11974). Development of an entrepreneur: A behavioural model IIM (A)

Goyal. D.P. (1994). Management information system (MIS). concept applications. New Delhi. Deep and Deep, New Delhi

James S A.F and Freeman, R.E. (1994). Management. New Delhi. Prentice Hall of India. Pvt. Ltd.

Drucker,P.F (1964). Managing for results. Harper and Row. New York

Huber,G.P (1980). Managerial decision making. Glenview inc. Scot Foresman.

Hussain, B (1989). Decision support system: Principles and practices. St. Paul. West Publishing. co.
Reddin, W.J. (1971). Effective management by objectives. The three D. method of MBO.. Mc Grawhill. New York
Chatterjee. S.S (1988). Introduction to management its principles and techniques Gold press. Calcutta.
Blanahard,H.K (1985). Management of organisational behaviour. Utilising human resources. Prentice Hall. New Delhi.

5. Extn.4105. Rural agricultural work experience (RAWE) 20

Co-ordination of RAWE programme will be carried out by the Department of Agricultural Extension and will be conducted in a multidisciplinary mode.. RAWE Model II with slight modification is chosen.

Sl.No.	RAWE Model II	Duration (Week)
1.	Orientation	1
2.	Village attachment	6
	Krishi Bhavan Training	1
	Watershed Management Analysis	1
	Farm Planning	1
	SHG Training	1
	Village stay programme	2
3.	Agri-clinics / Plant Health Clinics / Experiential Learning / Industrial attachment	12
	Agri-clinics	2
	Attachment to progressive farmers	2
	NGO Training	1
	Industrial attachment	1
	EDP and Project management	2
	Research Station Training	1
	KVK Training	1
	Bank attachment	1
	Media attachment	1
4.	Project report preparation and examination	1

X. PLANT PHYSIOLOGY

1. Crps. 2201. Crop physiology (2+1)

Introduction, importance in agriculture. Seed physiology, seed structures, morphological, physiological and biochemical changes during seed development, physiological maturity – morphological and physiological changes associated with physiological maturity in crop, harvestable maturity, seed viability and vigour, factors affecting seed viability and vigour. Methods of testing seed viability and vigour, germination, utilization of seed reserves during seed germination, morphological, physiological and biochemical changes during seed germination, factors affecting seed germination. growth and development, definition, determinate and indeterminate growth, monocarpic and polycarpic species with examples. Measurement of growth, growth analysis growth characteristics, definitions and mathematical formulae. Crop water relations, physiological importance of water to plants, water potential and its components, measurement of water status in plants. Transpiration, significance, transpiration in relation to crop productivity, water use efficiency, WUE in C_3, C_4 and CAM plants. Factors effecting WUE. Photosynthesis, Energy synthesis, significance of C_3, C_4 and CAM pathway, relationship of photosynthesis and crop productivity, photorespiration; Factors affecting photosynthesis and productivity, methods of measuring photosynthesis, photosynthetic efficiency. Translocation of assimilates, phloem loading, apoplastic and symplastic transport of assimilates, source and sink concept, dry matter partitioning, harvest index of crops, respiration and its significance, brief account of growth respiration and maintenance respiration, alternate respiration – salt respiration – wound respiration – measurement of respiration. Nutriophysiology – definition – classification of plant nutrients based on quantity, function and mobility – physiology of nutrient uptake – functions of plant nutrients – deficiency and toxicity symptoms of plant nutrients – foliar nutrition – hydroponics. Introduction of photoperiodism and vernalisation in relation to crop productivity – photoperiodism. Plant growth regulators – occurrence – biosynthesis – mode of action of auxins, gibberellins, cytokinins, ABA, Ethylen. Novel plant growth regulators, commercial application of plant growth regulators in agriculture. Senescence – physiological and biochemical changes and their significance. Post harvest physiology – seed dormancy – definition – types of seed dormancy – advantages and disadvantages of seed dormancy – causes and remedial measures for breaking seed dormancy, optimum conditions of seed storage – factors influencing seed storage (ISTA standards). Fruit ripening - metamorphic changes – climateric and non-climeteric fruits – hormonal regulation of fruit ripening (ethrel, CCC, polaris, paclobuterazole).

Practical

Preparation of solutions; growth analysis; calculation of growth parameters; yield analysis, measurement of leaf area by various methods; methods of measuring water status in roots, stems and leaves; measurement of water potential by Chardakov's method; measurement of absorption spectrum of chloroplastic pigments; Chlorophyll fluorescence and its applications. Measuring photosynthetic rate using IRGA; measuring light intensity; leaf anatomy of C_3 and C_4 plants; stomatal frequency and index – respirometer – measurement of respirometer; measurement of transpiration rate; imbibition of seed; optimum conditions for seed germination; breaking seed dormancy; (a) Chemical method (b) Mechanical method; seed viability and vigour tests; plant growth regulator – quantification and its effect on plant processes.

Lecture schedule

1. Introduction; importance of crop physiology in agriculture
2. Seed physiology: seed structures; morphological, physiological and biochemical changes during seed development
3. Physiological maturity: morphological and physiological changes associated with physiological maturity in crop; harvestable maturity
4. Seed viability and vigour; factors affecting seed viability and vigour; methods of testing seed viability and vigour
5. Methods of testing seed viability and vigour
6. Seed germination; utilization of seed reserves during germination; physiological and biochemical changes during seed germination – factors affecting seed germination –
7. Seed dormancy : classification of dormancy , causes of dormancy and measures for breaking dormancy.
8. Seed storage: optimum conditions of seed storage and factors influencing seed storage (ISTA standards)
9. Fruit ripening: metamorphic changes, climacteric and non-climacteric fruits, hormonal regulation of fruit ripening (use of ethrel, CCC, polaris, paclobutrazol)
10. Growth and development: definition, determinate and indeterminate growth, monocarpic and polycarpic species with examples.
11. Measurement of growth: growth analysis, importance of growth analysis, growth indices- RGR, CGR, NAR, LA, SLA, SLW.
12. Dry matter production and physiological efficiency, growth curves, mathematical expression of growth.
13. Crop water relation, physiological importance of water to plants, water potential – definition and components of water potential, measurement of water potential.
14. Transpiration, significance of transpiration, stomatal, lenticular and cuticular transpiration, mechanism of transpiration
15. Transpiration in relation to crop productivity – WUE in C_3, C_4 and CAM plants – factors affecting transpiration and WUE – Antitranspirants.
16. Photosynthesis : radiant energy , efficiency of plants in converting radiant energy to chemical energy.
17. Plant pigments in relation to photosynthesis, chloroplast structure, chlorophyll forms and reaction to light.

18. Hill reaction, red drop, emersion enhancement effect, two-pigment system, photosynthetic phosphorylation and production of assimilatory power.
19. C_3, C_4 and CAM pathway – significances.
20. Relationship of photosynthesis and crop productivity, significance of photorespiration.
21. Factors affecting photosynthesis and productivity – methods of measuring photosynthesis, photosynthetic efficiency of plants.
22. Translocation of assimilates in plants, phloem loading, apoplastic and symplastic transport, source-sink relation, dry matter partitioning and harvest index of crops.
23. Respiration: aerobic and anaerobic, importance and functions of high-energy phosphates.
24. Glycolysis, Krebs cycle, electron transport systems.
25. Alternate respiration, salt respiration, and wound respiration, measurement of respiration.
26. Nutriophysiology, definition, importance and classification of nutrients.
27. Role of nutrients in plant metabolism, growth and development.
28. Deficiency and toxicity symptom of nutrients in plants.
29. Foliar nutrition, hydroponics and significance.
30. Photoperiodism and vernalisation in relation to flowering.
31. Plant growth regulators, classification.
32. Biosynthesis and mode of actions of auxins, Gibberilin, and cytokinins
33. Biosynthesis and mode of actions of ABA, ethylene, and other growth retardants.
34. Novel PGR, Commercial application of plant growth regulators in agriculture and horticulture
35. Senescence: definition, classification – genetic, correlative and environmental – mechanism of senescence.
36. Abscission – definition – mechanism of abscission and significance.

Practical Schedule

1. Preparation of solutions.
2. Growth analysis; calculation of growth parameters
3. Yield analysis.
4. Measurement of leaf area by different methods.
5. Measurement of water status in plant parts.
6. Measurement of water potential by Chardakov’s dye method
7. Measuring photosynthetic rate using Portable Photosynthesis system.

8. Chlorophyll fluorescence and its application.
9. Measuring light intensity in canopies.
10. Leaf anatomy of C_3, C_4 and CAM plants.
11. Stomata; structure; frequency and index
12. Identification of plant nutrient deficiency symptoms.
13. Measurement of transpiration rate.
14. Detection of NPK deficiencies in plant samples by rapid tissue testing.
15. Imbibition and Seed germination studies
16. Seed dormancy- methods of breaking dormancy.
17. Seed viability and vigour tests
18. PGRs – quantification and its effect on plant growth auxins GA
19. PGRs – quantification and its effect on plant growth cytokinine

Suggested Readings

Devlin R.M. 1979. Plant Physiolgoy II End. Affiliated East West Press, New Delhi
Noggle G.R. & Fritz G.J. 1992. Introductory Plant Physiology II End. Prentice Hill of India (P) Ltd., New Delhi
Bidwil R.G.S. Plant Physiology II End. Macmillan, Publishing Co., Inc. New York
Salisburry, F. B. & Ross. C.W. Plant Physiology, CBS Publishers & Distributors, New Delhi
Milthrope, F.L. and Marby, J. 1979. An introduction to Crop Physiology, Cambridge University Press, London
Devlin R. M. and Witham F. H. 1983. Plant Physiology 4th Edn. CBS Publishers and Distributors, New Delhi.
Gupta .N.K and Sunita Gupta.2002. Plant Physiology. Oxford & IBH Publishing Co.Pvt.Ltd.NewDelhi.
Malick ,C.P and Srivastava,A.K.2000.Text book of Plant Physiology.Kalyani publishers,New Delhi.

XI. AGRICULTURAL MICROBIOLOGY

I. Micr. 1101. Agricultural Microbiology (2+1)

Introduction to microbial world - history of microbiology - Spontaneous generation theory – prokaryotic and eukaryotic microorganisms – bacterial cell - morphology and structure - germ theory of disease - protection against infections - applied areas of microbiology - metabolism in bacteria - ATP generation - chemoautotrophy, photoautotrophy, respiration, fermentation – bacteriophages - structure and properties of bacterial viruses – lytic and lysogenic cycles - viroids, prions - bacterial genetics - gene expression - genetic recombination - transformation, conjugation and transduction - genetic engineering - plasmids, episomes - genetically modified organisms - soil microbiology - microbial groups in soil - microbial transformations of carbon, nitrogen, phosphorus and sulphur - biological nitrogen fixation - microflora of rhizosphere and phyllosphere microflora - microbes in composting - microbiology of water - microbiology of food - role of microbes in fermentation - microbial spoilage and principles of food preservation - beneficial microorganisms in agriculture - biofertilizer (bacterial, cyanobacterial and fungal) - microbial insecticides - microbial agents for control of plant disease – biodegradation - biogas production - biodegradable plastics - plant microbe interactions – beneficial – symbiotic, associative and non symbiotic – PGPR – plant pathogens.

Practical

General instructions - familiarization with instruments, materials, glassware etc. in a microbiology laboratory - practice of aseptic methods: I - evaluation of aseptic technique with nutrient broth tubes. II- evaluation of aseptic technique with a nutrient agar plate - methods of sterilization and preparation of media I- preparation of nutrient broth, nutrient agar plates, nutrient agar slant and nutrient agar stabling; II- sterilization of glassware by dry heating; III - sterilization of nutrient broth by filtration - plating methods for isolation and purification of bacteria I - isolation of bacteria by streak plate method. II - isolation of aerobic spore forming bacteria by enrichment using streak plate method. III - checking of purity of a bacterial culture by streak plating method - identification of bacteria by staining methods and biochemical tests: I– morphological examination of bacteria by simple and differential staining. II – different biochemical tests for identification of bacterial culture; enumeration of bacteria: I - enumeration of bacteria by stain slide method. II- enumeration of bacteria by most probable number method. III - enumeration of bacteria by pour plate method and spread plate method.

Lecture Schedule

1-2. Introduction to microbial world – history of microbiology – important contributions - spontaneous generation theory – germ theory of diseases -applied areas of microbiology
3. Prokayotic and eukaryotic microorganisms – differences
4-6. Bacterial cell morphology and structure
7. Nutrition and nutritional groups of bacteria
8-9. Metabolism in bacteria - ATP generation – respiration - fermentation
10-11. Bacteriophages – structure and properties of bacterial viruses – lytic and lysogenic cycles – viroids, prions

12-14. Bacterial genetics – gene expression – genetic recombination – transformation, conjugation and transduction

15. Genetic engineering – plasmids, episomes, genetically modified organisms

16. Soil microbiology - microbial groups in soil
17-18. Microbial transformation of C, N, P & S
19. Mid term examination
20. Biological nitrogen fixation
21. Rhizosphere and phyllosphere microflora
22. Microbes in composting
23. Microbiology of water
24. Food microbiology – microbial spoilage – principle of food preservation
25-27.Beneficial microorganisms in agriculture – biofertilizers – bacterial, cyanobacterial and fungal

28-29. Microbial inoculants for management of plant diseases – microbial insecticides

30-31. Biodegradation of pesticides, herbicides and agricultural wastes
32. Biogas production
33. Biodegradable plastics
34-35. Plant microbe interactions – beneficial – symbiotic, associative and non symbiotic
36. Plant microbe interaction – Plant growth promoting rhizobacteria- plant pathogens

Practical Schedule

1. Use and care of microscope – focusing
2. Familiarization with instruments, glassware and other materials in a microbiology laboratory

3. Preparation of media – nutrient broth – nutrient agar plates, slant etc
4-5.Sterilization – different methods of sterilization – sterilization of glasswares – sterilization by filtration

6. Evaluation of aseptic techniques with nutrient broth tubes

7. Evaluation of aseptic techniques with nutrient agar plates
8. Isolation of bacteria by streak plate method
9. Isolation of aerobic spore forming bacteria by enrichment
10. Checking of purity of a bacterial culture by streak plating
11. Identification of bacteria – staining techniques – simple staining
12. Differential staining – gram staining
13-14. Identification – biochemical tests
15-18. Enumeration of bacteria – stain slide method-Enumeration of bacteria by MPN method-Enumeration of bacteria – pour plate and spread plate method

Suggested Readings

Pelczar,M.J.,Chan, E.C.S.and Kreig, N.R. 1993. *Microbiology*. Tata McGraw Hill Publishing Co., Ltd., New Delhi.
Stanier ,R.Y., Ingraham, Wheelis ,M.G. and Paintor ,P.R. 1986.*The Microbiology World.* Prentice Hall, New Jersey.

Tauro, P., Kapoor, K.K. and Yadav, K.S. 1989 . *An Introduction to Microbiology.* Wiley Publications ,New Delhi.
Alexander, M. 1985. *Introduction to Soil Microbiology* .John Wiley & Sons , New York.
Subba Rao, N.S. 1999 .*Biofertilizers in Agricultural and Agroforestry* .Oxford & IBH , New Delhi.
Subba Rao , N.S. 1995 .*Soil Microorganisms and Plant Growth* .Oxford & IBH , New Delhi.

XII. STATISTICS AND COMPUTER APPLICATION

1. Stat. 1201. Basic statistics (1+1)

Introduction: Definition of Statistics, its use and limitations, Functions of Statistics, Collection of Statistical Data. Formation of Frequency Distribution. Diagramatic and Graphical presentation of Statistical Data. Measures of Central Tendency: Characteristics of an ideal average. Arithmetic mean, Median, Mode, Geometric Mean and Harmonic Mean. Comparisons of these averages and the selection of appropriate average. Properties of Arithmetic Mean. Weighted Arithmetic Mean. Measures of Dispersion: Definition. Characteristics of a good measure of Dispersion. Range, Quartile Deviation, Mean Deviation and Standard Deviation. Relative measures of Dispersion – Coefficient of Variation. Skewness, Kurtosis and their measures. Correlation. Scatter Diagram. Correlation Coefficient. Rank Correlation Coefficient. Coefficient of Concordance. Regression. Linear Regression and its applications in Agriculture, Interpretation of Regression Coefficicent. Correlation Vs. Regression. Probability: Definition and Concept of Probability, Addition, Multiplication and Compound Theorems on Probability. Binomial, Poisson and Normal Distributions. Introduction to Sampling. Sampling Distribution and Standard Error. Sample Surveys in Agriculture. Simple Random Sampling, Stratified Random Sampling, Systematic Sampling, Cluster and Multi-Stage Sampling, Purposive Sampling. Tests of Statistical Hypothesis. Definition of Hypothesis. Type I and II Errors. Steps involved in Testing of Hypothesis. Level of Significance and Degrees of Freedom. Crtitical Region. Large Sample Tests – Z transformation of the Correlation Coefficient . Small Sample Tests. Tests for equality of Means and Variances, t and F tests. Paired t-Test. Tests of Significance of Correlation Coefficient. Chi-Square Test – Assumptions, Limitaions and Applications. Contingency Table. Yates' Correction for Continuity. Analysis of Variance – One-way and two-way classified data.

Practical

Formation of Frequency Distributions, Diagramatic and Graphical presentations, Computation of different measures of Central Tendency and Dispersion, Coefficient of Variation, Coefficient of Skewness and Kurtosis, Simple Correlation Coefficient, Regression Coefficient, Rank Correlation Coefficient and Coefficient of Concordance. Fitting of Linear Regression models for prediction. Simple problems on Probability. Fitting of Binomial and Poission Distributions, Problems based on Normal Distribution. Large Sample Tests for Mean, Variance and Correlation Coefficient. F test, t test for Mean, Correlation Coefficient. Paired t test, Chi-Square test of goodness of fit and test of independence of Attributes.

Lecture Schedule

1	Introduction – importance of statistics -Elementary statistical concepts – functions of statistics – collection of statistical data – formation of frequency distribution
2	Diagrammatic and graphical presentation of Statistical data
3	Measures of central tendency – requisites for an ideal measure of central tendency – Arithmetic mean – its calculation – properties – weighted arithmetic mean
4	Median and other measures of location – Formula for calculation – merits and demerits – comparison of different averages

5	Measures of dispersion – range – mean deviation – quartile deviation – their calculation
6	Standard deviation and variance – comparisons among different measures of dispersion and their applications to specific situations – relative measures of dispersion – coefficient of variation – measures of skewness and kurtosis
7	Presentation of bi-variate data – scatter diagram – measures of association – product moment correlation coefficient – rank correlation – coefficient of concordance
8	Linear regression – its application in agriculture – interpretation of regression coefficient – correlation vs. regression
9	Elementary ideas on probability – addition and multiplication theorems on probability
10	Binomial theorem on probability – binomial and poisson distribution
11	Normal distribution – its importance in statistics – Normal probability integral
12	Elementary ideas on sampling – sampling distributions and standard error
13	Simple random sampling – selection of a simple random sample – estimation of parameters in SRS – choice of sample size – stratified random sampling – advantages – equal, proportional and Neyman's optimum allocation
14	Systematic sampling, cluster sampling and multistage sampling – their applications in agricultural surveys
15	Tests of statistical hypotheses – critical region – large sample tests – Z transformation of the correlation coefficient
16	Small sample test – tests for equality of means and variances – t and F tests – applications and assumptions – Test of significance of correlation coefficient
17	Chi – square test – assumption and limitations – application of chi – square test – Yates' correction for continuity
18	Introductory ideas on analysis of variance – assumptions underlying analysis of variance – ANOVA of one way and two way classified data

Practical Schedule

1	Formation of frequency distribution
2	Diagrammatic presentation of statistical data
3	Graphic presentation of statistical data
4	Calculation of various measures of central tendency
5	Computation of various measures of dispersion
6	Calculation of coefficient of variation – coefficients of skewness and Kurtosis
7	Computation of product moment correlation coefficient – rank correlation coefficient and coefficient of concordance
8	Fitting of linear regression models for prediction
9	Simple problems on probability – fitting of binomial distribution
10	Fitting of Poisson distribution and Normal distribution using agricultural data
11	Selection of simple random sample – estimation of parameters – sample size determination
12	Selection of stratified random sample – equal, proportional and Neyman's allocation in stratified sampling
13	Large sample tests
14	Small sample tests – t and F tests

15 Paired t test – Cochran and Cox 't ' test, Tests on correlation coefficients
16 Chi – square test of goodness of fit – test of independence of attributes in a contingency table
17 Analysis of variance – one way classification
18 Analysis of variance – two way classification

Suggested Readings

Gupta.S.C. and Kapoor.V.K. (1997) Fundamentals of Mathematical Statistics. Sultan Chand & Sons Publisher, New Delhi.
Chakravorthi. S.R. and Giri.N. (2002) Basic Statistics. South Asian Publishers, New Delhi – 110 014.
Cochran.W.G. (1989) Sampling Techniques. Oxford and IBH Publishing Co.
Snedecor.G.W. and Cochran.W.G. (1992) Statistical Methods. Oxford and IBH Publishing Co.

Rangaswamy. R. (2002) A text book of Agricultural Statistics. John Wiley & Sons
Balakrishnan. N. (2002) Statistical Methods and Practice. Prentice Hall of India.
Croxton and Cowden. (1966) Applied General Statistics. Prentice Hall of India Pvt. Ltd., New Delhi.
Fisher. R.A. (1950) Statistical Methods for Research Workers – 11th Edition. Oliver & Boyd, Edinburg.
Fisher.R.A. and Yates (1948) Statistical Tables for Biological, Agricultural and Medical Research. Oliver & Boyd, Edinburg.
Panse. V.G. and Sukhatme. P.V. (1967) Statistical Methods for Agricultural Workers. ICAR, New Delhi.
Ferrold H. Zar. (2005) Biostatistical Analysis. Fourth Edition, Pearson Education, India.

2. Stat. 2102. Introduction to computer applications (1+1)

Introduction to Computers, Anatomy of Computers, Input and Output Devices. Units of Memory, Hardware, Software and Classification of Computers. Personal Computers, Types of Processors, Booting of Computer, Warm and Cold Booting. Computer Viruses, Worms and Vaccines. Operating System – DOS and WINDOWS. Disk Operating System(DOS): Some fundamental DOS Commands, FORMAT, DIR, COPY, PathH, LABEL, VOL, MD, CD, DEL and TREE, Rules for naming files in DOS and Type of files. WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, Working with files and folders, Setting Time and Date, Starting and Shutting down of WINDOWS. Anatomy of WINDOW, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars. Applications – MSWORD: Word Processing and Units of Document, Features of Word Processing Packages. Creating, Editing Formatting and Saving a document in MSWORD. MSEXCEL: Electronic Spreadsheets, Concept, Packages. Creating, Editing and Saving a Spreadsheet with MSEXCEL. Use of in-built Statistical and other functions and writing Expressions. Use of Data Analysis Tools, Correlation and Regression, t-test for two Samples and ANOVA with One-way Classification. Creating Graphs. MS Power Point: Features of Power Point Package. MSACCESS: Concept of Database, Units of Database, Creating Database. Principles of Programming: Flow Charts and Algorithms, Illustration through examples. Internet: World Wide Web (WWW), Concepts, Web Browsing and Electronic Mail.

Practical

Study of Computer Components, Booting of Computer and its Shut Down. Practice of some fundamental DOS Commands: TIME, DATE, DIR, COPY, FORMAT, VOL, LABEL, PathH. Practicing WINDOWS Operating System. Use of Mouse, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars. WINDOWS Explorer, Creating Folders, COPY and PASTE functions. MSWORD: Creating a Document, Saving and Editing. MSWORD: Use of Options from Tool Bars, Format, Insert and Tools (Spelling and Grammer), Alignment of text. MSWORD: Creating a Table, Merging of Cells, Column and Row Width. MSEXCEL: Creating a Spreadsheet, Alignment of Rows, Columns and Cells using Format Tool Bar. MSEXCEL: Entering Expressions through the Formula Tool Bar and use of Inbuilt Functions, SUM, AVERAGE, STDEV. MSEXCEL:Data Analysis using Inbuilt Tool Packs, Correlation and Regression. MSEXCEL: Creating Graphs and Saving with & without Data. MSACCESS: Creating Database, Structuring with different types of fields. MS Power Point: Preparation of Slides on Power Point. Transforming the data of WORD, EXCEL and ACCESS to other formats. Internet Browsing: Browsing a Web Page and Creating of E-Mail ID.

Lecture schedule

1	Introduction to computers-characteristics of computers-evolution of computers-generations of computers
2	Hardware and software-classification of computers-personal computers-software categories-system software and application software
3	Anatomy of computers-Input and output units-central processing unit-types of processors- memory-primary and secondary memory-RAM and ROM
4	Operating system-DOS and WINDOWS-fundamental DOS commands-FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD, DEL and TREE, Rules for naming files in DOS
5	WINDOWS: GUI, Desktop and its elements- creating folders-WINDOWS Explorer - Anatomy of WINDOW – Title bar-Minimum, Maximum and close buttons-scroll bars-menus and tool bars
6	Number systems-binary and decimal-conversion between number bases
7	Word Processing-word processing packages-features-MSWORD-Document-units of Document
8	Menus in MSWORD -Creating, editing, formatting and saving a document in MSWORD
9	MSWORD- copy, cut and paste functions -creating tables-merging of cells-column and row width
10	Electronic Spreadsheets- concept- Spreadsheet packages – MSEXCEL-worksheet and workbook-creating, editing and saving a workbook in MSEXCEL
11	MSEXCEL-alignment of rows, columns and cells using Format toolbar-Entering a formula in a cell
12	MSEXCEL- Statistical functions-SUM, AVERAGE, VARIANCE, MAX, MIN, IF -Data Analysis-regression, correlation, frequency distribution, t-test
13	MSEXCEL-Creating graphs and charts MS Power point-features of power point package-creation of slides
14	MSACCESS-concept of database-units of database-creating database

15 Principles of programming-flowcharts and algorithms-programming languages-low level and high level languages
16 Internet-introduction, evolution of internet-basic internet terms-getting connected to internet-internet applications-electronic mail-introduction-web browsing

Practical Schedule

1 Study of computer components-booting and shut down of computer- practice of some DOS commands-TIME, DATE, FORMAT, DIR, COPY, PATH, LABEL, VOL, MD, CD, DEL
2 Practicing WINDOWS Operating system-Using mouse-Title bar-Minimum, Maximum and Close buttons, Scroll bars, menus and toolbars
3 Desktop-icons-creating folders-COPY and PASTE functions, Windows Explorer
4 MSWORD-creating and saving a document- editing and formatting a document
5-6 MSWORD-Use of options from Tool bars-Format, Insert and Tools
7 MSWORD- copy, cut and paste functions -creating tables-merging of cells-column and row width
8 MSEXCEL-creating, editing and saving a workbook in MSEXCEL
9 MSEXCEL-alignment of rows, columns and cells using Format toolbar-Entering a formula in a cell
10 MSEXCEL- statistical functions- SUM, AVERAGE, VARIANCE, MAX, MIN, IF -Data Analysis-regression, correlation, frequency distribution, t-test
11-12 MSEXCEL-Creating graphs and charts
13-14 MS Power Point-preparation of slides on power point
15-16 MSACCESS-creating database-structuring with different types of fields
17-18 Internet- creating E-mail ID-web browsing

Suggested Readings

Gene Wrisskpof (1998) ABC's of Excell
Sharma K.V.S. (2001) Statistics made simple: Do it yourself on PC. Prentice Hall of India.
Capron.H.L. (1996) Computers – Tools for an information age – Fourth Edition. The Benjamin / Cummings Publishing Company, Inc., New York.
Colin Haynes. (1990) The Computer Virus Protection Handbook. BPB Publications, New Delhi.
Peter Nortons. (2001) Introduction to Computers – Fourth Edition. Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.
Ruth Maran (1999) Teach yourself MS Office visually. IDG Books Worldwide Inc., New York.

3. Stat.3103. Design and analysis of experiments (1+1)

Introduction. Need for designing an experiment – Basic principles of Experimentation. Practical considerations in field experimentation. Soil heterogeneity, Uniformity trials, Size and Shape of Plots and Blocks, Border effects. Methods of analaysis of data from designed experiments. Analysis of Variance, assumptions, Construction of ANOVA Table, Critical Difference. Completely Randomised Design:

Layout and Analysis, advantages and limitatons. Randomised Block Design: Layout and Analysis, advantages and limitations. Latin Square Design: Layout and Analysis, advantages and limitations. Problem data or data that violate the assumptions of Analysis of Variance: Transformation of data, Square root, Logarithmic and Angular Transformations, Tuckey's Test. Statistical control of error through Analysis of Covariance. Missing plot techniques in RBD and LSD. Factorial experiments, Symmetrical and Asymmetrical factorials. Main effects and Interaction effects. Advantages of Factorial Experiments over Single Factor Experiments. Analysis of 2n Factorial experiments by Yates' algorithm. Analysis of data from Asymmetrical Factorial experiments. Split plot Design – Layout and Analysis. Strip-plot Design – Layout and Analysis. Experiments in Cutivators' fields – On Farm Trials.

Practical

Layout and Analysis of CRD, RBD and LSD. Transformation of data and Analysis, Tuckey's Test. Missing plot techniques in RBD and LSD. Analysis of Covariance. Analysis of data from 2n Factorial experiments. Calculation of Main effects and Interaction effects through Yates algorithm for 2n experiments. Analysis of Aymmetrical factorials. Layout and Analysis of Split plot and Strip plot Designs. Analysis of data generated from On Farm Trial.

Lecture Schedule

1	Introduction – Important terms and definitions – Need for designing an Experiment. Basic principles of experimention – replication, randomization and local control
2	Practical considerations in field experiments Coping with soil heterogeneity - size and shape of plots and blocks – border effect – uniformity trials and their uses.
3	Review on tests of hypotheses – Analysis of variance – assumptions – Construction of ANOVA table – conclusions based on ANOVA. Comparisons based on means – critical difference
4	Data that violate assumptions of the analysis of variance. Transformations of data – square root, logarithmic and angular transformations.
5	Completely Randomized Design – Lay out, analysis, advantages and limitations
6	Randomized Block Design – Layout, analysis, choice of No. of blocks, advantages and limitations
7	Latin square designs – layout, analysis, applications, advantages and limitations
8	Missing plot techniques in RBD and LSD.
9	Statistical control of error and analysis of covariance – computational procedure –Applications of ANOCOVA.
10	Factorial experiments – symmetrical and asymmetrical factorials – Definition of main effects and interaction effects. Advantages of factorial experiments over single factor experiments – layout of factorial experiments.
11	Analysis of 2^n factorial experiments – Yate's algorithm
12	Analysis of data from mixed factorial experiments without confounding
13	Split-plot design – Lay out, analysis, applications and advantages
14	Experiments in cultivator's field – experimental design and field layout.
15	On farm trials and technology generation and technology verification experiments

16 Experimental on perennial crops – design and analysis of data
17 Progeny row trials.
18 Compact family block design – layout and analysis

Practical Schedule

2 Layout and analysis RBD
3 Layout and analysis LSD
4 Transformation of data and analysis
5-6 Missing plot technique in RBD and LSD
7 Analysis of covariance
8-9 Analysis of data from 2^n factorial experiments in RBD. Formation of Yate's table – formula for calculation of main effects and interaction effects.
10-11 Analysis of data from 2^n factorial experiments in RBD. Formation of Yate's table – calculation of main effects and interaction effects.
12 Layout and analysis of split-plot design
13-14 Analysis of data from progeny row trials and those from compact family block designs
15-16 Analysis of data generated from on-farm trials and technology-generation experiments
17 Analysis of data from experiments in cultivator's field
18 Analysis of groups of experiments- experiments on perennial crops

Suggested Readings

Gomez.K.A. and Gomez.A.A. (1993) Statistical procedures for Agricultural Research. John Wiley & Sons

Panse. V.G. and Sukhatme.P.V. (1998) Statistical Methods for Agricultural Workers. ICAR Publication

Snedecor.G.W. and Cochran.W.G. (1992) Statistical Methods. Oxford and IBH Publishing Co.

Rangaswamy. R. (2002) A Text Book of Agricultural Statistics. John Wiley & Sons.

Cochran.W.G. and Cox.G.M. (1957) Experimental Designs. John Wiley & Sons Inc., New Delhi

Cox. D.R. (1958) Planning of Experiments. Wiley, New York

Das.M.N. and Giri.V.V. (2003) Design and Analysis of Experiments. New Age International (P) Ltd.

Federer.W.T. (1967) Experimental Design. Oxford & IBH Pub.Co., New Delhi.

Fisher.R.A. (1950) Statistical Methods for Research Workers – 11th Edition. Oliver & Boyd, Edinburg.

Fisher.R.A. and Yates.F. (1948) Statistical Tables for Biological, Agricultural and Medical Research. Oliver & Boyd., Edinburg.

XIII. ANIMAL HUSBANDARY

1. Anhs. 2101. Fundamentals of livestock and poultry production (2+1)

Introduction - Role of Livestock in Indian Agriculture - Livestock census - Livestock development agencies and Programmes in Kerala - Common Animal Husbandry terms Definition of Breed – Classification of indigenous and exotic cattle - Breed characteristics of Sindhi, Kangayam, Kankrej, Jersey, Holstein Friesian, Brown Swiss, Murrah and Surti. Systems of mating – Importance of cross breeding. Female reproductive system - Oestrous cycle-signs of heat - Time of A.I.- Artificial insemination - Merits and demerits – Methods of A.I. - Care & management of pregnant cow - Gestation period in different species – Parturition - Care and management of new born calf.

Milk – Definition - Composition of milk - Factors affecting milk yield and composition - Clean milk production - Preservation of milk – Pasteurization – Various methods – low temperature long time – high temperature short time and ultra high temperature – Advantages and disadvantages. Nutrition – Definition –Ration - Balanced ration - Requirement and importance of green fodder - Conservation of fodder - Hay making - Silage making.

Importance health care & signs of health in cattle – Diseases - Classification – Basic principles in controlling infectious and contagious diseases - Common diseases of cattle - Bacterial diseases – Anthrax, Haemorrhagic septicemia, Black Quarter, Tuberculosis, Brucellosis, Mastitis - Prevention and control. Viral diseases - Foot and Mouth disease – Rabies - Prevention and control. Non specific diseases - Milk fever – ketosis - Tympanites.

Goat farming - Breeds - Indigenous and exotic origin – Nomenclature alone - Housing – Feeding – Breeding - Care and management of buck, doe and kid.

Rabbit rearing – Breeds - Nomenclature alone – Housing – Feeding – Breeding - Care and Management.

Swine husbandry – Common breeds - Nomenclature alone – Housing of pigs – Care and management of sow, boar and piglets - Control and prevention of swine diseases - Hog cholera and Foot and Mouth Disease

Poultry - Definition—Poultry production in India - Common terms in Poultry Science - Introduction of systems of poultry rearing - deep litter - cage and backyard systems - Brooding and rearing of chicks - Rearing of growers and layers - Broiler rearing - Common diseases -symptoms and prevention – Bacterial - Coryza, Salmonellosis. Viral - Ranikhet disease, Infectious Bursal disease. Protozoan – Coccidiosis - Vaccination schedule for poultry.

Practical

Body parts of cow - Identification of animals – Instruments used in Animal Husbandry practices – Ageing of cattle - Housing of Cattle - Milking of animals -physical examination of milk - Determination of Specific gravity - Fat percentage, Total solids, Solid Not Fat – Legal standards of milk- Determination of adulterants in milk – Common cattle feeds and their classification - Measuring usefulness of feed - Feeding and calculation of feed for various classes of livestock - Body parts and Handling of birds - Classification of Poultry - Housing and management of poultry - visit to poultry farm -

culling of unproductive birds - Demonstration of vaccination and deworming - Broiler poultry farming and cost benefit analysis

Lecture schedule

1. Introduction - Role of Livestock in Indian Agriculture - Livestock census
2. Livestock development agencies and Programmes in Kerala
3. Common Animal Husbandry terms
4. Definition of Breed – Classification of indigenous and exotic cattle - Breed characteristics of Sindhi, Kangayam, Kankrej, Jersey, Holstein Friesian, Brown Swiss, Murrah and Surti.
5. Systems of mating – importance of cross breeding. Female reproductive system
6. Oestrous cycle - signs of heat-Time of A.I. - Artificial insemination - merits and demerits – Methods of A.I.
7. Care &management of pregnant cow -Gestation period in different species-Parturition-
8. care and management of new born calf
9. Milk - definition –Composition of milk
10. Factors affecting milk yield and composition
11. Clean milk production
12. Preservation of milk – Pasteurization – various methods – low temperature long time – high temperature short time and ultra high temperature –advantages and disadvantages.
13. Nutrition–definition-Ration-Balanced ration -Requirement and importance of green fodder
14. Conservation of fodder -Hay making - Silage making.
15. Importance health care & signs of health in cattle
16. Diseases-Classification–Basic principles in controlling infectious and contagious diseases
17. Mid semester examination
18. Common diseases of cattle - Bacterial diseases – Anthrax, Haemorrhagic septicemia, Black Quarter, Tuberculosis, Brucellosis, mastitis - prevention and control.
19. Common diseases of cattle - Viral diseases-Foot and Mouth disease – Rabies - prevention and control.
20. Non specific diseases of cattle - milk fever-ketosis-Tympanites.
21. Goat farming - breeds - indigenous and exotic origin – Nomenclature alone
22. Goats - Housing – feeding -breeding
23. Care and management of buck, doe and kid.
24. Rabbit rearing-Breeds - nomenclature alone - Housing – Feeding – Breeding - Care and Management.
25. Swine husbandry – common breeds - Nomenclature alone – Housing of pigs
26. Care and management of sow, boar and piglets

27. Control and prevention of swine diseases - Hog cholera & Foot and Mouth Disease
28. Poultry - Definition —Poultry production in India- Common terms in Poultry Science
29. Introduction of systems of poultry rearing-deep litter-cage and backyard systems
30. Brooding and rearing of chicks
31. Rearing of growers and layers
32. Broiler rearing
33. Common diseases - symptoms and prevention – Bacterial - Coryza - Salmonellosis. Viral - Ranikhet disease - Infectious Bursal disease. Protozoan - Coccidiosis
34. Vaccination schedule for poultry.

Practical schedule

1. Body parts of cow
2. Identification of animals
3. Instruments used in Animal Husbandry practices
4. Ageing of cattle
5. Housing of Cattle
6. Milking of animals
7. Physical examination of milk and Determination of Specific gravity
8. Determination of Fat percentage, Total solids, Solid Not Fat
9. Legal standards of milk- Determination of adulterants in milk
10. Common cattle feeds and their classification
11. Measuring usefulness of feed
12. Feeding and calculation of feed for Dairy cattle
13. Body parts and Handling of birds
14. Classification of Poultry
15. Housing and management of poultry-visit to poultry farm-culling of unproductive birds- Demonstration of vaccination and deworming
16. Broiler poultry farming and cost benefit analysis
17. PRACTICAL EXAMINATION

Suggested Readings

Banerjee, G.C. 1993. The Text Book of Animal Husbandry. Oxford Book Company, CALCUTTA

Dairy India Year Book 2001. A-25, Priyadarshini Vihar, DELHI.

Gopalakrishnan, C.A., and Lal, D.M.M., 1992. Livestock and Poultry Enterprises for Rural Development. Vikas Publishing House Private Limited,Ghaziabad, U.P.,

ICAR, 2001. A Hand Book of Animal Husbandry.

Indian Poultry Industry Year Book 1998. A25 Priyadarshini Vihar, DELHI.

Kadirvel, R., and Balakrishnan, V., 1998. Hand Book of Poultry Nutrition. Madras Veterinary College, TANUVAS., CHENNAI-7.

Maynard, C. and Loosli, S. 1989. Animal Nutrition. Tata Mc Graw Hill Publishing Company Limited., NEW DELHI.

Prabakaran, R., 1998. Commercial Chicken Production. Publisher P.Saranya, 5/2, Ramalingam Street, Seven Wells, CHENNAI-1.

Ranjan, S.K. 1985. Animal Nutrition in Tropics. Vikas Publishing House Private Limited, GHAZIABAD, Uttar, Pradesh.

Sastry, N.S.R., Thomas, C.K. and Singh, R.A. 1982. Farm Animal Management and Poultry Production. Vikas Publishing House Private Limited, GHAZIABAD, Uttar Pradesh.

Sukumar De., 1980. Outlines of Dairy Technology. Oxford University Press, DELHI.

Hand book of Animal husbandry-Indian council of agricultural research publication, New Delhi, Third edition, 2002

XIV AGRICULTURAL METEOROLOGY

1. Agmt. 1101 Agricultural meteorology (1+1)

Introduction to Meteorology and Agricultural Meteorology - Scope and importance of Agricultural Meteorology - Composition of Atmosphere - Role of greenhouse gases in global cooling and warming - Concept of weather and climate - Micro-meso-macro and phyto climates - Electromagnetic Spectrum - Nature and properties of solar radiation - shortwave radiation and long wave radiation - Radiation balance - Response of plants to solar radiation and photosynthetically active radiation - Thermal structure of atmosphere - vertical profiles - factors affecting surface air temperature - spatial and temporal variations in surface air temperature - soil temperature and its variations - Atmospheric pressure and its variation with height - Global distribution of pressure and wind - Atmospheric humidity - saturation and actual vapour pressure - relative humidity and dew point temperature - Cloud classification and measurements - cloud seeding - Rainfall and its mechanisms - forms and types of rainfall - Indian monsoons - southwest monsoon - northeast monsoon - monsoon variability across Kerala and India - Rainfall over India and Kerala - Importance of weather forecasting in Agriculture - weather service to farmers - agricultural seasons - crop weather diagrams and calendars – crop weather relationships - Role of weather on insect pest and diseases - weather and climate related natural disasters, risk and management - Climate change and global warming - weather modification - Introduction to Remote Sensing

Practical

Meteorological and Agrometeorological Stations - Types of Agricultural Meteorological Stations - Selection of site and layout of agro meteorological stations - Installation and exposure of meteorological instruments- Measurement of atmospheric variables - Air temperature and soil temperature - Relative humidity - Determination of vapour pressure - dew point temperature and measurement of dew fall - Identification and measurement of clouds - Measurement of wind speed and direction - Measurement of rainfall and open pan evaporation - Installation of soil thermometers and measurement - Sun shine recorder and measurement of sun shine duration - Automatic Weather Station - recording of weather data - tabulation - processing and presentation - Preparation of crop weather calendars

Lecture schedule

1. Introduction to Meteorology and Agricultural Meteorology - Scope and importance of Agricultural Meteorology
2. Composition of Atmosphere - Role of greenhouse gases in global cooling and warming
3. Concept of weather and climate - Micro-meso-macro and phytoclimates
4. Electromagnetic Spectrum - Nature and properties of solar radiation - shortwave radiation and long wave radiation - Radiation balance
5. Response of plants to solar radiation and photosynthetically active radiation
6. Thermal structure of atmosphere - vertical profiles - factors affecting surface air temperature
7. Spatial and temporal variations in surface air temperature - soil temperature and its variations
8. Atmospheric pressure and its variation with height - Global distribution of pressure and wind
9. Atmospheric humidity - saturation and actual vapour pressure - relative humidity and dew point temperature

10. Cloud classification and measurements - cloud seeding
11. Indian monsoons - southwest monsoon - northeast monsoon - monsoon variability across Kerala and India
12. Rainfall and its mechanisms - forms and types of rainfall - Rainfall over India and Kerala
13. Agricultural seasons - Importance of weather forecasting in Agriculture - weather service to farmers
14. Crop weather diagrams and calendars – crop weather relationships - Role of weather on insect pest and diseases
15. Weather and climate related natural disasters - risk and management
16. Weather modification
17. Climate change and global warming
18. Introduction to Remote Sensing

Practical schedule

1. Meteorological and Agrometeorological Stations
2. Types of Agricultural Meteorological Stations
3. Selection of site and layout of agrometeorological stations
4. Installation and exposure of meteorological instruments
5. Measurement of Air temperature
6. Installation of soil thermometers and measurement and recording of soil temperature
7. Measurement of Relative humidity and vapour pressure
8. Dew point temperature and dew fall
9. Identification and measurement of clouds
10. Measurement of wind speed and direction
11. Measurement of rainfall
12. Measurement of open pan evaporation
13. Sunshine Recorder and measurement of sunshine
14. Automatic Weather Station
15. Recording of weather data – tabulation- Processing and presentation Meteorological data
16. Recording of weather data – tabulation- Processing and presentation Meteorological data
17. Preparation of crop weather calendars
18. Preparation of crop weather calendars

Suggested Readings

Das.P.K. 1968. The Monsoons. NBT, New Delhi

Khadekar, S.R. 2001. Meteorology. Agromet publishers, Nagpur

Mavi, H.S. 1986. Introduction of Agrometeorolgy. Oxford & IBH Publishing Co. New Delhi

Menon, P.A. and Rajan, C.K. 1989. Climate of Kerala. Classic publishing house, Kochi

Prasada Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Second Edition. Keral Agricultural University, Thrissur.

Sachati, A.K. 1985. Agricultural Meteorology – Instruction-cum-practical manual, NCERT, New Delhi

Varshneya, M.C. and Balakrishna Pillai, B. 2003. Textbook of Agricultural Meteorology. ICAR, New Delhi.

Venketaraman, S. and Krishnan, A. 1992. Crops and weather. ICAR, New Delhi.

Wilsie, P.C. 1961.Crop Adaptation and distribution. Eurasia Publishing House (P) ltd., New Delhi.

XV PLANT BIOTECHNOLOGY

1. Biot. 2201 Principles of plant biotechnology, biosafety rules and intellectual property rights (2+1)

Concepts of Plant Biotechnology: History of Plant Tissue Culture and Plant Genetic Engineering; Scope and importance in Crop Improvement: Totipotency and Morphogenesis, Nutritional requirements of *in-vitro* cultures; Techniques of In-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above i*n-vitro* culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in crop improvement. Genetic engineering; Restriction enzymes; Blotting techniques. Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants and their applications. DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in crop improvement. Biosafety rules and regulations: Rules related to GM crops-research, development, field trials, and commercial cultivation. Intellectual Property Rights- concepts, Trade related aspects of IPR. Intellectual property and international trade - WTO, WIPO, GATT, TRIPS. Protection of plant and animal genetic resources, biological materials, gene patenting, biotechnology related IPR issues - status.

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel-electrophoresis techniques.

Lecture Schedule

1.	Concepts of Plant Biotechnology
2.	History of plant tissue culture and plant genetic engineering
3.	Scope and importance in crop improvement
4.	Totipotency and morphogenesis
5 – 7.	Nutritional requirements of *in-vitro* cultures
8.	Techniques of in-vitro cultures: micro propagation
9-10.	Routes of in vitro propagation – enhanced release of axillary buds, organogenesis, embryogenesis.
11-12.	Factors affecting above i*n-vitro* culture; problems, methods to overcome, advantages and disadvantages.

13-14. Anther culture, pollen culture, ovule culture embryo culture

15-16. Test tube fertilization, endosperm culture applications and achievements

17-18. Somaclonal variation, types, reasons, applications.

19. Somatic embryogenesis and synthetic seed production technology

20. Protoplast isolation, culture.

21. Protoplast fusion - methods; somatic hybrids and cybrids, applications in crop improvement.

22. Genetic engineering – principles

23. Enzymes in recombinant DNA technology, blotting techniques.

24. Vectors for gene transfer.

25. Gene cloning - steps involved

26. Selection of recombinants, markers.

27. Gene transfer – direct methods.

28. Gene transfer - indirect methods.

29. Transgenic plants and their applications.

30. DNA finger printing – DNA based markers – RFLP, AFLP, RAPD, SSR and DNA Probes

31. Mapping QTL – future prospects.

32. Marker assisted selection (MAS), application in crop improvement.

33. Bio-safety rules and regulations- Rules related to GM crops-research, development, field trials, and commercial cultivation.

34. Intellectual Property Rights-concepts, trade related aspects. IPR and international trade - WTO, WIPO, GATT, TRIPS.

35. Protection of plant and animal genetic resources, biological materials, gene patenting.

36. Biotechnology related IPR issues.

Practical Schedule

1. Requirements for Plant Tissue Culture Laboratory
2. Media components and preparations.
3. Preparation and sterilization of media
4. Aseptic manipulation and inoculation of various explants.
5. Callus induction and plant regeneration.
6. Micro propagation of important crops
7. Anther culture
8. Embryo culture
9. Endosperm culture
10. Hardening / Acclimatization of regenerated plants.
11. Somatic embryogenesis and synthetic seed production

12. Isolation of protoplast; demonstration of culturing of protoplast.
13. Demonstration of isolation of DNA.
14. Demonstration of gene transfer techniques, direct methods.
15. Demonstration of gene transfer techniques, indirect methods.
16. Demonstration of confirmation of genetic transformation.
17. Demonstration of gel-electrophoresis techniques.
18. Practical examination

Suggested Readings

Bhojwani, S.S. and M.K. Razdan. 1993. Plant Tissue Culture: Theory and Practice. Elsevier Science Publications, Netherlands.

Chawla, H.S. 2003. Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

Lewin, B. 2007. Genes IX. Oxford University Press, Inc., New York.

Singh, B.D. 1998. Biotechnology. Kalyani Publications, New Delhi.

XVI HOME SCIENCE

1. Hmsc. 2201 Food and Nutrition (1+1)

Definition of health nutrition, nutrients and nutritional status. Food- its functions and classification - food groups- Food pyramid-Daily food guide-composition and nutritive value of common foods. Nutrients, functions, food sources, deficiency & toxicity. Digestion and absorption of various nutrients present in foods. Recommended dietary allowances of nutrients for various age groups, sex and classes of individuals. Balanced diet and its formulation, Food habits and regional variations. Common nutritional problems of India and their causes. Assessment of nutritional status. Food borne infections and food hygiene. Toxicants in foods - Food adulteration. Trends in food production and consumption in India. Effect of agricultural practices on the quality of foods. Post harvest losses - Need for conservation- Food fortification, enrichment and restoration. Nutrition intervention programmes for vulnerable groups. Ensuring food security among population.

Practical

Planning balanced diets for different age and income groups based on their activity. Assessment of Nutritional status of vulnerable groups and agrarian population Detection of adulterants in edible agricultural commodities. Identification of nutrient deficiency disorders. Methods of food processing and preservation.

Lecture Schedule

1. Definition of nutrition- nutrients and nutritional status
2. Food- functions- classification- food groups- food pyramid- daily food guide- factors to be considered- different age groups-composition and nutritive value of common foods.
3. Major nutrients- carbohydrate- importance- nature classification functions- digestion and absorption of carbohydrate present in foods. sources- deficiency- toxicity.
4. Proteins- Importance- nature- classification-functions- digestion and absorption of proteins present in foods- sources- deficiency- toxicity.
5. Fats - Importance- nature- classification-functions- digestion and absorption of fats present in foods- sources- deficiency.
6. Recommended dietary allowances of nutrients for different age groups and sex. Formulation of balanced diet for different age groups and sex.
7. Vitamins- fat soluble- functions- digestion and absorption- sources- deficiency.
8. Vitamins- water soluble- functions- digestion and absorption- sources- deficiency.
9. Micronutrients- functions- deficiency- sources.
10. Food habits and regional variation- factors affecting
11. Nutritional problems of India – causes- PEM- Obesity- clinical symptoms- diagnosis- management
12. Assessment of nutritional status- anthropometry biochemical- clinical diet surveys- determinants of nutritional status of an individual.
13. Toxicants naturally occurring in foods
    Food adulteration- definition- common food adulterants-prevention.

14. Effect of Agricultural practices- genetic and environmental factors on the nutritional composition of foods.
15. Post harvest losses- conservation of nutrients- need-methods. Food fortification- enrichment and restoration- objectives- levels of fortification.
16. Food hygiene- food borne intoxification- bacterial food poisoning.
17. Nutrition intervention programmes for vulnerable group- Mid day meal programmes.
    - ICDS- Prophylaxis Programmes
    - Anemia- Vitamin A
18. Food security- need- factors influencing- methods

Practicalschedule

1. Planning balanced diets for preschool and school going male and female children of different income groups and activity.
2. planning balanced diets for adolescent boys and girls of different income groups and activity .
3. Planning balanced diets for pregnant and lactating mothers of different income groups and activity .

4-8 Assessment of nutritional status of male and female agricultural labourers through anthropometry , diet , clinical and biochemical methods.

9-12 Assessment of nutritional status of vulnerable groups through anthropometry diet , clinical and biochemical methods.

13. Detection of adulterants in edible agricultural commodities.
14. Identification of nutrient deficiency disorders among population.

15-17 Preservation and processing of fruits and vegetables by different methods.

18. Exam.

Suggested Readings

B.Srilakshmi, Nutrition Science, New age International(p)Ltd, publishers
M. Swaminathan Essentials of Food and Nutrition Vol. I and II ,
Ganesh and Company, Madras
Shakunthala Manay.N and Shadaksharaswamy.M Foods – Facts and
Principles, New Age International (p) Ltd Publishers New Delhi
M. Swaminathan and P K Bhargavan, Ganesh and Company, Madras.
William C Frazier and Dennis C Westhoft, Food MicroBiology, Tata Mc GrawHill
Publishing Co. Ltd. New Delhi.
Sumathi R , Mudambi and Rajagopal M V ,Fundamentals of Foods and
and Nutrition, New Age International (P) Ltd., New Delhi.

XVII NON CREDIT COURSES

1. Physical education

1. Phed.1101. Physical Education (0+1)

Definition, aims and objectives of Physical Education. Modern concept of health, physical fitness and wellness. Hypo kinetic/ life style diseases and its management. First aid

Practical (Optional: any two)

Athletics

i. Conditioning (warming up- jogging- free hand exercises- short sprints)
ii. Types of running
iii. Start and finish
iv. Types of jumps (long, triple, high jump, pole vault)
v. Types of throws (shot put, discus throw, javelin throw, hammer throw)
vi. Team events (4x100 relay, 4x400m relay)
vii. Combined events (decathlon, heptathlon)

Games

Basketball

i. Hold
ii. Passing – chest pass, bounce pass, baseball pass, overhead pass
iii. Dribbling – high dribble, low dribble, zigzag dribble, figure of eight
iv. Shooting- lay-ups, free throw and jump shot
v. Moves- two man, three man weave, four man and five man running pass
vi. Tactics- Offence, defense, pivot and screening

Volleyball

i. Hold, passing (over head- under arm)
ii. Lift – Vertical lift, arch lift, short lift
iii. Service – Simple service, tennis service
iv. Smash and block

Football

i. Passing and stopping, instep-inside-back pass- wall pass weaving – dribbling and long pass
ii. Trapping – Foot trapping- chest-thigh and head

Shuttle Badminton

i. Grip – forehand and backhand
ii. Service – long service and short service

iii. Lob – underhand and overhead
iv. Overhead strokes – drop shot and smash
v. Tactics: Singles and doubles

Yoga and Meditation

i. Suryanamaskar
ii. Asanas
iii. Pranayama
iv. Meditation

Health Related Physical Fitness Test (Compulsory)

1. 1 mile run
2. Abdominal sit-ups
3. Sit and reach
4. Modified pull ups
5. BMI

2. STU 2201 - Study Tour I (South India) (0+1)

3. STU 3202 - Study Tour II (All India) (0+1)

EXPERIENTIAL LEARNING

I. CROP PRODUCTION

1. Elcp. 4201. Seed production technology (1+2)

Seed quality – concepts, importance and characteristics – Seed dormancy –types, methods to break seed dormancy – Genetic and agronomic principles of seed production – Seed processing, post harvest processing, seed blending, seed storage – Problems of storage – Seed testing and certification, quality control, seed treatment, hybrid seed production-Evaluation of seed farm for profitability and sustainability-Formulation of project proposal for availing funds from various agencies-Preparation of project reports for monitoring and evaluation.

Practical

Seed testing – taking seed samples –germination test, moisture test and conventional purity tests of different crops – seed treatment – methods of breaking seed dormancy. Seed production in different crops – Rice, coconut, cocoa, tuber crops, vegetable crops, ornamental plants, spices, fruit plants, medicinal plants, fodder crops and green manure plants. Maintaining isolation distance –roguing practices –harvesting-cleaning and packing.

Lecture Schedule

1 The concept of a seed-definition-structure of a seed-seed development process
2 Physiology and mechanism of seed germination
3 Seed and seedling vigour-classification, measurement and evaluation
4 Seed quality – concept ,importance and characteristics
5 Factors affecting seed quality – ecological influences
6 Factors affecting seed quality – package of seed production technology
7 Factors affecting seed quality-harvest and post harvest handling
8 Seed dormancy – types
9 Methods to break seed dormancy-factors affecting seed germination
10 Genetic principles of seed production
11 Agronomic principles of seed production
12 Seed processing , post harvest processing , seed blending
13 Seed storage- problems of storage
14 Seed testing and certification , quality control
15 Seed treatment - methods
16 Seed production of major crops – field crops
17 Seed production of major crops – plantation crops , fruit plants ,spices ,ornamental plants , medicinal plants
18 Hybrid seed production

Practical schedule

1	Seed sampling
2	Visit to ware house of State Warehousing Corporation and familiarisation with seed sampling procedures
3	Seed testing –different tests followed in a Seed Testing Laboratory-
4-6	Germination test- different tests followed in different crops
7-8	Seed Moisture test of different crops
9	Visit to Seed Testing Laboratory ,familiarisation with equipments and hands on experience in seed testing
10	Seed treatment against systemic diseases
11	Seed treatment – scarification
12	Seed coating and pelleting
13	Seed treatment with beneficial organisms,
14	Seed treatment for convenience in sowing
15	Seed treatment for breaking seed dormancy
16	Visit to NBPGR for studying seed storage methods
17-18	Seed production in rice
19-20	Seed production in coconut
21-22	Seed production in tuber crops
23-26	Seed production in vegetable crops
27	Seed production in cocoa
28-29	Seed production in ornamental plants
30	Seed production in spices
31	Seed production in fruit plants
32	Seed production in medicinal plants
33	Seed production in fodder crops
34	Seed production in green manure crops
35-36	Hybrid seed production in rice

Suggested Readings

Agrawal, P.K. and Dadlani, M. 1992. *Techniques in Seed Science & Technology*, South Asian Pub., New Delhi.

Agrawal, R.L. 1995. *Seed Technology* (2nd ed.), Oxford & IBH Pub., New Delhi.

Dahiya, B.S. and Rai, K.N. 1997. *Seed Technology*. Kalyani Pub., New Delhi.

Desai, B.B., Kotecha, P.M. and Salunke, D.K. 1997. *Seeds Handbook-Biology, Production, Processing and Storage*, Marcel Dekker Inc, New York

Ram, H.H., and Yadava, R. 2007. *Genetic Resources and Seed Enterprises. Management and Policies- Part-1*, New India Publishing Agency, New Delhi

Ram, H.H., and Yadava, R. 2007. *Genetic Resources and Seed Enterprises. Management and Policies- Part-I1*, New India Publishing Agency, New Delhi

Sen, S. and Ghosh, N. 1999. *Seed Science & Technology*, Kalyani Pub., New Delhi.

2. Elcp. 4202 Remote sensing GIS and land use planning (1+2)

Computers and Database. Managing your computer-data base concepts. Design and management of RDBMS. **Geographic Information Systems.** Introduction to GIS - GIS technology and applications - Maps, map scales and data resolution - Conceptual

models of spatial and non spatial information - Co-ordinate systems and map projections - Global positioning systems and its uses in data collection for GIS - Electromagnetic radiation and its features - Solar radiation and its interaction with earth and earth features- Introduction to aerial photography and satellite remote sensing- Remote sensing satellites - Satellites, sensors, imageries and their interpretations- Data structure in remote sensing- Data interpretation techniques - Remote sensing and its applications in Agriculture, forestry and in resource planning - Digital cartography - Landscape attributes versus soils. Use of digital elevation models (DEM) - Enabling of GIS data - Digitization and structuring of map data - Projection systems- Comparison of software applications in GIS -GIS based resource planning in agriculture- GIS in Watershed planning and development .

Practical

Familiarisation of Maps map scales -Use of different maps - Cartography - Use of GIS software in handling maps - Remote sensing imageries in GIS - Digital cartography - Image classification and interpretation -Geo-referencing and geo-coding of maps - Providing proper projection systems -Vectorisation of data -Storage and retrieval of data - Quering and data analysis -Preparation of reports - Project work

Lecture Schedule

1. Computers and Data base -Manage your computer
2. Database concepts . Design and management of RDBMS
3. Introduction to GIS and GIS technology and applications
4. Maps, map scales and data resolution
5. Conceptual models of spatial and non spatial information and co-ordinate systems and map projections
6. Global positioning systems and its uses in data collection for GIS
7. Electromagnetic radiation and its features.
8. Solar radiation and its interaction with earth and earth features
9. Introduction to aerial photography and satellite remote sensing
10. Remote sensing satellites, sensors, imageries and their interpretations
11. Data structure in remote sensing and data interpretation techniques
12. Remote sensing and its applications in Agriculture, forestry and in resource planning
13. Digital cartography
14. Landscape attributes versus soils. Use of digital elevation models (DEM)
15. Enabling of GIS data and digitization and structuring of map data
16. Projection systems and comparison of software applications in GIS
17. GIS based resource planning in agriculture
18. GIS in Watershed planning and development

Practical Schedule and Project work

1. Familiarisation of Maps map scales
2. Use of different maps
3. Cartography
4. Use of GIS software in handling maps
5. Use of GPS
6. Remote sensing imageries in GIS
7. Digital cartography
8. Image classification and interpretation
9. Geo-referencing and geo-coding of maps
10. Providing proper projection systems

11. Vectorisation of data
12. Storage and retrieval of data
13. Quering and data analysis
14. Preparation of reports.
15 -36. Project work.

Suggested Readings

Burrough, Peter A. and Rachael A. McDonnell. 1998. *Principles of Geographical Information Systems*, Oxford University Press, Toronto. Clarke, Keith C., Parks, Bradley O., and Michael P. Crane (eds.)

Jayathi, D. 2007. *Remote Sensing and GIS Based Land Resource Information System*. Published by AGOBIOS(India), Jodpur

Jeffery Star and John Essates. 1990. *Geographic Information System*. Printice Hall India Pvt. Ltd. New Delhi

Khan, M.A. 2006. Watershed Management for Sustainable Agriculture. Published by AGROBIOS (India), Jodpur

Konecny and Gottfries. 2003. *Geo Information, Remote Sensing, Photogrammetry and Geographic Information System.* Taylor and Francis , New York

Lilles, T.M and Kiefer, R.W. 1998. *Sensing and Image Interpretation*. 3rd Edn John Wily Publications.

3. Elcp. 4203. Integrated farming system (1+2)

Integrated Farming Systems - goals, components and advantages – Integration of components – livestock, poultry, rabbitry, apiculture, aquaculture, sericulture, mushroom culture, etc. Contribution of components in IFS – economic contribution, resource recycling and employment generation - Regional adaptation of various farming systems in India and Kerala - Crops and animal waste utilization – modern techniques – Biogas plant- installation, working and maintenance – Model IFS in wet lands, uplands and in agro forestry systems- Evaluation of IFS- Evaluation of farms for profitability and sustainability. Environmental impact analysis of IFS-Farm plan models for IFS.

Practical

Survey of homesteads and identification of various IFS in practice - Economic analysis of various farming systems- Assessment of efficiency of land, labour and capital – Studies on employment generation in farming systems– Exploring and introducing new components into the existing systems – Visit to livestock farm and poultry units – Visit to wet land farming systems – Visit to instructional farm and nursery for first hand experience in nursery practices, coconut processing, vermicomposting etc – visit to Kole lands – visit to nursery units - Visit to small scale agribusiness units.

Lecture Schedule

1	Integrated Farming Systems – definition, goals , components and advantages
2-5	Integration of components – livestock, poultry, rabbitry, apiculture, aquaculture, sericulture, mushroom culture -case studies
6-8	Contribution of components in IFS – economic contribution, resource recycling and employment generation
9	Regional adaptation of various farming systems in India

10-11	Regional adaptation of various farming systems in Kerala , crop, livestock, rice, fish, rice-prawn, rice--duck etc
12	Crops and animal waste utilization-modern techniques-coir pith composting , vermicomposting
13	Biogas plant- installation, working and maintenance
14-15	Model IFS in wet lands, kole, kuttanad and pokkali
16-18	Model IFS in uplands and agro forestry – homestead system

Practical schedule

1-6	Survey of homesteads and identification of various IFS in practice
7-8	Indices to measure efficiency of cropping systems - land use efficiency, biological potential and economic efficiency
9-11	Economic analysis of various farming systems –rice-fish,rice-prawn,agroforestry,livestock,rubber,apiculture,farming systems, homesteads based farming system involving various components- cattle, rabbits, poultry, quail etc
12-14	Computation of man power required for various farming systems.
15-16	Visit to livestock farm and study of various practices
17	Visit to poultry units and study of various practices
18	Visit to goat farm and study of various practices
19	Visit to instructional farm ,familiarisation with farm records and activities and cropping / farming system
20	Visit to nursery for first hand experience in nursery practices of coconut and various activities of coconut processing
21-22	Visit to vermicomposting unit and Vermicompost preparation
23	Visit to mushroom raising unit
24	Visit to kole lands
25	Visit to various nursery units
26-27	Bio gas plant installation , working and maintenance
28-30	Visit to successful farmers fields involving integrated farming systems – case studies
31-32	Visit to smll scale Agribusiness units

Suggested Readings

Balasubramaniyan, P. and Palaniappan, S.P. 2001. *Principles and Practices of Agronomy*. Agrobios Publishers,Jodhpur.

Chatterjee, B.N., Maiti, S. and Mandal, B.K. 1989. *Cropping Systems - Theory and Practice*. Oxford and IBH Publication, New Delhi

Francis, C.A. 1986. *Multiple Cropping Systems*. Macmillan Publication

Gomez, A.A. and Gomez, K.A. 1983. *Multiple Cropping in the Humid Tropics of Asia*. International Development Centre (IDRC),Ottawa.

Jayanthi, C. N., Sakthivel, N., Sankaran and Thiyagarajan, T.M.2003.*Integrated Farming System-A Path to sustainable Agriculture*, TNAU Publication.

Palaniappan.S.P., and K.Sivaraman.1996. *Cropping System in the Tropics. Principles and Management.* New Age India (P) Ltd.,

Panda, S.C. 2003.*Cropping and Farming Systems*. Agrobios Publishers, Jodhpur.
Raman, K.V. and Balaguru, T. 1992. *Farming systems Research in India. Strategies for Implementation.* Pragati Art Printers, Hyderabad,India.
Rangasamy, A., Annadurai, K., Subbian, P., and Jayanthi, C. 2002. *Farming System in the Tropics*. Kalyani Publishers, Ludhiana

4. Elcp. 4204. Water management (1+3)

(Micro-irrigation, use of problamatic water, and watershed management)

Importance of irrigation –Methods of irrigation –surface, subsurface and overhead irrigation- Micro irrigation methods – Sprinkler and drip irrigation- localized irrigation- Irrigation management in different soil types. Water conveyance structures- Irrigation of principal crops – Water logging and drainage -quality of irrigation water-

Watershed – Concepts, approaches, objectives, delineation, resource appraisal – Planning watershed development – Watershed development plan – PLA techniques – Implementation of watershed development programmes- soil and water conservation- Terracing- water harvesting and recycling- Ground water recharge- Roof water harvesting

Practical

Field demonstration of surface, subsurface and overhead irrigation systems– installation, operation and maintenance- Field demonstration unit of sprinkler irrigation system- Drip irrigation unit in coconut with filters, pumps and drippers - Demonstration of micro sprinkler, mist, foggers, bubblers, etc. Water management for establishing lawnusing sprinkler, rain gun- Water conveyance structures - Quality testing of irrigation water

Watershed – Delineation of watersheds- soil survey for land capability classification- Soil and water conservation measures –Erosion control structures – Continuous and discontinuous terraces- Water harvesting structures- Different methods of ground water recharge- Monitoring of ground water level- Preparation of watershed development plan – Visit to AHARDS or watersheds under NWDPRA and Hariyali schemes–Field study of ongoing schemes**.**

Lecture Schedule

1	Importance of irrigation
2 -4	Methods of irrigation –surface, subsurface and overhead irrigation
5	Micro irrigation methods
6	Water conveyance structures
7	Irrigation management in different soil types
8	Irrigation of principal crops
9	Water logging and drainage
10	Quality of irrigation water
11	Watershed - concepts, approaches, objectives,
12	Delineation of Watershed, Resource appraisal
13	Planning watershed development -Watershed development plan
14	PLA techniques
15	Implementation of watershed development programmes,Soil

and water conservation methods Terracing-

16 Water harvesting and recycling

17 Ground water recharge

18 Roof water harvesting

Practical schedule

1-4 Lay out and Field demonstration of surface, and subsurface methods of irrigation and

5-9 Overhead irrigation systems, Field demonstration unit of sprinkler irrigation system, installation, operation and maintenance

10-15 Drip irrigation unit in coconut with filters, pumps and drippers, Lay out of drip irrigation system in other important crops

16-17 Water management for establishing lawn using sprinkler, rain gun etc

18-20 Demonstration of mini and micro sprinkler, mist, foggers, bubblers etc

21-23 Water conveyance structures , Measurement of irrigation water

24-27 Quality testing of irrigation water

28-31 Watershed – Delineation of watersheds

32-34 Soil survey - Land capability classification

35-38 Soil and water conservation measures

39-41 Erosion control structures

42-44 Water harvesting structures- demonstration of construction of ferrocement tanks

45-46 Different methods of ground water recharge

47 Monitoring of ground water level

48-49 Preparation of watershed development plan

50 Visit to AHARDS

51 Visit to watersheds under NWDPRA and Hariyali schemes–

52-54 Field study of ongoing schemes and evaluation of watershed scheme

Suggested Readings

Datta, S.K. 1986. *Soil Conservation and Land Management*. International Book Distributors, Dehradun, India.

Foster, A.B.1973. *Approved Practises in Soil Conservation* (4th ed.). The Interstate Printers 7 Publishers, Inc., Illinois, USA..

Gupta, I. C.1990.*Use of Saline Water in Agriculture*. Oxford and IBH publishing Company Pvt. Ltd.,

Gurmel Singh, Venkataraman, C., Sastry, G. and Joshi, B.P. 1988. *Manual of Soil and Water Conservation Practices.* Oxford and IBH.385p.

Hansen, V.E., Israelsen, O.W., and Stringham, G.E. 1979. *Irrigation Principles and Practices* (4th ed.). John Wiley and Sons, New York

Hudson, N. 1981. *Soil Conservation* (2nd ed.). Batsford Academic and Educational, London.324p.

Hudson, N.W. 1992. *Land Husbandry.* Batsford, London, 192 p.

IARI.1977.*Water Requirement and Irrigation Management of Crops in India*. IARI Monograph No.4,Water Technology Centre, IARI, New Delhi.

Lenka D.1999. *Irrigation and Drainage*. Kalyani publishing House, Ludhiana..

Maitra, M. K. 2001.*Watershed Management. Project Planning, Development and Implementation.* Omega Scientific Publishers, New Delhi.
Michael, A.M. 1978. *Irrigation. Theory and Practice*. Vikas Publishing House, New Delhi.
Mishra.R.D. and Ahamed.M.1993. *Manual of Irrigation Agronomy*. Oxford and IBH Publishing Co., New Delhi
Murthy, V. V. N. 1995. *Land and Water Management Engineering*. Kalyani Publishers, Ludhiana.
Paranjape, S., Joy, K.J. Machado, T. Varma, A. and Swaminathan, S. 1998. *Watershed Based Development. A Source book.* Bharath Gyan Vigyan Samithi, New Delhi.
Roose, E. 1996. *Land husbandry- Components and Strategy.* FAO soils bulletin No.70. Food and Agriculture Organization, Rome.
Sankara Reddi, G.H. and Yellamanda Reddy, T. .2003 *Efficient Use of Irrigation Water*. Kalyani Publishing House, New Delhi.
Tideman, E.M. 1996. *Watershed Management. Guidelines for Indian Conditions.* Omega Scientific Publishers, New Delhi.
USDA [United States Department of Agriculture]. 1964. *A Manual on Conservation of Soil and Water*. *Handbook of Professional Agricultural workers*. Reprint, 1984. Oxford & IBH, New Delhi.

5. Elcp. 4205. Soil Management (1+3)

(Conservation, Problematic soil, Soil quality)

Soil loss- soil and water conservation – methods of soil conservation – Agronomic and Engineering. - Soil wetness- anaerobiosis – desertification – management and alternative use. Chemical degradation – Soil acidity- liming materials. Acid sulphate soils-genesis – classification- problems associated with crop management in such soils. Salt affected soils-classification , mine soils, causes , problems and management for agriculture and alternate uses.. Quality of irrigation water and its effect on soil. Diagnostic symptoms – deficiency and toxicity of common crops. Soils of the state- Kari, kayal, karappadom, kole, pokkali, kaipad and poonthalpadom- problems and management Laterites and associated soils- problems and management.

Practical

Estimation of soil loss by Multislot device for soil conservation studies – Erection of vegetative barriers – soil conservation – Agronomic measures for different slopes/crops –construction of terraces and stone walls.

Field visit to different areas in Kerala requiring special management. Identification of problem soils-red soils, laterites, kuttanad, pokkali, kole, onattukara, chittur – Profile studies-soil sample collection- bulk soil sample collection and incubation study. Identification of the crops showing either toxicity or deficiency symptoms. Soil analysis – Estimation of pH, EC, redox potential, available N, P, K - Exchangeable Ca, Mg, S, micronutrients, detection of heavy metals if any.

Rating of soils into fertility classes and recommendation of fertilizers for different crops. Laying out of observational trial and data recording based on the fertility classes. Soil health index and soil health cards.

Lecture Schedule

1. Soil and water loss – sources – methods of assessment
2. Soil and water conservation- agronomic and engineering techniques – advantages and limitations
3. Cont…. Soil and water conservation- agronomic and engineering techniques – advantages and limitations
4. Cont…Soil and water conservation- agronomic and engineering techniques – advantages and limitations
5. Cont… Soil and water conservation- agronomic and engineering techniques – advantages and limitations
6. Soil wetness – anaerobiosis – desertification –management and alternative use
7. Chemical degradation –soil acidity – sources- reclamation- liming materials
8. Acid Sulphate soils –genesis - classification -characterization
9. Cont… Acid Sulphate soils – problems and crop management
10. Salt affected soils – classification – characterizations and management
11. Mine soils – causes, problems ,management for agriculture and alternative use
12. Irrigation water – quality assessment and its effects in soil
13. Cont… Irrigation water – quality assessment and its effects in soil
14. Essential elements –diagnostic symptoms of nutrient deficiency and toxicity of common crops grown in Kerala
15. Cont… Essential elements –diagnostic symptoms of nutrient deficiency and toxicity of common crops grown in Kerala
16. Soils of Kerala – kari, kayal, karappadom, kole, pokkali and kaipad and poonthalpadom – Problems and management
17. Cont… Soils of Kerala – kari, kayal, karappadom, kole, pokkali and kaipad and poonthalpadom – Problems and management
18. Laterite and associate soils – problems and management

Practical Schedule

1. Field visit to selected locations – identification of different types soil and water loss
2. Cont… Field visit to selected locations – identification of different types soil and water loss
3. Estimation of loss for conservation studies by Multislot device
4. Soil conservation – erection of vegetative barriers types – scope and limitations
5. Conservation measures – agronomic measures for different slope/ crops
6. Cont… Conservation measures – agronomic measures for different slope/ crops
7. Soil conservation –Engineering measures –construction of terraces and stone walls
8. Cont… Soil conservation –Engineering measures –construction of terraces and stone walls
9. Field visit to locations where both agronomic and engineering measures taken for soil conservations
10. Cont… Field visit to locations where both agronomic and engineering measures taken for soil conservations
11. Field visit to Trivandrum, Neyyattinkara and Varkala area and study of soil profile and collection of surface and subsurface soil samples and in situ observation on soil parameters
12. Cont…. Field visit to Trivandrum, Neyyattinkara and Varkala area and study of soil profile and collection of surface and subsurface soil samples and in situ observation on soil parameters

13. Cont…Field visit to Trivandrum, Neyyattinkara and Varkala area and study of soil profile and collection of surface and subsurface soil samples and in situ observation on soil parameters
14. Processing of soil samples collected from Trivandrum, Neyyattinkara and Varkala areas and storing for laboratory studies
15. Particle size analysis of the soil sample collected and estimation of pH, EC, Available N, P and K
16. Cont…. Particle size analysis of the soil sample collected and estimation of pH, EC, Available N, P and K
17. Estimation of Ca, Mg and S
18. Extraction and estimation of micronutrients and heavy metals and rating of the fertility classes
19. Field visit to Chittur and collection of surface soil samples and in situ observation on soil parameters
20. Collection of surface and sub surface soil for Project Work from a near by area of the college
21. Processing of soil samples and storing for laboratory studies of Chittur and local area
22. Particle size analysis of the soil samples collected and estimation of pH, EC, Available N, P and K and rating of soils in the soil fertility classes and recommendation of fertilizers for different crops
23. Cont…. Particle size analysis of the soil sample collected and estimation of pH, EC, Available N, P and K and rating of soils in the soil fertility classes and recommendation of fertilizers for different crops
24. Project Work – Laying out observational trial for raising vegetable crops based on the soil fertility classes
25. Cont… Project Work – Laying out observational trial for raising vegetable crop based on the soil fertility classes
26. Cont…Project Work – Laying out observational trial for raising vegetable crop based on the soil fertility classes
27. Estimation of Ca, Mg and S of soil samples collected from Chittur and attending the field work
28. Extraction and estimation of micronutrients and heavy metals of soil samples collected from Chittur and attending the field work
29. Field Visit to Kuttanad, Pokkali and kole areas and collection of surface and bulk soil samples for Project Work and in situ observation on soil parameters
30. Cont… Field Visit to Kuttanad, Pokkali and kole areas and collection of surface and bulk soil samples for Project Work and in situ observation on soil parameters
31. Processing of soil samples collected from Kuttanad, Pokkali and kole areas and storing for laboratory studies and attending the field work
32. Particle size analysis of the soil samples collected and estimation of pH, EC, redox potential and Available N, P and K and attending the field work
33. Cont…. Particle size analysis of the soil samples collected and estimation of pH, EC, Available N, P and K and attending the field work
34. Estimation of Ca, Mg and S and attending the field work
35. Extraction and estimation of micronutrients and heavy metals and attending the field work
36. Project on incubation study and attending the field work
37. Estimation of Ca, Mg and S and attending the field work and incubation study
38. Extraction and estimation of micronutrient and heavy metals and attending the field work and incubation study

39. Estimation of quality parameters of irrigation water and interpretation
40. Estimation of quality parameters of irrigation water and interpretation
41. Attending the field work and incubation study
42. Attending the field work and incubation study
43. Attending the field work and incubation study
44. Data analysis and submission of the project report – Lab. Study and field trial
45. Data analysis and submission of the project report - Lab. Study and field trial
46. Data analysis and submission of the project report - Lab. Study and field trial
47. Data analysis and submission of the project report - Lab. Study and field trial
48. Data analysis and submission of the project report - Lab. Study and field trial

Suggested Readings

Donahu, L.R, Miller, W.R. and Shickuluna, 1977. *Soils*. Prentice Hall of India Pvt. Ltd., New Delhi

Gupta, P.K. 2007. Soil, Plant, Water and Fertilizer Analysis. Published by AGROBIOS (India), Jodpur

Gustafson, A.F. 2006. Soils and Soil Management. Published by AGROBIOS (India), Jodpur

ISSS, 2002. *Fundamentals of Soil Science*. Published by Indian Society of Soil Science, IARI, New Delhi.

KAU, 1994. *A Glimpse to Problem Soils of Kerala* (ed. Padmaja, P. *et al*) Kerala Agricultural University

Khan, M.A. 2006. Watershed Management for Sustainable Agriculture. Published by AGROBIOS (India), Jodpur

Samuel L.Tisdale, Werner.L. Nelson, James D.Beaton and John L. Havlin. 1995. *Soil Fertility and Fertilisers*. 5th Edn. Macmillan publishing company, USA.

Shilpa, S, Varma, H.N and Bhargava, S.K. 2006. *Air Pollution and its Impacts on Plant growth* Published by New India Publishing Agency, New Delhi

Wild, A. 1988. *Russell's Soil Conditions and Plant Growth*. ELBS Publications, London

6. Elcp. 4206. Crop growth simulation modelling (2+1)

Concept of plant growth and development – Principles of crop production – Impact of natural and induced variability of crop production - Agroclimatic analysis of crop production - Principles in crop forecasting and Crop modelling - Evaluation of crop response and weather elements – Climate change and impacts in agriculture sector – Empirical and statistical crop weather models – Multiple regression analysis – Stepwise regression technique – Time series analysis - Incorporating weather, soil, plant and other environmental related parameters and Remote sensing inputs – Water balance models – Agrometeorological crop monitoring using FAO model – Versatile soil moisture budget – Soil water balance model – SPAW model – Crop modelling and its applications – Minimum dataset – Genetic coefficients – Agrometeorological indices and phasic development – Nitrogen uptake and Nitrogen balance - CERES models of barley, millet, sorghum, wheat and rice - ORYZA rice model - CROPGRO models of drybean, peanut and soybean - CROPCAST model for maize, soybean and WTGROW and its application - Forecasting of pests and diseases and other natural hazards

Practical

Deriving the prediction equations for different crops with the use of empirical and statistical methods. Crop weather analysis models and crop simulation models. Forecasting of frost, pests and diseases. Hands on experience on CERES models of barley, millet, sorghum, wheat and rice, ORYZA rice model, CROPGRO models of dry bean, peanut and soybean, CROPCAST model for maize and soybean and WTGROW.

Lecture Schedule

1. Concept of plant growth and development
2. Principles of crop production – Impact of natural and induced variability of crop production - Agroclimatic analysis of crop production
3. Principles in crop forecasting and Crop modeling
4. Evaluation of crop response and weather elements
5. Climate change and impacts in agriculture sector
6. Empirical and statistical crop weather models – Multiple regression analysis – Stepwise regression technique – Time series analysis
7. Incorporating weather, soil, plant and other environmental related parameters and Remote sensing inputs
8. Water balance models – Agrometeorological crop monitoring using FAO model
9. Versatile soil moisture budget – Soil water balance model – SPAW model
10. Crop modelling and its applications
11. Minimum dataset – Genetic coefficients – Agrometeorological indices and phasic development
12. Nitrogen uptake and Nitrogen balance
13. CERES models of barley, millet, sorghum, wheat and rice and its application
14. ORYZA rice model and its application
15. CROPGRO model of drybean, peanut and soybean and its application
16. CROPCAST model for maize, soybean and its application
17. WTGROW model and its application
18. Forecasting of pests and diseases and other natural hazards

Practical Schedule

1. Deriving the prediction equations for different crops with the use of empirical and statistical methods
2. Crop weather analysis models and crop simulation models
3. Forecasting of frost, pests and diseases
4. Hands on experience on CERES models of barley, millet, sorghum, wheat and rice
5. Hands on experience on CERES models of barley, millet, sorghum, wheat and rice
6. Hands on experience on CERES models of barley, millet, sorghum, wheat and rice
7. Hands on experience on CERES models of barley, millet, sorghum, wheat and rice
8. Hands on experience on ORYZA rice model
9. Hands on experience on ORYZA rice model
10. Hands on experience on ORYZA rice model
11. Hands on experience on ORYZA rice model
12. Hands on experience on CROPGRO models of dry bean, peanut and soybean
13. Hands on experience on CROPGRO models of dry bean, peanut and soybean
14. Hands on experience on CROPGRO models of dry bean, peanut and soybean
15. Hands on experience on CROPCAST model for maize and soybean
16. Hands on experience on CROPCAST model for maize and soybean
17. Hands on experience on WTGROW model for wheat.

18. Hands on experience on WTGROW model for wheat.

Suggested Readings

CASAM. 1998. Crop modeling (eds. Varshneya, M.C. and Salunke, S.S.) Centre of advanced studies in agricultural meteorology, college of agriculture, Pune pp.251

Gadvian J. 1977. Crop Micrometeorology and Simulation Study, PUDOC. Wagenedigan, pp.249.

Gopalaswamy, N. 1994. *Agricultural meteorology*. Rawat publications, Jaipur, p.153.

Grace, John 1983. Plant Atmospheric Relationships. Outline studies in Ecology

Mavi, H.S. 1986. Introduction to Agrometeorology. Oxford IBH Publishing Company, New Delhi. pp281.

Munn, R.E., 1970. Biometeorological Methods. Meteorological services of Canada Toronto, Canada.

Petterson, S., 1958. Introduction to meteorology. McGraw Hill. Inc. New York, pp.327. pp.395.

Rao, G.S.L.H.V.P. 2005. Agricultural Meteorology. 2nd edn, Kerala Agricultural University, Thrisur. Pp326

Varshneya.M.C. Pillai.P.B. 2003. Text book of Agricultural Meteorology. ICAR, New Delhi. p.221

Venkatraman,S and Krishnan, A.1992. Crops and Weather. Indian Council of Agricultural Research, New Delhi, p 320

II. CROP PROTECTION

1. Elpt . 4201. Integrated pests and disease management (Pest disease scouting) (2+2)

Pest status and pest concept. Types of pests. Population and damage levels, loss assesment. Biodiversity- concept and importance . Concept of agroecosystem in pest management – community, ecosystem and agroecosystem. Principles of agroecosystem based pest management. IPM for major pests of crops.

Concept of plant disease - definition – classification of plant diseases – types of diseases based on symptom – general study of diseases with symptomatology – etiology – epidemiology – physiology of parasitism – patho physiology. Damping off and seedling blight of root and fruit diseases, blight, spot and anthracnose, downy mildew, powdery mildew, rust, smut, bunt diseases. The leaf curl, mosaic, yellows, galls, witches broom, scab, post harvest diseases. Management of plant diseases through chemical, cultural, biological and other means.

Practical

Agroecosystem analysis – recording of data on weather parameters, other factors contributing to yield and yield attributes – finalising and adoption of the pest management strategies in major crops.

Study of the different types of symptoms of diseases – host parasite relationships and their management.

Lecture Schedule

1. Pest status and pest concept.
2. Types of pests.
3. Population and damage levels,
4. Loss assesment.
5. Biodiversity- concept and importance.
6. Concept of agroecosystem in pest management
7. Community
8. Ecosystem
9. Agroecosystem.
10. Principles of agroecosystem based pest management.

11-20 IPM for major pests of crops.

21. Concept of plant disease - definition
22. Classification of plant diseases
23. Types of diseases based on symptom
24. General study of diseases with symptomatology
25. Etiology – epidemiology, physiology of parasitism – patho physiology.
26. Damping off and seedling blight of root and fruit crops.
27. Blight, spot and anthracnose diseases
28. Downy mildew and powdery mildew diseases.
29. Rust , smut and bunt diseases.
30. Leaf curl, mosaic, yellows, gallsetc.
31. Witches broom, scab & post harvest diseases.

32-36 Management of plant diseases through chemical, cultural, biological and other means.

Practical schedule

1-18. Agroecosystem analysis – recording of data on weather parameters, other factors contributing to yield and yield attributes – finalising and adoption of the pest management strategies in major crops *viz*., rice, coconut, vegetables, banana, mango, cashew, medicinal plants and ornamental plants.

19-36. Study of the different types of symptoms, loss assessment, and diseases management of major crops *viz*., rice, coconut, vegetables, banana, mango, cashew, medicinal plants and ornamental plants.

Suggested Readings

Dhaliwal, G.S. and Arora, R. 2001. *Integrated Pest Management – Concepts and Approaches*. Kalyani publishers, New Delhi.

Dhaliwal. G. S. and Heinnchs, E. A. 1998. *Crticial Issues in Integrated Pest Management*. Common wealth publishes, New Delhi.

Nair, M. C. and Menon. M. R. 1985. *Diseases of Crop Plants*. Kerala Agricultural University . Thrissur

Pedigo, T. P. 1996. *Entomology and Pest Management*. Prentice – Hall of India, New Delhi

Santhakumari, P (ed) 2004. *Advances in the Diseases of Plantation Crops and Spices*, IDB Co., Lucknow

Singh. R. S 2002. *Introduction to Principles of Plant Pathology*.Oxford and IBH publishing co.pvt.ltd.bombay

2. Elpt . 4202 Management of post harvest insect pests and diseases (1+1)

Causes of storage losses - losses caused by storage pests. Studies on the pests of stored products – biology, nature of damage, management- prophylactic, curative methods. Methods of domestic and commercial management of insect infestation on stored commodities. Storage structures-under ground and above ground structures- rural, improved and modern. Post harvest management of field crop pests- fruit flies, stone weevil etc.

Post harvest diseases of important vegetable crops – brinjal, bhindi, tomato, carrot, curcubits, chillies, beans – softrot, dry rot, spices – changes induced by bacterial and fungal pathogens under storage conditions. Post harvest diseases of banana, mango, papaya, apple, grapes, sapota, etc. Types of storage of post harvest agricultural products and their management. Seed born diseases of crop plants, identification and management of seed born diseases.Loss of nutrients due to post harvest diseases.

Practical

Types of damage caused by pests of stored products. Identification of pests of stored products. Types of storage structures. Different methods of pest management. Visit to FCI godown

Biotic and abiotic factors responsible for deterioration of fruits, vegetables and seeds. Nature of damage. Collection and identification of pathogens associated with various vegetables, seeds and fruits – from different storage conditions – isolation of pathogens – isolation of seed born pathogens – quantification – isolation of toxins – nature of damage – techniques of storage – control of storage pathogens

Lecture Schedule

1. Causes of storage losses.
2. Losses caused by insect pests in storage.
3-5 Major pests of stored products – biology, nature of damage
6. Management- prophylactic, curative methods.
7. Methods of domestic and commercial management of insects infestation on stored commodities.
8. Storage structures-under ground and above ground structures- rural, improved and modern.
9 Post harvest management of field crop pests- fruit flies, stone weevil etc.
10-12 Post harvest diseases of important vegetable crops – brinjal, bhindi, tomato, carrot, curcubits, chillies, beans
13. Soft rot and dry rot disease of spices
14. Changes induced by bacterial and fungal pathogens under storage conditions
15. Post harvest diseases of banana, mango, papaya, apple, grapes, sapota etc.
16. Types of storage of post harvest agricultural products and their management.
17. Seed born diseases of crop plants- identification and management of seed born diseases.
18. Loss of nutrients due to post harvest diseases.

Practical schedule

1. Types of damage caused by pests of stored products.
2-3 Identification of coleopteran pests of stored products.
4 Identification of lepidopteran pests of stored products
5 Types of storage structures.
6-7 Different methods of pest management.
8-9 Visit to FCI and other storage godowns
10 Biotic and abiotic factors responsible for deterioration of fruits, vegetables and seeds.
11-13 Collection of diseased plant or plant parts and identification of pathogens associated with various vegetables, seeds and fruits – from different storage conditions
14-16 Isolation of pathogens – isolation of seed born pathogens – quantification – isolation of toxins – nature of damage
17 Techniques of storage
18 Control of storage pathogens

Suggested Readings

Ghosh. S. K. Durbey S. L. 2003. *Integrated Management of Stored Grain Pests*. International Book Distributing Company.

Metcalf . L. C and Flint. W. P. 1973. *Destructive and Useful Insects*. Tata Mc Graw Hill New Delhi.

Rao, P. A ., Mathur, K. C and Pasalu. L. C. 1987. *Rice Storage and Insect Pest Management*. B.R publishers. New Delhi.

3. Elpt . 4203. Non insect pests and their management (1+1)

General characters of important non insect pest species. Plant parasitic nematodes- field identification and management. Phytophagous mites - important species, nature and symptoms of damage on crops. Management of important mite pests of crops. Snails and slugs. - biology, habits, economic importance and management. Rodents- biology, habits, economic importance and management. Rodent control campaign. Birds and other vertebrate pests - nature of damage, management. Rodenticides, acaricides and molluscicides - formulations and applications.

Practical

Identification of important plant parasitic nematodes. Identification of important mite species - symptoms of damage. Identification of important rodent species. Aquaintance with burrow patterns. Field practice of recommended rodent management techniques. Identification of snails, slugs, birds and other vertebrate pests and the symptoms of damage caused by them. Field practice of management measures. Formulations and application of acaricides. rodenticides and molluscicides. Preparation of poison baits.

Lecture Schedule

1. General characters of important non insect pest species.
2-4 Plant parasitic nematodes- identification and management.
5-8 Phytophagous mites - important species, nature and symptoms of damage on crops.
9. Management of important mite pests of crops.
10 Snails and slugs. - biology, habits, economic importance and management.
11-13 Rodents- biology, habits, economic importance and management.
14-15 Rodent control campaign.
1. Birds and other vertebrate pests - nature of damage, management.
17-18 Rodenticides, acaricides , molluscicides and nematicides - formulations and applications

Practical schedule

1-3 Identification of important plant parasitic nematodes.
4-6 Identification of important mite species and symptoms of damage.
7-9 Identification of important rodent species.
10-11 Aquaintance with burrow patterns.
12-14 Field practice of recommended rodent management techniques.
15. Identification of snails, slugs, birds and other vertebrate pests and the symptoms of damage caused by them.
16. Field practice of management measures.
17-18. Formulations and application of acaricides. rodenticides, molluscicides and nematicides.

Suggested Readings

David, B. V. and Kumaraswamy, T. 1996. *Elements of Economic Entomology*, Popular Book Depot, Madras.
Gupta, S.K. 1985. *Hand Book Plant mites of India*, Zoological Survey of India, Calcutta

Haq, M. A. and Ramani, N. 1992. *Mites and Environment* Anjengo Publications, Kerala
Jeppson, L. R., Keifer, H. H. and Baker, E. W. 1975. *Mites Injurious to Economic Plants*. University of California Press
Nair, M. R. G. K. 1976. *Insects and Mites of Crops in India*, ICAR, New Delhi
Prakash, I and Mathur, R.P. 1987. *Management of Rodent Pests*, ICAR, New Delhi.

4. Elpt . 4204. Productive insects (1+1)

Bee keeping – history and development. Honey bees- kindsof bees, anatomy , biology-Hiving and domestication. Seasonal management of bees. Bee pasturage. Bee products- extraction ,uses, composition and preservation . Diseases and enemies of honey bees and their control. Bee poisoning . Scope of apiculture in Kerala . Recent advances in apiculture research.

Sericulture – history and development. Types of silkworms in India – morphology, biology, rearing of silkworms. Host plants and their cultivation. Diseases and enemies of silkworm and their control. Use of biotechnology in sericulture. Scope of sericulture in Kerala. Recent advances in sericulture research.

Lac culture –behaviour and development of lac insects. Different strains and their host plants. Inoculation, harvesting and processing of lac. Lac and its uses. Enemies of lac insect and their control. Scope for cultivating lac in Kerala. Recent advances in lac culture research.

Practical

Different types of bees and bee equipment. Handling of bee colonies. Diseases and enemies of bees- Extraction and processing of honey. Visit to apiaries.
Study and identification of silkworms.Rrearing of mulberry silkworms and visit to rearing units. Identification of lac insects and their natural enemies.

Lecture Schedule

1. Bee keeping – history and development.
2. Honey bees- kinds, morphology, anatomy, biology.
3. Hiving and domestication . Seasonal management of bees.
4. Bee pasturage.
5-6. Bee products- uses, composition and preservation .
7. Diseases and enemies of honey bees and their management. Bee poisoning
8. Scope of apiculture in Kerala . Recent advances in apiculture research.
9. Sericulture – history and development.
10. Types of silkworms in India – morphology and biology
11. Rearing of mulberry and other silk worms.
12 Host plants and their cultivation.
13 Diseases and enemies of silkworm and their management. Use of biotechnology in sericulture.
14 Scope of sericulture in Kerala, recent advances in sericulture research.
15 Lac culture –behaviour and development of lac insects.

16. Different strains and their host plants.
17. Inoculation, harvesting, processing and uses of lac.
18. Enemies of lac insect and their management. Scope of lac cultivation in Kerala. Recent advances in lac culture research.

Practical schedule

1-5	Different types of bees and bee equipment.
6.	Handling of bee colonies.
7.	Diseases and enemies of bees
8.	Extraction and processing of honey.
9.	Visit to apiaries.
10-12	Identification of silkworms
13-16	Laboratory rearing of mulberry silkworms and visit to rearing units.
17-18	Identification of lac insects and their natural enemies

Suggested Readings

David, B. V. and Kumarawami, T. 1978. *Elements of Economic Entomology* Popular Book Depot, Madras.
Ganga, G. and Sulochanachetty. 1999. *An Introduction to Sericulture* Second edition. IBM and Oxford Publishing Company, New Delhi.
Groul, R.A. 1963. *The Hive and the Honeybee.* Dadani and Sons. Inc. Illinois.
Jolly, M. S. 1986. *Economics of Sericulture Under Irrigated Conditions*, CSTRI, Mysore.
Jolly, M. S. 1986. *Economics of Sericulture Under Rainfed Conditions*. CSTRI, Mysore.
Krishnaswami, S., Narasimhanna, Suryanarayana and Kumararaj. 1991. *FAO Manuals on Mulberry Cultivation, silkworm rearing and silk reeling*. IBM and Oxford Publishing Company, New Delhi.
Mishra, R. C. 1998. *Perspectives in Indian Apiculture*. Agro botanica, Bikaneer, Rajasthan.
Sardar Singh. 1962. *Bee Keeping in India*. ICAR, New Delhi.

5. Elpt . 4205. Mushroom cultivation (0+2)

Importance of mushroom cultivation – definition of mushroom - its importance – present scenario of mushroom cultivation – general morphological features, taxonomy and identification of different mushrooms-poisonous, hallucinogenic and medicinal mushrooms. Pure culture of mushrooms and their nutritional requirements. Definition of spawn, substrate for spawn, types of spawn, methods of spawn production, characteristic of a good spawn, storage of spawn. Cultivation of Agaricus species – composting – its formulation, casing, preparation of casing mixture, sterilization, cultivation of pleurotus, Volvariella, Lentinus, Calocybe and Auricularia. Different types of substrates, substrate preparation and sterilization, Spawning, methods of spawning, spawn run phase, cropping. Identification and management of different pests and diseases of mushrooms. Methods of harvesting mushrooms, post harvest treatments and preservation of mushrooms. Packing and processing – Different methods of processing, canning and dehydration. Nutritive value of mushrooms and preparation of different recipes.

Practical

Techniques used in Agaricology – Identification of edible and poisonous mushroom – preparation of spore print and preparation of spore culture – isolation of different mushrooms in pure culture – preparation of spawn – preparation of substrates and cultivation of mushroom, harvesting, processing and packing for marketing – preparation of different recipes.

Practical Schedule

1. Identification of common edible and poisonous mushrooms
2. Equipments used in mushroom laboratory
3. Physical and chemical sterilization techniques
4. Preparation of spore print and spore culture
5. Preparation of culture media
6. Pure culture techniques
7. Isolation of different mushrooms in pure culture
8. Preparation of spawn - mother spawn and bed spawn
9. Visit to a commercial spawn production unit
10. Preparation of substrates for mushroom cultivation
11. Oyster mushroom cultivation
12. Milky mushroom cultivation
13. Casing soil preparation for milky mushrooms
14. Paddy straw mushroom cultivation
15. Button mushroom cultivation
16. Commonly used compost formulae, long and short method of composting
17. Cultivation of *Auricularia* sp.,
18. Substrate preparation and sterilization of *Auricularia* sp.
19. Familiarization with other edible mushroom varieties
20. Visit to a commercial mushroom production unit
21. Identification and management of different pests and diseases of mushroom
22. Methods of harvesting mushrooms
23. Post harvest treatment and preservation of mushrooms
24. Packaging and processing of mushrooms
25. Different methods of processing, canning and dehydration
26. Mushroom recipes - preparation
27. Design and layout of mushroom farm
28. Cost analysis of mushroom farm
29. Preparation of projects
30. Market survey to assess the potentiality for various mushrooms
31. Organization setup at financial management, record keeping and store management
32. Use of mushrooms in bioremediation
33. Bio-waste management with mushroom fungi
34. Trainings to be conducted to farmers
35. Popularization through seminars and symposia etc.
36. Evaluation of the local production units to assess the targets achieved.

Suggested Readings

Chadha, C. L and Sharma, S. R 1995. *Advances in Horticulture, Mushroom* – Vol. 13 (ed) Malhotra Publishing House, New Delhi.

Chang, S. T. Miles, P. G. and Hays, W. A. 1978. *The Biology and Cultivation of Edible Mushrooms.* Academic Press, London.

Christensen, C. M. 1955. *Common Fleshy Fungi*., Burgress Publishing Company, Minneapolis, Minn.
Cook, R. C. 1977. *Fungi. Man and His Environment*., Longman Incorp, New York.
Lulu Das. 2002. *Mushroom Recipes*. (Released in the VIII Biennial meeting of AICMIP)
Nair, M. C. 1991. *Mushrooms* – Technical bulletin No. 14. Director of Extension, KAU.
Nair, M. C. 1994. *Advances in Mushroom Biotechnology*. Scientific Publishers, New Pali Road, Jodhpur.
Nair, M. C. 1995. *Beneficial Fungi and TheirUtilization.* Scientific publishers, New Pali Road, Jodhpur.

6. Elpt . 4206. Biocontrol agents and biopesticides (Mass production and uses) (1+2)

Biological balance – attributes of successful pathogen and parasites- concepts and components of biocontrol of plant pathogens. Organic amendments and botanicals for plant disease management. Myco herbicides and their role in weed management.

Isolation, identification, purification and pure culturing of recognized biocontrol organisms with commercial potential for crop disease management and growth promotion – *Pseudomonas* spp., *Bacillus* spp., *Trichoderma* spp. and Actinomycetes. Pilot scale mass production in laboratory . Nutritional requirement and designing of media for commercial production of biocontrol agents. Carrier materials and their importance in maintaining the shelf life of wettable powder formulations. Different types of biocontrol formulation and their efficacy under field level. Legislature Acts in the production and marketing of biocontrol agents and biopesticides.

Mass production – pilot and commercial scale production of microbial insecticides – *Beauveria* spp., *Metarhizium*,spp, *Fusarium pallidoroseum*. Designing of media for fermentation of biocontrol agents – different types of fermentors and fermentation process – solid, semi solid and liquid fermentation – optimization of fermentation process. Processing, formulation and quality testing of biocontrol agents. Different methods of application of various biocontrol agents in different cropping systems and soil condition. Mass production and field evaluation of parasitoid (*Trichogramma* spp) and predator (*Chrysoperta carnea*).

Practical

Isolation of antagonists from phyllosphere, rhizosphere, spermosphere – in vitro and in vivo evaluation for biocontrol potential. Isolation, purification, pure culture and multiplication of biocontrol agents, *Pseudomonas* spp., *Bacillus* spp., *Trichoderma* spp., Actinomycetes, *Beauveria* spp., *Metarhiziumsp* ,*Fusarium pallidoroseum*. Laboratory multiplication of *Trichogramma* spp. and *Chrysoperla carnea*. In vitro efficiency testing, mass production and product formulation in laboratory. Working of different types of commercial fermentors . Liquid and solid fermentation for commercial production, processing and formulation and packing of biocontrol agent. Quality evaluation of products. Field application of biocontrol agents in different cropping systems against different diseases and pests. Visit to commercial production unit. Use of various organic amendments in the management of plant diseases.

Lecture Schedule

1. Introduction to Biological control - Biological equilibrium– attributes of successful pathogen and parasites- concepts and components of biocontrol of plant pathogens.

2-3 Organic amendments and botanicals for plant disease and pest management. Mycoherbicides and their role in weed management.
4-5 Isolation, identification, purification and pure culturing of recognized biocontrol organisms with commercial potential for crop disease management and growth promotion – *Pseudomonas* spp., *Bacillus* spp., *Trichoderma* spp. and Actinomycetes.
6. Nutritional requirement and designing of media for culturing of biocontrol agents and maintanance of culture.
7. Mass production of microbial inoculants in the laboratory.
8-9 Designing of media for fermentation of biocontrol agents – different types of fermentors and fermentation process – solid, semi- solid and liquid fermentation – optimization of fermentation process
10-11 Processing, formulation and quality testing of biocontrol agents.
12. Carrier materials and their importance in maintaining the quality of formulations.
13. Methods of application of biocontrol agents in different cropping systems and soil conditions.
14-15 Mass production – pilot and commercial scale production of microbial insecticides – *Beauveria* spp., *Metarhizium* spp,*Fusarium pallidoroseum.*
16-17 Mass production and field evaluation of parasitoid (*Trichogramma* spp) and predator (*Chrysoperta carnea*).
18. Legislature Acts and CIB registration for the production and marketing of biocontrol agents and biopesticides.

Practical Schedule

1-3.1 Isolation of antagonistic microorganisms from phyllosphere, rhizosphere and spermosphere and entomopathogens of major insect pests .
5-10. Pure culturing and evaluation of biocontrol potential of isolates - of *Pseudomonas* spp., *Bacillus* spp., *Trichoderma* spp., Actinomycetes, *Beauveria* spp., *Metarhizium* spp and *Fusarium pallidoroseum.*
11-12. Laboratory multiplication of *Trichogramma* spp., *Chrysoperla carnea*, *Beauveria*, *Metarhizium* and *Fusarium.*
13-15. Mass production and product formulation of biocontrol agents .
16-19. Working of different types of commercial fermentors .
20-25. Liquid and solid fermentation for commercial production, processing, formulation and packing of biocontrol agents.
26-28. Quality evaluation of formulated products.
29-33. Field application of biocontrol agents in different cropping systems against different diseases and pests.
34-35. Visit to commercial production unit.
36. Use of various organic amendments in the management of plant diseases.

Suggested Readings

Baker, K.F and Cook. R. J. 1974. *Biological Control of Plant Pathogens*. Freman.W.H. Francisco.

Burges H.D. 1998. *Formulation of Microbial Biopesticides*, Kluwer Academic Publsihers, Dordrecht

Tanada, Y and Kayes, H.K. 1993. *Insect Pathology*. Academic Press Inc. New York

Whilips, S.M. 1977. *Developments in the Biological Control of Soil Borne Plant pathogens.* Advances in botanical Research. 26. 1-34

7. Elpt . 4207. Pesticides and plant protection equipment (1+2)

History, principles and scope of insect toxicology – Classification and chemistry of pesticides. Mode of action and metabolism of major insecticides and new molecules. Factors affecting toxicity of insecticides. Insecticidal pollution – pathways of environmental contamination. Pesticide resisitance. Bio-accumulation and susceptibility of biological materials to insecticides. Insecticidal poisoning – symptoms and treatment. Residue problems caused by insecticides – methods of estimation of residues – management of residue. Plant protection equipments- classification and working principles. Parts of plant protection equipment.

Importance of fungicides in plant disease management – familiarization with common terminologies – groups and classification of fungicides – fungicides formulation – spray adjutants/ auxiliary spray materials – methods of preparation of Bordeaux mixture – Bordeaux paste, Cheshnut compound etc. Methods of application of fungicides – foliar spray , dust – pouring, soil drenching , fumigation – seed dressing etc. Dosage calculation of fungicides – application equipment- Rules and registration of fungicides. Phytotoxicity and compatiablity of fungicides – safe use of fungicides , hazards. Bioassay of fungicides- assay of fungicide resistance.

Practical

Biological evaluation of toxicity of pesticides – studies on the effect on target and non-target organisms. Methods of residue analysis from plant and environmental samples.Plant protection equipments- parts and working.

Study on the different symptoms of plant diseases – familirization with common fungicides – preparation of Bordeaux mixture – Bordeaux paste, Cheshnut compound – storage – application of fungicides – application of seed dosage calculation – study of PP equipments- Bioassay of fungicide- Assay on the residue of fungicide

Lecture Schedule

1. History, principles and scope of insect toxicology
2. Classification and chemistry of pesticides.
3. Mode of action and metabolism of major insecticides and new molecules.
4. Factors affecting toxicity of insecticides.
5. Insecticidal pollution – pathways of environmental contamination.
6. Pesticide resistance.
7. Bio-accumulation and susceptibility of biological materials to insecticides.
8. Insecticidal poisoning – symptoms and treatment.
9. Residue problems caused by insecticides – methods of estimation of residues – management of residues.
10. Plant protection equipments- classification and working principles.
11. Parts of plant protection equipment.
12. Importance of fungicides in plant disease management – familiarization with common terminologies
13. Groups and classification of fungicides – fungicide formulations – spray adjutants/ auxiliary spray materials
14. Methods of preparation of Bordeaux mixture – Bordeaux paste, Cheshnut

compound.

15. Methods of application of fungicides – foliar spray – dust – pouring- soil drenching – fumigation – seed dressing .
16. Dosage calculation of fungicides . Application equipment. Rules and registration of fungicides.
17. Phytotoxicity and compatiablity of fungicides. Safe use of fungicides to avoid hazards.
18. Bioassay of fungicides- assay of fungicide resistance.

Practical Schedule

1-10 Biological evaluation of toxicity of insecticides – studies on the effect on target and non- target organisms.
11-15 Methods of residue analysis from plant and environmental samples.
16-20. Plant protection equipments- parts and working.
21-25 Different symptoms of plant diseases
26-28 Familirization with common fungicides
29-31 Preparation of Bordeaux mixture – Bordeaux paste, Cheshnut compound
32 Application of fungicides
33 Calculation of dosage for seed treatment
34. Study of PP equipments for fungicide application
35. Bioassay of fungicides
36. Assay on the residue of fungicides

Suggested Readings

Bindra, O. S. and Harcharan singh. 1977. *Pesticide Application Equipments*. Oxford and IBH publishers, New Delhi.
Carlie, W. R. 1995. *Control of Crop Diseases*. Cambridge University Press, U. K.
David, B. V. 1981. *Indian Pesticide Industry – Facts and Figures*. Vishvas publications, Bombay
David, B. V. 1992. *Pest Management and Pesticides. Indian Scenario*. Namrutha publication, Madras.
Edwards, C.A. 1973. *Persistent Pesticides in the Environment*. CRC, Press.
Handa, S.K. 1999. *Principles of Pesticide Chemistry*. Agrobios (India),
Hutson, D and Miyamoto, J. 1996. *Fungicidal Activity – Chemical and Biological Approaches to Plant Protection*. John Wiley and Sons, New York.
Lyr, H. (Ed). 1987. *Modern Selective Fungicides*. Longman, London.
Maloy, O. C. 1995. *Plant Disease Control. Principles and Practice*. John Wiley and Sons INC, New York
Mathews, Y. A. *Pesticides Application Method*., Longman, London
Nene, Y. L. and Thapliyal, P. N. 1993. *Fungicides in Plant Disease Control*. Oxford and IBH publishers, New Delhi.
Sree Ramulu. N. S. 1985. *Chemistry of Insecticides and Fungicides*. Oxford and publishers, New Delhi
Wiegel, S, and Michael, L. 1983. *Pest and Disease Control*. BCPC publications London
G180

III. HORTICULTURE

1. Elht. 4201. Commercial vegetable productioin (1+2)

Definitions of vegetables, Economic, nutritive and aesthetic value of vegetables, Methods of classification, relative merits and demerits, Types of vegetable growing and vegetable forcing structures. Vegetable growing tracts in India with special reference to Kerala, Special systems of cultivation in Kerala, Production potential of vegetables in Kerala, Nutrition- Role of macro and micronutrients, growth regulators in vegetable production. Plant protection – identification and control of important pest and disease problems of vegetables. Vegetable seed production – General principles. Post harvest handling, grading and marketing of vegetables.

Practical

Familiarization of different varieties of tropical vegetable crops- Calculation of ANV, carrying capacity- Seed and soil treatments- Preparation of nursery bed, sowing and aftercare- Main field preparation and planting of transplanted and direct sown vegetables- Formation of beds, ridges and furrows, application of manures and basal dressing of fertilizers, gap filling, inter cultural operations, plant protection, harvesting and marketing- preparation of cost o f cultivation.

Lecture Schedule

1. Introduction – Importance and scope of vegetable crops of India with special emphasis to Kerala
2. Nutritional importance- nutrient value of vegetables, ANV, carrying capacity.
3. Types of vegetable farming – Kitchen garden; Market garden; Truck garden; vegetable forcing; Vegetable garden for processing; Vegetable garden for seed production.
4. Kitchen garden- site selection, principles of layout, cropping schedule.
5. Systems of vegetable cultivation – Traditional and specialised systems; Low-cost and high-tech systems; Riverbed system, Glasshouse cultivation and other protected systems.
6. Cropping systems and patterns- Vegetables in rice-based and coconut based cropping systems; mixed cropping, intercropping, relay cropping.
7. Basic principles of vegetable production – Nursery, Sowing and transplanting, Care and management.
8. Irrigation – Surface, Sub-surface and Spray irrigations.
9. Nutrition – Essential nutrients, Organic and inorganic; Deficiency symptoms;
10. Nutrition – Methods of application of manures and fertilizers.
11. Growth regulators – Important growth regulators and their effects; Methods of application.
12. Plant protection – identification and control of important pest problems of vegetables
13. Plant protection – identification and control of important disease problems of vegetables
14. Plant protection –Special precautions, Rotation, Resistant varieties, Seed treatments
15. Vegetable seed production – General principles, Breeding system, Isolation distance, Rouging, Cultural operations.

16. Vegetable seed production- Seed standards, Packing & Storage; Seed production in cool season vegetable crops.
17. Post harvest handling – Losses; Causes and measures to reduce losses; Packing and transport.
18. Marketing of vegetables – Retail markets, Wholesale market, Auction market, export and import markets.

Practical Schedule

1. Familiarisation of characters of different tropical vegetable crops
2. Familiarisation of characters of different varieties of vegetable crops
3. Nutritional value of vegetables- calculation of ANV, carrying capacity
4. Seed and soil treatments- chemical treatments
5. Seed bio priming techniques, soil sterilisation
6. Preparation of nursery bed, sowing and aftercare of transplanted vegetables.
7. Preparation of nursery bed, sowing and aftercare of transplanted vegetables.
8. Preparation of calendar of operations
9. Calculation of fertilizer requirement, application by different methods
10. Main field preparation and planting of transplanted vegetables- Formation of beds, ridges and furrows, application of manures and basal dressing of fertilizers, gap filling –tomato
11. Main field preparation and planting of transplanted vegetables- Formation of beds, ridges and furrows, application of manures and basal dressing of fertilizers, gap filling –brinjal
12. Main field preparation and planting of transplanted vegetables- Formation of beds, ridges and furrows, application of manures and basal dressing of fertilizers, gap filling –chillies
13. Main field preparation and planting of transplanted vegetables- Formation of beds, ridges and furrows, application of manures and basal dressing of fertilizers, gap filling –amaranthus
14. Main field preparation and planting of cucurbits- Formation of pits, application of manures and basal dressing of fertilizers, gap filling
15. Main field preparation and planting of cucurbits- Formation of pits, application of manures and basal dressing of fertilizers, gap filling
16. Main field preparation and planting of cucurbits- Formation of pits, application of manures and basal dressing of fertilizers, gap filling
17. Main field preparation and planting of cucurbits- Formation of pits, application of manures and basal dressing of fertilizers, gap filling
18. Main field preparation and planting of cowpea and other leguminous vegetables- Formation of pits/ ridges and furrows, application of manures and basal dressing of fertilizers, gap filling
19. Main field preparation and planting of cowpea and other leguminous vegetables- Formation of pits/ ridges and furrows, application of manures and basal dressing of fertilizers, gap filling
20. Main field preparation and planting of cowpea and other leguminous vegetables- Formation of pits/ ridges and furrows, application of manures and basal dressing of fertilizers, gap filling
21. Main field preparation and planting of okra- Formation of ridges and furrows, application of manures and basal dressing of fertilizers, gap filling

22-23. Irrigation scheduling

24-25 . Top dressing of fertilizers and earthing up operation.

26. Preparation of growth regulator solutions and application
27. Preparation and application of pesticides/ fungicides/ botanicals
28. Preparation and application of pesticides/ fungicides/ botanicals
29. Mechanical control, setting up of traps.
30. Inter cultural operations- training and pruning, staking.
31. Maturity indices and harvesting of vegetables for vegetable purpose
32. Maturity indices and harvesting of vegetables for seed purpose
33-34 Seed extraction methods, processing and storage
35 Marketing of vegetables- marketing channels- wholesale markets and retail markets.
36. Economics of vegetable cultivation

Suggested Readings

Bose, T. K. and Som, M. G. 1990. *Vegetable crops in India*. Naya Prokash, Calcutta.
Das, P. C.1993. Vegetable crops in India.Kalyani Publishers
Hazra, P. and Som, M. G. 1999. *Technology for vegetable Production and Improvement*. Naya Prokash, Calcutta
Thamburaj, S. and Singh, N. 2005. *Vegetables, tuber crops and spices*. ICAR, New Delhi.

2. Elht. 4202. Commercial floriculture (1+2)

Status and prospects of commercial cultivation of flowers. Varieties, planting systems, spacing, manuring, irrigiation, pruning, mulching, plant protection, harvesting, postharvest handling and marketing of major traditional and cut flowers - jasmine, crossandra, marigold, celosia, gomphrena, lotus, tuberose, gladiolous, heliconia etc. Protected cultivation of rose, gerbera, chrysanthemum etc. - general concepts and practices.

Commercial cultivation of orchids and anthurium. Status and prospects of Kerala. Classification and varieties, planting material production, methods of planting, media components and management, shade regulation, irrigation, nutrition, plant protection, stage and method of harvest, postharvest handling and marketing. Economics of cultivation.

Pot plant and cut foliage production - species and varieties, propagation, media, shade and water requirement, nutrition, pruning, plant protection, harvesting, postharvest handling and marketing.

Practical

Hands on training on selection of varieties, cultural practices, propagation and post harvest handling techniques. Visit to commercial production units of orchids, anthurium and other cut flowers. Visit to flower markets and auction centres. Field grown commercial flowers - Hands on training in selection of varieties, propagation methods, cultural operations, harvesting and post harvest handling techniques. Visit to growers' field, societies and flower markets.

Lecture Schedule

1 Status and prospects of commercial cultivation of flowers
2 Varieties, propagation, planting, cultivation practices and post harvest handling of orchids, cost benefit analysis of production.
3 Varieties, propagation, planting, cultivation practices and post harvest handling of anthurium, cost benefit analysis of production.

4 Varieties, propagation, planting, cultivation practices and post harvest handling of rose, cost benefit analysis of production.
5 Varieties, propagation, planting, cultivation practices and post harvest handling of chrysanthemum and carnation, cost benefit analysis of production.
6 Varieties, propagation, planting, cultivation practices and post harvest handling of gerbera, cost benefit analysis of production.
7 Varieties, propagation, planting, cultivation practices and post harvest handling of tuberose and gladiolus, cost benefit analysis of production.
8 Varieties, propagation, planting, cultivation practices and post harvest handling of heliconia and alpinia.
9 Varieties, propagation, planting, cultivation practices and post harvest handling of *Alstroemeria*, *Lilium* and other cut flowers.
10 Varieties, propagation, planting, cultivation practices and post harvest handling of jasmine and crossandra, cost benefit analysis of production.
11 Varieties, propagation, planting, cultivation practices and post harvest handling of marigold and other annual flowers, cost benefit analysis of production.
12 Hi-tech cultivation of commercial flowers.
13 Production of pot plants.
14 Importance of cut foliage - commercial production.
15 Post harvest handling and value addition of cut flowers and foliage.
16 Production of dry flowers and plants.
17 Management of pests and diseases in cut flowers and foliage.
18 Marketing of cut flowers and loose flowers - preparation of projects for production of cut flowers and foliage.

Practical Schedule

1 Selection of varieties, cultural practices and propagation of orchids.
2 Selection of varieties, cultural practices and propagation of anthurium.
3 Post harvest handling techniques in orchids and anthurium.
4 Selection of varieties, cultural practices and propagation and post harvest handling techniques in rose.
5 Selection of varieties, cultural practices and propagation and post harvest handling techniques in chrysanthemum and carnation.
6 Selection of varieties, cultural practices and propagation and post harvest handling techniques in tuberose.
7 Selection of varieties, cultural practices and propagation and post harvest handling techniques in gladiolus.
8 Selection of varieties, cultural practices and propagation and post harvest handling techniques in heliconia and alpinia.
9 Selection of varieties, cultural practices and propagation and post harvest handling techniques in gerbera.
10 Selection of varieties, cultural practices and propagation and post harvest handling techniques in jasmine.
11 Selection of varieties, cultural practices and propagation and post harvest handling techniques in crossandra.
12 Selection of varieties, cultural practices and propagation and post harvest handling techniques in marigold.
13 Seed production in annual flower crops
14 Seed production in annual flower crops

15 Selection of varieties, cultural practices and propagation of important cut foliage.
16 Harvesting and post harvest handling techniques in important cut foliage.
17-18 Integrated pest and disease management practices in cut flowers and foliage.
19-20 Value addition in cut flowers and loose flowers, hands on training in preparation of garlands, bouquet, flower arrangements etc.
21-22 Production techniques of dry flowers
23-24 Production of pot plants
25-26 Hi-tech cultivation of commercial flowers.
27-29 Visit to commercial production units of orchids, anthurium and other cut flowers.
30-31 Visit to production units of field grown commercial flowers
32-35 Visit to flower markets and auction centres
36 Preparation of projects for starting a commercial unit of cut flowers and foliage

Suggested Readings

Bose, T.K. and Yadav, L.P. 1989 Ed. *Commercial Flowers*. Naya Prakash, Calcutta, India

Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. 1999 Ed. *Floriculture and Landscaping* Naya Prakash, 206, Bidhan Sarani, Calcutta.

Hardenbug, R.E. Watadar. A.E and Wong C.Y. 1986. The *Commercial storage of Fruits*. *Vegetables, Florist and Nursery stock*. U.S. Department of Agriculture. New York.

Chadha, K.L., 2001 (Ed). *Handbook of Horticulture*. ICAR, New Delhi.

Choudhary, M.L. and Prasad, K.V. 2003. *The value addition in Horticulture*. Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi. p. 100-104.

Larson, R.A. 1980. *Introduction to Floriculture* Academic Press, London

Laurie, A., Kiplinger, D.C. and Nelson, K.S. 1979. *Commercial Flower Forcing*. Mc-Graw Hill Book Company, New York.

Pal B.P. 1972. *The Rose in India*. Indian Council of Agricultural Research, New Delhi.

Prakahs, J. and Bhandary, K.R. *Floriculture Technology, Trades and Trends* 1994. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Rajeevan, P.K. Singh, K.P. and Valsalakumari P.K. 2003 *ed*. *Bulbous Flowers.* Indian Society of Ornamental Horticulture Division of Floriculture & Landscaping, IARI, New Delhi.

Rajeevan, P.K., Sobhana, A., Bhaskar, J., Swapna, S and Bhattacharjee, S.K 2002. *Orchids*. Technical Bulletin. AICRP on Floriculture ,ICAR, New Delhi.

Rajeevan, P.K., Valsalakumari, P.K., Geetha, C.K., Leena Ravidas., Vinod Kumar and Bhattacharjee, S.K. 2002. Anthurium. Technical Bulletin. AICRP on Floriculture, ICAR, New Delhi

Randhawa, G.S. and Mukhopadhyay, A. 1986. *Floriculture in India*. Allied publishers, New Delhi

Sessler, G.J. 1978. *Orchids and how to grow them.* Prentice Hall, New Jersey

Steffek, E.F. 1972. Ed. *The world of the gladiolus*. The North American Gladiolus Council, Inc., Maryland

Yadav, I.S. and Choudhary, M.L.. 1997 *Ed*. *Progressive Floriculture*. The House of Sarpan (Media), Bangalore.

3. Elht.4203. Commercial fruit production (1+2)

Importance and scope of commercial fruit production – Global scenario of fruit production and export - Present status of fruit production in the state and in the country - problems and prospects. Commercial varieties of regional, national and international importance. Ecophysiological requirements. Propagation and production of elite planting materials. Root stock – scion relationship. Planting systems and cropping systems. Crop management practices – selection and preparation of planting materials, field preparation and planting, manuring, irrigation, weed management, use of bio-regulators, organic farming practices, intercropping, pest and disease control, root zone and canopy management, other cultural operations. Physiological and nutritional disorders-causes and remedies. Cultural practices for quality improvement. Maturity indices, harvesting, grading, packing, storage and ripening techniques. By - product development. Industrial and export potential. Crops–Banana, mango, pineapple and papaya. Introduction to crops gaining importance in the state recently (apple, strawberry, mangosteen, rambutan, passion fruit).

Practical

Familiarization with important varieties. Practice in propagation, selection of good planting materials, field preparation and planting , manuring and use of growth regulators. Familiarization with weedicides, and plant protection chemicals. Studies on major pests, diseases and nutritional disorders. Studies on maturity indices and storage. Visit to research stations, farmers' field, marketing outlets and processing units.

Lecture Schedule

1	Present status of fruit - production in the world and the country. Problems and prospects of fruit production with special reference to the state.
2	Banana - commercial varieties of the state, nation and world - export potential.
3	Selection of suckers, TC plants and preparation, field preparation and planting. Different planting systems ; Ecophysiological requirements.
4	Cultural operations - fertigation, physiological and nutritional disorders - causes, remedies, Intercropping. Pest and disease management.
5	Organic farming and other cultural practices for quality improvement - ratooning.
6	Maturity indices, harvesting, grading, packing and storage. Ripening techniques ; Byproduct development.
7	Mango - commercial varieties - export potential.
8	Ecophysiological requirements - propagation techniques - stock and scion relationships - cropping systems and planting.
9	Crop management practices - manuring, irrigation - weed management - canopy management - pest and disease control.
10	Physiological and nutritional disorders - Use of bioregulators in different aspects of crop production - cultural practices for quality improvement.
11	Harvest indices - harvesting - grading - packinging and storage - different ripening techniques.

12 Pineapple - varieties - propagation methods.
13 Climatic and soil requirements - different planting systems - production technology and bioregulator application.
14 Harvest indices ; post harvest handling techniques , marketing.
15 Papaya - important varieties - ecophysiological requirements
16 Production technology - problems encountered, harvesting and post harvest handling.
17 Introduction of crops gaining importance in the state recently - apple, strawberry, mangosteen, rambutan and passion fruit - important varieties with potential for introduction. Ecophysiological requirements - protected cultivation.
18 Propagation and rootstocks - planting details - cultural operations - training and pruning, use of dormancy breakers.
19 Harvest indices, post harvest handling and packing for distant markets and export.

Practical Schedule

1 Different planting systems and layout
2 Propagation methods - sexual propagation - viability test, dormancy breaking methods.
3 Vegetative propagation
4 Layering - different methods
5 Budding - different methods.
6 Grafting- different methods.
7 Propagation structures - mist chamber, green house, hot beds etc.
8 Growth regulators - preparation and application of important bioregulators
9 Plant protection chemicals and weedicides - conventional and ecofriendly products.
10 Banana - Familiarisation with commercial and choice varieties.
11 Banana - Selection of suckers - sucker treatments
12 Practice in layout and planting - conventional and high density methods.
13 Manuring practices, fertigation
14 Irrigation - conventional and recent practices including drip irrigation.
15 Intercropping in banana plots, propping.
16 Maturity indices, harvesting, grading and packing.
17 Visit to commercial banana plots and research stations.
18 Visit to markets
19 Mango - familiarisation with important varieties
20 Propagation - selection of root stocks - Grafting techniques - epicotyl, softwood approach methods.
21 Layout and planting
22 Post planting care and management - manuring, pruning and plant protection aspects.
23 Use of bioregulators and other chemicals for regular cropping, increasing fruit set and retention.
24 Harvesting, grading and packing for local and distant markets
25 Visit to commercial mango growers' plots
26 Visit to packing yards and local markets
27 Pineapple - familiarisation with varieties

28 Sucker selection and treatments - practicing in layout and planting
29 Manuring and weedicide application
30 Bioregulator application for induction of flowering.
31 Visit to farmer's fields.
32 Visit to markets
33 Papaya - Acquaintence with commercial varieties.
34 Propagation - different aspects - crop management
35 Papain extraction
36 Visit to commercial orchards and papain processing units.
37 Rambutan, mangosteen, passion fruit - familiarisation with these crops - propagation and management practices.
38 Harvesting and post harvest case of the fruits.
39 Visit to apple and strawberry orchards.

Suggested Readings

Alvim, T.P. and Kozlowski, T.T. (Eds.). 1977. Ecophysiology of Tropical Crops. Academic Press, London.

Bose, T.K. 1985. Fruits of India - Tropical and sub tropical Nayaprokash, Calcutta.

Bose, T.K. 1988. Mineral nutrition of fruit crops. Nayaprokash, Calcutta.

Bose, T.K., Mitra, S.K. and Sanyal, D. (Eds.). 2002. Fruits. Tropical and subtropical Vol.I & II. NayaProkash, Calcutta.

Chadha, K.L. and Pareek, O.P. (Ed.). 1993. Advances in Horticulture. Malhothra Publishing House, New Delhi.

Chadha, K.L. Reddy, B.M.C and Sikhamony, S.D.1998. Pineapple. ICAR, New Delhi.

Collins, J.L. 1968. The Pineapple. Leonard Hill, London.

Davies, F.S. and Albrigo, L.G. 1994. *Citrus*. CAB International, UK

Iyer, C.P.A. and Reju, M.K. 2006. Strategies for High Density Planting in tropical Fruits - Principles and Parctices. International book distributing, Co, pp.17-30.

Radha, T. and Lila Mathew. 2007. Fruit crops. (Peter, K.V. eds.). Horticulture Science Series -3. New India Publishing Agency, New Delhi.

Ram, M. 2005. Papaya. ICAR, New Delhi.

4. Elht. 4204. Nursery management of horticultural crops (1+3)

Importance of plant propagation. Sexual and asexual methods– advantages and disadvantages. Propagation through seeds – seed formation, maturation, dormancy, treatments for breaking dormancy, germination, viability. Vegetative propagation – cuttings, layering , budding and grafting – different methods. Other plant parts used for propagation – bulbs, tubers, runners, stolons etc., Polyembryonic and apomictis seedlings. Progeny orchards – establishment, maintenance and utilization. Factors affecting rooting – physiological, anatomical, external factors. Root stock production, use of rootstocks for imparting high yield, quality and for tackling specific problems like tree size control , resistance / tolerance to pests, disease, salinity. Rootstock-scion relations. Use of growth regulators in plant propagation. Plant growing structures for propagation – design, construction and maintenance. Care and handling of nursery plants. Rapid production of uniform and good quality planting materials. Plant protection in nurseries – control of pests and diseases.

Tissue culture technique – advantages and disadvantages – Study of activities in a tissue culture unit. Establishment of tissue culture unit. Establishment and maintenance of commercial plant propagation units.

Importance of elite planting materials in crop production with respect to plantation crops, spices and medicinal plants. Fundamental principles and practices to be followed in nursery management. Factors to be considered in the establishment of commercial nurseries in plantation crops, spices and medicinal plants – Green houses, store houses and nursery structures. Techniques of propagation of the above crops. Application of tissue culture in the propagation of crops. Special treatments for improving germination and rooting. Advances in nursery techniques. Application of mist in the propagation of plantation crops, spices and medicinal plants. Importance of polythene in the nursery. Packing, storage and transport of nursery plants. Hardening of the nursery plants. Productions of disease free nursery stock and protection of nursery plants from pests and diseases. Export of nursery plants and seed materials of plantation crops, spices and medicinal plants.

Practical

Practice in propagation of plants through seeds. Familiarization with media , implements and containers for plant propagation. Studies on seed testing, certification and storage. Practice in rootstock production ,vegetative propagation methods – cutting, budding, grafting layering etc. separation of propagules. Use of growth regulators for plant propagation. Study of propagation through tissue culture. Studies on preparation of designs and estimates for establishment of plant propagation unit, plant growing structures and tissue culture unit. Identification of common pests and diseases in nursery plants and their control.

Visit to different types of nurseries, selection of site – factors to be commercial in establishment – Familiarization with components of nurseries– handling, display and sales of plants – cultural practices – Estimation of production costs for different kinds of planting materials.

Collection of elite seed materials, storage and nursery techniques of plantation crops, spices and medicinal plants. Practice of vegetative propagation methods in the above crops. Practice of potting / bagging, re-potting etc. Packing and transport of nursery materials. Practice in tissue culture laboratory. Registers to be maintained in a commercial plantation crops, spices and medicinal plant nursery. Visit to different nurseries (both government and private).

Lecture schedule

1. Importance of plant propagation-sexual and asexual methods-advantages and disadvantages
2. Propagation through seeds-seed formation, maturation, dormancy treatment of breaking dormancy, germination, viability
3. Vegetative propagation-cuttings, layering, budding and grafting-different methods
4. Other plant parts used for propagation-bulbs, tubers, runners, stolons etc-polyembryonic and apomictis seedlings
5. Progeny orchards-establishment, maintenance and utilization
6. Factors affecting rooting-physiological, anatomical, external factors
7. Root stock production, use of rootstocks for imparting high yield, quality and for tackling specific problems relations
8. Use of growth regulators in plant propagation
9. Plant growing structures for propagation-design, construction and maintenance
10. Care and handling of nursery plants-rapid production of uniform and good quality planting materials-plant protection in nurseries-control of pests and diseases

11. Tissue culture technique-advantages and disadvantages-study of activities in a tissue culture unit-Establishment of tissue culture unit-establishment and maintenance of commercial plant propagation units.
12. Importance of elite planting materials in crop production with respect to plantation crops, spices and medicinal plants-Fundamental principles and practices to be followed in nursery management.
13. Factors to be considered in the establishment of commercial nurseries in plantation crops, spices and medicinal plants-green houses, store houses and nursery structures
14. Techniques of propagation of plantation crops, spices and medicinal plants
15. Application of tissue culture in the propagation of these crops-special treatments for improving germination and rooting-advances in nursery techniques-application of mist in the propagation of plantation crops, spices and medicinal plants
16. Importance of polythene in the nursery –packing-storage-transport of nursery plants
17. hardening of the nursery plants-production of disease free nursery stock and protection of nursery plants from pests and diseases
18. Export of nursery plants and seed materials of plantation crops, spices and medicinal plants

Practical Schedule

1. Practice in propagation of plants through seeds
2. Familiarization with media, implements and containers for plant propagation
3. Studies on seed testing, certification and storage

4-6. Practice in rootstock production, vegetative propagation methods-cutting, budding, grafting, layering etc. separation of propagules

1. Use of growth regulators for plant propagation

8-9. Study of propagation through tissue culture

10. Studies on preparation of design and estimates for establishment of plant propagation unit, plant growing structures and tissue culture unit

11-12. Identification of common pests and diseases in nursery plants and their control

13-14. Visit to different types of nurseries

15. Selection of site-factors to be commercial in establishment
16. Familiarization with components of nurseries
17. handling-display and sales of plants
18. Cultural practices-estimation of production costs for different kinds of planting materials

19-25. Collection of elite seed materials-storage and nursery techniques of plantation crops, spices and medicinal plants-practice of vegetative propagation methods - practice of potting/bagging, repotting etc-packing and transport of nursery materials of coconut, arecanut, coffee, tea, cocoa, pepper, ginger, turmeric, cardamom, tree spices etc.

26. Practice in tissue culture laboratory-registers to be maintained in a commercial plantation crops, spices and medicinal plant nursery.

5. Elht. 4205. Protected cultivation of horticultural crops (1 +1)

Introduction – scope and importance – problems and prospects of protected culture in India – growing structures – green house – polyhouse – net house – basic considerations in establishment and operation of green houses – maintenance – advantages of growing plants in a green house – functioning and maintenance. Manipulation of environmental factors – environmental control systems in green house – containers – substrate culture – soil decontamination – water management – nutrient management. Crop regulation – special horticultural practices – harvesting methods – postharvest handling – standards – grading – packing and marketing.

Practical

Study of various protected structures – estimate preparation – unit cost arrival – study of inputs – containers – substrate preparation – fertigation – growth and development – special horticultural practices and flowering-assessment under protected cultivation of rose, chrysanthemum, carnation, gerbera, orchids, anthurium, lilium and cut foliage – visit to cut flower industry.

Lecture schedule

1. Scope and importance of protected floriculture.
2. Problems and prospects of Indian protected floriculture industry.
3. Different kinds of growing structures for protected floriculture.
4. Basic consideration for establishment and operation of green house – poly house and net house.
5. Maintenance and advantages of growing plants in green houses.
6. Role of different growing structures.
7. Manipulation of environmental factors with reference to protected culture.
8. Different kinds of containers and substrates used in protected culture.
9. Mid-Semester Examination.
10. Soil decontamination in green house.
11. Water management in green house.
12. Nutrient management in protected culture.
13. Crop regulation in protected culture.
14. Special horticultural practices in green house.
15. Harvesting indices for floricultural crops.
16. Postharvest handling and standards for cut flowers.
17. Grading, packing and marketing of floriculture products.

Practical Schedule

1. Study of structures utilized for protected culture.
2. Cost estimation of different growing structures.
3. Design and orientation of poly/green houses.
4. Study of various inputs utilized for protected culture.
5. Type of containers used in protected culture.
6. Use of substrate and preparation of substrate for protected floriculture.
7. Fertigation system in green house.
8. Maintenance of cooling and heating system in green houses.
9. Special horticultural practices in protected floriculture.
10. Special lecture on – Protected cultivation of rose.
11. Protected cultivation of chrysanthemum.
12. Protected cultivation of carnation and gerbera.

13. Protected cultivation of orchids and anthurium.
14. Protected cultivation of lilium.
15. Protected cultivation of cut foliage.
16. Visit to cut flower industry.
17. Practical Examination.

Suggested Readings

Baily., 1971. Perpetual flowering carnation. Faber and Faber, London.
Biswas, T.D. 1984. Rose growing. Principles and practices. Assoc. Pub.Co., New Delhi.
Bose, T.K.and S.K. Bhattacharjee., 1980. Orchids of India. Naya Prakash, Calcutta.
Bose, T.K. and P.Yadav. 1989. Commercial flowers. Naya Prakash, Calcutta.
FAO Manual on Export packaging of Cut flowers. 1993.
Foja Singh., 1997. Advances in Floriculture. Media Today Pvt. Ltd., New Delhi-17.
Prasad, S. and U.Kumar. 1998. Commercial floriculture. Agro Botanica. Bikaner – 334 004.
Roy. A. Larson., 1992. Introduction of Floriculture. International Book Distributing Co., Lucknow.
Vishnu Swarup., 1997. Ornamental Horticulture. Macmillan India Ltd., New Delhi-2.
Wltez, S., 1972. The world gladiolus, NAGG, USA.
Yadav, L.P. and Bose, T.K., 1986. Biology, conservation and culture of orchids. East-West Press Private Limited, New Delhi.E.
Yadav. I.S. and M.L. Choudhary., 1997. Progressive floriculture. The House of Sarpan, (Media), Bangalore.

6. Elht.4206. Seed production of vegetables and flowers (1+1)

Scope and importance of seed production in vegetable and flower crops- seed demand and production- importance of quality seeds. Classification of vegetables based on mode of pollination, pollinating agents- response to day length and other environmental factors on vegetables. Types of seeds- field standards, crop standards and seed standards for breeders, foundation and certified seeds, labeling of seeds etc.

Seed production techniques in tropical vegetables (tomato, brinjal, chillies, bhindi, potato, vegetable cowpea, garden beans, cluster bean, pumpkin, ash gourd, bitter gourd, ribbed gourd, snake gourd, bottle gourd, cucumbers, melons),important temperate vegetables (cabbage, cauliflower, carrot, beetroot, peas) and flowers (marigold, chrysanthemum, petunia, aster, zinnia, gaillardia, phlox balsam, etc.)

Hybrid seed production- importance and scope of hybrid seeds in vegetables and flowers- production of inbred lines and parental varieties-technique of hybrid seed production- use of male sterility, self-compatibility in seed production, partial exploitation of heterosis etc, seed production for export purpose. Economics of seed production in vegetable and ornamental plants

Harvesting indices- post harvest seed management techniques seed extraction-seed processing- drying-cleaning-upgrading-seed treatment- packaging-storage and seed health management-marketing etc., -environmental factors affecting seed viability and longevity. Dormancy of seed, role of growth regulators in restoring seed viability, physical agents for increased seed germination, seed vigour etc.

Seed legislation and seed law enforcement-certification and seed law enforcement-seed testing-seed standards- organization set up of seed company- organizations involved

in seed production i.e., public, quasi, co operative, private etc. Planning seed production programme- seed farm organistion-procurement and pricing policy-economics of seed production of different crops-government policy in seed production and study of export potential of seeds.

Practical

Practice in site selection, ensuring field standards,crop standards, familiarization of verities, isolation distance for different crops, rouging, harvesting at correct maturity stage, seed extraction, cleaning, drying, etc. in different vegetable and flower crops. Studies on seed recovery, preparation of cost cultivation in seed production. Testing for various seed quality parameters. Types of dormancy in vegetable and flower seeds. Role of physical and chemical substances in restoring seed viability. Study on factors responsible for seed germination, seedling vigour. Field layout for hybrid seed production of a few important vegetables.Production of inbred lines, and parental varieties, emasculation, bagging, pollination, hybrid seed harvesting, processing and packing. Visit to seed processing and packing units.

Lecture schedule

1. Introduction, seed programme implementation, seed agencies and importance of quality seeds
2. Classification of vegetables and flowers based on extent of cross pollination, pollinating agents
3. Classes of seed, variety release, notification of varieties etc.
4. Seed development, maturation, dormancy and germination
5. Seed production of Solanaceous vegetables
6. Seed production of various cucurbitaceous vegetables
7. Seed production of various leguminous vegetables
8. Seed production of various cole crops
9. Seed production of bhindi and amaranthus
10. Seed production of various root, bulb and tuber vegetables
11. Hybrid seed production in vegetables
12. Classification of ornamental plants based on extent of cross pollination, mode of pollination, pollinating agents
13. Seed production of annual ornamental plants
14. Seed production of vegetables and ornamental plants for export
15. Economics of seed production
16. Seed processing - seed drying, cleaning and upgrading; packing and handling
17. Seed senescence, seed treatment and storage
18. Seed act and legislation, seed law enforcement

Practical Schedule

1. Identification of seeds of summer vegetables
2. Identification of seeds of cool season vegetables
3. Varietal characterisation of vegetable crops
4. Varietal characterisation of flower crops
5. Estimation of seed requirement of various vegetable crops
6. Estimation of economics of seed production
7. Germination of vegetable and flower seeds in different media
8. Effect of pre-sowing seed treatments
9. Land preparation, planting and aftercare of crops

10. Land preparation, planting and aftercare of crops
11. Land preparation, planting and aftercare of crops
12. Land preparation, planting and aftercare of crops
13. Techniques of hybrid seed production in tropical vegetables
14. Field standards and certification in vegetables
15. Methods to improve seed storability
16. Seed extraction techniques
17. Seed processing
18. Seed testing
19. Visit to vegetable seed production fields and seed testing laboratory

Suggested Readings

Agrawal, R.L. 1995. *Seed Technology* . Oxford, IBH Publishing Co., New Delhi.
Bose, T. K. and Som, M. G. 1990. Vegetable crops in India. Naya Prokash, Calcutta.Das, P. C.1993. Vegetable crops in India.Kalyani Publishers
Dahiya, B.S and Rai, K.N., 1997. *Seed Technology*, Published by Kalyani Publishers, Chennai
Raymond, A.T. George, 1985. *Vegetable Seed Production*. Longman, London and NewYork
Singh, S.P., 2001. *Commercial Vegetable Seed Production,* Kalyani publishers, Chennai.
Subir Sen and Nabinanandha Ghosh, 1999. *Seed Science,*. Kalyani Publishers, Chennai.

7. Elht. 4207. Processing and value addition of horticultural crops (2+1)

Postharvest loss assessment of fruits and vegetables in marketing as a surveying and documentation , familiarization of harvesting indices of fruits and vegetables and harvesting devices, measurement of post harvest respiration rate under various situations, exposure to various storage structures in fruits and vegetables- cold storage, evaporative cool chamber and traditional field storage structures, packaging of various fruits and vegetables in different materials, spray drying of fruit juice powders, freeze drying of fruit and vegetable products, fruit juice concentrates other products from fruits and vegetables like jam, candy, preserve jelly etc. Dry processing and wet processing in coconut, diversified uses of coconut, chali nut and kaliadaka processing, visit to cashew nut processing factories and cashew apple processing, visit to rubber factory and visit to oil pal industry . processing and dehydration of pepper, ginger, turmeric, preparation of white pepper, green pepper, preparation of spice oil and oleoresins.

Lecture schedule

1-2 Reasons for the spoilage of fruits and vegetables
3. Post harvest respiration.
4-5 Storage structure in fruits and vegetables.
6 Packaging of fruits and vegetables
7-8 Drying techniques and various driers.
9-10 Processing of coconut -dry and wet
11 Processing of areanut
12-13 Processing of cashew nut and cashew apple
14 Processing of Palm oil
15-18 Processing of spices – viz pepper, ginger, turmeric, spice oil and spice oleoresin

Practical schedule

1-2	Survey and collection of data on post harvest losses in fruits and vegetables
3	Documentation of data under various post harvest operations
4-5	Familiarization of postharvest indices in various fruits and vegetables and record the observations
6	Familiarization on the various harvesting devices employed in fruits and vegetables
7	Measurement of postharvest respiration and draw the respiration curves
8	Exposure to various packaging materials in fruits and vegetables.
9	Visit to a packaging unit
10-11	Packaging – storage studies in selected fruits and vegetables.
12-13	Exposure to various storage structures for the storage of horticultural crops.
14-15	Spray drying of fruit juice powders.
16-17	Freeze drying studies in fruit & vegetables
18	Vacuum drying of fruit and vegetables
19	Fermentation of fruit juices
20	Copra making
21	Wet processing
22	Chali nut processing
23	Kaliadakka processing
24	Processing of cashew apple products
25	Drying of pepper
26	Drying of ginger and turmeric
27	Processing of spice oil
28	Processing of spice oleoresin
29-36	Visit to various processing factories and exposure to commercial processing .

Suggested Readings

Pantastico, Er. B. (Ed.), 1975. Postharvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. Westport, AVI Publ. Co., 560 pp.

Ryall, A.L. and W.J. Lipton, 1979. Handling, Transportation and Storage of Fruits and Vegetables, Vol. 1, Vegetables and Melons, 2nd ed. Westport, AVI Publ. Co. 588 pp.

Ryall, A.L. and W.T. Pentzer, 1982. Handling, Transportation and Storage of Fruits and Vegetables. Vol. 2, Fruits and Tree Nuts. Westport,. AVI Publ Co. 610pp.

Salunkhe, D.K., 1975. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Boca Raton, FL. CRC Press, 166 pp.

Wills, R.H.H., T.H. Lee, D. Graham, W.B. McGlasson and E.G. Hall, 1984 Postharvest . An Introduction to the Physiology and Handling of Fruit and Vegetables. Westport, AVI Publ. Co. 163 pp.

P.N.Ravindrarau, K. Nirmal babu, K.N.Shiva and Johny, A. Kallupurackal-Advance in spice research- Publishers - Agrobios (India) Jodhpur.

V.A. Parthasarathy, P. Rajeev.-Major spices – Production and processing -IISR, Kozhikode

E.V.Nybe, M.Miniraj and K.V. Peter-Quality requirements of spice for export spice board, Cochin. New India Publishing Company, NewDelhi.

J.S. Pruthi -Major Spices of India – crop management and Postharvest technology –ICAR NewDelhi

J.S. Prithi -Minor spices and condimens – Crop management and postharvest technology – ICAR NewDelhi.

Giridhari Lal, G.S. Siddappa and G.L. Tandon -Preservation of fruits and vegetables. ICAR, NewDelhi.
R.P. Srivastava and Sanjeevkumar - Fruit and vegetable preservation – principles and practices . International Book Distributing Co, Lucknow.

8. Elht.4208. Landscape designing and indoor gardening techniques (1+1)

Principle of landscape design. Selection and use of plants in the landscape. Preparation of landscape plan. Various soft ware used in garden designing. Digitalisation in designing. Planting and maintenance of plants in the landscape. Methods of irrigation – sprinkler and drip irrigation-pot irrigation, wick irrigation etc. Use of tools and implements. Use of different types of sprayers, lawn mowers, hedge cutters, tree cutters, leveling methods. Methods of application of fertilisers to garden plants. Garden structures, roads and paths, enclosures, paving, garden lights, furniture. Computer aided landscape designing – GIS.

Establishment and maintenance of lawn. Selection of indoor plants. Layout and designs of indoor gardens - types of containers used, media composition, preparation of media, planting and placement of plants. Models for interior plant scaping - vertical garden, miniature garden and terrariums. Manuring, irrigation, illumination, grooming and holiday care of indoor plants.

Practical

Development of landscape plans - lay out and implementation. Use of software tools in landscape architecture. Identification of ornamental plants. Establishment and maintenance of lawn. Planting and maintenance of trees, shrubs, creepers, flowers etc. Establishment and maintenance of nonliving components. Practice in layout of indoor gardens. Planting and maintenance of plants in different kinds of indoor environments. Preparation and maintenance of terrariums, vertical garden etc.

Lecture schedule

1	Principles of landscape design
2	Preparation of landscape plan
3	Functional use of plants in the landscape
4-5	Use of software in landscape designing, computer aided landscape designs
6	Landscape components - living and nonliving.
7	Enrichment items - selection, construction and maintenance.
8	Establishment and maintenance of lawn
9	Planting and maintenance of trees and shrubs
10	Preparation of flower beds and maintenance
11	Different methods of irrigation and application of fertilizers in landscapes
12	Landscape enclosures and paving - selection, construction and maintenance.
13	Roads and paths, enrichment items, garden furniture and lights
14	Selection of plants for indoor garden, layout and design
15-16	Different types of indoor gardens.
17-18	Manuring, irrigation, illumination, grooming and holiday care of indoor Plants.

Practical Schedule

1-2	Preparation of landscape plan, identification of plants.
3-4	Use of software in landscape designing, computer aided landscape designs.
5	Planting of lawn
6	Rolling and mowing of lawn - use of different types of lawn mowers.
7	Planting of trees and shrubs, preparation of flower beds.
8	Pruning of shrubs, hedges and trees.
9	Application of manures and fertilizers to garden plants.
10	Practice in different methods of irrigation in landscapes.
11	Practice in application of plant protection chemicals, use of different types of sprayers.
12	Selection and establishment of enclosures and paving.
13	Layout of roads, paths and walks
14	Preparation of rock garden
15	Preparation of water garden
16	Designing indoor garden
17	Preparation of miniature garden and vertical garden.
18	Preparation of terrarium.

Suggested Readings

Bland, J. and Davidson, W. 2004. *Houseplant – Survival Manual*. Quantum Books Ltd., London.

Bose,T.K., Maiti, R.G., Dhua,R.S and Das,P.1999.Eds-Floriculture and Landscaping-Naya Prakash,206,Bidhan Sarani,Calcutta

Carpenter, P.L., Walker, T.D. and Lanphear,F.O. 1975. *Plants in theLandscape*. W.H.Freeman and Co., San Franciso

Chadha, K.L. and Choudhury, B. 1992. *Ornamental Horticulture in India.* ICAR,New Delhi

Das, S.N. 2007. Handbook of Ornamental Horticulture. Agrotech Publishing Academy, Udaipur -313 002.

Desai, B.L.1979. *Planning and planting Designs of Home Gardens*. Indian Council of Agricultural Research, New Delhi

Joiner, J.N.1981. *Foliage Plant Production*. Prentice Hall Inc.London

Nambisan, K.M.P. 1991.*Design elements of Landscape Gardening*. Oxford and IBH publishers Pvt. Ltd., Calcutta

Swarup, V. 1996. *Indoor Gardening*. ICAR, New Delhi.

IV . POST HARVEST TECHNOLOGY AND VALUE ADDITION

1. Elph. 4201. Post harvest technology of horticultural crops (1+2)

Postharvest loss assessment of fruits and vegetables in marketing as a surveying and documentation , familiarization of harvesting indices of fruits and vegetables and harvesting devices, measurement of post harvest respiration rate under various situations, exposure to various storage structures in fruits and vegetables- cold storage, evaporative cool chamber and traditional field storage structures, packaging of various fruits and vegetables in different materials, spray drying of fruit juice powders, freeze drying of fruit and vegetable products, fruit juice concentrates other products from fruits and vegetables like jam, candy, preserve jelly etc. Dry processing and wet processing in coconut, diversified uses of coconut, chali nut and kaliadaka processing, visit to cashew nut processing factories and cashew apple processing, visit to rubber factory and visit to oil pal industry . processing and dehydration of pepper, ginger, turmeric, preparation of white pepper, green pepper, preparation of spice oil and oleoresins.

Lecture schedule

1-3	Reasons for the spoilage of fruits and vegetables
3.	Post harvest respiration.
4-5	Storage structure in fruits and vegetables.
6	Packaging of fruits and vegetables
7-8	Drying techniques and various driers.
9-10	Processing of coconut -dry and wet
11	Processing of areanut
12-13	Processing of cashew nut and cashew apple
14	Processing of Palm oil
15-18	Processing of spices – viz pepper, ginger, turmeric, spice oil and spice oleoresin

Practical schedule

1-3	Survey and collection of data on post harvest losses in fruits and vegetables
3	Documentation of data under various post harvest operations
4-5	Familiarization of postharvest indices in various fruits and vegetables and record the observations
6	Familiarization on the various harvesting devices employed in fruits and vegetables
7	Measurement of postharvest respiration and draw the respiration curves
8	Exposure to various packaging materials in fruits and vegetables.
9	Visit to a packaging unit
10-11	Packaging – storage studies in selected fruits and vegetables.
12-13	Exposure to various storage structures for the storage of horticultural crops.
14-15	Spray drying of fruit juice powders.
16-17	Freeze drying studies in fruit & vegetables
18	Vacuum drying of fruit and vegetables
19	Fermentation of fruit juices
20	Copra making
21	Wet processing
22	Chali nut processing

23 Kaliadakka processing
24 Processing of cashew apple products
25 Drying of pepper
26 Drying of ginger and turmeric
27 Processing of spice oil
28 Processing of spice oleoresin
29-36 Visit to various processing factories and exposure to commercial processing .

Suggested Readings

Pantastico, Er. B. (Ed.), 1975. Postharvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. Westport, AVI Publ. Co., 560 pp.
Ryall, A.L. and W.J. Lipton, 1979. Handling, Transportation and Storage of Fruits and Vegetables, Vol. 1, Vegetables and Melons, 2nd ed. Westport, AVI Publ. Co. 588 pp.
Ryall, A.L. and W.T. Pentzer, 1982. Handling, Transportation and Storage of Fruits and Vegetables. Vol. 2, Fruits and Tree Nuts. Westport,. AVI Publ Co. 610pp.
Salunkhe, D.K., 1975. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Boca Raton, FL. CRC Press, 166 pp.
Wills, R.H.H., T.H. Lee, D. Graham, W.B. McGlasson and E.G. Hall, 1984 Postharvest . An Introduction to the Physiology and Handling of Fruit and Vegetables. Westport, AVI Publ. Co. 163 pp.
Advance in spice research. Edited by P.N.Ravindrarau, K. Nirmal babu, K.N.Shiva and Johny, A. Kallupurackal. publishers. Agrobios (India) Jodhpur.
Major spices – Production and processing Edited by V.A. Parthasarathy, P. Rajeev. IISR, Kozhikode
Quality requirements of spice for export spice board, Cochin.
Spices. E.V.Nybe, M.Miniraj and K.V. Peter. New India Publishing Company, NewDelhi.
Major Spices of India – crop management and Postharvest technology – J.S. Pruthi ICAR NewDelhi
Minor spices and condimens – Crop management and postharvest technology – J.S. Prithi, ICAR NewDelhi.
Preservation of fruits and vegetables. Giridhari Lal, G.S. Siddappa and G.L. Tandon ICAR, NewDelhi.
Fruit and vegetable preservation – principles and practices by R.P. Srivastava and Sanjeevkumar. International Book Distributing Co, Lucknow.

Suggested Readings

Pantastico, Er. B. (Ed.), 1975. Postharvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. Westport, AVI Publ. Co., 560 pp.
Ryall, A.L. and W.J. Lipton, 1979. Handling, Transportation and Storage of Fruits and Vegetables, Vol. 1, Vegetables and Melons, 2nd ed. Westport, AVI Publ. Co. 588 pp.
Ryall, A.L. and W.T. Pentzer, 1982. Handling, Transportation and Storage of Fruits and Vegetables. Vol. 2, Fruits and Tree Nuts. Westport,. AVI Publ Co. 610pp.
Salunkhe, D.K., 1975. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Boca Raton, FL. CRC Press, 166 pp.
Wills, R.H.H., T.H. Lee, D. Graham, W.B. McGlasson and E.G. Hall, 1984 Postharvest . An Introduction to the Physiology and Handling of Fruit and Vegetables. Westport, AVI Publ. Co. 163 pp.

Advance in spice research. Edited by P.N.Ravindrarau, K. Nirmal babu, K.N.Shiva and Johny, A. Kallupurackal. publishers. Agrobios (India) Jodhpur.

Major spices – Production and processing Edited by V.A. Parthasarathy, P. Rajeev. IISR, Kozhikode
Quality requirements of spice for export spice board, Cochin.
Spices. E.V.Nybe, M.Miniraj and K.V. Peter. New India Publishing Company, NewDelhi.
Major Spices of India – crop management and Postharvest technology – J.S. Pruthi ICAR NewDelhi
Minor spices and condimens – Crop management and postharvest technology – J.S. Prithi, ICAR NewDelhi.
Preservation of fruits and vegetables. Giridhari Lal, G.S. Siddappa and G.L. Tandon ICAR, NewDelhi.
Fruit and vegetable preservation – principles and practices by R.P. Srivastava and Sanjeevkumar. International Book Distributing Co, Lucknow.

2. Elph. 4202. Unit operation for quality value addition processing and development of new products (1+3)

Unit operations involved in the post harvest management of quality fruits and vegetables- harvesting operations , equipments used for washing, sorting grading and packaging. Exposure to unit operations involved in pasteurization, canning, aseptic packaging of fruit and vegetable products, familiarization with various pasteurizers, plate heat exchanger, tabular pasteurizers and their operation in food processing, unit operations involved in evaporation, exposure to various harvesting devices and their functions, introduction to cannery equipment and layout . Unit operations involved in the manufacture of instant coffee powder, instant tea powder, instant fruit milk shake milk powders. Unit operations in freeze drying and preparation of freeze dried products. Role of osmotic dehydration, preparation of osmotically dehydrated pineapple slices, sapota, aonla, exposure to various equipments involved in food processing through visit to processing factories. Exposure to packaging machine and their operations related to horticultural products, layout of processing unit, laws and regulations in establishing processing units.

Lecture schedule

1. Introduction to the course
2-3 Exposure to unit operations involved in the post harvest management of fruit and vegetables
4. Application of heat in processing
5-6 Various pasteurizers and their functions
7. Canning operations in thermal processing
8. Aseptic packaging
9. Evaporation concentration in fruit and vegetable juices
10-11 Various evaporators
12. Unit operations in the manufacture of instant coffee powder
13. Unit operations in the manufacture of instant – tea powder
14-15 Unit operations in freeze .drying
16. Osmotic dehydration principles and methods

17-18 Laws and regulations in processed food products.

Practical schedule

1-4 Familiarization with various post harvest operations
4-6 Pasteurization of fruit juices and shelf life study
7-10 Familiarization with various pasteurizers viz plate heat exchangers, tabular pasteurizers, surface scrape pasteurizers
11-14 Familiarization with various evaporators and their functions and trial runs for various products.
15-18 Visit to canning industries and familiarization with cannery equipments and trial runs for canning various horticultural products
19-21 Familiarization with spray driers and trials for spray drying instant coffee, tea and cocoa powders.
22-25 Spray drying equipments for instant fruit milk shake powders
26-28 Familiarization with freeze driers and trial runs freeze drying fruit and vegetable products and their package studies.
29-31 Osmotic dehydration trials using, sugar, syrup and honey for sapota, gooseberry, pineapple and other fruits.
32-35 Packaging and storage studies in dried products.
36-40 Development of sorption iso-therm curves of various dried products and their significance in packaging
41-44 Exposure to various packaging machines and their functions.
45-49 Familiarization with quality testing equipments in food products including package testing instruments.
50-54 Visit to various factories and learning various unit operations.

Suggested Readings

Pantastico, Er. B. (Ed.), 1975. Postharvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. Westport, AVI Publ. Co., 560 pp.
Ryall, A.L. and W.J. Lipton, 1979. Handling, Transportation and Storage of Fruits and Vegetables, Vol. 1, Vegetables and Melons, 2nd ed. Westport, AVI Publ. Co. 588 pp.
Ryall, A.L. and W.T. Pentzer, 1982. Handling, Transportation and Storage of Fruits and Vegetables. Vol. 2, Fruits and Tree Nuts. Westport,. AVI Publ Co. 610pp.
Wills, R.H.H., T.H. Lee, D. Graham, W.B. McGlasson and E.G. Hall, 1984 Postharvest . An Introduction to the Physiology and Handling of Fruit and Vegetables. Westport, AVI Publ. Co. 163 pp.
Preservation of fruits and vegetables. Giridhari Lal, G.S. Siddappa and G.L. Tandon ICAR, NewDelhi.
Fruit and vegetable preservation – principles and practices by R.P. Srivastava and Sanjeevkumar. International Book Distributing Co, Lucknow.
Principles of Agricultural Engineering Vol. II. Jain Brothers NewDelhi.

3.Elph.4203. Postharvest technology of spices, plantation crops, medicinal and aromatic crops. (1+3)

Commercial uses of spices, processing of major spices, different methods of drying, examining the influence of temperature and time combination on active principles, extraction and analysis of active principles using HPLC technology, essential oil extraction, various distillation techniques, exposure to super critical fluid extraction.

Identification of different odour factors with GLC / GC – MS in essential oil in spices and aromatic plants.

Exposure to various grinding in spices powders, preparation of gravy mix and exposure to retort able pouch processing of gravy mixes.

Processing of coffee – Harvesting – wet and dry methods processing of cherry coffee, parchment coffee, specialty coffee, pulping, demucilaging, washing curing, fermentation, drying, roasting, grinding , grading, blending and packaging.

Processing of cocoa . - Harvesting, extraction of seeds, fermentation, changes in fermentation, various fermentation in cocoa tray and basket method, different drying methods, roasting shelling, grinding extraction of cocoa butter and preparation of chocolate and packaging of cocoa products.

Tea processing . - Visit to tea factory and familiarization with plucking of leaves, withering, orthodox and CTC process in tea manufacture, grading, tea tasting, blending and packaging.

Exposure to important medicinal plants and their processing, drying, extraction, and packaging of these products.

Lecture schedule

1.	Introduction to the course
2.	Commercial uses of spices and major spices
3-4	Different methods of drying
5-6	Various processes involved in the extraction of spice oil and plant extracts
7-8	Various products from spice and their process
9-10	Processing of coffee – wet and dry methods
11-12	Processing of cocoa
13-14	Processing of tea
15-16	Major medicinal and aromatic plants and its important products
17-18	Major process involved in the extraction of alkaloids and other active principles and their storage.

Practical Schedule

1-3	Familiarization with various spices and their commercial parts used for processing
4-7	Harvesting and cleaning of various spices and primary processing
8-11	Drying of spices using various driers.
12-15	Grinding of spice powders and blending of spice mixes.
16-19	Extraction of oil and oleoresin
20-22	Analysis of spice quality including microbiology
23-25	Exposure to HPLC and other analytical instruments like GC- MS
26-29	Exposure to super critical fluid extraction of spice oil
30-32	Preparation of gravy mixes and retort packaging of wet gravy
33-35	Processing of coffee – harvesting, drying, hulling, grinding etc.
36-38	Processing of Cocoa – harvesting, extraction of seeds, fermentation – drying.
39-40	Extraction of cocoa butter and powder
41-44	Preparation of chocolate and other cocoa products.

45-47 Familiarization of medicinal plants and their uses.
48-49 Drying of medicinal plants
50-51 Extraction of alkaloids and other active principles from aromatic plants.
52-54 Visit to various processing factories.

Suggested Readings

Advance in spice research. Edited by P.N.Ravindrarau, K. Nirmal babu, K.N.Shiva and Johny, A. Kallupurackal. publishers. Agrobios (India) Jodhpur.
Major spices – Production and processing Edited by V.A. Parthasarathy, P. Rajeev. IISR, Kozhikode
Quality requirements of spice for export spice board, Cochin
Spices. E.V.Nybe, M.Miniraj and K.V. Peter. New India Publishing Company, NewDelhi.
Major Spices of India – crop management and Postharvest technology – J.S. Pruthi ICAR NewDelhi
Minor spices and condimens – Crop management and postharvest technology – J.S. Prithi, ICAR NewDelhi.

4.Elph. 4204. Integrated storage management of fruits, flowers and vegetables (1+2)

Postharvest management for quality produce . - Pre-storage treatments for quality retention using chemicals, application of skin coatings in fruits and vegetables, application of irradiation to extend the shelf life, pre-cooling, forced air cooling, water cooling and vacuum cooling, low temperature storage, modified atmosphere storage, modified atmosphere packaging, hypobaric storage, storage requirements evaporative cool chambers, storage disorders, package house operations, different types of packaging in fruit, vegetable and cut flowers. Pre-treatments to extend vase life of cut flowers. Application of freeze drying in cut flowers and its storage stability, extraction of concrete and absolute from flowers, extraction of natural colours from flowers.

Lecture schedule

1 Introduction to the course
2-3 Various reasons for the spoilage of fruits and vegetables
4-5 Various techniques for the extension of shelf life of fruit / vegetables / flowers
6-7 Various chemicals used for preservation
8-9 Pre-cooling and its significance on the extension of shelf life
10 Application of irradiation
11-12 MA and CA storage
13-14 Hypobaric storage, evaporative cool chambers and their requirements.
15-16 Storage disorders and methods for controlling the disorders
17 Freeze drying in cut flowers.
18 Methods for the extension of vase life in cut flowers.

Practical schedule

1-2 Familiarization with harvests indices and methods of harvest
3-4 Washing, sorting and grading in fruits/ vegetables / flowers
5-6 Application of chemicals in the extension of shelf life
7-8 Exposure to irradiaton in fruit / vegetables and cut flowers.
9-10 Pre-cooling of fruits / vegetable / cut flowers
11-12 Application of low temperature in extension of shelf life

13-14 Exposure to packaging of fruits / vegetables / cut flowers
15-16 Exposure to modified atmospheric packaging of fruit / vegetables / Cut flowers
17-18 Preparation of field level storage structure and its functions
19-21 Exposure to storage disorders in fruit/ vegetables / cut flowers
22-25 Familiarization with package house operations
26-27 Exposure to green house and glass house techniques in cut flower production
28-30 Exposure to freeze drying of fruit/ vegetables / cut flowers
31-32 Application of various techniques for the improvement of vase value in cut flowers.
33-36 Visit to various factories / centres

Suggested Readings

Pantastico, Er. B. (Ed.), 1975. Postharvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. Westport, AVI Publ. Co., 560 pp.
Ryall, A.L. and W.J. Lipton, 1979. Handling, Transportation and Storage of Fruits and Vegetables, Vol. 1, Vegetables and Melons, 2nd ed. Westport, AVI Publ. Co. 588 pp.
Ryall, A.L. and W.T. Pentzer, 1982. Handling, Transportation and Storage of Fruits and Vegetables. Vol. 2, Fruits and Tree Nuts. Westport,. AVI Publ Co. 610pp.
Salunkhe, D.K., 1975. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Boca Raton, FL. CRC Press, 166 pp.
Salunkhe, D.K. and B.B. Desai, 1984 a. Postharvest Biotechnology of Fruit Vol. 1. Boca Raton, FL. CRC Press, 184 pp.
Wills, R.H.H., T.H. Lee, D. Graham, W.B. McGlasson and E.G. Hall, 1984 Postharvest . An Introduction to the Physiology and Handling of Fruit and Vegetables. Westport, AVI Publ. Co. 163 pp.
Preservation of fruits and vegetables. Giridhari Lal, G.S. Siddappa and G.L. Tandon ICAR, NewDelhi.
Fruit and vegetable preservation – principles and practices by R.P. Srivastava and Sanjeevkumar. International Book Distributing Co, Lucknow
Kader, A.A., Kasmire, F.R., Mitchell. F.D., Rcid, M.S., Somner, N.F. and Thomes, J.F. 1985. Post harvest technology of horticultural crops. Agrl. And Natural Resources Pub. U.C David USA.

5. Elph. 4205. Post harvest handling of cut flowers and dry flowers (1+2)

Factors affecting post harvest quality and vase life of cut flowers and foliage. Stage method and time of harvest. Postharvest handling - pre-cooling, pulsing, grading, bunching, packing and storage of important cut flowers. Types of packaging materials – methods of packaging for short term and long term transport and transit. Use of bud opening and holding solutions. Quality deterioration in the storage environment - sanitary procedures to be followed. Internal and global demand and consumption trends of cut flowers - standards – marketing systems in India and abroad – role of intermediaries – problems and prospects in production for export. Postharvest handling of cut foliage. Value addition in flowers - garlands, bouquet, flower arrangements. Extraction of oil and pigment, use in aromatherapy. Preparation of dry flowers, dry flower arrangements and marketing of dry flowers. Storage and care of dried products.

Practical

Practice in post harvest handling operations of cut flowers. Packaging, storage and marketing activities. Use of pulsing and holding solutions for bud opening and extension of vase life. Preparation garlands, bouquet and flower arrangements. Other value added products. Practice in preparation of dry flowers and value added products made from dry flowers and foliage. Visit to oil and pigment extraction units. Visit to auction centres and flower markets.

Lecture schedule

1	Important cut flowers (rose, chrysanthemum, carnation, gerbera, anthurium, orchid, *Lilium*, *Alstroemeria*, heliconia, alpinia, tuberose, gladiolus etc.) and foliage, internal and global demands.
2-3	Factors affecting post harvest quality and vase life of cut flowers, pre and post harvest factors.
4	Post harvest quality and vase life of cut foliage - factors affecting.
5	Harvesting cut flowers and foliage, stage of maturity, time and method of harvest.
6	Post harvest handling of important cut flowers, pre-cooling, pulsing, grading, bunching, packing, cold chain.
7	Types of packaging materials, methods of packaging for different terms of transport.
8	Storage, methods, quality deterioration in the storage environment, sanitary procedures, management of pests and diseases.
9	Use of bud opening and holding solutions.
10	Quality standards for domestic and export purpose
11	Post harvest handling of cut foliage
12-13	Marketing of cut flowers and foliage, domestic and international market, role of intermediaries, consumption trends, problems and prospects in production for export, quarantine measures.
14-15	Value addition in flowers, preparation of garlands, bouquet, flower arrangement.
16-18	Dry flowers and plants, importance, production techniques - drying, bleaching and dyeing - storage and care of dried flowers and foliage.

Practical Schedule

1-3	Practice in harvesting and post harvest handling operations of different cut flowers (rose, chrysanthemum, carnation, gerbera, anthurium, orchid, *Lilium*, *Alstroemeria*, heliconia, alpinia, tuberose, gladiolus etc.).
4-5	Precooling, and pulsing - preparation of pulsing solutions and studying their effect on extension of post harvest longevity of cut flowers .
6	Grading of important cut flowers.
7-8	Packing and storage of cut flowers.
9	Study of different methods of transport.
10-11	Preparation of bud opening and holding solutions and studying their effect on extension of post harvest longevity of cut flowers.
12-13	Practice in post harvest handling operations of different cut foliage.
14	Study of different channels of marketing of cut flowers and foliage.
15	Sanitary and quarantine measures for export.
16	Value addition, practice in preparation of garlands.

17-18 Practice in preparation of bouquet.
19 Tinting of fresh flowers.
20 Flower arrangement.
21-22 Practice in post harvest handling of cut foliage.
23 Dry flowers and plants - practicing different methods of drying.
24 Bleaching and dyeing, skeletonizing leaves, storage of dry flowers.
25 Preparation of natural dyes and observing their effect on dyeing dry flowers.
26-28 Preparation of value added products from dry flowers and foliage, flower arrangements, bouquets, wall hangings, greeting cards, *pot pourri* and other floral crafts.
29-31 Visit to commercial production units and post harvest handling units of cut flowers.
32-33 Visit to flower markets and auction centres.
34-35 Visit to export oriented units of cut flowers.
36-38 Visit to dry flower units

Suggested Readings

Bose, T.K. and Yadav, L.P. 1989 Ed. *Commercial Flowers*. Naya Prakash, Calcutta, India

Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. 1999 ed. *Floriculture and Landscaping* Naya Prakash, 206, Bidhan Sarani, Calcutta.

Hardenbug, R.E. Watadar. A.E and Wong C.Y. 1986. The *Commercial storage of Fruits*. *Vegetables, Florist and Nursery stock*. U.S. Department of Agriculture. New York.

Chadha, K.L., 2001 (ed). *Handbook of Horticulture*. ICAR, New Delhi.

Choudhary, M.L. and Prasad, K.V. 2003. *The value addition in Horticulture*. Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi. p. 100-104.

Larson, R.A. 1980. *Introduction to Floriculture* Academic Press, London

Laurie, A., Kiplinger, D.C. and Nelson, K.S. 1979. *Commercial Flower Forcing*. Mc-Graw Hill Book Company, New York.

Pal B.P. 1972. *The Rose in India*. Indian Council of Agricultural Research, New Delhi.

Prakahs, J. and Bhandary, K.R. *Floriculture Technology, Trades and Trends* 1994. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Rajeevan, P.K. Singh, K.P. and Valsalakumari P.K. 2003 *ed*. *Bulbous Flowers.* Indian Society of Ornamental Horticulture Division of Floriculture & Landscaping, IARI, New Delhi.

Rajeevan, P.K., Sobhana, A., Bhaskar, J., Swapna, S and Bhattacharjee, S.K 2002. *Orchids*. Technical Bulletin. AICRP on Floriculture ,ICAR, New Delhi.

Rajeevan, P.K., Valsalakumari, P.K., Geetha, C.K., Leena Ravidas., Vinod Kumar and Bhattacharjee, S.K. 2002. Anthurium. Technical Bulletin. AICRP on Floriculture, ICAR, New Delhi

Randhawa, G.S. and Mukhopadhyay, A. 1986. *Floriculture in India*. Allied publishers, New Delhi

Sessler, G.J. 1978. *Orchids and how to grow them.* Prentice Hall, New Jersey

Steffek, E.F. 1972. Ed. *The world of the gladiolus*. The North American Gladiolus Council, Inc., Maryland

Yadav, I.S. and Choudhary, M.L. *ed*. 1997. *Progressive Floriculture*. The House of Sarpan (Media), Bangalore.

6. Elph. 4206. Processing and value addition of cereals, pulses and oilseeds (1+2)

Structure, composition and nutritional significance of cereals millets, pulses, nuts and oilseesds that has relevance to Kerala. Presence of antinutritional factors, hazards and detoxification. Primary and secondary processing of cereals, pulses, nuts and oilseeds – need and significance. Preparation and processing of value added products and by-products from rice, wheat, millets, common pulses, nuts and oilseeds. Their use and economic significance – cost benefit analysis.

Practical

Processing and preparation of value added products using cereals, pulses, nuts and oilseeds. Utilization of combination of cereals, pulses, nuts and oilseeds for production of value added blended/products – calculation of cost yield and process loss.

Lecture schedule

1-2 Structure, composition and nutritional significance of cereals – Rice and Wheat.
3-4 Major processed rice products –puffed, flaked, popped rice – Instant rice, breakfast cereals.
5 By- products of rice – rice bran, rice polishing, rice bran oil.
1-9 Wheat products – Types of flour – pasta products – Instant food mixes from cereals.
10-12 Nature, composition and nutritional significance of pulses – processing of pulses – decortications, germination, fermentation – processed products of pulses.
13 Significance of pulses - Malted products from cereals and pulses.
14-15 Presence of antinutritional factors in pulses – ill effects –methods of removal of antinutritional factors – soy products – milk substitutes.
16-18 Composition and nutritional significance of oilseeds and nuts, with special reference to coconut, sesame and groundnuts, processed products of nuts and oilseeds.

Practical Schedule

1-3 Processing of cereals – milling, dehulling, parboiling, puffing, roasting, pulverization.
4-8 Processing of pulses – malting of pulses, preparation of fermented products from pulses – preparation of milk substitutes.
9-11 Preparation of soy products.
12-15 Preparation of baked products.
16-19 Preparation of pastries and cakes.
20-25 Preparation of supplementary foods – weaning mixes.
21-28 Preparation of extruded products/ pasta products.
29-32 Preparation of processed other products from coconut and oilseeds.
33-34 Preparation of Beverages/ health mixes.
35,36 Visits to various food processing industries.

Suggested Readings

Indian Food Industry, AFST, Mysore.
Journal of Food Science and Technology, AFST, Mysore.
Potter, N.N. 1998. Food Science. AVI publishing company, Connecticut.
Srilakshmi, B. 1997. Food Science. New Age International (P) Ltd, New Delhi
Pillayar, P. 1998. Rice post production manual. Wiley eastern ltd. Madras.

V. AGRI-BUSINESS MANAGEMENT

1.Elab. 4201. Information and communication management (1+2)

Fundamentals of information and communication- solving agricultural problems with information systems- a managerial overview of information and communication Information- characteristics, Information Vs Knowledge, ABC nature of information, Information as a crucial resource, Processing of information, Analysis of information, Information retrieval.Types of information, communication technology, use of different channels and media .Multimedia information, formats, use of multimedia systems and standards.Computer system- input and out put devices, Multipurpose computer system, Data base management system, Decision Support system, Information management

System of organizations, Remote sensing, Geographical information system. Multimedia and their application. Satellite communication-VSAT application-CD ROM-Techniques of teleconferencing, Video conference and its application to Transfer of technology, Bio informatics and its application**.**

Practical

Familirising with the working of Telephone, Modem, Fax, Radio, TV, Video Soft ware for printing- MS-office, Adobe Photoshop, Adobe PageMaker, Flash, insight, inscriber, Practice on digital printing and on line publishing ,Practicing to prepare script writing for radio talk, skits, documentaries, docu-features. Editing, mixing in audio track. Basics of Photography- use of camera and digital camera, focusing methods, exposure controls. Taking still pictures and transferring to computer, Editing of still picture, Photo journalism, Digitized video, pictures and movies - capturing of images to computer Touch screen presentation –design and programming, Texts and images. Video production technology- - video scripting, camera handling, shooting editing, mixing post production Animation- animation authoring, Multimedia Authoring- Website designing, Net working- LAN/MAN/WAN.

Lecture schedule

1. Fundamentals of information and communication- solving agricultural problems with information systems- a managerial overview of information and communication.
2. Information- characteristics, Information Vs Knowledge, ABC nature of information, Information as a crucial resource
3. Processing of information, Analysis of information, Information retrieval, Types of information, communication technology, use of different channels and media
4. Different channels of information – communication- Radio, TV, Video, E-mail, facsimile
5. Network connecting devices-intranet, internet, Photography, basics –its use in ICM, Digital Photography –its advantages
6. Print media- different types, role in transfer of technology, Role of modern communication devices in print media, Desk top publication system
7. Role of computer in information -communication - Data base management system,
8. Agricultural Information System – Agricultural databases – Definition and objectives, Decision Support system, Expert system
9. Remote Sensing – Geographic data and maps, Geographical information system

10. Computer net works and communication, Network components- LAN, WAN,
11. Video conferencing, Tele conferencing, Tele text, Videotext, Electronic Data Interchange
12. Video- use and advantage, integrating visuals in ICM,
13. Video production process- presentation formats, pre and post production,
14. Searching and locating of agriculture literature – e- journals and technical reports, electronic publishing and e-books
15. E- publications- content and formats of agricultural information.
16. Multimedia-concept and its advantages; applicability in transfer of technology, education & training, publication; virtual reality, interactive media.
17. Satellite communication-V-SAT application in agriculture and rural development, its role in transfer of information
18. Bio informatics – Definition – History – Links between modern biology genomics and Bio-informatics, Use of bio-informatics in agriculture

Practical schedule

1. Principles and uses of various communication devices -Print, audio, audio &visual like Telephone, Modem, Fax, Radio, TV, Video
2. Types of information available and presentation mode in various media- print, audio and visual
3. Visit to popular dailies to know the various type of agricultural information management technique.
4. Modern communication devices in print media. DTP- design and printing of information, pagination
5. Soft ware for printing- MS-office, Adobe Photoshop, Adobe PageMaker, Flash, insight, inscriber
6. E-book, e-journals- content, layout, pictures. editing and publishing
7. Practice on digital printing and on line publishing
8. Visit to AIR station-to study the modern/electronic communication for farm broadcasts.
9. Practicing to prepare script writing for radio talk, skits, documentaries, docu-features
10. Presentations and recording of audio tracks. Use of tapes, CD, DVD players and recorders
11. Editing, mixing in audio track. Coping and multiplication of audio tapes/CD/DVD.
12. Basics of Photography- use of camera and digital camera, focusing methods, exposure controls.
13. Taking still pictures and transferring to computer
14. Editing of still picture, Photo journalism
15. Computer based teaching technology-Expert System – building blocks of expert system
16 Digitized video, pictures and movies - capturing of images to computer
17. Introduction to GIS and remote sensing software
18. Touch screen presentation –design and programming, Texts and images
19. Visit to DD station to study in the various communication technology used for agricultural information management
20. Role of video in transfer of technology -Using digital video
21. Video production technology- pre production- video scripting, location and facilitation

22. Video production technology- production – camera handling, shooting tips
23. Video production technology- production –shooting –outdoor & indoor
24. Video production technology- production –filler shots,
25. Video production technology- editing, mixing post production
26. Video production technology- post production
27. Animation- animation authoring
28. Integration of animation with video
29. Video & audio capturing practice, Editing of images
30. Multimedia Authoring- steps
31. Multimedia Authoring –the assembly task, testing
32. Website designing
33. Website designing
34. Net working- LAN/MAN/WAN
35. Computer net works- Video conferencing, Tele conferencing, Tele text,
36. Bio informatics, Searching internet sites for protein sequences and protein structures.

Suggested Readings

Cope, Peter 2003 Digital video & PC editing; Hodder Headline ltd, London, UK
Dahama.O.P. and O.P. Bhatnagar, 1980. Education and Communication for development, Oxford and IBH, New Delhi.
Fuller.R, 2000. Special Edition using MS Power point, McMillan Publishing Company, USA.
Luther, Arch, C, 1995 Using digital video, Academic Press Ltd, London, UK
Musburger, Robert B 2005 Single camera video production; Linacre House, Jordan Hill, Oxford, UK
Boctor. B.S., 2000. MS Office 2000-Microsoft Press Release, USA.
Alexis Leon & Mathews Leon (2004) "Introduction to Information System" Vijay Nicole (P) Ltd., Chennai
Lay, Vaughan 1999; Multimedia –Making it works Fata, MGH,
Singh and Singh, 1994. DTP Course, Asian Publishers, New Delhi.
Chandrakanthan.K and Palanichamy.S., 2002. Advances in Communication Technology, Indian publishers and distributor, New Delhi.
Swaminathan, M.S. (1993) (ed) Informationtechnology. Reaching the unreached. .
Claverie, Jean-Michel and Notredame, Cedric, 2004,"Bioinformatics – A Beginner's Guide" Published by Wiley Dreamtech India Pvt. Ltd., New Delhi
Robert A. Day 2001., "How to write and publish scientific paper", Cambridge University Press (Local Priced Edition).

2.Elab 4202. Management of agro based industries (1+3)

Understanding entrepreneurship, entrepreneurial process, entrepreneurial competencies, Agribusiness-concepts, nature and scope of Agri business, Status-present role and future prospects, forms of Agribusiness organization-their advantages and disadvantages, special economic zone, preparing business plan, lay out of a pilot plant setup- estimation, costing, site selection, Agri business development licensing-government polices-sanction, patent laws, certification, analysis of opportunities, value addition, product diversification, small business management, marketing management, financial accounting, book keeping, accounting procedures, records and systems, financial management, production management, people management ,business context and strategy. Private/ Public ventures in agro based industries.

Pracrtical

Interaction with successful entrepreneurs, visit to various agri business units, practical exercises on business plan preparation, micro screening, piolot plan set up, product diversification, market survey, accounting, book keeping, people management skills. The students are expected to attach themselves to one of the selected agri business unit, study it critically and prepare viable project on similar line.

Lecture schedule

1. Understanding entrepreneurship-need for EDP, entrepreneurial process, entrepreneurial traits and competence-dynamics of entrepreneurship.
2-3. Agribusiness-concept, nature and scope of agri. Business-status-present role and future prospects, forms of agribusiness organizations-their advantages and disadvantages. Special economic zone-It's advantages and disadvantage.
4-5 Preparing business plan-what is a business plan. Characteristics of a good business plan, elements of business plan, why some plans fail, licensing-government policies and sanction, certification and patent law (ENGG.).
6. Agribusiness development, steps in setting up a small enterprise analysis of opportunities.
7. Micro screening techniques-product selection.
8-10 Value addition and product diversification in Coconut and Rice (ENGG.).
11-13 Value addition and product diversification in fruits, vegetables and mushroom (HOMESCIENCE).
14. Market surveys -need importance, scope and procedures involved. Small business management, the process of management, organising the enterprise.
15. Marketing management- concept, needs for marker plan, elements of marketing strategy, market positioning, marketing mix, types of market.
16. Financial accounting- purpose basic accounting concept, balance sheet, profit and lose account, cash flow statement, bookkeeping, accounting procedures , records and systems.
17. Financial management-key activities of financial management. Production management-characteristics of services, decisions involved in service process planning service. Manufacturing process, types of production/Basic conversion system, service/Product design, Quality management.

18. People management-man power planning, recruitment and selection, orientation, training and development, creating a positive work environment, building up a team of advisors, networking for entrepreneurs, employment regulations.
19. Business context and strategy-what is strategy, strategic analysis of environment, components of strategic plan, generic competitive strategies.

Practical schedule

1-4 Interaction with successful entrepreneurs
i. Agriculture graduate entrepreneur- 1 class
ii. Other entrepreneurs - 3 class
5-9 Visit to agri based units.
Bakery based units and rice based units.
9-12 Visit to Coconut based units and mushroom units.
13-16 Visits to bio based and honey bee units.
17-20 Visit to nursery units and floriculture units, and seed production units.
21-22 Visit to fruit and vegetable units and curry power making units.
23-24 Visit to Agribusiness ventures in private/ public like Reliance fresh, Walmart, Spencer network
25-27 Visit to export oriented units and rural business hubs.
28-29 Visit to banana based units and paper bag units.
30-31 Practical exercise on preparing a good business plan.
32-33 Practical exercise on micro screening techniques.
33-37 Practical exercise on layout of a pilot plan set up, estimation, costing and site selection.
38-40 Exercise on product diversification-skill acquisition
41-42 Exercise on market survey.
43-44 Exercise on accounting and book keeping.
45-46 Exercise on preparing balance sheet.
47-49 Exercise on people management skills.
50-57 Attachment training in a selected Agri business unit and preparation of a viable project in similar line.

Suggested Readings

Drilon, Dr.J.D, 1971, Introduction to Agri-Business Management (Asian Productivity Organization, Tokyo).
Drilon, Dr.J.D, 1971, Agri-Business (Asian case studies, Part II (Asian Productivity Organization, Tokyo).
Saksena, S.G, 1981, Organization and Management (Sahitya Bhavan, Agra).
Dinkar Pagare, 1981, Business Management (Sultan Chand and son, New Delhi)
Vasant Desai, Management of Small Scale Industry Himalayan Publishing House, Bombay, 1982.
Kotler, Philip, Marketing management Analysis, Planning and control, Fourth edition, Prentice Hall, Inc, Englewood Cliffs, Newyork 1997.
Price Gttnger J, Economic Analysis of Agricultural projects, The Johns Hopkins university Press, Baltimore and London, 1982.

Ramaswamy V.S. and Navin Kumari R.S., Marketing Management in Indian Environment, Macmillan India Limited, Delhi, Madras, 1983.
Developing Entrepreneurship, Asia pacific Theories and practices ASEED, New Delhi.
David H. Holt, Entrepreneurship New Venture Creation, Prentice Hall of India, New Delhi.

3 . Elab. 4203. Marketing management (1+2)
(Agricultural import- export policy of Govt. of India and business laws)

Concept of marketing management – scope- marketing management process - marketing mix - Market structure and Consumer buying behaviour- marketing environment, micro and macro environments- Marketing Opportunities Analysis - Marketing Planning Process. Product policy and planning - New product development process. International trade - Free trade vs protection, methods of protection - quotas, tariffs- licencing etc., Foreign exchange rates and policies- exchange control, devaluation, terms of trade balance of payments, exim policy, Exports- Direct exports, indirect exports, Imports- Dumping- anti-dumping measures- Licensing, Joint Ventures, Direct investment & internationalization process - GATT, WTO. World Trade Agreements related with agri exports and imports- Business Laws. Policies and licensing procedures.

Practical

Collection of basic statistics related to agricultural trade- . Salient features of International Trade in India- Composition & direction of Indian exports and imports; International marketing environment analysis; Familiarization with techno-legal procedures connected with the export and import of agricultural products- Visit to Agri Export Zones in Kerala – Visit to different Govt. institutions related to international food trade; APEDA- Commodity Boards like Tea Board, Spice Board, Rubber Board.

Lecture schedule

1. Concept of marketing management – Marketing – new concept – business marketing – holistic marketing - scope- marketing management process
2. Marketing mix - Market structure and Consumer buying behaviour.
3. Marketing environment- micro-environment, suppliers, marketing intermediaries customers, competitors publics. The macro-environment, Demographic, economic, natural, technological, political and cultural environment. Responding to market environment.
4. Marketing opportunities analysis – marketing management tasks
5. Marketing Planning Process. Product policy and planning. New product development process – Challenges in new product development, Organisational arrangements, managing the development process, consumer adoption process.
6. International trade - Free trade vs protection, methods of protection - quotas, tariffs- licencing etc.
7. Foreign exchange rates and policies- exchange control, devaluation, foreign exchange risk management.
8. Terms of trade, balance of payments.
9. Exim policy, Exports- Direct exports, indirect exports, Imports- Dumping- anti-dumping measures – subsidy schemes, mode of export payments
10. Licensing, Joint Ventures, Direct investment & internationalization process
11. Marketing segmentation, Product, Brand, Selection of Market and product, Source of Information, Global Sourcing, Marketing intelligence.

12. Packaging and Transportation- Functions of Packaging, Factors, Promotions, Distribution (Direct and Indirect Export), Role of Agents and Distributors, Model Agency Agreement, Export Correspondence, Pre and Post negotiation Phases Export priming, Export costing & pricing. Export finance – basic types – nostro, vostro and loro accounts
13. Setting up own Export Business- Naming, Style, Location, Personnel, Market Research, Export planning, Export costing and Pricing.
14. International Commercial Terms – Need, Groups, Ex-works, FOB, FAS, CFR, CIF.
15. Quality Systems – ISO 9000 series, Patenting, Project, Import and Export (Contract, Turnkey, Civil Construction, Services), EPZs, EOUs, TPs & SEZs.
16. Air and Sea Shipments – Procedure, Liner Freight, Containerisation, Cargo claims.
17. GATT, WTO. World Trade Agreements related with agri exports and imports-
18. Business Laws. Policies and licensing procedures.

Practical schedule

1-2. Documentation of basic statistics related to agricultural trade, analysis and presentation.
3-4. Studying salient features of international trade in India- Composition & direction of Indian exports and imports, preparation of reports and presentation.
5-6. Study of marketing channels and price spread of raw and processed agricultural commodities and presentation of report.
7-8. International marketing environment analysis. Case studies on spices and floriculture and presentation of report.
9-10. Familiarization with techno-legal procedures connected with the export and import of agricultural products. Visit to agricultural product exporting agency and to an importing agency.
11-13. Visit to Agri Export Zone in Kerala and studying the organization and functions like grading, standardization and discussion with officials and preparation of report presentation.
14-16. Visit to Govt. institutions related to international food trade like APEDA. Preparation of reports and presentation of results.
17-19. Visit to MPEDA. Studying its functioning, preparation of report and presentation of results.
20-21. Comparative study of the structure of marketing of organic products and conventional agricultural products and presentation of results.
22-24. Visit to Spices Board. Study of export of spices and their quality control. Presentation of results.
25-27. Visit to Coffee Board, Study of export of coffee and its quality control. Presentation of results.
28-30. Visit to Coir Board, Study of product diversification and marketing. Presentation of results.
31-32. Visit to Rubber Board. Studying its functioning and discussion with officials, presentation of results.
33-36. Visit to Tea Board, Study of export of tea and its quality control. Presentation of results.

Suggested Readings

Alagumani ,T , Chinnaiyan, P and Elangovan, S . 1998. *Agricultural Management* . Publishers K9 International, Madurai

Downey, W.D and Troche, J K. 1981. *Agribusiness Management*. Mc Graw Hill Inc.,New Delhi

Gittinger, J.P. 1982. *Economic Analysis of Agricultural Projects*. The Johns Hopkins University Press, Baltimore

Philip, K. 2004. *Marketing Management*. Prentice Hall, New Delhi.

4. Elab. 4204. Financial management of agri business (1+3)

Financial management- concepts and objectives-Tools of financial management- Different Systems of Accounting. Financial Accounting, Cost accounting, Management Accounting. Double entry system of Book-Keeping. Preparation of Accounting Records. Journal, Purchases and Sales Book and Posting in Ledger, Cash Book. Statements of Financial Information., Classification of capital and revenue expenditure, Balance Sheet, Profit and Loss Account, Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making. Financial Analysis . Nature and uses of financial analysis, Cost Volume – Profit analysis and operating leverage, Break-even analysis, Management of capital, cost of debt, debentures, preference share capital, equity share capital & retained earning, overall cost of capital. Investment decision . Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Pay back period method, Accounting rate of return method. Capital budgeting and capital rationing- Project Report; Feasibility Report Valuation. Working capital management- Concept & determinants of working capital, Estimating working capital needs. Depreciation – Concept and method.- Various methods of apportioning indirect expenses. Inventory Management. Planning, control and costing.

Practical

Preparation of Profit and Loss account - Preparation of Balance Sheet- Preparation of Cash flow statements- Preparation of Funds flow statements- Problems on Ratio analysis-. Liquidity ratios, Leverage ratios, Acidity ratios, Profitability ratios- Break-Even Analysis- Estimation and decision making applications- Problems on Break-Even Analysis - Exposure to Profit analysis and its application - Problems on Operating Analysis- Problems on Financial leverage- Problems on Cost of Capital- . Problems on Capital budgeting.

Lecture Schedule

1. Financial management- concepts and objectives- The nature and purpose of financial management - Tools of financial management- Financial objectives and relationship with corporate strategy.
2. Accounting as an information system, Uses and users of accounting information. Concepts in accounting.
3. Different Systems of Accounting. Financial Accounting, Cost accounting, Management Accounting.

4. Fundamentals of book keeping. Double entry system of Book-Keeping. Concept of double Entry Theory; Types of account, golden rules regarding debit and credit.

5-7. Preparation of Accounting Records. Preparation of Cash Book - Single column, double columns and treble columns; balancing thereof, journals and posting to Ledger account. Preparation of trial balance -provision for depreciation under different methods - writing off bad debt, creation of provision for bad and doubtful debt-creation of revenue reserve and provisions - treatment of taxation - provision for dividend etc.
8. Statements of Financial Information. Classification of capital and revenue expenditure

9. Financial Analysis . Nature and uses of financial analysis

10. Statement of changes in the financial position, funds flow statements, cash flow statement, uses of funds flow and cash flow statements in financial decision making.

11. Cost Volume – Profit analysis and operating leverage, Break-even analysis,

12. Management of capital, cost of debt, debentures, preference share capital, equity share capital & retained earning, overall cost of capital.

13-14. Investment decision . Time value of money, Net present value, Investment evaluation criteria, NPV method, Internal rate of return method, Profitability index method, Pay back period method, Accounting rate of return method. Capital budgeting and capital rationing.

15. Allowing for inflation and taxation in discounted cash flow (DCF) techniques. Adjusting for risk and uncertainty in investment appraisal. Specific investment decisions (lease or buy; asset replacement, capital rationing)

16. The nature, elements and importance of working capital. Working capital management- Concept & determinants of working capital, Estimating working capital needs. Management of inventories, accounts receivable, accounts payable and cash. Determining working capital needs and funding strategies.

17. Depreciation – Concept and method.- Various methods of apportioning indirect expenses

18. Inventory Management. Planning, control and costing. Inventory valuation. Objectives, Introduction to FIFO, LIFO & Weighted Average method of inventory valuation, Valuation of inventory on balance sheet date, inventory accounting and control.

Practical schedule

1-2. Review of cost concepts and depreciation methods.

3-6 Preparation of Profit and Loss account. Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

7-10. Exposure to Profit analysis and its application. Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

11-14. Problems on Operating Analysis- Problems on Financial leverage. Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

15-19. Preparation of Balance Sheet. Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

20-23. Preparation of Cash flow statements, Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

24-28. Preparation of Funds flow statements, Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

29-33. Problems on Ratio analysis-. Liquidity ratios, Leverage ratios, Acid test ratios,

Profitability ratios, Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

34-38. Break-Even Analysis- Estimation and decision making applications- Problems on Break-Even Analysis, Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

39-43. Visit to an agribusiness firm, acquaintance with book keeping, preparation of report and presentation.

44-48. Problems on Cost of Capital- . Problems on Capital budgeting., Review of concepts – visit to an agribusiness firm, preparation of report and presentation.

Suggested Readings

Kahlon,A.S. and Singh, K.1980. *Managing AgriculturalFinance.* Allied Publishers, New Delhi.
Reddy,S., Raghuram,P., Neelakantan,T.V and Bhavani Devi I.2004. *Agricultural Economics*. Oxford and IBH Publishers, New Delhi.
Reddy,Subba,S. and Raghu Ram.P. 1996. *Agricultural Finance and Management*. Oxford IBH, New Delhi.
Kuchal, S.C. 1982. *Financial Management – An Analytical and Conceptual Approach*. Chaitanya Publishing House, Allahabad.
Book Keeping and Accountancy. Choudhari, Chopde

5. Elab. 4205. Natural resource economics and management (1+2)

Natural resources- Definition, Classification- Scope and importance- basic terms and concepts- objectives of natural resource management- Natural resources and associated problems- Scarcity- indicators of scarcity- factors influencing scarcity- sustainability and management- Economics of resource – issues in management of land, forest and water resources and Common Property Resources (CPR). Optimal extraction of non renewable resources-Use over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.. Natural resource processes- conservation of resources- methods of conservation- recycling- property rights- meaning- degradation of resources- nature and its relationship with poverty- Valuation of natural resources- market and non market techniques- Global policies in natural resource management relating to poverty, development and environment- concept of green accounting.

Practical

Collection and analysis of relevant data on various natural resources in the state and national level- Visits to prominent reserves of natural resources- Identifying resource problems- land, water and forest resource- Exposure to international and voluntary agencies for natural resource management- Review of International conferences, conventions and summits - individual and group presentations- group discussions on global warming, impact of climate change, waste land management and afforestation

Lecture Schedule

1. Natural resources- Definition, Classification- Scope and importance- basic terms and concepts- objectives of natural resource management

2. Natural resources and associated problems- Scarcity- indicators of scarcity- factors influencing scarcity- sustainability and management.

3. Economic perspectives of natural resource use. static efficiency, dynamic efficiency and sustainability.

4. Sources of inefficiency in the use of natural resources. Externalities, improperly defined property right systems, imperfect market structures, divergence of social and private discount rates and government failure

5. The pursuit of efficiency. private resolution through negotiation, property rights & liability rules, and government policies

6-12. Economics of resource use – issues in management of land, forest, energy, fishery, biodiversity, and water resources. Optimal extraction of non renewable resources

13-14. Natural resource processes- conservation of resources- methods of conservation- recycling- property rights - degradation of resources- nature and its relationship with poverty

15-16. Valuation of natural resources - market and non market techniques.

17-18. Global policies in natural resource management relating to poverty, development and environment- concept of green accounting.

Practical schedule

1-4. Visit to Forest Research Institute, Peechi and studying its activities Study of special attributes of forestry resource, efficient management of forestry resource, source of inefficiency, and public policy toward forestry. Presentation of results.

5-8. Visit to CMFRI, Cochin and studying its activities. Studying special attributes of the fishery resource, fisheries as a common-property resource, efficient extraction, sources of inefficiency, public policy toward fisheries. Presentation of results.

9-13. Visit to CWRDM, Kozhikode and studying its activities. Studying water. a global perspective of water scarcity, water allocation policy in India, water allocation inefficiency and potential remedies. Presentation.

14-19. Visit to wind mills, Tirunelveli and studying its activities. Studying Energy economics. Trends in Energy Production and Consumption, Renewable and non-renewable sources of energy, Externalities of conventional fuels, Energy Conservation, and presentation.

20-24. Visit to the Land Use Board, Trivandrum and studying its activities. Land economics. Documentation of trends in land use pattern in India and Kerala, Analysis of changes in land use pattern in Kerala – causes and consequences, and presentation.

25-28. Visit to the Centre for Environment and Development, Vattiyoorkavu and studying its activities and presentation.

29-31. Visit to Kerala State Pollution Control Board, Trivandrum and studying its activities and presentation.

32-36. Visit to MSSRF, Kalpetta and studying its activities. Studying Economics of biodiversity preservation - Use versus non-use values of resources. Biodiversity. Determining priorities and values. Policy options for conservation of biodiversity. "Bioprospecting" for genetic resources. resource conservation from the private sector and presentation.
Economics of biodiversity preservation - Use versus non-use values of resources Biodiversity. Determining priorities and values. Policy options for conservation of biodiversity. "Bioprospecting" for genetic resources. resource conservation from the private sector
Use versus Non-use values of resources and measurement techniques (Oct 25, 27, 30)
Basis for Option, Discovery and Existence Values. Uncertainty, Lack of Information and Possible Irreversible Consequences (Measures of Caution)
Reasons for Higher Value of Resources in Future. Asymmetry of Technological Progress and Inability of technology to reproduce unique resources (supply side reason) and Changing Preferences in Favor of Natural Resources – learning by doing (demand side reason)
Non-human value – the difference between economic value and environmental value

Suggested Readings

Kerr J.M, Marothia D.K, Katar Singh, Ramasamy. C. and Bentley W.R. 1997. *Natural Resource Economics – Theory and Application in India*. Oxford &IBH Publishing co. New Delhi.
Moorthy M.N., James A.J. and Smitha Misra 1999.*Economics of Water Pollution – Indian Experience.* Oxford &IBH Publishing co. New Delhi.
Vaidyanathan, A. 1999. *Water resource Management.* Oxford &IBH Publishing Co. New Delhi.
Folmer, H and Gabel, H.L 2000, *Principles of Environmental and Resource Economics*, Edward Elgar Publishing Ltd., UK
Karpagam, M. 1999 *Environmental Economics.* Sterling Publishers Pvt Ltd., New Delhi.

6. Elab. 4206. Project formulation, evaluation and monitoring (1+2)

Project concept- definitions- project approach to development- agricultural projects. characteristics- relationship of projects with plans and programmes- Phases of project cycle- identification- formulation, appraisal- implementation- monitoring and evaluation-

Project identification. need, concept, significance and approaches- Project formulation. need, concept, significance and technical, commercial, managerial, organizational, financial, economic aspects of project formulation Appraisal of projects. concept- significance- tools of appraising a bankable project- discounted and undiscounted measures-Implementation of projects. concept, importance- project design and network analysis- Project evaluation. concept, need, mid course, ex post and ex ante evaluation-Risk in agricultural projects- methods of handling risk projects

Practical

Practical exercises on Discounting techniques- estimation of PBP, BCR, NPW, and IRR- Visit to Financial institutions and familiarization with model bankable projects- Survey of successful entrepreneurs – identification and preparation of individual agricultural project of area of interest to the student and develop one complete project for execution of the same on the following guidelines - identification of the project, selection of the locale and clientele, input sources – manpower, finance and infrastructure facilities. Scope for implementation (cost benefit analysis)- Presentation of a report on the final project .

Lecture Schedule

1. Project concept- definitions- project approach to development

2. Agricultural projects. characteristics- relationship of projects with plans and programmes.

3-4. Phases of project cycle- identification- formulation, appraisal- implementation- monitoring and evaluation-

5. Project identification. need, concept, significance and approaches

6-8. Project formulation. need, concept, significance and technical, commercial, managerial, organizational, financial, economic aspects of project formulation

9-10. Appraisal of projects. concept- significance- tools of appraising a bankable project- discounted and undiscounted measures. Choice of discount rate - Consideration of alternatives - Divergence of private and social profits-Government action to bring out equality of social and private profits

11-12 Implementation of projects. concept, importance- project design and network analysis

13-14. Project evaluation. concept, need, mid course, ex-post and ex-ante evaluation. Private sector projects- Method of evaluation of private projects- Social benefit-cost analysis - Uses and abuses of sensitivity analysis. Shadow pricing.

15-18 Risk in agricultural projects- methods of handling risk projects. Uncertainty and investment criteria - External effects related to inputs and outputs of the projects. Sensitivity analysis – Tangible and intangible benefits. Decision tree analysis and project selection

Practical schedule

1-3 Practical exercise on discounting techniques- estimation of PBP, BCR, NPW, and IRR for a watershed project.

4-7 Practical exercise on estimation of PBP, BCR, NPW, and IRR for a coconut garden.

7-11 Practical exercise on estimation of PBP, BCR, NPW, and IRR for a soil and water conservation project.

12-17 Practical exercise on estimation of PBP, BCR, NPW, and IRR for a horticultural nursery project.

18-22 Practical exercise on estimation of PBP, BCR, NPW, and IRR for a dairy project.

23-24 Practical exercise on estimation of PBP, BCR, NPW, and IRR for a sericulture project

25-26 Practical exercise on estimation of PBP, BCR, NPW, and IRR for a goatry project.

27-28 Visit to financial institutions and familiarization with model bankable projects.

29-31 Survey of successful entrepreneurs – identification and preparation of individual agricultural project in the area of interest to the student and develop one complete project for execution of the same on the following guidelines - identification of the project, selection of the locale and clientele, input sources – manpower, finance and infrastructure facilities. Scope for implementation (cost benefit analysis) - Presentation of a report on the final project.

32-34 Social cost benefit analysis of watershed project.

35-36 Social cost benefit analysis of coir processing industry.

Suggested Readings

Chandra, P. 1984. *Projects – Preparation, Appraisal, Implementation,* Tata Mc Graw-Hill Publishing Company Limited, New Delhi.

Gittinger J. P. 1984. *Economic Analysis of Agricultural Projects.* The Johns Hopkins University Press, Baltimore

Squire, L and Tak,H.G.1975. *Economic Analysis of Projects*. The Johns Hopkins University Press, Baltimore.

Reddy,S., Raghuram,P., Neelakantan,T.V and Bhavani Devi I. *Agricultural Economics*. Oxford and IBH Publishers, New Delhi.

VI. SOCIAL SCIENCE

1. Elss. 4201. Agricultural journalism (1+2)

Concept of journalism- meaning and scope- principles of modern journalism- Role of mass media in the world today-Radio, film, TV and other mass media. Agricultural journalism as a means of mass communication-Agricultural publications- Print media-news paper-News- definition of news, news value, sources of news. Principles of writing feature stories-types of features-Leads, captions and endings-Magazine articles-photojournalism. Editing –principles and techniques-Electronic media for development. Radio, TV and Video. Role of video in transfer of technology-effective agricultural advertisement- public relations, e-journalism, media anchoring.

Practical

Visit to newspaper Press, AIR station, TV and news agencies to study the mode of presentation and use of various modern electronic media. Visit to advertisement agencies. Writing news stories, features, Practice in editing. Script writing for radio, TV and Video story. Photo feature writing. Students will be attached to various media for individual learning experience.

Practical Schedule

1. Journalism Concept, definition, meaning and scope.
2. Principles of modern journalism, cannons and ethics of journalism
3. Role of mass media in the world today. Radio, TV and other mass media
4. Agricultural journalism as a means of mass communication, scope of agricultural Journalism
5. Agricultural publications-books, booklets, brochure, circular, folder etc.
6. Print media-different types, role in transfer of technology
7. News-definition, news value news agencies
8. Writing news stories- principles, inverted pyramid style
9. Writing feature stories-type of features
10. Leads, captions and endings-types of leads
11. Role of modern communication devices in print media
12. Role of video in transfer of technology
13. Writing script for radio and TV
14. Writing for specialized magazines
15. Principles of advertisement communication
16. Public relations
17. Comparative study of strengths and weaknesses of various media of communication

Practical schedule

1. Collection of various agricultural publications, journals- popular , technical and research

2&3 Exercises in writing news stories

4&5 Exercise in writing feature stories

6&7 Professional writing skills-exercises

8&9 Practice in gathering information and writing news

10&11 Practice in photojournalism using analog and digital cameras

11&12 Practice in videography using analog and digital cameras
13. Visit to AIR to study the modern electronic communication and satellite communication used for information management
14. Visit to Doordarshan Kendra study the modern electronic communication and Satellite communication used for information management
15&16 Visit to various TV channel studio to study the programme production formats
17&18 Visit to leading daily offices to study various types of information management
19. Visit to printing press to study the modern printing process.
21&22 Visit to news agencies-UNI and PTI to study the pattern of message. receiving, storing, treating and transmitting.
23&24 Visit to advertising agencies to study the advances in advertisement technology.
25&26 Preparing and presenting radio scripts.
27&28 Writing TV/video scripts.
29&30 Hands on exercises on shooting and editing TV scripts.
31. Visit to Farm Information Bureau.
32. Visit to IIIT-K Techno Park.
33. Visit to Press Information Bureau.
34. Visit to PRD, Govt. of Kerala.

Suggested Readings

Ahuja, B.N., 1977, Theory and Practices of Journalism, Surjeet publications, NewDelhi.
Shama, J.K., 2002, Ethics of Journalism in Transition. Authors press publication, NewDelhi.
Loosely, A.E., 1970, The Business of Photo journalism, Local Press London.
Mehta, D.S., 1979, Mass communication and Journalism in India, Allied Publishers Pvt. Ltd. Bombay.
D'souza, Y.K., 1999, Function and areas of journalism, Dominant Publishers and distribution, NewDelhi.
Rengaswamy, P., 1995, Journalism in India, Sterly Publishers Pvt. Ltd. NewDelhi.

2. Elss. 4202. Visuals and graphic communications (1+2)

Visuals in communication – Planning and design of visual aids – Non projected visual aids – Pictures, Posters, Charts, Graphs, Chalk Board, Magnetic Board, Bulletin Board – Cartoons-Comics – Wall Newspaper, Exhibitions. Projected visual aids – Projectors – Cameras – Digital photography – Photojournalism – Movie camera – Three dimensional pictures – Power point – Picture shop – LCD. Advertising – Role and functions – Corporate and promotional advertising – Advertising agency and media – Consumer behaviour – Advertising campaign. Translation of ideas into campaign – Visualization, designing and layout, copywriting – Types of headlines, body copy base lines, slogans, logos and trade marks – Typography, writing styles, scripting, story board. Basics of graphic design – computer graphics – Image processing – computer animation. Web designing – World wide web – Writing good HTML – Web page design – graphics on the web.

Practical

Planing, preparation and presentation of posters, charts, and other visual aids, handling of audio visual equipments – OHP, slide projector, visualiser, DLP, LCD, practice in digital photography, movie and Computer aided presentation, visits to various visual and graphic institutions.

Lecture schedule

1. Visuals in information and communication.
2. Choice of visuals – Planning for use of visuals – selecting – theme of visuals
3. Layout and design of visual aids.
4. Visual aids – Non-projected – Teaching aids – Display of visuals – Flat pictures – Posters – Diagrams – Flip chart Flash cards – Flip book – Felt boards – Flannel graphs – Khaddar graphs.
5. Chalk board – Magnetic Board – Bulleting Board – Combination Board.
6. Cartoons – Comics – Wall Maps – Wall Newspaper – Stick Bills – Exhibitions.
7. Visual aids – projected – projectors – slide projector – Slides – Overhead projector – transparencies.
8. Cameras-Still cameras –Automatic picture taking – Digital photography – Photojournalism – Photo features – Photo essays, Writing captions – Visual story telling – Resolution – Compression – Editing photos – Sharing photos.
9. Digital cameras – digital films – Getting prints – Accessories – Print size versus image dimensions – Effective mega pixels- Image processing – Photo image storage – digital negative storage and print processing.
10. Handling the movie camera – angle of filming – length of scenes – editing the film – three dimensional pictures – Power Point – Photoshop – LCD projector.
11. Advertising – Definition, nature and scope of advertising – Role of advertising – Societal, Communication, marketing and Economics – Functions of advertising – Based on target audience – Geographic areas – Media and purpose.
12. Corporate and promotional advertising – Environment, Components – Advertiser, advertising agency and media consumer behaviour.
13. Latest trends in advertising, conceptualization and ideation – Translation of ideas into campaigns – Visualization designing and layout, copywriting – Types of headlines, body copy base lines, slogans logos and trade marks – Typography, writing styles, scripting, story board – Advertising campaign from conception in execution.
14. Basics of graphic design – Definition – Elements of graphic design process – Research, a source of concept, the process of developing ideas – Verbal, visual, Combination and thematic.
15. Computer graphics, computer aided design – presentation graphics – computer art – Visualization – Image processing – Graphics functions – Colour selection and applications – Computer animation – Design of animation sequences.
16. Web Designing – Introduction to web environment – World wide web – Meaning – Writing good HTML – knowing the audience – Considering the site's purpose – Designing for a variety of displays – Fixed versus flexible.
17. Web page design, accessibility – Alternate displays, web design.
18. Principles for print designers – Colour on the web, graphics on the web, typography on the web.

Practical schedule

1. Planning, Preparation, evaluation and presentation of posters and charts.
2. Planning, preparation, evaluation and presentation of flannel graphs and bulleting board.
3. Planning, preparation, evaluation and presentation of transparencies in overhead projector.
4. Familiarizing digital camera.
5. Practice in digital photography.
6. Practice in photo journalism.
7. Familiarizing the movie camera – Handicam.
8. Practice in shooting with Handicam.
9. Study of Power Point.
10. Planning, preparation, evaluation and presentation of Power Point slides.
11. Study of photoshop.
12. Practice in Photoshop.
13. Familiarizing and practice in use of LCD.
14. Familiarizing and practice in use of LapTop.
15. Visit to a Government advertising agency.
16. Visit to a commercial advertising agency.
17. Conducting a survey to study the perception of farmers towards advertisements in mass media.
18. Content analysis of advertisements on agricultural aspects in various channels of television.
19. Content analysis of advertisements on agricultural aspects in radio.
20. Content analysis of advertisements on agricultural aspects in newspapers.
21. Content analysis of advertisements in agricultural aspects in farm magazines.
22. Visit to a digital studio.
23. Visit to a TV station.
24. Practice in graphic design.
25. Planning, preparation, evaluation and presentation of computer aided graphic designs.
26. Practice in computer animation.
27. Practice in designing animation sequences.

28 to30. Practice in writing good HT ML.

31 to33 Practice in Web Page design.

34 to36. Practice in creating a website for an Institution.

Suggested Reading

Dahama,O.P. and Bhatnagar,O.P. (1985) Education and Communication for Development – Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Gerard, J. Tellis. 2004 Effective Advertising, Sage Publications, India Pvt. Ltd., Chennai.

John Maloy, 1996 Mastering Web Design Tools of the Trade from the Industry Leaders, BPB Publications, New Delhi.

Mahendramohan 1997 Advertising Management – Concept and Cases, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi.

Vilanilam,J.V. and Varghese, A.K. 2004 Advertising Basics, Sage Publication India, Chennai.

Xavier, C. 2000 Worldwide Web Design with HTML, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi.

3. Elss. 4203. Cyber extension (1+2)

Orientation, introduction of Cyber extension concepts, principles, elements of cyber extension – study of cyber extension tools – cyber extension efforts in India & abroad – cyber extension software, hardware and other related packages like – AV, MAV, UIS etc., e – extension efforts of Government of India, SAU's and other state Departments of Agricultural Cyber extension efferts in public private partnership. ATMA ad cyber extension – Agri KIOSKS, and call centers and other ventures.

Practical

Orientation of computer hard ware and software - installation of programmes - net working comcepts - LAN/WAN expert system orientation knowledge base creation and flow chart preparation familisation with various expert system visits to kiosks /kissan call centre /c-DIT / VUAT .project preparation with the development of domain project presentation and evaluation

Lecture Schedule

1. Introduction scope and importance of cyber extension.
2. Areas and dimensions of cyber extension
3. cyber extension elements
4. functions of cyber extension
5. utilities of cyber extension
6. cyber extension tools and its applications
7. cyber extension efforts in India and abroad
8. Cyber extension software- expert system AIS, MAIS.
9. Development concepts. Knowledge base creation, flow chart.
10. flow charts, preparation for diagnosis ,data entry -compilation application s
11. e- extension , cyber extension efforts in ICAR,
12. department of agriculture and SAU
13. e- Krishi- kissan approach , Krishi call centre . net working of cyber effosrts thru cyber corridor.
14. e-extension efforts under PPP
15. e-extension efforts like Gyandoot. bio village . Simputer project, Warna wired village –village knowledge centre .
16. ATMA and cyber extension.
17. Cyber extension issues and concerns.
18. Installation of agro kiosks-touch screen –e-bay and e- market .

Practical schedule

1-4 orientation of computer hard ware and software
5-7 installation of programmes
8-10 net working comcepts . LAN/WAN
11-14 expert system orientation
15-19 knowledge base creation and flow chart preparation
20-24 familisation with various expert system
25- 28 visits to kiosks /kissan call centre /c-DIT / VUAT .

29- 32 project preparation with the development of domain
33-36 project presentation and evaluation

Suggested Readings

Grover I Kaushik S. Yadav . S.K. Varma (2002) communication and instructional technology. Udaipur. Agro tech Publishers.
John.Mc coy (1996) Mastering web design tools of the trade from the industry leaders. New Delhi BPB. Publishers
Venkatasubramain V (2001) technology communication and AV aids in extension education. Chennai New centruy books.Pvt ltd.
Witich.W.A (1968) audio visual materials their nature and use. Harperand Row New York

4. Elss. 4204. Behavioural skills (1+2)

Behaviour- meaning, definitions, dimensions-; Factors affecting behaviour. Performance- measuring performance; performance management. Self awareness- need and importance, SWOT analysis, Use of JOHARI window concept. Goal setting- Features of a good objective; Long term goals and short term goals. Interpersonal relationship- Barriers to effective relationship; Steps to improve understanding of others; influencing others. Transactional analysis- meaning; study of ego states. Assertiveness- Passive behaviour, aggressive behaviour and assertive behaviour; Why and how to be assertive; Attitude and behaviour. Time management- Importance of time, characteristic features of time; time management techniques. Team building- Team Vs Group; Stages of team formation; Group dynamics. Decision making- meaning, definitions and steps; Problem solving. Presentation skills- Types of presentations; Tips for effective presentations; Audience behaviour. Listening- Active listening; Ways to improve listening skills. Memorising- what is memory; Techniques of memorizing- Thinking- meaning, tools/instruments, Emotional intelligence skills- Feelings and emotions; handling feelings. Motivation- internal and external motivation; fear motivation and incentive motivation; motivators and demotivators; Achievement motivation. Conflict management and negotiation- Sources of conflict; stages of conflict; Conflict management styles and techniques. Stress management- What is stress; causes and consequences of stress; Techniques of management of stress.

Practical

Exercises on Self awareness, Goal setting, Communication, Perception, Body language interpretations, Nonverbal communication, Transactional analysis, Assertiveness, Attitude, Public relations, time management, Team building, Decision making, Problem solving, Presentation skills, Facing interview, Listening, Memorising, Thinking, creativity, Influencing people, Motivation, Emotional intelligence, Conflict management, Negotiation, Stress management

Lecture Schedule

1. Orientation about the course; Behaviour- meaning, definitions, dimensions- cognitive, conative, and affective; Factors affecting behaviour.
2. Performance- Efficiency Vs Effectiveness; measuring performance; performance management.

3. Self awareness- need and importance; SWOT analysis; Use of JOHARI window concept.
4. Goal setting- Goal Vs Objectives; Features of a good objective; Long term goals and short term goals.
5. Interpersonal relationship-Barriers to effective relationship; Steps to improve understanding of others; influencing others.
6. Transactional analysis- meaning; study of ego states- parent, adult and child ego states; study of transactions- parallel, crossed and disguised transactions.
7. Assertiveness- Passive behaviour, aggressive behaviour and assertive behaviour; Why and how to be assertive; Attitude and behaviour.
8. Time management- Importance of time, characteristic features of time; time management techniques
9. Team building- Team Vs Group; Stages of team formation; Group dynamics.
10. Decision making- meaning , definitions and steps; Problem solving.
11. Presentation skills- Types of presentations; Steps in presentations; Tips for effective presentations; Audience behaviour.
12. Listening- Active listening; Ways to improve listening skills
13. Memorising- what is memory; the memory machinery; Techniques of memorizing- association, link method, peg system etc.
14. Thinking- meaning, tools/instruments, convergent thinking and divergent thinking-creativity
15. Emotional intelligence skills- Feelings and emotions; handling feelings
16. Motivation- internal and external motivation; fear motivation and incentive motivation; motivators and demotivators; Achievement motivation.
17. Conflict management and negotiation- meaning; Sources of conflict; stages of conflict; Conflict management styles and techniques.
18. Stress management- What is stress; causes and consequences of stress; Techniques of management of stress.

Practical schedule

1. Self introduction
2. Self awareness- SWOT analysis
3. Self awareness- Johari window
4. Self rating Questionnaire
5. Goal setting
6. Communication exercises-I
7. Communication exercises-II
8. Perception exercises
9. Body language interpretations
10. Nonverbal communication exercises
11. Transactional analysis – Questionnaire
12. Assertiveness- Questionnaire
13. Attitude measurement and attitudinal change
14. Public relations- case analysis
15. Exercises on techniques of time management
16. Team building- Broken square
17. Win- lose game
18. Management game- Tower building
19. Decision making- case
20. Problem solving- exercises

21. Presentation skill lab-I
22. Presentation skill lab-II
23. Presentation skill lab-III
24. How to face an interview- tips
25. Listening exercises
26. Memorising techniques-I
27. Memorising techniques-II
28. Thinking skills-exercises on divergent thinking/creativity
29. Influencing people-role plays
30. Motivating techniques
31. Emotional intelligence- exercises
32. Conflict management – case analysis
33. Negotiation – role play
34. Stress management exercise-I
35. Stress management exercise-II
36. PRACTICAL EXAMINATION

Suggested Readings

Aquinas,P.G. (2006). Organisational Behaviour- concepts, realities, application and challenges. Excel Books, New Delhi.
Bidgol Hussain (1989). Decision Support System. Principles and practices. St Paul Co.
Borker, D. (1980). Transactional Analysis and Training. The theory and use of TA in organization. Grier Press, London.
David Boddy (2002). Management. An Introduction. Prentice Hall, New Delhi.
Hersey Pod, K. Blanchard (1985). Management of organizational behaviour. utilizing human resources. Prentice Hall, New Delhi.
Markham Ursula (2003). Managing Stress. Vega, London.
Neil Thompson (2002). People skills, Palgrave Mac Millan, New York.
Plotnik, R. and Mollenaeur, S. (1986) Introduction to Psychology, Randon House, New York.
Ravi,N. (2000). The Hindu speaks on management. Kasturi & Sons Ltd. Chennai
Shiv Khera (1998). You can win, Mac Millan India Ltd., Delhi.

5. Elss. 4205. Livestock, poultry and fish marketing (1+2)

Scope for livestock, poultry and fish marketing – Present position of dairying in India – Milk marketing and dairy development projects – Grading of milk – Producing quality milk and milk products – Marketing- Price trends, Strategy and Channels.

Present position of poultry production in India – Egg marketing - Practices in maintaining egg quality – Grading and preservation of eggs – Standards of quality live and dressed poultry- Marketing - Price trends, strategy and channels

Meat production and Marketing – beef, Pork and Rabbit.

Practical

Field visits to small holder dairy, poultry, pig and rabbit production units – Field tours to processing units and marketing organizations – Understanding working of milk

cooperatives – Practising hand and machine milking – Manufacture of value added dairy products - Project formulation – Production and marketing units – Establishing Broiler Poultry unit – Dressing of Poultry – Market surveys for livestock, poultry and fish.

lecture schedule

1. Scope for livestock, poultry and fish marketing
2. Present position of dairying in India
3. Milk marketing and dairy development projects
4. Grading of milk – Producing quality milk and milk products
5. Value added dairy products
6. Milk marketing-concept and strategy
7. Price trends and marketing channels
8. Present position of poultry production in India
9. Egg marketing - Practices in maintaining egg quality
10. Grading and preservation of eggs
11. Broiler poultry production
12. Standards of quality live and dressed poultry
13. Marketing - Price trends, strategy and channels
14. Production and Marketing – Beef
15. Production and Marketing – Beef
16. Production and Marketing –Pork
17. Production and Marketing –Rabbit

Practical schedule

1. Field visit to small holder dairy production units
2. Field visit to dairy farms
3. Practising hand and machine milking
4. Understanding working of milk cooperatives
5. Field tours to milk processing units and marketing organizations
6. Field tours to milk processing units and marketing organizations
7. Manufacture of value added dairy products 1
8. Manufacture of value added dairy products 2
9. Manufacture of value added dairy products 3
10. Project formulation – Dairy production and marketing units
11. Project formulation – Dairy production and marketing units
12. Field visit to poultry farms
13. Project formulation – Broiler production and marketing unit
14. Project formulation – Broiler production and marketing unit
15. Project formulation – Layer production and marketing unit
16. Project formulation – Layer production and marketing unit
17. Establishing broiler production and marketing unit
18. Establishing broiler production and marketing unit
19. Dressing of Poultry
20. Field visit to piggery units
21. Project formulation – Swine production and marketing units
22. Project formulation – Swine production and marketing units
23. Field visit to Goat production units
24. Project formulation – Goat production and marketing units
25. Field visit to small holder rabbit production units

26. Project formulation – Rabbit production and marketing units
27. Field tours to meat processing units and marketing organizations
28. Field tours to meat processing units and marketing organizations
29. Market surveys for livestock, poultry and fish.
30. Market surveys for livestock, poultry and fish.
31. Market surveys for livestock, poultry and fish.
32. Market surveys for livestock, poultry and fish.
33. Market surveys for livestock, poultry and fish.

PRACTICAL EXAMINATION

6. Elss. 4206. Farm planning and budgeting (1+2)

Farm planning and budgeting - Concept and importance- types of farm plans- location specific plans - Budgeting techniques – partial and complete budgeting- Farming systems –Record keeping as a tool of control. – need, information, format- implementing the plan, scheduling the work, Net working- PERT, CPM- cost of cultivation and production- cost concepts- financial statements- analysis- measures of income, break even analysis, decision making under risk and uncertainty.

Practical

Visit to Instructional farms- identifying cropping systems- familiarization of farm records- inventory- valuation of assets- preparation and analysis of financial statements- Identification and study of selected farm households- cropping system identification- farm inventory preparation- analysis of existing plan- SWOT analysis- preparation of alternate plan- presentations- modification and finalization – discussion with farmer and finalization - individual and group presentations. Visit to farms of progressive farm households and evaluation of success factors.

Lecture Schedule

1. Farm planning and budgeting - Concept and importance, Steps in farm planning, characteristics of a good farm plan.

2-3. Types of farm plans- location specific plans - Budgeting techniques – partial and complete budgeting. Importance of budgeting

4-6 Farming systems organization of homestead, coconut based, tapioca based–Record keeping as a tool of control – need, information, Types of farm records – format Records maintained by a corporate firm and a state farm.

7-9. Implementing the plan, scheduling the work.

10-12. Networking- PERT – Technique – advantages, quality control circle. Applications in programme planning for agricultural development., Gant charts – Network analysis – Diagramming methods - CPM – Steps in CPM project planning, Limitations.

13-14. Cost of cultivation and production- cost concepts – returns concepts.

15-16. Financial statements- analysis- measures of income, break even analysis – Income statement, balance sheet.

17-18. Decision making under risk and uncertainty – sensitivity – decision tree analysis – sources of risk - measuring the expectation and various measures to manage risk.

Practical

1-2. Visit to Instructional farms- identifying cropping systems.

3-6. Visit to a state farm, and familiarization with farm records and accounts, preparation of report and presentation.

7-9. Visit to farmer's field, valuation of assets - preparation and analysis of financial statements.

10-15. Identification and study of selected farm households - cropping systems identification.

16-19. Farm inventory preparation- analysis of existing plan - SWOT analysis- preparation of alternate plan- presentations- modification and finalization – discussion with farmer and finalization - individual and group presentations.

20-25. Analysis of homestead farming system and analysing the profitability and preparation of suitable alternative farm plan.

26 – 30 Formulating and budgeting for lowlands including assessing the possibility of crop rotation.

31-32. Planning and budgeting for mixed farming.

33-36. Undertaking case studies of successful farmers of different farming systems including fisheries and preparation of budget.

Suggested Readings

Reddy,S., Raghuram,P., Neelakantan,T.V and Bhavani Devi I. 2004. *Agricultural Economics*. Oxford and IBH Publishers, New Delhi.

A.S.Kahlon and Singh, K. 1987. *Economics of Farm Management in India*. Allied Publishers, New Delhi.

Dhondyal,S. P.1987. *Farm Management. An Economic Analysis*. Friends Publications, Meerut.

Gittinger J. P. 1984. *Economic Analysis of Agricultural Projects*. The Johns Hopkins University Press, Baltimore

7. Elss. 4207. Government policies and programmes related to agriculture (1+2)

Agricultural policy of the state and central governments- land, seed, fertilizers, irrigation, machinery, credit and technology- .Concept of planned growth- Five Year Plans-Government policies and programs in agriculture and rural development. IADP – IAAP- IWDP- Watershed development Programmes- IRDP- NREGP- SGSY – Kudumbasree- etc. Peoples' Plan- Decentralised planning- current Plans – Agricultural development programmes and schemes of the dept. of Agriculture- liaison with Local Self Government - Panchayati raj system and institutions- grama sabha- Preparation of plan projects in agriculture.

Practical

Familiarization with the various Policies and Plans- presentation- Group discussion- visits to PRIs, KILA, DRDA , IMG- participation in gramasabha- Krishi bhavans- acquaintance with Agrl. programmes of the panchayats- State and Central sector schemes- interaction with experts and officials.

Lecture Schedule

1-2. Introduction to agricultural policies of Kerala and of India – need and importance – National Agricultural Policy in brief.

3-4 Agricultural policies regarding land – need and scope for land reforms – Abolition of intermediaries – Tenancy reforms – Ceiling on land holdings – appraisal of land reforms.- Size pattern of operational holdings, problem of sub-division and fragmentation of holdings.

5-6 Agricultural policies regarding labour – present position of agricultural labour – minimum wages – abolition of bonded labour – Recommendations of the National Commission on Rural Labour - NREGP

7-8. Agricultural policies regarding seeds - National Seeds Policy - varietal development and plant variety protection - seed production - quality assurance - seed distribution and marketing - infrastructure facilities - transgenic plant varieties - import of seeds and planting material - export of seeds - promotion of domestic seed industry

9-10. Agricultural policies regarding fertilizers – Fertilizer pricing policy – payment of subsidy. Agricultural policies regarding plant protection chemicals – pesticide production and consumption in India - protection of consumers from adverse impacts of pesticides.

11-12. Agricultural policies regarding irrigation, machinery, technology etc.

13. Agricultural policies regarding credit – Co-operatives and rural credit – Commercial banks and rural credit – Regional Rural Banks – Lead Bank Scheme – NABARD.

14. Agricultural policies of Kerala and of India- regarding agricultural products and their marketing, export and prices - food security.

15-16. Concept of planned growth- Five Year Plans-Government policies and programs in agriculture and rural development. IADP – IAAP- IWDP- Watershed development Programmes- IRDP- NREGP- SGSY – Kudumbasree- etc.

17. Peoples' Plan- Decentralised planning- current Plans – Agricultural development programmes and schemes of the dept. of Agriculture- liaison with Local Self Government.

18. Panchayati raj system and institutions- grama sabha- Preparation of plan projects in agriculture.

Practical schedule

1-3. Evaluating the land reform policy – studying its implementation and shortcomings – preparation of report and presentation.

4-6 Evaluating the agricultural labour policy – studying its implementation and shortcomings – preparation of report and presentation.

7-9 Evaluating the seed policy – studying its implementation and shortcomings – preparation of report and presentation.

10-12 Evaluating the irrigation policy – studying its implementation and shortcomings – preparation of report and presentation.

13-15 Evaluating the agricultural credit policy – studying its implementation and shortcomings – preparation of report and presentation.

16-19. Evaluating the fertilizer policy – studying its implementation and shortcomings – preparation of report and presentation.

20-23. Evaluating the agricultural product marketing policy – studying its implementation and shortcomings – preparation of report and presentation

24-26. Evaluating the price support policy – studying its implementation and shortcomings – preparation of report and presentation.
27-28. Visit to PRI. Study of its functioning, preparation of report and presentation
30-31. Visit to KILA, ATMA. Study of their functioning, preparation of report and presentation
32. Visit to DRDA. Study of its functioning, preparation of report and presentation
33-34 Visit to IMG. Study of its functioning, preparation of report and presentation
35-36. Participation in gramasabha- Krishi bhavans- acquaintance with Agrl. programmes of the panchayats- State and Central sector schemes- interaction with experts and officials.

Suggested Readings

Government of India. Five year Plan Documents .
Government of India. *Economic Survey*. Published by Planning Commission (various issues)
Government of India. *Economic Review*. Published by State Planning Board (various issues)

VII. BIOTECHNOLOGY

1. Elbt. 4201. Molecular breeding (1+2)

Molecular cytogenetics - introduction , definition, history, scope. Genome size evolution, adaptability. Development and use of different kinds of molecular markers – RFLP, RAPD, SSR, STRS, AFLP, VNTR, SAMPL BSA. Generation of mapping populations (F2, BC, DH, RILS, NILS,). Softwares for preparation of molecular maps. Comparison of genetic maps and synteny, their use in study of evolution . Marker aided selection. Development of markers - QTLs . Techniques of FISH, McFISH , and GISH and genome analysis. Flow cytometry and it's use in cytogenetics. Artificial chromosome and their uses .

Practical

Banding of chromosomes, - C, G and N banding . Plant DNA isolation, purification and quantification. Restriction digestion of DNA, southern blotting, polymerase chain reaction , RAPD and STS analysis . Cloning of micro satellite. Marker segregation in mapping population . Linkage analysis – use of copter package. QTL mapping (from available data) FISH, McFISH , and GISH and analysis of genetic diversity. Construction of Dendrograms . DNA finger printing (from available data) . Comparative genome and synteny. alignment of genome sequences (Data from gene banks)

Lecture Schedule

1. Molecular cytogenetics – an introduction, defininion and history.
2 - 3. Scope of molecular cytogenetics, Genome size, evolution , adaptability.
4 Chromosomal DNA and evolution.
5. Repetitive DNA - physical localization, banding patterns.
6 - 7. Restriction enzymes, restriction mapping.
8 - 10. Molecular markers - Restriction fragment length polymorphism (RFLP), random amplified polymorphic DNA (RAPD), Simple sequence repeats (SSRs) Amplified fragment length polymorphism (AFLP).
11 - 13.Molecular maps, generation of a mapping population), Marker-aided selection (MAS) Bulk segregant analysis (BSA), Use of NILs for tagging genes, genotyping individuals of mapping populations, study of linkage using software.
14. Mid term Examination
15 Simple regression approach, simple interval mapping (SIM), composite interval mapping (CIM).
16. Genomic libraries, cDNA libraries, ESTs,
17. Yeast artifical chromosome (YACs), bacterial artifical chromosomes (BACs), plant artifical chromosomes (PACs) – uses, development.
18. Transposons microarrays. Genomics – application, Flow cytometry - uses.
19. Final Examination

Practical schedule

1. Banding of chromosomes – C, G and N banding.
2-5. Plant - DNA isolation, purification, quantification. Restriction digestion of DNA.
6-9. Southern blotting - probe preparation, purification, hybridization, autoradiography.

10-12. Polymerase chain reaction, RAPD.
13-16. Analysis of genetic diversity, construction of dendrograms,
17-18. DNA fingerprinting)
19-20. Comparative genome and synteny,
21-23. Alignment of genome sequences
24-26. Linkage analysis, use of computer packages,
27-28. QTL mapping.
29-31. Preparation of molecular maps.
32-34. Assigning linkage groups to chromosomes.
35. Marker segregation in mapping population, detection of segregation distortion, generation of a mapping population (F2, BC, DH, RILs, NILs)
36. Inheritance and linkage of molecular markers.
37. Practical Examination.

Suggested Readings

Lewin, B. 2007. Genes IX. Oxford University Press. Inc., New York
Singh, B.D. 1998. Biotechnology. Kalyani Publications, New Delhi
Chawla, H.S. 2003. Introduction to Plant Biotechnology. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi
Watson, J.D., N.H. Hopkins, J.W. Roberts, J.A. Steits and A.M. Weiner. 1987. Molecular Biology of the Gene. The Benjamin/Cummings Publishing Co. Inc. Menlo Park

2. Elbt. 4202. Plant tissue culture (1+3)

Plant tissue culture principles, historical background, general applications. Plant tissue culture media- methods of preparation of media, culture conditions, Stages of *in vitro* propagation, Tissue culture methods, production of artificial seeds. Planting out and related problems. Handling methods-structures, potting media. Commercial micropropagation. Single cell culture. *In vitro* production of secondary metabolites. Micropropagation - advantages, disadvantages, prospects. Problems of *in vitro* propagation. Production of virus free plants. Somaclonal variation, Protoplast culture, somatic hybridisation, haploid culture, Gene transfer techniques, importance, tissue culture as a tool in genetic engineering.

Practical

Plant tissue culture – micropropagation, embryo culture, haploid culture. Protoplast isolation and fusion, *in vitro* mutagenesis.

Lecture Schedule

1. Plant tissue culture – definition, principles
2. Plant tissue culture - historical background, general applications
3. Culture media – components
4. Culture media – components
5. Preparation of media, culture conditions

6. Stages of *in vitro* propagation, Methods of tissue culture - propagation *via* enhanced release of axillary buds, organogenesis, somatic embryogenesis, production of artificial seeds.
7. Commercial micropropagation
8. Single cell culture
9. *In vitro* production of secondary metabolites
10. Micropropagation - advantages, disadvantages, prospects
11. Problems of *in vitro* propagation
12. Production of virus free plants.
13. Somaclonal variation
14. Protoplast culture and somatic hybridization
15. Haploid culture and production of homo diploids
16. Gene transfer techniques- importance, direct and indirect methods
17. Genetically modified crops - status, prospects
18. Relevance of tissue culture in genetic modification

Practical Schedule

1. Familiarization of Plant Tissue Culture laboratory
2-7. Preparation of stock solutions of MS basal medium
8-13. Preparation of media
14-21. Inoculation of explant
22-37. Subculturing
38-43. Planting out of tissue culture plantlets
44. Synthetic seed production.
45-46. Embryo culture
47-48. Haploid culture
49-51. Protoplast isolation
51-52. Protoplast fusion
53. *In vitro* mutagenesis
54. Practical Examination

Suggested Readings

Bhojwani, S.S. and Razdan, M.K. 1993. Plant Tissue Culture. Theory and Practice. Elsevier Science Publications, Netherlands.
Chawla H S. 2003. Oxford & IBH Publishing Co. Pvt. Ltd. Chawla H. S. Introduction to Plant Biotechnology.

3. Elbt. 4203. Recombinant DNA technology (1+2)

Genetic engineering-principles and methods. Identification and isolation of genes. DNA cloning strategies. Characteristics of vectors - plasmids, phages and cosmids as cloning vehicles, PCR techniques for cloning. Separation and isolation of nucleic acids and proteins, sequencing. Enzymes of molecular cloning - exo and endo nucleases, restriction enzymes, classes of restriction enzymes, mode of action. Methylation. ligases. DNA polymerases. preparation and screening of genomic and cDNA libraries. cDNA cloning. Structural and regulatory genes. Antisense RNA-ribozymes.

Practical

Isolation of nucleic acids, sequencing, experiments with cloning vectors, extraction and purification of plasmid DNA. Restriction, methylation and ligation reactions. Preparation and transformation of competent *E. coli*. Identification of recombinants.

Lecture Schedule

1. Genetic engineering-principles and methods
2. Identification and isolation of genes.
3. DNA cloning strategies
4. Characteristics of vectors
5. Plasmids, phages and cosmids as cloning vehicles
6. PCR techniques for cloning
7. Separation and isolation of nucleic acids
8. Separation and isolation of proteins
9. DNA sequencing
10. Enzymes of molecular cloning
11. Exo and endo nucleases
12. Restriction enzymes, classes of restriction enzymes, mode of action
13. Methylation. Ligases.
14. DNA polymerases.
15. Preparation and screening of genomic and cDNA libraries
16. cDNA cloning
17. Structural and regulatory genes
18. Antisense RNA-ribozymes.

Practical Schedule

1-10. Isolation of nucleic acids
11-12. Sequencing
13-17. Experiments with cloning vectors
18-22. Extraction and purification of plasmid DNA
23-30. Restriction, methylation and ligation reactions
31-34. Preparation and transformation of competent *E. coli*.
35. Identification of recombinants
36. Practical Examination

Suggested readings

Brown, T.A. 1995. Gene cloning an Introduction (3rd edition). Chapman Hill, U.K.

Lehninger. 1993. Principles of Biochemistry. CBS Publications, New Delhi.

Lewin, B. Genes VII. Oxford University Press, Inc., New York.

4. Elbt. 4204. Bioinformatics (1+2)

Bioinformatics as a tool for biotechnology – databases – dynamic programming – sequence analysis using different programmes – BLAST, FASTA, ClustalW, applications of bioinformatics – dendrograms – phylogenetic trees – DNA chips. Molecular Mechanics and dynamics – molecular simulation. Prediction of molecular structure using neural network, hidden Markov model etc. Structure of protein and nucleic acid. Structure prediction methods. Application of bioinformatics. Database management. Computer aided drug design - limitations and advantages.

Practical

Docking, homology modeling. Sequence analysis by BLAST-FASTA - ClustalW-primer designing prediction of 3D structure of proteins -construction of dendrograms - phylogenetic trees. Molecular visualization using Molmol, Rasmol, 3-D structure.

Lecture Schedule

1. Bioinformatics as a tool for biotechnology
2-3. Databases
3-4. Dynamic programming
5-7. Sequence analysis using different programmes
8-10. BLAST, FASTA, ClustalW
11-12. Applications of bioinformatics
13-15. Dendrograms – phylogenetic trees
16-17. DNA chips
18-20. Molecular Mechanics and dynamics
21-22. Molecular simulation
23-25. Prediction of molecular structure using neural network, hidden Markov model etc.
26. Structure of protein - prediction
27. Structure of nucleic acid - prediction
28-29. Structure prediction methods
30-31. Applications of bioinformatics
32-33. Database management
34-36. Computer aided drug design - limitations and advantages.

Practical Schedule

1-4 Bioinformatics tools: Internet Basics

5-8 Biological databases

9-13 Sequence analysis tools: BLAST, FASTA, ClustalW, Omiga

14-19 Expasy Proteomics server

20-21 Analysis tools at EBI

22-24 Tools for analyzing Gene structure prediction tools

25-26 Protein structure prediction tools

27-29 Phylogenetic prediction

30-32 Molecular visualization tools

33-35 Homology Modeling and structure validation

36. Practical Examination

Suggested Readings

Mani K., Vijayaraj, N. 2004. Bioinformatics- A practical appraoch. Aparnaa Publications, Tamil Nadu

Rastogi S.C, Namitha M. 2006. Bioinformatics. Concepts, Skills and Applications. Rastogi Publications, New Delhi

5. Elbt. 4205. Microbial and environmental technology (1+3)

Role of microbes in environment – air, water, soil – microbes in environmental process – nutrient recycling – biodegradation of environmental pollutants – pesticides, fungicides, weedicides, hydrocarbon and other pollutants – bioremediation – restoration of vegetation in degraded and polluted soil ecosystems – organic matter decomposition and solid waste management – composting and biofuel production – industrial waste management – effluent treatment, aerobic and anaerobic – biological control of pests, diseases and weeds – microbial technology based food and animal feed – strain improvement for environmental quality management – GEMO's risks, release, regulation etc.

Practical

Sampling and microbial analysis of air, water and soil – isolation and characterization of cellulolytic and lignolytic microorganisms – aerobic composting of agricultural waste – methanogenesis from different agricultural waste – isolation of microbial community involved in different nutrient cycles –isolation of pesticide degrading microorganisms from polluted environment – preparation of microbial inoculum – AMF, *Azospirillum*, P solubilizers for restoration of vegeta tion in degraded soils – inoculum preparation, mass multiplication and field application of biocontrol agents – preparation of single cell protein and microbial enriched animal feeds – evaluation of industrial waste for crop production and bioremediation to improve the manorial quality - quality evaluation of air, water and soil – monitoring of genetically marked beneficial microbes in the field.

Lecture Schedule

1. Role of microbes in environment – air, water, soil
2-4. Microbes in environmental process – nutrient recycling
5-7. Biodegradation of environmental pollutants – pesticides, fungicides, weedicides, hydrocarbon and other pollutants.
8-9. Bioremediation – restoration of vegetation in degraded and polluted soil ecosystems
10-11. Organic matter decomposition and solid waste management
12-14. Composting and biofuel production
15. Iindustrial waste management – effluent treatment, aerobic and anaerobic
16. Biological control of pests, diseases and weeds
17-18. Microbial technology based food and animal feed – strain improvement for environmental quality management – GEMO's risks, release, regulation etc

Practical schedule

1-5. Sampling and microbial analysis of air, water and soil
6-12. Isolation and characterization of cellulolytic and lignolytic microorganisms
13-15. Aerobic composting of agricultural waste – methanogenesis from different agricultural waste
16-24. Isolation of microbial community involved in different nutrient cycles
25-30. Isolation of pesticide degrading microorganisms from polluted environment.
31-36. Preparation of microbial inoculum – AMF, *Azospirillum*, P solubilizers for restoration of vegetation in degraded soils
37-45. Inoculum preparation, mass multiplication and field application of biocontrol agents
46-50. Preparation of single cell protein and microbial enriched animal feeds
51-54. Evaluation of industrial waste for crop production and bioremediation to improve the manorial quality - quality evaluation of air, water and soil – monitoring of genetically marked beneficial microbes in the field.

Suggested Readings

Nerris J.R. and M.H. Richmond 1981. Essays in Applied Microbiology John, Wiley & Son Ltd.
Grassi G. and H.Zibelta. 1987, 1988 (Edn) Energy from Biomass 1 to 4 volume. Elsevier Applied Science London &P New york.

6.ELbt. 4206. Molecular diagnostics (1+2)

Molecular techniques for detection and characterization of plant pathogens-PCR, RT-PCR, RAPD, AFLP, microsatellites. Southern, Northern and Western blotting, hybridization and autoradiography. Immunodiagnostics-polyclonal and monoclonal antibodies. Agglutination & precipitation-Immunofluorescence technique for detection of pathogens. ELISA, RIA, immunocytochemical staining. FISH for detections of translocations, inversions - PCR-SSCP to detect mutations. SNP analysis for known SNPs. PAGE - band detection of enzyme variants.

Practical

Use of molecular techniques for identification and characterization of plant and animal pathogens – PCR, RAPD, AFLP, microsatellite. Southern, Northern and Western blotting and hybridization. Autoradiography, labeling of nucleic acid probes, preparation of antibody, agglutination, precipitation, titre estimation. ELISA. Bioassay of pathogens.

Lecture Schedule

1-2 Introduction to Molecular diagnostics-advantages over conventional methods of detection

3-6 PCR methods to diagnose pathogens- different steps

7 RFLP method for detecting pathogens

8-10 Genetic fingerprinting of pathogens by AFLP, RAPD

11-12 Detection of variability by cluster analysis

13-15 Microsatellites-SSR, ISSR

16-18 Rep-PCR for genetic fingerprinting of pathogenic bacteria-REP,ERIC & BOX primers

19-20 Southern, Northern blotting & Western blotting

21-22 Probes, hybridization

23 Autoradiography

24-25 Immunodiagnostics-types and structure of antibodies

26-27 Agglutination & precipitation reactions

28-29 Polyclonal & monoclonal antibodies

30 Immunofluorescence technique

31-32 ELISA & RIA

33-34 FISH for detections of translocations, inversions - PCR-SSCP to detect mutations.

35. SNP analysis for known SNPs.

36. PAGE - band detection of enzyme variants.

Practical Schedule

1-3. Use of molecular techniques for identification and characterization of plant and animal pathogens – PCR
4-6. RAPD
7-9. AFLP
10-12. Microsatellite
13-14. Southern blotting
15-16. Northern blotting
17 -18. Western blotting
19-20. Hybridization.
21-23. Autoradiography
24-25. Labeling of nucleic acid probes
26-28. Preparation of antibody
29-30. Agglutination, precipitation
31. Titre estimation.
32- 33. ELISA.
34-35. Bioassay of pathogens.
36. Practical examination

Suggested Readings

K.R. Aneja. 2003. Experiments in Microbiology, Plant Pathology and Biotechnology, 4th Edn, New Age international.

7. Elbt. 4207. Breeding for biotic and abiotic stress (1+1)

Resistance breeding – its importance- general principles and methods of breeding for resistance. Breeding for resistance. Mechanism of resistance. Genetic basis of disease/pest resistance – gene for gene relationship, biochemical basis of disease resistance. Problems in breeding for biotic stresses Methods of breeding for resistance – recent approaches. Vertical resistance breeding. Horizontal resistance breeding

Innovative techniques in breeding for biotic stresses. Breeding for abiotic stress – drought, salinity, heat cold flood. Achievements in breeding for biotic and abiotic stress

Practical

Screening techniques for insect resistance.Screening techniques for disease resistance. Screening techniques for abiotic stress drought, salinity, nutrient stress. Screening for through biochemical methods – proline. Invitro screening techniques Transfer of resistance through conventional and innovative techniques

Lecture Schedule

1. Resistance breeding it's importance
2. General principles and methods of breeding for resistance
3. Important pest – Assessment of pest population – Estimation of pest damage
4. Studies on the symptoms of various plant pathogens
5. Estimation of losses due to diseases

6-8. Scoring for important fungal/Viral/bacterial diseases

9. Midterm Exam

10. Method of scoring for diseases
11. Plant response to abiotic stress factors – Drought – Salinity
12. Shade – Temperature – Flooding – Pollutants – UVß radiation
13. Stress resistance – Physiological, biochemical and molecular mechanisms
14-15. Physiological selection criteria – Cell membrane stability – Osmotic adjustant – WUE and 13_C isotope discrimination – CCATD
16. Marker assisted selection – Inheritance of resistance
17. Selection and breeding methods – Durability of resistance
18. Achievements in resistance breeding.
19. Final Exam

Practical schedule

1-4. Rearing and release of major pest of selected crops
5-8. Assessment of damage for susceptibility/ tolerance/ resistance
9-12. Mass multiplication of important plant pathogens on cheap substrates
13-14. Application on soil/plant – Scoring for tolerance/susceptibility for these pathogens
15. Techniques to determine tissue water status
16. Assessment of membrane integrity – Stress induction response technique
17. Determination of WUE – Quantification of Osmolytes.
18. Final Exam

Suggested Readings

Russel, G.E. 1978. Plant breeding for pest and disease resistance. Butterworth & Co., U.K.

Painter, H.R. 1951. Insect Resistance in crop plants. Mc Millan Company, New York

Blum, A. 1988. Plant Breeding for Stress Environments. CRC Press, Florida

Levitt, J. 1980. Response of Plants to Environmental Stress. Water, Salt and other Stresses. Academic Press, New York

Singh, K.N. 1995. Recent approaches to breeding for salt tolerance in crop plants. In. Proc. genetic research and education. Current Trends & the Next fifty years. (Eds. B. Sharma *et. al*.) Vol. 1 Indian Society of Genetics and Plant Breeding, New Delhi 490-499

Vijendra Das, L.D. 2000. Problems Facing Plant Breeding. CBS Publishers, New Delhi

Vijendra Das, L. D. 1998. Plant Breeding. New Age International Publishers, New Delhi

8. Elbt. 4208. In vitro production of secondary metabolites (1+1)

Secondary plant metabolites-definition-their value as medicinal, aromatic and industrial materials-plant cell and tissue culture as an alternative source of secondary and natural products; establishment of productive cell culture systems; enzymatic potential of plant cell culture - bioreactors for large scale culture of plant cells; enhanced production of secondary metabolites – immobilization – elicitation – biotransformation - genetic transformation - preserving productive cell lines - non-frozen storage - cryopreservation of potential cell lines; *in vitro* production of secondary metabolites - L. doapa, shikonin, anthraquinone; morphinan alkaloids like morphine and codeine, cardenolide like digoxin and digitoxin, tropanes like hyoscyamine, saponins like diosgenin, antitumor compounds like vincristin, vinblastin and taxol, hypotensive alkaloids like reserpine and ajmalcine. Other significant active principles - commercial exploitation.

Practical

Maintaining callus and suspension cultures. Manipulation of culture media and conditions for secondary metabolite production. Assessing the potential of cells/cultures for secondary metabolic production.

Lecture schedule

1. Secondary plant metabolites-definition, value as medicinal, aromatic and industrial materials
2. Plant cell and tissue culture as an alternative source of secondary and natural products
3. Establishment of productive cell culture systems, enzymatic potential of plant cell culture
4. Bioreactors for large scale culture of plant cells;
5 Enhanced production of secondary metabolites–immobilization, elicitation
6. Biotransformation
7. Genetic transformation
8. Preserving productive cell lines – non-frozen storage
9 Cryopreservation of potential cell lines;
10-11 *In vitro* production of secondary metabolites - L. dopa, shikonin, anthraquinone.
12-13 Morphinan alkaloids like morphine and codeine, cardenolide like digoxin and digitoxin
14 Tropanes like hyoscyamine, saponins like diosgenin,
15 Antitumor compounds like vincristin, vinblastin and taxol
16 Hypotensive alkaloids like reserpine and ajmalcine.
17-18 Other significant active principles - commercial exploitation.

Practical schedule

1-10 Maintaining callus and suspension cultures.
11-25 Manipulation of culture media and conditions for secondary metabolite production.
26-35 Assessing the potential of cells/cultures of various plants for secondary metabolic production.
36 Practical examination

Suggested Readings

Bhojwani, S.S. and Razdan, M.K. 1993. Plant Tissue Culture. Theory and Practice. Elsevier Science Publications, Netherlands.
Chawla H S. 2003. Oxford & IBH Publishing Co. Pvt. Ltd. Chawla H. S. Introduction to Plant Biotechnology.

9. Elbt. 4209. In vitro conservation of germplasm (1+2)

Introduction – significance of conserving the germplasm – *in vitro* and field gene bank. *In vitro* techniques for germplasm conservation – short and medium term conservation – manipulation of culture media and conditions for prolonging the culture

period – long term storage/cryopreservation – freeze preservation – significance of liquid nitrogen – pre freezing treatments - use of cryoprotectants – dry freezing – storage/incubation – alterations/modifications in cell components during cryopreservation - recalcitrant species - thawing and reculture - survival of freeze preserved cells/tissues. Conal fidelity and karyotype stability of cryopreserved cultures and regenerants – use of biochemical and molecular markers for testing and stability.

Practical

Preparation of *in vitro* cultures for short, medium and long term preservation. Practicing different protocols for conservation. Thawing and reculture - assessing the stability of regenerants by RAPD and related techniques.

Lecture Schedule

1-2. Introduction – significance of conserving the germplasm
3-4 *In vitro* and field gene bank
5-6 *In vitro* techniques for germplasm conservation – short and medium term conservation –
7-8 Manipulation of culture media and conditions for prolonging the culture period –
9-10 Long term storage/cryopreservation – freeze preservation – significance of liquid nitrogen –
11-13 Pre freezing treatments - use of cryoprotectants – dry freezing – storage/incubation – alterations/modifications in cell components during cryopreservation
14 Recalcitrant species - thawing and reculture
15 Survival of freeze preserved cells/tissues
16 Clonal fidelity and karyotype stability of cryopreserved cultures and regenerants
17-18. Use of biochemical and molecular markers for testing and stability.

Practical schedule

1-10. Preparation of *in vitro* cultures for short, medium and long term preservation.
11-20. Practicing different protocols for conservation.
21-25. Thawing and reculture
26-35. Assessing the stability of regenerants by RAPD and related techniques.
36. Practical examination.

Suggested Readings

Bhojwani, S.S. and Razdan, M.K. 1993. Plant Tissue Culture. Theory and Practice. Elsevier Science Publications, Netherlands.
Chawla H S. 2003. Oxford & IBH Publishing Co. Pvt. Ltd. Chawla H. S. Introduction to Plant Biotechnology.

10. Elbt. 4210. Diagonistic physiology (1+2)

Role of plant physiology in plant diagnosis-systematic approach to diagnosing plant damage. Factors causing plant damage – living (biotic) and non living (abiotic).Response of plants to adverse abiotic factors- deficiency and toxicity of nutrients, ligh,water, temperature,carbondioxide,pollutants, heavy metals, salinity, acidity and radiation Plant identification and characterization- growth and appearance of identified plants- normal and abnormal. Pattern of damage- uniform and non-uniform. Damage pattern in plant community, plant and plant parts.

Symptoms- identification, testing, correction and indicator plants. Nutrient standards- sampling techniques, index tissue. Physiological disorders- symptom-identification using mechanical, biochemical and visual techniques. Storage disorders-identification, management.

Training schedule

1. Define the field problems
2. Identifying the cause of the field problems.
3. Hydroponics under controlled conditions (glass house)- preparation and development of symptoms due to nutrient, light and temperature stress.
4. Nutrient diagnostic techniques- deficiency and toxicity symptoms.
5. Physiological disorders in major crops, field identification.
6. Symptoms due to acidity alkalinity and radiation
7. Rapid tissue testing for nutrient deficiencies.
8. Quantifying the stress damage using instruments- chlorophyll fluorescence mete, infrared thermometer- SPAD meter
9. Biochemical methods to assess stress damage
10. Storage disorders- pre-harvest and post harvest techniques for post harvest management.
11. Application techniques/ mitigation techniques to manage the stress.
12. On- farm diagnosis of plant damage patterns

Suggested Readings

Porter, J.R and D.W.Lawlor, 1991.Plant growth interaction with nutrition and environment. Cambridge University Press, UK

Werner Bergmann, 1992.Nutritional disorders of plants-Development, visual and analytical diagnosis. Gustare Fischer VerlayJena, New York.

Madhu Arora, 1998.Biological control of Environmental pollution. John Wiley and Sons.

VIII. COMMERCIAL AGRICULTURE

1. Elca. 4201. Commercial Floriculture (1+2)

Status and prospects of commercial cultivation of flowers. Varieties, planting systems, spacing, manuring, irrigiation, pruning, mulching, plant protection, harvesting, postharvest handling and marketing of major traditional and cut flowers - jasmine, crossandra, marigold, celosia, gomphrena, lotus, tuberose, gladiolous, heliconia etc. Protected cultivation of rose, gerbera, chrysanthemum etc. - general concepts and practices.

Commercial cultivation of orchids and anthurium. Status and prospects of Kerala. Classification and varieties, planting material production, methods of planting, media components and managements, shade regulation, irrigation, nutrition, plant protection, stage and method of harvest, postharvest handling and marketing. Economics of cultivation.

Pot plant and cut foliage production - species and varieties, propagation, media, shade and water requirement, nutrition, pruning, plant protection, harvesting, postharvest handling and marketing.

Practical

Hands on training on selection of varieties, cultural practices, propagation and post harvest handling techniques. Visit to commercial production units of orchids, anthurium and other cut flowers. Visit to flower markets and auction centres. Field grown commercial flowers - Hands on training in selection of varieties, propagation methods, cultural operations, harvesting and post harvest handling techniques. Visit to growers' field, societies and flower markets.

Lecture Schedule

1 Status and prospects of commercial cultivation of flowers
2 Varieties, propagation, planting, cultivation practices and post harvest handling of orchids, cost benefit analysis of production.
3 Varieties, propagation, planting, cultivation practices and post harvest handling of anthurium, cost benefit analysis of production.
4 Varieties, propagation, planting, cultivation practices and post harvest handling of rose, cost benefit analysis of production.
5 Varieties, propagation, planting, cultivation practices and post harvest handling of chrysanthemum and carnation, cost benefit analysis of production.
6 Varieties, propagation, planting, cultivation practices and post harvest handling of gerbera, cost benefit analysis of production.
7 Varieties, propagation, planting, cultivation practices and post harvest handling of tuberose and gladiolus, cost benefit analysis of production.
8 Varieties, propagation, planting, cultivation practices and post harvest handling of heliconia and alpinia.
9 Varieties, propagation, planting, cultivation practices and post harvest handling

of *Alstroemeria*, *Lilium* and other cut flowers.

10 Varieties, propagation, planting, cultivation practices and post harvest handling of jasmine and crossandra, cost benefit analysis of production.

11 Varieties, propagation, planting, cultivation practices and post harvest handling of marigold and other annual flowers, cost benefit analysis of production.

12 Hi-tech cultivation of commercial flowers.

13 Production of pot plants.

14 Importance of cut foliage - commercial production.

15 Post harvest handling and value addition of cut flowers and foliage.

16 Production of dry flowers and plants.

17 Management of pests and diseases in cut flowers and foliage.

18 Marketing of cut flowers and loose flowers - preparation of bankable projects for production of cut flowers and foliage.

Practical Schedule

1 Selection of varieties, cultural practices and propagation of orchids.

2 Selection of varieties, cultural practices and propagation of anthurium.

3 Post harvest handling techniques in orchids and anthurium.

4 Selection of varieties, cultural practices and propagation and post harvest handling techniques in rose.

5 Selection of varieties, cultural practices and propagation and post harvest handling techniques in chrysanthemum and carnation.

6 . Selection of varieties, cultural practices and propagation and post harvest handling techniques in tuberose.

7 . Selection of varieties, cultural practices and propagation and post harvest handling techniques in gladiolus.

8 . Selection of varieties, cultural practices and propagation and post harvest handling techniques in heliconia and alpinia.

9 . Selection of varieties, cultural practices and propagation and post harvest handling techniques in gerbera.

10 . Selection of varieties, cultural practices and propagation and post harvest handling techniques in jasmine.

11 . Selection of varieties, cultural practices and propagation and post harvest handling techniques in crossandra.

12 . Selection of varieties, cultural practices and propagation and post harvest handling techniques in marigold.

13 . Seed production in annual flower crops

14 . Seed production in annual flower crops

15 . Selection of varieties, cultural practices and propagation of important cut foliage.

16 . Harvesting and post harvest handling techniques in important cut foliage.

17-18 . Integrated pest and disease management practices in cut flowers and foliage.

19-20 . Value addition in cut flowers and loose flowers, hands on training in preparation of garlands, bouquet, flower arrangements etc.

21-22 . Production techniques of dry flowers

23-24 . Production of pot plants

25-26 . Hi-tech cultivation of commercial flowers.

27-29 . Visit to commercial production units of orchids, anthurium and other cut flowers.

30-31 . Visit to production units of field grown commercial flowers
32-35 . Visit to flower markets and auction centres
36 . Preparation of projects for starting a commercial unit of cut flowers and foliage

Reference

Bose, T.K. and Yadav, L.P. 1989 Ed. *Commercial Flowers*. Naya Prakash, Calcutta, India

Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. 1999 ed. *Floriculture and Landscaping* Naya Prakash, 206, Bidhan Sarani, Calcutta.

Hardenbug, R.E. Watadar. A.E and Wong C.Y. 1986. The *Commercial storage of Fruits. Vegetables, Florist and Nursery stock.* U.S. Department of Agriculture. New York.

Chadha, K.L., 2001 (ed). *Handbook of Horticulture*. ICAR, New Delhi.

Choudhary, M.L. and Prasad, K.V. 2003. *The value addition in Horticulture*. Division of Floriculture and Landscaping, Indian Agricultural Research Institute, New Delhi. p. 100-104.

Larson, R.A. 1980. *Introduction to Floriculture* Academic Press, London

Laurie, A., Kiplinger, D.C. and Nelson, K.S. 1979. *Commercial Flower Forcing*. Mc-Graw Hill Book Company, New York.

Pal B.P. 1972. *The Rose in India*. Indian Council of Agricultural Research, New Delhi.

Prakahs, J. and Bhandary, K.R. *Floriculture Technology, Trades and Trends* 1994. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Rajeevan, P.K. Singh, K.P. and Valsalakumari P.K. 2003 *ed. Bulbous Flowers.* Indian Society of Ornamental Horticulture Division of Floriculture & Landscaping, IARI, New Delhi.

Rajeevan, P.K., Sobhana, A., Bhaskar, J., Swapna, S and Bhattacharjee, S.K 2002. *Orchids*. Technical Bulletin. AICRP on Floriculture ,ICAR, New Delhi.

Rajeevan, P.K., Valsalakumari, P.K., Geetha, C.K., Leena Ravidas., Vinod Kumar and Bhattacharjee, S.K. 2002. Anthurium. Technical Bulletin. AICRP on Floriculture, ICAR, New Delhi

Randhawa, G.S. and Mukhopadhyay, A. 1986. *Floriculture in India*. Allied publishers, New Delhi

Sessler, G.J. 1978. *Orchids and how to grow them.* Prentice Hall, New Jersey

Steffek, E.F. 1972. Ed. *The world of the gladiolus*. The North American Gladiolus Council, Inc., Maryland

Yadav, I.S. and Choudhary, M.L. *ed*. 1997. *Progressive Floriculture*. The House of Sarpan (Media), Bangalore.

2. Elca. 4202. Commercial fruit production (1+2)

Importance and scope of commercial fruit production – Global scenario of fruit production and export - Present status of fruit production in the state and in the country - problems and prospects. Commercial varieties of regional, national and international importance. Ecophysiological requirements. Propagation and production of elite planting materials. Root stock – scion relationship. Planting systems and cropping systems. Crop management practices – selection and preparation of planting materials, field preparation and planting, manuring, irrigation, weed management, use of bio-regulators, organic farming practices, intercropping, pest and disease control, root zone and canopy management, other cultural operations. Physiological and nutritional disorders-causes and

remedies. Cultural practices for quality improvement. Maturity indices, harvesting, grading, packing, storage and ripening techniques. By - product development. Industrial and export potential. Crops–Banana, mango, pineapple and papaya. Introduction to crops gaining importance in the state recently (apple, strawberry, mangosteen, rambutan, passion fruit).

Practical

Familiarization with important varieties. Practice in propagation, selection of good planting materials, field preparation and planting , manuring and use of growth regulators. Familiarization with weedicides, and plant protection chemicals. Studies on major pests, diseases and nutritional disorders. studies on maturity indices and storage. Visit to research stations, farmers' field and marketing outlets and processing units.

Lecture Schedule

1 . Present status of fruit - production in the world - the country. Problems and prospects of fruit production with special reference to the state.
2 . Banana - commercial varieties of the state, nation and world - export potential.
3 . Selection of suckers, TC plants and preparation, field preparation and planting. Different planting systems - Ecophysiological requirements.
4 . Cultural operations - fertigation, physiological and nutritional disorders - causes, remedies, intercropping. Pest and disease management.
5 . Organic farming and other cultural practices for quality improvement - ratooning.
6 . Maturity indices, harvesting, grading, peeling and storage. Ripening techniques - Byproduct development.
7 . Mango - commercial varieties - export potential.
8 . Ecophysiological requirements - propagation techniques - stock and scion relationships - cropping systems and planting.
9 . Crop management practices - manuring, irrigation - weed management - canopy management - pest and disease control.
10 . Physiological and nutritional disorders - use of bioregulators in different aspects of crop production - cultural practices for quality improvement.
11 . Harvest indices - harvesting - grading - peeling and storage - different ripening techniques.
12 . Pineapple - varieties - propagation methods.
13 . Climatic and soil requirements - different planting systems - production technology and bioregulator application.
14 . Harvest indices - post harvest handling techniques - marketing.
15 . Papaya - important varieties - ecophysiological requirements
16 . Production technology - problems encountered, harvesting and post harvest handling.
17 . Introduction of crops gaining importance in the state recently - apple, strawberry, mangosteen, rambutan and passion fruit - important varieties with potential for introduction. Ecophysiological requirements - protected cultivation.

18 . Propagation and rootstocks - planting details - cultural operations - training and pruning, use of dormancy breakers.
19 . Harvest indices - post harvest handling and packing for distant markets and export.

Practical Schedule

1 . Different planting systems and layout
2 . Propagation methods - sexual propagation - viability test, dormancy breaking methods.
3 . Vegetative propagation
4 . Layering - different methods
5 . Budding - different methods.
6 . Grafting- different methods.
7 . Propagation structures - mist chamber, green house, hot beds etc.
8 . Growth regulators - preparation and application of important bioregulators
9 . Plant protection chemicals and weedicides - conventional and ecofriendly products.
10 . Banana - Familiarisation with commercial and choice varieties.
11 . Banana - Selection of suckers - sucker treatments
12 . Practice in layout and planting - conventional and high density methods.
13 . Manuring practices - fertigation
14 . Irrigation - conventional and recent practices including drip irrigation.
15 . Intercropping in banana plots - propping.
16 . Maturity indices, harvesting, grading and packing.
17 . Visit to commercial banana plots and research stations.
18 . Visit to markets
19 . Mango - familiarisation with important varieties
20 . Propagation - selection of seed and root stocks - grafting techniques - epicotyl, softwood approach methods.
21 . Layout and planting
22 . Post planting care and management - manuring, pruning and plant protection aspects.
23 . Use of bioregulators and other chemicals for regular cropping, increasing fruit set and retention.
24 . Harvesting, grading and packing for local and distant markets
25 . Visit to commercial mango growers' plots
26 . Visit to packing yards and local markets
27 . Pineapple - familiarisation with varieties
28 . Sucker selection and treatments - practicing in layout and planting
29 . Manuring and weedicide application
30 . Bioregulator application for induction of flowering.
31 . Visit to farmer fields.
32 . Visit to markets
33 . Papaya - Acquaintence with commercial varieties.
34 . Propagation - different aspects - crop management
35 . Papain extraction
36 . Visit to commercial orchards and papain processing units.

37 . Rambutan, mangosteen, passion fruit - familiarisation with these crops - propagation and management practices.
38 . Harvesting and post harvest case of the fruits.
39 . Visit to apple and strawberry orchards.

3. Elca. 4203. Nursery management of horticultural crops (1+3)

Importance of plant propagation. Sexual and asexual methods– advantages and disadvantages. Propagation through seeds – seed formation, maturation, dormancy, treatment of breaking dormancy, germination, viability. Vegetative propagation – cuttings, layering , budding and grafting – different methods. Other plant parts used for propagation – bulbs, tubers, runners, stolons etc., Polyembryonic and apomictis seedlings. Progeny orchards – establishment, maintenance and utilization. Factors affecting rooting – physiological, anatomical, external factors. Root stock production, use of rootstocks for imparting high yield, quality and for tackling specific problems like tree size control , resistance / tolerance to pests, disease, salinity. Rootstock-scion relations. Use of growth regulators in plant propagation. Plant growing structures for propagation – design, construction and maintenance. Care and handling of nursery plants. Rapid production of uniform and good quality planting materials. Plant protection in nurseries – control of pests and diseases.

Tissue culture technique – advantages and disadvantages – Study of activities in a tissue culture unit. Establishment of tissue culture unit. Establishment and maintenance of commercial plant propagation units.

Importance of elite planting materials in crop production with respect to plantation crops, spices and medicinal plants. Fundamental principles and practices to be followed in nursery management. Factors to be considered in the establishment of commercial nurseries in plantation crops, spices and medicinal plants – Green houses, store houses and nursery structures. Techniques of propagation of the above crops. Application of tissue culture in the propagation of these crops. Special treatments for improving germination and rooting. Advances in nursery techniques. Application of mist in the propagation of plantation crops, spices and medicinal plants. Importance of polythene in the nursery. Packing, storage and transport of nursery plants. Hardening of the nursery plants. Productions of disease free nursery stock and protection of nursery plants from pests and diseases. Export of nursery plants and seed materials of plantation crops, spices and medicinal plants.

Practical

Practice in propagation of plants through seeds. Familiarization with media , implements and containers for plant propagation. Studies on seed testing, certification and storage. Practice in rootstock production ,vegetative propagation methods – cutting, budding, grafting layering etc. separation of propagules. Use of growth regulators for plant propagation. Study of propagation through tissue culture. Studies on preparation of designs and estimates for establishment of plant propagation unit, plant growing structures and tissue culture unit. Identification of common pests and diseases in nursery plants and their control.

Visit to different types of nurseries, selection of site – factors to be commercial in establishment – Familiarization with components of nurseries– handling, display and sales of plants – cultural practices – Estimation of production costs for different kinds of planting materials.

Collection of elite seed materials, storage and nursery techniques of plantation crops, spices and medicinal plants. Practice of vegetative propagation methods in the above crops. Practice of potting / bagging, re-potting etc. Packing and transport of nursery materials. Practice in tissue culture laboratory. Registers to be maintained in a commercial plantation crops, spices and medicinal plant nursery. Visit to different nurseries (both government and private).

Lecture schedule

1. Importance of plant propagation-sexual and asexual methods-advantages and disadvantages
2. Propagation through seeds-seed formation, maturation, dormancy treatment of breaking dormancy, germination, viability
3. Vegetative propagation-cuttings, layering, budding and grafting-different methods
4. Other plant parts used for propagation-bulbs, tubers, runners, stolons etc-polyembryonic and apomictis seedlings
5. Progeny orchards-establishment, maintenance and utilization
6. Factors affecting rooting-physiological, anatomical, external factors
7. Root stock production, use of rootstocks for imparting high yield, quality and for tackling specific problems relations
8. Use of growth regulators in plant propagation
9. Plant growing structures for propagation-design, construction and maintenance
10. Care and handling of nursery plants-rapid production of uniform and good quality planting materials-plant protection in nurseries-control of pests and diseases
11. Tissue culture technique-advantages and disadvantages-study of activities in a tissue culture unit-Establishment of tissue culture unit-establishment and maintenance of commercial plant propagation units.
12. Importance of elite planting materials in crop production with respect to plantation crops, spices and medicinal plants-Fundamental principles and practices to be followed in nursery management.
13. Factors to be considered in the establishment of commercial nurseries in plantation crops, spices and medicinal plants-green houses, store houses and nursery structures
14. Techniques of propagation of plantation crops, spices and medicinal plants
15. Application of tissue culture in the propagation of these crops-special treatments for improving germination and rooting-advances in nursery techniques-application of mist in the propagation of plantation crops, spices and medicinal plants
16. Importance of polythene in the nursery –packing-storage-transport of nursery plants
17. Hardening of the nursery plants-production of disease free nursery stock and protection of nursery plants from pests and diseases
18. Export of nursery plants and seed materials of plantation crops, spices and medicinal plants

Practical Schedule

1. Practice in propagation of plants through seeds
2. Familiarization with media, implements and containers for plant propagation
3. Studies on seed testing, certification and storage

4-6.Practice in rootstock production, vegetative propagation methods-cutting, budding, grafting, layering etc. separation of propagules

7. Use of growth regulators for plant propagation

8-9.Study of propagation through tissue culture

10. Studies on preparation of design and estimates for establishment of plant propagation unit, plant growing structures and tissue culture unit

11-12.Identification of common pests and diseases in nursery plants and their control

13-14. Visit to different types of nurseries

15. Selection of site-factors to be commercial in establishment

16. Familiarization with components of nurseries

17. Handling-display and sales of plants

18. Cultural practices-estimation of production costs for different kinds of planting materials

19-25. Collection of elite seed materials-storage and nursery techniques of plantation crops, spices and medicinal plants-practice of vegetative propagation methods - practice of potting/bagging, repotting etc-packing and transport of nursery materials of coconut, arecanut, coffee, tea, cocoa, pepper, ginger, turmeric, cardamom, tree spices etc.

26. Practice in tissue culture laboratory-registers to be maintained in a commercial plantation crops, spices and medicinal plant nursery.

4. Elca. 4204. Cultivation of commercially important medicinal and aromatic plants (1+1)

Importance of medicinal plants, historical account, origin, distribution, present status and future prospects, active principles, crop improvement, cultivation practices, organic farming techniques, GAP, GMP, protected cultivation of high value crops, integrated pest and disease management, post harvest handling, extraction of active principles, bioprospection and uses of, Cinchona, Senna, Catharanthus, Dioscorea, Solanum, Datura, Atropa, Rauvolfia, Acorus, Digitalis, Ephedra, Aconitum, Opium Poppy, Cannabis, Neem, Kaempferia, Plumbago, Artemesia, Long pepper, Alpinia, Adhatoda, Asparagus, Indigofera, Holostemma, Isabgol, Liquorice, Aloe, Safed musli, Sapan wood and Withania. Emerging plant drugs - future and prospects of medicinal plants. Plants used in local health traditions. Role of aromatic plants in Indian economy - important aromatic plants in India. Origin, distribution, Botany & crop improvement, cultivation practices, GAP, GMP organic farming techniques, integrated pest and disease management, protected cultivation of high value crops, post harvest handling, extraction of essential oil and active principles, bioprospection and uses of, Lemon grass, Java citronella, Palmarosa, Vetiver, Japanese mint, Artemisia, Rose, Tuberose, Basil, Eucalyptus, Sandalwood, Geranium, Jasmine, Patchouli, *Abelmoscus moschatus* and under exploited and miscellaneous essential oil yielding plants.

Practical

Medicinal plants-Identification of species and varieties of medicinal plants – maintenance of herbal garden - propagation techniques - post harvest handling, techniques of extraction of active principles - study of field problems. Visit to national and regional institutes dealing with research and development of medicinal plants.

Aromatic plants-Identification of species and varieties of major aromatic plants – planting and maintenance of garden - propagation techniques - post harvest handling, techniques of extraction of active principles - study on field problems. Visit to national and regional institutes dealing with R&D of aromatic plants.

Lecture Schedule

1. History-importance –classification of medicinal plants-active principles in medicinal plants
2. Rauvolfia- Botany-cultivation-post harvest handling-active principles and uses
3. Cinchona- Botany-cultivation-post harvest handling-active principles and uses
4. Catharanthus- Botany-cultivation-post harvest handling-active principles and uses
5. Dioscorea, Costus, Solanum- Botany-cultivation-post harvest handling-active principles and uses
6. Datura, Digitalis- Botany-cultivation-post harvest handling-active principles and uses
7. Opium, Cannabis- Botany-cultivation-post harvest handling-active principles and uses
8. Pyrethrum, Neem, Nux-vomica- Botany-cultivation-post harvest handling-active principles and uses
9. Atropa, Aconitum, Acorus- Botany-cultivation-post harvest handling-active principles and uses
10. Senna, Chenopodium, Ephedra- Botany-cultivation-post harvest handling-active principles and uses

B. Aromatic/Essential Oil yielding plants

11. Important essential oil yielding plants of India-their role in Indian economy
12. Lemon grass, Palmarosa-Importance-origin-distribution-botany-morphology-propagation-cultivation-harvesting-extraction-value addition & utilization
13. Citronella, Vetiver- Importance-origin-distribution-botany-morphology-propagation-cultivation-harvesting-extraction-value addition & utilization
14. Mint, Eucalyptus- Importance-origin-distribution-botany-morphology-propagation-cultivation-harvesting-extraction-value addition & utilization
15. Jasmine- Importance-origin-distribution-botany-morphology-propagation-cultivation-harvesting-extraction-value addition & utilization
16. Sandal wood- Importance-origin-distribution-botany-morphology-propagation-cultivation-harvesting-extraction-value addition & utilization
17. Patchouli, Geranium- Importance-origin-distribution-botany-morphology-propagation-cultivation-harvesting-extraction-value addition & utilization
18. Problems and prospects of medicinal and aromatic plant cultivation

Practical Schedule

1. Classification with terms used in the study of medicinal plants

2-6. Identification of medicinal plants grouped based on therapeutic uses

7. Propagation in medicinal plants
8. Land preparation and field planting of medicinal plants
9. Harvest of officinal parts and seeds in medicinal plants

10. Familiarization of medicinal plants based on tradition grouping and classes
11. &12. Identification of aromatic plants
13. Propagation of aromatic plants
14.-15. Methods of distillation of essential oil
16-17. Visit to user industry and Research stations

Suggested Readings

Aiyar.N. and Kolammal.M 1962. Pharmacognosy of Ayurvedic Drugs of Kerala, Kerala University, Thiruvananthapuram.

Asima chatterjee and Pakrashi S.C. (Eds) 2003 The Treatise of Indian medicinal plants Vol 1 to 8 National Institute of Science,Communication and Information resources, New Delhi

Atal.C.K. and Kapur.B.M. 1982. Cultivation and Utilization of Medicinal Plants. RRL, CSIR, Jammu.Tawi.

Cains.J. F. 1986. Medicinal and Poisonous Plants of India. Scientific Publishers, Jaodhpur.

Chadha. K.L. and Gupta. R. 1995. Advance in Horticulture Vol. 11 Medicinal & Aromatic plants. Malhotra Pub. House, New Delhi.

CSIR. 1971. The Wealth of India. Vol. A-Z. CSIR, New Delhi.

Dastur.J.F. 1977. Medicinal Plants of India and Pakistan. Taraporevala Sons & Co. Pvt. LTd. Bombay.

Farooqui A.A and Sreeramu, B.S. 2001 Cultivation of Medicinal and Aromatic Crops, Universities Press (India) Limited, Hyderabad

Guenther. E. 1975. The Essential Oils. Robert K. Krieger Pub. Co., New York.

Handa SS and M.K. Kanul 1996. Supplement to Cultivation and Utilization of Medicinal Plants RRL (CSIR) Jammu- Tawi

Jain.S.K. 1979. Medicinal Plants. National Book Trust of India, New Delhi.

Kaushik.P. 1988. Indigenous Medicinal Plants Including Microbes and Fungi. Today and Tomorow's Printers and Pub. New Delhi.

Kirthikar.K.R. and Basu.B.D. 1993. Indian Medicinal Plants, Vol. 1-4. Lalit Mohan Basu, Allahabad.

Kurian, A and Sankar, M.A.2007. Medicinal Plants. New India Publishing Agency, New Delhi.

Morton.J.P. 1971. Major Medicinal Plants –Botanic Culture and Uses. Charles. C. Thomas Pub., Ilnois, USA.

Narong Chom Chalow and Hans V Henle (Eds) (1995) Medicinal and Aromatic Plants in Asia – Breeding and Improvement Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, Calcutta, New Hampshvice

S.S.Handa and M.K. Kaul (Eds) (1996) Cultivation and Utilization of Aromatic Plants , RRL , CSIR Jammu- Tawi

Sivarajan, V.V. and Balachandran, I. 1994. Ayurvedic Drugs and Their Plant Sources. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.

Warrier.P.K. Nambiar, V.P.K. and Ramankutty.C. 1993 - 1996. Indian Medicinal Plants – a Compendium. Vol. 1-5. Orient Longman Ltd., New Delhi.

Weiss. E.A. 1996. Essential Oil Crops. CAB International U.K.

5. Elca. 4205. Commercial spices production (1+2)

Importance, origin, distribution, botany, crop improvement, varieties, agro-ecological requirements, nursery techniques, establishment and maintenance of spice gardens-cultural practices - water and nutrient management, protected cultivation of seed and herbal spices- shade regulation - weed control, organic spices, integrated pest and disease management, GAP, protected cultivation of high value crops, harvesting and post

harvest handling, grading, packing and marketing, commercial products, value addition, quality control in spices, problems and prospects of cultivation, medicinal and other properties ,bioprospection, problems & prospects of cultivation of the following crops. Ginger, turmeric, chilli, seed spices, (coriander, cumin, fennel, fenugreek, mustard) and herbal spices.

Practical

Morphology and floral biology of various spices. Propagation techniques and maintaining nursery of pepper, vanilla and tree spices. Lay out and planting- maintenance of spice gardens- harvesting- on farm processing- grading- estimation of oil and oleoresin- identification of field patterns and their control. Visit to Regional and National Institutes. Visit to Plantation and factories.

Lecture schedule

1. Introduction-Spices, condiments and culinary herbs-Definition-classification-importance with special reference to Kerala.
2. Pepper-Origin-distribution-area-production-export botany and varieties
3. Pepper-Climate and soil-propagation and nursery management-site selection – layout and planting of standards and pepper
4. Pepper-Crop management including manuring irrigation-shade regulation-harvesting and processing
5. Ginger-Origin-distribution-area-production-botany-varieties-climate and soil6
6. Ginger-Site selection-land preparation-planting cultural and manurial practices-harvesting-seed-rhizomes-storage-processing-mango ginger
7. Turmeric-Origin-distribution-area-production-botany-varieties-climate and soil
8. Turmeric-Site selection- land preparation-planting-cultural and manorial practices-harvesting-seed rhizomes storage-curing
9. Cardamom-Origin-distribution-area-production-botany-varieties
10. Cardamom-Climate-soil-propagation-nursery techniques-planting
11. Cardamom-Manuring-weeding-trashing-mulching-irrigation shade regulation-harvesting-processing-large cardamom
12. Nutmeg-Origin-distribution-area-production-botany-propagation-climate and soil-planting and aftercare-harvesting and processing
13. Clove-Origin-distribution-area-production-botany-propagation-climate and soil-planting and aftercare-harvesting and processing
14. Cinnamon- Clove-Origin-distribution-area-production-botany-propagation-climate and soil-planting-training-bark peeling-processing
15. Allspice- Origin-distribution-area-production-botany-propagation-climate and soil-planting and aftercare-harvesting and processing
16. Vanilla- Clove-Origin-distribution-area-production-botany-propagation-climate and soil-planting of standards and vanilla-crop management-flower induction hand pollination-harvesting and processing
17. Seed and herbal spices-Botany-propagation-planting and aftercare-harvesting and processing of seed spice and herbal spices

18. Spices-Value addition-problems in cultivation of spices-analysis-prospects-organic spices and quality control in spices.

Practical Schedule

1. Pepper-Morphology- floral biology - identification of varieties
2. Pepper-Preparation of rooted cuttings, bush pepper-rapid multiplication
3. Pepper-Planting-trailing-manuring-processing
4. Pepper-Harvesting and post harvest handling, value added products
5. Ginger-Botany-floral biology-identification of varieties
6. Ginger-Seed treatment land preparation-manuring planting and mulching
7. Ginger-Harvesting –curing and processing
8. Turmeric- Botany-floral biology-identification of varieties
9. Turmeric- Seed treatment land preparation-manuring planting and mulching
10. Turmeric- Harvesting –curing and processing
11. Cardamom- Morphology- floral biology - identification of varieties
12. Nutmeg- Morphology- floral biology - identification of varieties-propagation
13. Clove- Morphology- floral biology – propagation
14. Cinnamon- Morphology- floral biology – propagation
15. Tree spices-Cultural and manorial practices in tree spices
16. Allspices- Morphology- floral biology – propagation
17. Tree spices-Coppicing. Harvesting and curing in cinnamon
18. Tree spices- Harvesting and curing in nutmeg and clove
19. Vanilla-Morphology-floral biology-hand –pollination-recording percentage of fruitset
20. Vanilla-Propogation-trailing and coiling- cultural practices
21. Extraction of spice oil and oleoresin
22. Familiarization with spice products and grades

23&&24.Visit to improved farms

25&26.Visit to processing and export units

27. Visit to local spice markets

Suggested Readings

Chadha K.L and P.Rethinam P. (Eds) (1994) Advances in Horticulture.Vol 9 &10 Plantation and Spice crops .Malhotra Publishing House , New Delhi, India.

Chadha.K.L, Ravindran P.N and Leela. S. 2000. Biotechnology in Horticultural and Plantation Crops. Malhotra Publishing House. New Delhi,836p

Edison.S., Johney.A.K. Nirmal Babu.K. and Ramadasan.A. 1991. Spice Varieties. Indian Institute of Spices Research (IISR), Calicut, India.

Nybe, E.V, 2001. Three Decades of Spices Research in KAU, Kerala Agricultural University, Thrissur, Kerala

Nybe, E.V, Mini Raj, N and Peter, K.V.2007. Horticulture Series Vol.5-Spices. New India Publishing Agency, New Delhi

Parry.J.W. 1969. Spices. Vol. I & II. Chemical Publishing Co. INC. New York

Peter.K.V.2001. Handbook of Herbs and Spices .Vol.I, Wood Head Publishing, Ltd, Cambridge, England CRC Press, Washington

Peter.K.V.2004. Handbook of Herbs and Spices .Vol.II, Wood Head Publishing, Ltd, Cambridge, England CRC Press, Washington

Peter.K.V.2006. Handbook of Herbs and Spices .Vol.IV, Wood Head Publishing, Ltd, Cambridge, England CRC Press, Washington

Pruthi.J.S. 1993. Major Spices of India, Crop Management – Post Harvest Technology, ICAR, New Delhi.
Pruthi.J.S. 2001. Minor Spices of India, Crop Management – Post Harvest Technology, ICAR, New Delhi.
Purseglove. J.W., Brown, E.G. Green, C.L. and Robbins, S.R.G. 1981. Spices.
Ravindran.P.N , Nirmalbabu,K and Sivaraman.K. 2007. Turmeric-The Genus Curcuma, CRC Press, U.K,484p.
Ravindran.P.N , Nirmalbabu,K, Shiva K.N and Johny. A.K. 2006. Advances in Spices Research. Agrobios (India), New Delhi,994p.
Ravindran.P.N and Madhusoodanan. K.J. 2002. Cardamom-The Genus *Elettaria.* Taylor and Francis. London,374p.
Ravindran.P.N and Nirmalbabu,K. 2005. Ginger-The Genus Zingiber.CRC Press U.K,552p.
Ravindran.P.N, Nirmalbabu,K and Shylaja. M. 2004. Cinnamon and Cassia. CRC Press,U.K,366p.
Ravindran.P.N.2000. Black pepper (*piper nigrum*) Harwood Academic Publishers, London.,553p
Spice Statistics .2006. Spices Board, Kochi
Tropical Agricultural Series, 1983. Spices. International Book Distribution Dehradun.

6. Elca. 4206. Production technology of economic forest plants (1+1)

Nursery establishment - site selection – planning, and layout of nursery area. Types of nursery, Pre-sowing treatments. Methods of seed sowing . Pruning, root culturing techniques, lifting windows, grading, packaging.Storing and transportation.. Containerized nursery technique - Planting techniques for containerized stock and bare-root seedlings., Conditions/practices affecting early survival and early growth. Methods for field handling, Nursery practices for some important tree species. Target seedling concept. Artificial regeneration - Choice of species - factors that govern - hardwoods, softwoods, fast growing exotic and indigenous species. Field planting Taungya. Thinning -kinds of thinning - improvement felling- salvage cuttings- pruning. - seed collection Industrial plantations- paper and pulp wood- match wood plantation- plywood plantation- NTFP plantation- tannin, resin and turpentine plantations. Climate - physiographic factors, nursery, establishment ,tending of important economic forest and tree medicinal species– Hanonia riperia,Holoptelia intergrifolia,Apama siliqusa,Alstonia venenata,Ruta gravelons,Saraca asoka,Salix tetraseprma,Nyzopyrum sinilacifolium,Plumbago rosea,Alpinia calcarata,Terminalia chebula,Strchnos nux vomica,Acacia catechu,Samadera indica,Aegle marmelos,Gmelina arborea, Rubia cordifolia ,Dracnia ternifolia,Pentapetes phoenicea,Emblicaofficinalis,Syzygium cumini, Oroxylon indicum,Pterocarpus marsupium ,Tectona grandis, Dalbergia latifolia, Swietenia mahagony, Azadirachta indica, bamboos,reed, rattans, Santalum album, Caesalpinnia saman

Practical

Seed collection methods – anatomy of seed & embryo - seed germination tests – pre-sowing treatments – nursery bed preparation & seed sowing Lay out of nurseries – practices in the raising and transporting of nursery materials. Poly house technology-climate controlled chamber-techniques mist chamber and green house technology Planting

methods and techniques, Exercise on plantation project development-plantation methods and techniques. Visits to some commercial tree nurseries.

Lecture schedule

1-2 Nursery establishment-site selection – planning, and layout of nursery area. Types of nursery

3&4 Pre-sowing treatments. Methods of seed sowing. Pruning, root culturing techniques, lifting windows, grading, packaging. Storing and transportation.

5. Containerized nursery technique – Planting techniques for containerized stock and bare-root seedlings.

6. Conditions/practices affecting early survival and early growth. Methods for field handling.

7. Nursery practices for some important tree spices. Target seedling concept. Artificial regeneration –

8. Choice of species-factors that govern-hardwoods, softwoods, fast growing exotic and indigenous species.

9. Field planting Taungya. Thinning-kinds of thinning-improvement felling-salvage cuttings-pruning-seed collection

10. Industrial plantations-paper and pulp wood-match wood plantation-plywood plantation-NTFP plantation-tannin, resin and turpentine plantations.

11-12 Climate-physiographic factors, nursery, establishment, tending of Important economic forest and tree ,medicinal species - *Hanonia riperia, Holoptelia intergrifolia, Apama siliqusa, Alsonia venenata, Ruta gravelons, saraca asoka, salix tetraseprma,*

13-14 Climate-physiographic factors, nursery, establishment, tending of Important economic forest and tree ,medicinal species *Nyzopyrum sinilacifolium, Plumbago rosea, Alpinia calcarata, Terminalia chebula, strchons nux vomica, Acacia catechur, Samadera indica,*

15-16 Climate-physiographic factors, nursery, establishment, tending of important economic forest and tree ,medicinal species *Aegle marmelos, Gmelina arborea, Rubia cordifolia, Dracnia ternifolia, Pentapetes phoenicea, Emblicaofficinalis, Syzygium cumini,*

17-18 Climate-physiographic factors, nursery, establishment, tending of important economic forest and tree ,medicinal species *Oroxylon indicum, Pterocarpus*

marsupium, Tectona grandis, Dalbergia latifolia, swietenia mahagony, Azadirachya indica, bamboos, red rattans, santalum album, Caesalpinnia saman.

Practical Schedule

1-2. Seed collection methods-anatomy of seed & embryo
3-4. seed germination tests-pre-sowing treatments
5-6 Nursery bed preparation & seed sowing
7-9 Lay out of nurseries practices in the raising and transporting of nursery materials
10-12 Poly house technology-climate controlled chamber-techniques mist chamber and green house technology
!3-14 Planting methods and techniques,
15-16 Exercise on plantation project development-plantation methods and techniques.
17-18 Visits to some commercial tree nurseries

Suggested Readings

Duryea, M.L. and Landis, T. D. (eds.) 1984. Forest Nursery Manual. Production of bareroot seedlings. Martinus Nijhoff/Dr. W. Junk Publishers, The Hague/Boston/Lancaster for Forest Research Laboratory, Oregon State University, Corvallis, 386 p.
Mehta, A.R and Bhatt, P.N. 1990. Hand book of plant tissue and all cultures. Academic book centre, Ahmedabad
Prakash, R. 1990. Propagation practices of important Indian trees. International Book Distributors, Dehra Dun.
Suzuki, K., Ishii, K., Sakurai, S. and Sasaki, S. 2006. Plantation Forestry in the Tropics. Springer Tokyo

7. Elca. 4207. Commercial seed production (1+2)

Seed quality – concepts, importance and characteristics – Seed dormancy –types, methods to break seed dormancy – Genetic and agronomic principles of seed production – Seed processing, post harvest processing, seed blending, seed storage – Problems of storage – Seed testing and certification, quality control, seed treatment, hybrid seed production-Evaluation of seed farm for profitability and sustainability-Formulation of project proposal for availing funds from various agencies-Preparation of project reports for monitoring and evaluation.

Practical

Seed testing – taking seed samples –germination test, moisture test and conventional purity tests of different crops – seed treatment – methods of breaking seed dormancy. Seed production in different crops – Rice, coconut, cocoa, tuber crops, vegetable crops, ornamental plants, spices, fruit plants, medicinal plants, fodder crops and green manure plants. Maintaining isolation distance –rouging practices –harvesting-cleaning and packing.

Lecture Schedule

1 The concept of a seed-definition-structure of a seed-seed development process
2 Physiology and mechanism of seed germination
3 Seed and seedling vigour-classification, measurement and evaluation
4 Seed quality – concept ,importance and characteristics
5 Factors affecting seed quality – ecological influences
6 Factors affecting seed quality – package of seed production technology
7 Factors affecting seed quality-harvest and post harvest handling
8 Seed dormancy – types
9 Methods to break seed dormancy-factors affecting seed germination
10 Genetic principles of seed production
11 Agronomic principles of seed production
12 Seed processing , post harvest processing , seed blending
13 Seed storage- problems of storage
14 Seed testing and certification , quality control
15 Seed treatment - methods
16 Seed production of major crops – field crops
17 Seed production of major crops – plantation crops , fruit plants ,spices ,ornamental plants , medicinal plants
18 Hybrid seed production

Practical schedule

1 Seed sampling
2 Visit to ware house of State Warehousing Corporation and familiarisation with seed sampling procedures
3 Seed testing –different tests followed in a Seed Testing Laboratory-
4-6 Germination test- different tests followed in different crops
7-8 Seed Moisture test of different crops
9 Visit to Seed Testing Laboratory ,familiarisation with equipments and hands on experience in seed testing
10 Seed treatment against systemic diseases
11 Seed treatment – scarification
12 Seed coating and pelleting
13 Seed treatment with beneficial organisms,
14 Seed treatment for convenience in sowing
15 Seed treatment for breaking seed dormancy
16 Visit to NBPGR for studying seed storage methods
17-18 Seed production in rice
19-20 Seed production in coconut
21-22 Seed production in tuber crops
23-26 Seed production in vegetable crops
27 Seed production in cocoa
28-29 Seed production in ornamental plants
30 Seed production in spices
31 Seed production in fruit plants
32 Seed production in medicinal plants
33 Seed production in fodder crops

34 Seed production in green manure crops
35-36 Hybrid seed production in rice

Suggested Readings

Agrawal, P.K. and Dadlani, M. 1992. *Techniques in Seed Science & Technology*, South Asian Pub., New Delhi.
Agrawal, R.L. 1995. *Seed Technology* (2nd ed.), Oxford & IBH Pub., New Delhi.
Dahiya, B.S. and Rai, K.N. 1997. *Seed Technology*. Kalyani Pub., New Delhi.
Desai, B.B., Kotecha, P.M. and Salunke, D.K. 1997. *Seeds Handbook-Biology, Production, Processing and Storage*, Marcel Dekker Inc, New York
Ram, H.H., and Yadava, R. 2007. *Genetic Resources and Seed Enterprises. Management and Policies- Part-1*, New India Publishing Agency, New Delhi
Ram, H.H., and Yadava, R. 2007. *Genetic Resources and Seed Enterprises. Management and Policies- Part-I1*, New India Publishing Agency, New Delhi
Sen, S. and Ghosh, N. 1999. *Seed Science & Technology*, Kalyani Pub., New Delhi.

8. Elca. 4208. Fermentation technology (1+2)

Concept and scope of microbial fermentation – microbial inocuclum in fermentation process – fermentation products – food, beverages, industrial pharmaceutical – types of fermentation – solid, semisolid, liquid, batch, continuous aerobic, anaerobic – Different types of fermentors – working and control systems – designing of fermentation media and different substrates for various fermentation processes – immobilization in fermentation – different types of immobilization and their importance – optimization of fermentation process for various products – strain improvement of microbial inoculants for fermentation.

Practical

Screening of microorganisms for various fermentation process/products – purification, identification and growth characteristics – preparation of inoculum and fermentation media – fermentation of alcohol, vine, beer, rum and other indigenous substrate beverage products – fermentation for industrial products – enzymes – cellulase, amylase, protease etc. – fermentation for pharmaceuticals – antibiotics, dyes and polysaccharides – preparation of fermented food and diary products – quality evaluation of fermented products – visit to fermentation industry.

Theory Schedule

1. Concept and scope of microbial fermentation
2. Microbial inocuclum in fermentation process.

3-5. Fermentation products – food, beverages, industrial pharmaceutical
6-8. Types of fermentation – solid, semisolid, liquid, batch, continuous aerobic, anaerobic.
9-10. Different types of fermentors – working and control systems
11-13. Designing of fermentation media and different substrates for various fermentation processes

14-15 Immobilization in fermentation – different types of immobilization and their importance

16-18.Optimization of fermentation process for various products – strain improvement of microbial inoculants for fermentation

Practical schedule

1-4. Screening of microorganisms for various fermentation process/products
5-9. Purification, identification and growth characteristics–
10-14. Preparation of inoculum and fermentation media
15-20. Fermentation of alcohol, vine, beer, rum and other indigenous substrate beverage products
21-24. Fermentation for industrial products – enzymes – cellulase, amylase, protease etc.
25-30. Fermentation for pharmaceuticals – antibiotics, dyes and polysaccharides
31-34. Preparation of fermented food and diary products – quality evaluation of fermented products.
34-36. Visit to fermentation industry

Suggested Readings

Prescott and Dunn. 1982. Industrial Microbiology. AVI Publishing Co., west port, Connecticut, U.S.A.
Mukerji, K.G., V.P.Singh and K.L.Garg, 1987. Frontiers in Applied Microbiology Print House (India)
Peppler, H.J., and D.Perlman. 1979. Microbial Technology Academic press, New York.

9. Elca. 4209. Agro ecotourism (1+3)

The agrarian state of Kerala famous for its natural beauty, eco-diversity and cultural heritage has great potential for Agro ecotourism as a business venture. The capability and job opportunities of graduates of KAU can be enhanced by a professional training on Agro ecotourism. The training programme proposed will impart the technical know how on both theoretical and practical aspects of eco farm establishment, management and marketing.

Theory

Tourism- classification-Agro ecotourism-Concept, principles and scope-Resources of India and Kerala-Tourism Policy and Planning-Essential conditions for establishment of an ecofarm adoption of rainwater harvesting-wastewater treatment-biowaste utilization- use of organics for effective and sustainable farming-maintaining the bio-diversity-use of local building material for building farm resorts-Tourism Marketing-Effective Communication-Guiding Skill and

Personality Development-Home stay-Resort Management-Accounting & Finance Management-Emerging Trends in agro eco tourism-Potential for integration with other forms of tourism.

Practical

Resource utilization , management and sustainability of agro ecotourism. Planning and implementation of agro ecotourism programmes.Economic and social audit of agro ecotourism.

Lecture schedule

1. Tourism- classification-Agro ecotourism-Concepts and principles-scope
2. Resources of India and Kerala- eco-diversity and cultural heritage

3-4. Tourism Policy and Planning

5-6. Essential conditions for establishment of an eco farm -adoption of rainwater harvesting

6-7. Wastewater treatment-biowaste utilization-Use of organics for effective and sustainable farming

8-9 Maintaining the bio-diversity-prospects

10-11 Use of local building material for building farm resorts

12-13 Tourism Marketing-Effective Communication-Guiding Skill and Personality Development

14 Home stay and agro ecotourism

15 Resort Management-Accounting & Finance Management

16-18. Emerging Trends in agro eco tourism-Potential for integration with other forms of tourism.

Practical Schedule

1-10 Field study tours-Visit to major ecofarms and related tourism units in the state. Gather first hand information on resource utilization, management and sustainability.

11-30 Planning at a land scape level , study of land scape ecology, Land scaping for varied situation. Mapping, aerial photography ,geographical information system analysis etc

31-33 Effective Communication-Guiding Skill and Personality Development

34-37 On-farm management through organic and habitat enhancement practices

38-42 Preparation of plan for conversion of an existing farm to an ecotourism unit.

43-45 Study of home stay and agro ecotourism practices

46-48 Development of Agro ecotourism in urban areas resource utilization, management and sustainability.

49-51 Development of Agro ecotourism in rural areas resource utilization, management and sustainability.

52-53 Development of Agro ecotourism in unexploited areas resource utilization, management and sustainability.

54 Integration of different forms of tourism.

Suggested Readings

1. Jarvis, D.I, C Padock and D Cooper (eds.) in press. Managing Biodiversity in Agricultural Ecosystems. Columbia University Press, New York, USA.
2. McNeely and Scheer, 2001. Common Ground Common Future: How Ecoagriculture can help feed the world and save Wild Biodiversity. IUCN/Future Harvest.
3. Tvohino, A and Hynonen, A 2001. Ecotourism- Imagery and reality. Reflection on concepts and practices in Finnish rural tourism. Nordia Geographical Publications 30(4): 21-34
4. Wight PA 1993. Ecotourism. Ethics or Eco-sepp. Journal of Travel Research 31(3): 3-9
5. Barkin.D. 2002. Ecotourism for sustainable regional development. Current issues on Toursim 5 (3-4): 245-253.