

CURRICULUM
OF
PLANT PATHOLOGY

(Revised 2005)



HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

Prof. Dr. Altaf Ali G. Shaikh	Adviser (Acad/R&D)
Malik Ghulam Abbas	Deputy Director
Miss Ghayyur Fatima	Deputy Director (Curri)
Mr. M. Tahir Ali Shah	Assistant Director
Mrs. Noshaba Awais	Assistant Director

Composed by Mr. Zulfiqar Ali, HEC Islamabad

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum one can judge the state of intellectual development and the state of progress of the nation. The world has turned into a global village; new ideas and information are pouring in like a stream. It is, therefore, imperative to update our curricula regularly by introducing the recent developments in the relevant fields of knowledge.

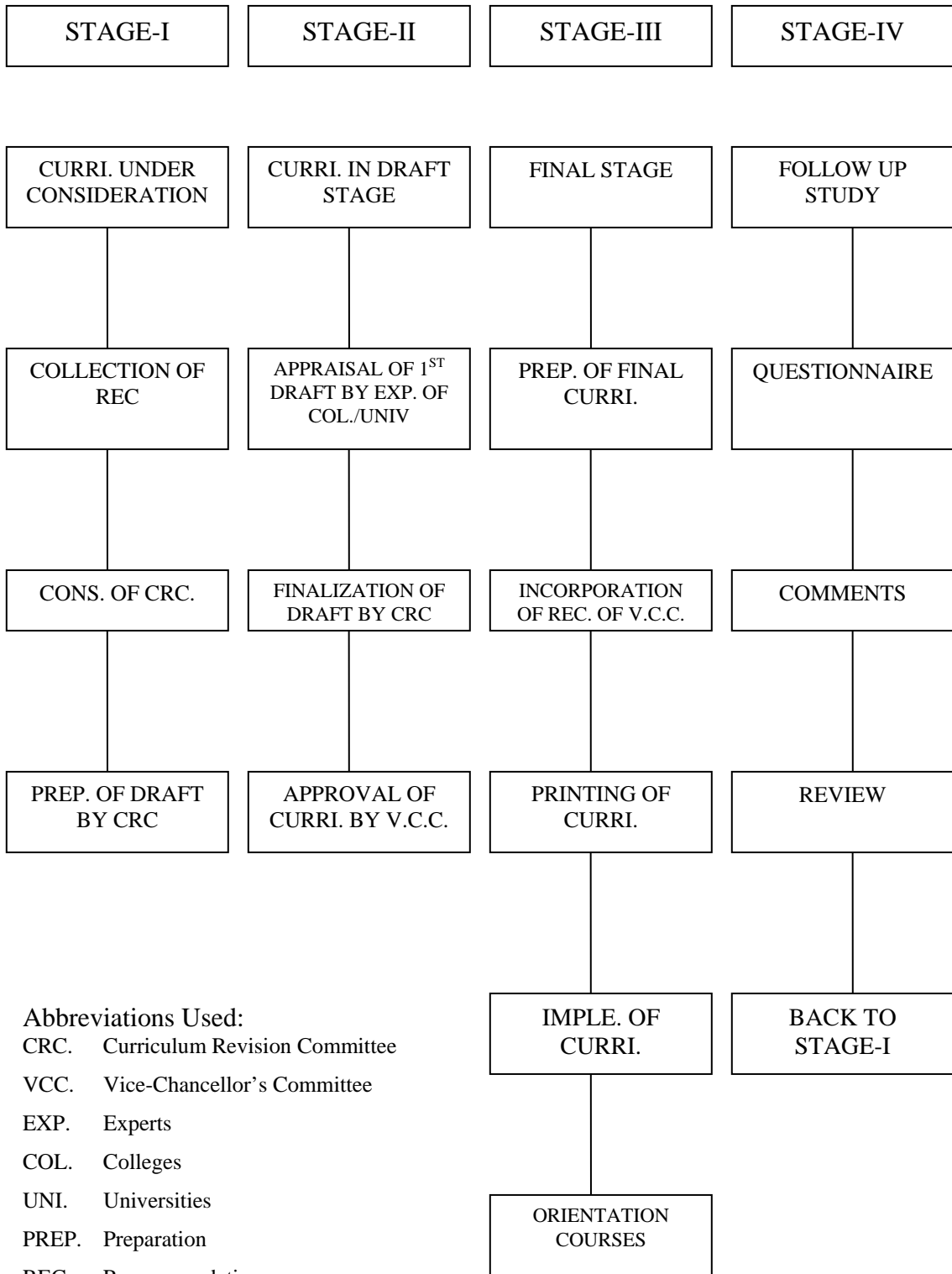
In exercise of the powers conferred by sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide notification no. D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the competent authority to look after the curriculum revision work beyond class XII at bachelor level and onwards to all degrees, certificates and diplomas awarded by degree colleges, universities and other institutions of higher education.

In pursuance of the above decisions and directives, the Higher Education Commission (HEC) is continually performing curriculum revision in collaboration with universities. According to the decision of the special meeting of Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various committees are constituted at the national level comprising senior teachers nominated by universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these committees. The National Curriculum Revision Committee for Plant Pathology in its meeting held in June 27-29, 2005 at the HEC Regional Centre, Peshawar revised the curriculum after due consideration of the comments and suggestions received from universities and colleges where the subject under consideration is taught. The final draft prepared by the National Curriculum Revision Committee duly approved by the Competent Authority is being circulated for implementation by architectural institutions.

(PROF. DR. ALTAF ALI G. SHAIKH)
Adviser (Acad/R&D)

August 2005

CURRICULUM DEVELOPMENT



Abbreviations Used:

- CRC. Curriculum Revision Committee
- VCC. Vice-Chancellor's Committee
- EXP. Experts
- COL. Colleges
- UNI. Universities
- PREP. Preparation
- REC. Recommendations

INTRODUCTION

Final meeting of the National Curriculum Revision Committee to finalize the draft curriculum of Plant Pathology was held on June 27-29, 2005 at HEC, Regional Centre, Peshawar, The following experts attended the meeting:-

1. **Prof. Dr. Sultan Mehmood Khan,** Convener
Chairman,
Department of Plant Pathology,
University of Agriculture,
Faisalabad.
2. **Prof. Mumtaz Ali Pathan,** Member
Dean/Principal,
Z. A. Bhutta Agriculture College,
Dhokri, Larkana.
3. **Prof. Dr. Shabir Ahmad** Member
Chairman,
Department of Plant Pathology,
NWFP Agricultural University,
Peshawar.
4. **Dr. Ghazala Nasim** Member
Assistant Professor,
Department of Mycology & Plant Pathology,
University of the Punjab,
Lahore.
5. **Prof. Dr. Muhammad Irfan-ul-Haque,** Member
Chairman,
Department of Plant Pathology,
University of Arid Agriculture,
Faisalabad.
6. **Dr. Rahim Din Khan,** Member
Associate Professor,
Department of Plant Breeding & Genetics,
Faculty of Agriculture,
Gomal University, D.I. Khan
7. **Dr. Mehmood Khan,** Member
Plant Pathologist,
Agriculature Research Institute,
Tarnab, Peshawar

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| 8. | DR. Alla Dad Khan,
Plant Protection Officer/Prov. IPM Coordinator
Directorate of Agriculture Extension,
University Road, Peshawar. | Member |
| 9 | Dr. Rashida Parveen
Assistant Professor
University College of Agriculture
B.Z. University, Multan | Member |
| 12. | Prof. Dr. Sayed Riaz Ali Gardezi
Chairman,
Department of Plant Pathology
University College of Agriculture,
Rawalakot, AJK | Member |
| 13. | Dr. Fauzia Yusuf,
Deputy Chief Scientist/Head,
Bio-fertilizer Division,
National Institute of Biotechnology & Genetic Engineering,
(NIBGE), Faisalabad | Member |
| 14. | Mr. Sahib Noor Khan,
Assistant Entomologist/ IPM & ICM Coordinator,
Agriculture Research Station, Srai Naurang,
District Bannu. | Member |
| 15. | Dr. Sher Hassan
HEC National Eminent Professor,
NWFP Agriculture University,
Peshawar | Member |
| 16. | Dr. Abdul Rauf Bhutta
Deputy Director,
Federal Seed Certification & Registration Department,
Mauve Area, G-9, Islamabad | Member/Secretary |

Meeting started with recitation from the Holy Quran

Mr. Muhammad Tahir Ali Shah, Assistant Director (Curriculum) HEC, Islamabad, welcomed the participants and briefed them of the obligations of the Commission for review, revision and development of curricula. He appraised the Committee about the academic activities of HEC for improvement of education in the shape of teachers training program, indigenous & foreign scholarships programs, short courses by subject experts, writing of monographs on topics of syllabi, etc. He said that HEC is trying to create environment of higher learning and research through revision of

present curriculum. He desired that curriculum should be developed keeping in view the new challenges at national and international level. We have to develop a standard course irrespective of present infrastructure. It will be our duty to improve the facility to meet the implementation requirement of the new curriculum.

Minutes of Dean Committee meeting was circulated as guideline for the development of unified curriculum.

Prof. Dr. Sulatan Mehmood and Dr. Abdul Rauf Bhutta continued as convener and secretary of the National Curriculum Revision Committee, HEC.

The committee finalized curriculum for B.Sc. (Hons.) Agriculture, M.Sc. (Hons.) Agriculture and Ph.D in Plant Pathology courses comprising core and supporting courses as compulsory for all students majoring in Plant Pathology. More emphasis has been given to the major courses in Plant Pathology and Research at post-graduate level. The committee considered number of new courses at under graduate level and Post graduate level.

1. **Under graduate level:**
 - a) Introduction to Molecular Plant Pathology
 - b) Dynamics of Plant Pathology
 - c) Seed and Post Harvest Pathology
 - d) Introduction to Forest Pathology
 - e) Pesticide, Their Action and Application

2. **Post graduate level:**
 - a) Plant Quarantine and SPS measure
 - b) Environmental Plant Pathology
 - c) Urban Plant Pathology
 - d) A Biotic Diseases of Plant

A number of courses were improved and addition/deletion were made in existing courses. Many new and latest books were also added in the draft curriculum. It was tried to make the curriculum Hi-technological innovated and practical oriented..

Scheme of Study for 4-Year B.Sc (Hons) Agriculture

Mathematics / Biology	6 Credits
Statistics 1 & 2	6
Computers / IT	3
Pak Studies	2
Islamiat	2
Communications Skills	3
English	3
Basic Agriculture	3
Sub-Total	28

One subject from each of the following disciplines

Agronomy	3
Plant Breeding & Genetics	3
Entomology	3
Plant Pathology	3
Food Technology	3
Horticulture	3
Soil Sciences	3
Agriculture Economics	3
Sub-Total	24

Additional Courses from disciplines mentioned below and above

Agriculture Extension	
Forestry & Range Management	
Animal Science	
Marketing & Agri Business	
Rural Development	
Human Nutrition	
Agriculture Chemistry	
Agriculture Engineering	
Water Management	
Sub-Total	21-25

Sub-Total during the first four semesters **73 – 77**

Semester 5, 6, 7 19 Credit Hours each **57**
Final Semester **15**

Grand Total **145 – 149**

**SCHEME OF STUDIES
FOR UNDER-GRADUATE COURSES IN
PLANT PATHOLOGY**

LIST OF COURSES

SR.NO.	_TITLE OF COURSES	CREDIT HOURS
1.	Introduction to Plant Pathogens	3(2-1)
2.	Introductory Plant Pathology	3(2-1)
3.	Introduction to Plant Viruses	3(2-1)
4.	Introduction to Plant Prokaryotes	3(2-1)
5.	Introductory Mycology	3(2-1)
6.	Introductory Plant Nematology	3(2-1)
7.	Diseases of Field Crops	3(2-1)
8.	Diseases of Fruits and ornamentals.	3(2-1)
9.	Diseases of Vegetables Crops.	3(2-1)
10.	Seed and post harvest pathology	3(2-1)
11.	Principles and Methods of Plant Disease Management.	3(2-1)
12.	Plant Resistance to Diseases	3(2-1)
13.	Beneficial Microorganisms.	3(2-1)
14.	Pesticides, their action and application	3(2-1)
15.	Introduction to Forest Pathology	3(2-1)
16.	Dynamics of plant disease	3(2-1)
17.	Methods and Research Techniques in Plant Pathology.	3(2-1)
18.	Clinical Plant Pathology.	3(2-1)
19.	Introduction to Molecular Plant Pathology	3(2-1)
20.	Internship / Project Study	15(0-15)
Total Credit Hours:		72

Detail of Courses for Under Graduate Studies in Plant Pathology

1. INTRODUCTION TO PLANT PATHOGENS

Theory

Credit Hours. 3(2-1)

Introduction, Economic importance, general characteristics, (morphology, and ecology). Identification of plant pathogens including fungi, bacteria & mollecutes, viruses & viroids, nematodes and higher parasitic plants.

Practicals

Orientation with laboratory equipments. Preparation of media and isolation of different plant pathogens. Study of various plant pathogens through slides, live specimens and their comparative account/study.

Books Recommended

Text

1. Agrios, G. N, 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.
2. Mehrotra, R. S. and Agarwal, A 2003. Plant Pathology,. 2nd Edition. TATA McGraw Hill. Pub. Company Ltd. New Delhi P-846.

Reference

1. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Food product Press and Haworth Press Inc. Binghamton, New York, USA.
2. Khan, J. A. and Dijkstra, J. 2002. Plant Virus as Molecular Pathogens. The Haworth Press Inc. USA.
3. Alexopoulos, C. J., C. W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley and Sons, Inc., New York, USA
4. Singh, R. S. 1989. Plant Pathogens: The Prokaryotes. Oxford and IBH Publ. Company, New Delhi, India.
5. Singh, R. S. 1982. Plant Pathogens: The Fungi. Oxford and IBH Publishing Company, New Delhi, India

2. INTRODUCTORY PLANT PATHOLOGY

Theory:

Credit Hours 3(2-1)

Introduction and history of plant pathology, definition of disease in plants; economic importance of plant diseases, nature and cause of (biotic and abiotic) diseases. Components of plant disease development. Principles of plant disease management. Symptoms, etiology, mode of infection, disease cycle and management of representative diseases of field and horticultural crops.

Practicals

Collection, preservation and identification of plant diseases based on symptoms. Demonstration of plant disease management tools.

Books Recommended

Text

1. Agrios, G. N. 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.
2. Ahmad, I and Bhutta A. R. 2005. A Text Book of Introductory Plant Pathology. Published by National Book Foundation, Islamabad, Pakistan.
3. Strange, R. N. 2003. Introduction to Plant Pathology. John Willey & Sons, New York.

Reference

1. Mehrotra, R. S. and Agarwal, A 2003. Plant Pathology,. 2nd Edition. TATA McGraw Hill. Pub. Company Ltd. New Dehli P-846.
2. Mathew, J. D. 2003. Molecular Plant Pathology. Bios Scientific Publishers Ltd. UK.
3. Hafiz, A. 1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad, Pakistan.

3. INTRODUCTION TO PLANT VIRUSES

Theory

Credit Hours 3(2-1)

Introduction and history. Virus characteristics: virus particle structure (RNA and DNA viruses), taxonomy; Symptomatology of virus infected plants: external and internal symptoms. Study and management of emerging and important viral diseases of Pakistan: symptoms, structure, transmission i.e. cotton leaf curl virus, banana bunchy top virus, potato leaf roll virus and tobacco mosaic virus.

Practicals

Study of virus infected plant disease symptoms, indicator plants, different methods of transmission (grafting, cell sap transmission and insect vectors). Virus-free plant propagation through tissue culture. Visit to tissue culture and Plant Virology Laboratories.

Books Recommended

Text

1. Misra, R.S. 2004. Virus and Plant Diseases. CBS, India.
2. Verma, H. N., 2003. Basics of Plant Virology. Oxford IBH Publishing Co. Pvt. Ltd. New Delhi.

3. Boss, L. 1999. Plant Viruses, unique and intriguing pathogens. Backhyus Publisher, Leiden, Netherlands. 358-P
4. Smith K.M, 1990. Plant viruses.6th ed. Universal bookstall. New Delhi.

Reference

1. Mathews, R. E. F. 2003. Mathew's Plant Virology (revised) Academic Press, New York, USA.
2. Khan, J. A. and Dijkstra, J. 2002. Plant Viruses as Molecular Pathogens. Haworth Press, USA.
3. Bashir, M. and Hassan S. 1998. Diagnostic Methods for Plant Viruses. Pakistan Agricultural Research Council, Islamabad, Pakistan.
4. Maramorosch, K. 1992. Plant diseases of viral, viriods, Mycoplasma and uncertain etiology. Oxford &IBH Publishing Co. PVT. LTD.
5. Frncki, R.I.B, Robert G. M, and Hatta T. 1990. Atlas of plant viruses. CBS Publishers & distributors, Delhi.

4. INTRODUCTION TO PLANT PROKARYOTES

Theory

Credit Hours 3(2-1)

Introduction, economic importance, general characteristics; morphology, reproduction and physiology, cultural characteristics, mode of infection and transmission of bacteria and mollicutes and their management. Study and management of soft rots, citrus canker, bacterial blight of rice, bacterial wilts of solanaceous crops, crown gall, ratoon stunting disease of sugarcane, citrus stubborn diseases.

Practicals

Collection of disease samples. Isolation, purification, identification and preservation of plant pathogenic prokaryotes, hypersensitive reactions and pathogenicity tests.

Books Recommended

Text

1. Jayarman, J and Verma J. P. 2002. Fundamentals of Plant Bacteriology, Kalyani Publishers Ludhiana, India.
2. Pathak, V. K. 2000. Fundamentals of Plant Pathology. TTPC, India.
3. Singh, R. S. 1989. Plant Pathogens: The Prokaryotes. Oxford and IBH Publishing Company, New Delhi, India.

Reference

1. Agrios, G.N. 2005. Plant Pathology. 5th edition. Academic Press, New York, USA.
2. Mishra, R.S. 2003. Bacterial Plant Diseases. Discovery Publication House, India.

- Schaad, M.W. 1988. Guide for Identification of Plant Pathogenic Bacteria, 2nd edition. American Phytopathological Society. Saint Paul, Minnesota, USA.

5. INTRODUCTORY MYCOLOGY

Theory

Credit Hours 3(2-1)

History and significance of fungi. Morphology, physiology and reproduction of fungi. Classification up to genus level with special reference to fungi of agricultural and industrial importance.

Practicals

Collection, isolation, identification & preservation of fungi. Use of diagnostic keys for important fungi.

Books Recommended

Text

- Johri, R. M., 2005. A Text Book of Fungi. Dominant Publishers and Distributors, India.
- Alexopoulos, C.J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley and Sons, Inc. New York, USA.

Reference

- Swanton, E. W. 2004. Hand Book of Fungi. Reprint Publication, India.
- Cangawane L.V., Ganju, V., Thomas, S, and Agarwal, S.K. 2000. Vistas in mycology and plant pathology. CMI, London.
- Barnett, H.L. 1998. Illustrated Genera of imperfect Fungi. ACS, Washington, DC, USA.
- Isaac, S. 1993. Aspects of Tropical Mycology. Cambridge Press, UK. London, UK.

6. INTRODUCTORY PLANT NEMATOTOLOGY

Theory

Credit Hours 3(2-1)

Introduction and economic importance of nematodes; taxonomy, morphology and biology of plant parasitic nematodes. Study and management of economically important diseases caused by different nematodes (Root knot nematodes, cyst nematodes, citrus nematode, stem & bulb nematode of onion and wheat seed gall nematodes).

Practicals

Sampling, extraction, and identification of nematodes from soil and infested plant materials; methods of maintenance and culturing of nematodes; use of nematicides, cultural and biological practices for the management of nematode diseases of plants.

Books Recommended

Text

1. Trivedi, P. C. 1998. Nematode Diseases in Plants CBS Publishers and Distributors. India.
2. Dropkin, V. H. 1989. Introduction to Plant Nematology. John Wiley and Sons, Inc., New York, USA

Reference

1. Gangler, R and Bilgrami, A. L. 2004. Nematode Behaviour. CAB-UK.
2. Alam, M. M. and Sharma, N. 2002. Nematode Control in Crops. International Book Distributors, India.
3. Perry, R. N. and Wright, D. J. 1998. The Physiology and Biochemistry of Free Living and Plant Parasitic Nematodes. Willingford, CAB. International, UK.
4. Maqbool, M. A., 1992. Distribution and host association of plant parasitic nematodes in Pakistan. NNRC Karachi.
5. Mai, M. F. and H. H. Lyon. 1975. Pictorial Key to Genera of Plant Parasitic Nematodes, 4th edition. Comstock Publishing Association, Cornell University Press, Ithaca, USA.

7. DISEASES OF FIELD CROPS

Theory:

Credit Hours. 3(2-1)

Detailed study of symptoms, etiology, nature and extent of losses, disease cycle, methods of perpetuation, epidemiology and management of major diseases of cereal, pulses, fodder, oil seed, fibre and sugar crops.

Practicals:

Field surveys; collection, preservation of diseased specimens, identification of diseases based on symptoms and microscopic studies, isolations of major pathogens of above mentioned crops.

Books Recommended:

Text

1. Gupta, G. P. 2004. Textbook of Plant Diseases. DPH, India.
2. Nyal. R. F. 1989. Field Crops Disease Handbook. AVI Publishing Company Inc. Westport, Connecticut, USA.

Reference

1. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Kaganviva, India.
 2. Zadoks, J.C. 2004. Modern Crop Protection. International Book Distribution Co, India.
 3. Rangaswami, G. and Mahadevan, A. 2004. Diseases of Crop Plants in India with Ed. Arentic Hall of India.
 4. Mew, T. W. and Gonzales, P., 2002. A Hand Book of Rice Seed Borne Diseases. IRRI, Science Publication, Philippine.
 5. Sharma R. S. 2000. Plant Disease. Campus Book International, Delhi, India.
 6. Hafiz, A.1986. Plant Diseases. Pakistan Agricultural Research Council, Islamabad.
- Compendia of wheat, barley, rice, maize, cotton, sorghum, pea, peanut diseases. American Phytopathological Society, St. Paul, Minnesota, USA.

8. DISEASES OF FRUITS AND ORNAMENTALS

Theory

Credit Hours 3(2-1)

Importance & symptoms, disease cycle, methods of perpetuation and control of major diseases of tropical (banana and papaya), subtropical (guava, mango and citrus) and temperate (pome, stone and nut fruits, grapes) fruits and common ornamentals like roses, tulips, composites.

Practicals

Field visits, collection and preservation of diseased specimens; Identification of diseases on the basis of symptoms. Isolation of pathogens and preparation of permanent mounts. Orientation with control measures.

Books Recommended

Text

1. Plootz, R.C. 2003. Diseases of Tropical Fruit Crops. CABI – UK.
2. Gupta, V. K. and S. K. Sharma 2000. Diseases of fruit crops. Kalyani Publishers New Delhi, India
3. Pathak, V. N. 1981. Diseases of Fruit Crops. Oxford and IBH Publishing Company, New Delhi, India.

Reference

1. Stefrud, A. 2005. Diseases of Fruits and Nuts. Biotech Book, Delhi.
2. Machardv, W.E. 1996. Apple Scab. Biology, Epidemiology and Management. APS, USA.
3. Leslie, A.R. 1994. Handbook of Integrated Pest Management for Fruit and Ornamentals. CRC Press, London.

4. Chase A. R. 1987. Compendium of foliage ornamental plant diseases. APS USA.
- Compendia of apple and pear, citrus, grapes, stone fruits and tropical fruits diseases. American Phytopathological Society, St. Paul, Minnesota, USA. Compendium of ornamental plants.

9. DISEASES OF VEGETABLE CROPS

Theory

Credit Hours 4(3-1)

Importance and symptoms of various vegetable diseases, disease cycle, methods of perpetuation and control of major diseases of okra, pea, solanaceous (chillies, potato, tomato, eggplant), crucifers (radish, turnip, cabbage, cauliflower) , cucurbits (gourd, cucumber, squash, melon), bulbs (onion, garlic), lettuce, spinach., carrot and non traditional vegetables.

Practicals

Identification of diseases on the basis of symptoms and isolation of pathogens. Field visits, collection and preservation of diseased specimens, preparation of permanent mounts.

Books Recommended

Text

1. Walker, J.C. 2004. Diseases of Vegetable Crops. TTPP, India.
2. Sherf, A. F., and A.A. Macnab. 1986. Vegetable Diseases and Their Control. John Wiley and Sons, Inc., New York, USA.

Reference

1. Gupta, V. K. and Paal, Y. S. 2001. Diseases of vegetables crops. Kalyani Publishers, New Dehli, India.
2. Dixon, D. R. 1981. Vegetable Crop Diseases. McMillan Press, London, UK.
- Compendia of cucurbits, onion and garlic, potato, tomato and pea diseases. American Phytopathological Society, St. Paul, Minnesota, USA.

10. SEED & POST HARVEST PATHOLOGY

Theory

Credit Hours 3(2-1)

Morphology and anatomy of healthy and infected seed. Seed-borne diseases and their effect on seed germination. Histopathology of infected seed, seed transmission of pathogen, mechanism of infection. Effect of biotic & abiotic stresses and storage/transit conditions on shelf life of seed and perishables. Loss estimation and Seed health testing. Mycotoxins, their hazards. Management of seed and postharvest diseases.

Practicals

Seed health testing, different techniques of isolation and identification of microorganisms associated with seeds and their effect on germination. Collection and identification of biotic and abiotic diseases of perishables. Use of safe chemicals for management of seed and postharvest diseases.

Books Recommended

Text

1. Bhutta, A.R., Hussain, A. and Rahman, M.R., 2004. Hand book on Seed Processing and Storage. Published by Federal Seed Certification and Registration Department, Islamabad, Pakistan.
2. Agarwal, V.K. and Sinclair, J.B. 1993. Principles of Seed Pathology. Vol. 1 & 11. CBS Publs. New Delhi.
3. Neergaard, P., 1979. Seed Pathology. Rev. ed. Mc Millan Press London.

Reference

1. Chakraverty, A, Mujumdar, A.S.Raghavan, G.S.V and Ramaswamy, H.S, 2003. Hand book of Post harvest Technology, Publ. By Marcel Dekker. INC, New York, USA.
2. Bhutta, A.R. and Ahmad, I, 2001. Seed Pathological Techniques and their Application. Published by National Book Foundation, Islamabad, Pakistan
3. Dasgupta, M.K. and Mandal, N.C., 1986. Postharvest Pathology of perishables. Oxford & IBH Publs. Co., New Delhi.
4. Dennis, C.1983. Postharvest Pathology of Fruits and Vegetables. Academic Press. New York, USA.

11. PRINCIPLES OF PLANT DISEASE MANAGEMENT

Theory

Credit Hours 3(2-1)

Principles of avoidance, exclusion, eradication, protection, and immunization. Management of plant diseases by regulatory (quarantine and inspection), cultural (host eradication, crop rotation and sanitation etc), biological (host resistance, cross protection, interference, hyperparasitism and tissue culture etc), physical (heat treatment, sterilization, refrigeration and radiation etc.) and chemical (soil and seed treatment, foliar spray and post harvest application) methods; integrated disease management.

Practicals

Equipment and machinery used for disease management and their calibration. Safety measures for disease managing chemicals; handling and application procedures; *In vitro* control of pathogens.

Books Recommended

Text

1. Agrios, G. N. 2005. Plant Pathology 5th ed. Academic Press New York.
2. Ahmad, I. and Bhutta A. R. 2005. Textbook of Introductory Plant Pathology. Published by National Book Foundation, Islamabad, Pakistan.
3. Helyer, N., Brown, K. and Cattlin, N. A., 2003. Biological Control in Plant Protection (A Colour Hand Book), Manson Publication Ltd, London, UK.
4. Alford, D. 2000. Pest and Disease Management Handbook. BCPC Publications, UK.
5. Fry, W. E. 1982. Principles of Plant Disease Management. Academic Press, New York, USA.

Reference

1. Kapoor, B. B. S. and Khatri. K. N., 2004. Management of Plant Diseases. Nadhu Publication, Bikaner, India.
2. Mehrotra, R.S. 2003. Plant Pathology. TATA McGraw Hill Pub. Company Ltd. New Delhi. India.
3. Lenteren, J. C. B., 2003. Quality Control and Production of Biological Control Agents. CAB International Wallingford Oxon, UK.
4. Upadhyay, R.K. 1999. Integrated pest and disease management. CAB Interner . Kew, UK.

12. PLANT RESISTANCE TO DISEASES

Theory

Credit Hours 3(2-1)

Importance of disease resistance in plants; resistance vs. susceptibility; Kinds & mechanisms of resistance; transgenic approaches for crop protection. Induced systemic resistance through biocontrol options. Screening of germplasm for resistance by using different rating scales/parameters.

Practicals

Preparation of inocula, inoculation techniques for various plant pathogens; demonstration of hypersensitive reaction, resistance and susceptibility: screening of germplasm in field and green house against major plant pathogens disease assessment parameters.

Books Recommended

Text

1. Agrios, G. N, 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.

2. Sadasivan, S and Thayumanavan, B. 2003. Molecular Host Plant Resistance to Pest. Marcel Dekker, USA.
3. Singh, D. P., 2002. Breeding for Resistance to Biotic Stress, International Books Distribution Co. India.
4. Staples, C. R., and G. H. Toenniessen. 1981. Plant Disease Control Resistances and Susceptibility. John Wiley and Sons, Inc. New York, USA.

Reference

1. Moore, D. and Frazer, L. A. N., 2002. Essential Fungal Genetics. Springer Verlag, New York, USA.
2. Boland, G. J., David, L., and Kuykendall 1998. Plant Microbe Interactions and Biological Control. Marcel Dekker, Inc, USA.
3. Stubbs, R.W., J. M. Prescott, E. E. Sarri and H. J. Dubin. 1986. Cereal Disease Methodology Manual. CIMMYT, Mexico.
4. Russel, G. C. 1981. Plant Breeding for Pest and Disease Resistance. Butterworths and Company, Ltd., London, UK.

13. BENEFICIAL MICROORGANISMS

Theory

Credit Hours 3(2-1)

Importance, nature and classification of beneficial microorganisms. Role of microorganisms in biodegradation of agricultural and industrial biproducts. Cultivation of edible fungi. Role of microorganisms (bacteria, cyanobacteria, nematodes and fungi inclusive of mycorrhizae) in soil fertility and biocontrol of plant diseases.

Practicals

Spawn production and cultivation of edible mushrooms. Identification of edible and poisonous mushrooms, isolation and identification of microorganisms from different agricultural and industrial wastes. Isolation and identification of mycorrhizal fungi. Demonstration of antagonism, competition and antibiosis. Isolation and identification of nitrogen fixing bacteria.

Books Recommended

Text

1. Chang, S. T. and Miles, P. G. 2004. Mushroom cultivation, nutritional value, medicinal effect and environmental impact. CRC Press, NYC, USA.
2. Podila, K and Douds, D. D. 2000. Current advances in mycorrhizae research. APS Press, USA.

Reference

1. Burges, H. Denis. 1998. Formulation of microbial biopesticides: beneficial microorganisms, nematodes and seed treatments. Kluwer Academic press.
2. Bahl, N. 1988. Handbook on Mushroom. 2nd edition. Oxford and IBH Publishing Company New Delhi, India.

14. PESTICIDES, THEIR ACTION AND APPLICATION

Theory

Credit Hours 3(2-1)

Introduction and history of pesticides, application for control of plant diseases, nature and major groups of pesticides and classification. Formulation and mode of action. Residues, resistance and phyto toxicity problems of pesticides (fungicides, bactericide, and nematicides etc.). Equipment and different methods of application. Calibration of equipment. Major hazard of pesticides and their safety measures.

Practicals

Demonstration of different groups of pesticides used for control of plant diseases. Preparation and formulation. Use of various equipments and their calibration. *In vitro* comparison of systemic and protectant pesticides.

Books Recommended

Text

1. Jorgen, S. 2004. Chemical Pesticide. Mode of action and Toxicology. CRC Press, London.
2. Parmar, B. S and Tomar, S. S. 2003. Pesticides Formulation. Theory and Practices. CBS Publ. Distri. Co. India.
3. Robert, T. 2000. Metabolism of Agro-chemicals in Plants. John Willey & Sons. USA.
4. Mathews, G. A and Meladen, M.A. 2000. Pesticides Application Methods 3rd ed. Blackwell Science Publication, New York.

Reference

1. Tomlin, C. 2003. The Pesticide Manual 13th Edition. BCPC – UK.
2. Biddle, A. 2001. Seed Treatment, Challenges and Opportunities. The BCPC Publications, UK.
3. Mathews, G.A. 1999. Application of Pesticides to Crops. World Science Publication Company.
4. Thompson, W.T. 1993. Agricultural Chemicals. Book IV. Fungicide. California, USA.

15. INTRODUCTION TO FOREST PATHOLOGY

Theory

Credit Hours 3(2-1)

Economic importance of forest and shade tree diseases. Principles of forest disease management. Development, epidemiology and management of important forest and shade tree diseases caused by biotic and abiotic agents. Management of forest nursery diseases. Mycorrhiza and its significance in forestry. Management of tree diseases i.e. shisham decline, pines root rot, pine wilt.

Practicals

Visit to forest plantation, collection of disease samples and identification based on symptoms and identification of causal agents of important diseases in tree deterioration of timber and other forest trees. Preservation of specimens of tree disease. Seed health testing of forest and shade tree seed, seed treatment and their effect on nursery seedlings/plants.

Books Recommended.

Text

1. Sharma, U. K., 2004. Trees and Protection of Environment. Deep and Deep Publication (Pvt.) Ltd. India.
2. Tainter, F.H. and Baker, F.A., 1996. Principles of Forest Pathology. John Wiley & Sons. USA.
3. Khan, A.H., 1989. Pathology of Trees, Vol. 11, Univ. of Agriculture, Faisalabad.

Reference

1. Strouts, R.G., and T.G., winter 1994. Diagnosis of 111-Health in Trees. HMS Office. London.
2. Zabel, R., and J.J., Morell, 1992. Wood Microbiology: Decay and its Preservation. Academic Press, San Diego. California, USA.
3. Manion, P.D., 1991. Tree Disease Concepts, 2nd Ed. Prentice Hall. Englewood Cliff, N.J.

16. DYNEMICS OF PLANT DISEASE

Theory

Credit Hours 3(2-1)

Definition and type of epidemics, factors influencing dynamics of epidemics. Epidemic growth curve and growth rate. Factors responsible for decline in epidemics. Forecasting of epidemics. Disease warning system.

Practicals

Recording temperature, humidity and rain. Crop loss assessment methods.

Books Recommended

Text

1. Agrios, G.N., 2005. Plant Pathology. 5th Ed. Academic Press N.Y. USA.
2. Kranz, J., 1990. Epidemics of Plant Diseases: Mathematical Analysis and Modeling. Springe Publ. London, UK.

Reference

1. Leonard, J.F. and Neher, D.A., 1997. Exercises in Plant disease Epidemiology. Amer. Phytopath. Soc. Press., Paul, Minnesota, USA.
2. Campbell, C.L. and Modden, L.V. 1990. Introduction to Plant Disease Epidemiology. John Wily & Sons, Inc. New York, USA.
3. Chiarappa, L (Ed), 1971. Crop loss assessment methods: FAO Manual on the evaluations and prevention of losses by pests, diseases and weeds. Farnham Royal, CAB – UK.

17. METHODS AND RESEARCH TECHNIQUES IN PLANT PATHOLOGY

Theory

Credit Hours 3(1-2)

Hypothesizing, problem identification, Basic components of research, defining objectives, elaborating methodology to achieve the objective, feasibility of the project. Histological, microscopy (light, phase contrast, electron microscopy, confocal), chromatographic, molecular and serological techniques. Layout of designs for laboratory and field experiments. Establishment of disease and testing for resistance. Data collection, analysis and interpretation. Project planning, execution and report writing.

Practicals

Introduction to Lab., Preparation of culture media and adjustment of pH. Isolation, purification and inoculation of bacteria, fungi, nematodes and viruses; methods of multiplication of inocula. Isolation of plant chemicals and use of chromatography for their separation. Artificial production of diseases in the laboratory and field; micrometry and photography of plant pathogens and disease specimens. Preparation of illustrations and slides for presentation of scientific papers. Project report and preparation. Visit to different research stations.

Books Recommended

Text

1. Hafeez, F., Zafar, Y. Khalid, A. M., 2005. Modern Techniques in Biotechnology. A Theoretical Manual. NIBGE, Faisalabad.
2. Aneja, K. R., 2003. Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International (Pvt.) Ltd. New Delhi. India.

3. Hicks, C.R and Turner, K.V. 1999. Fundamental Concepts in Design and Analysis of Experiments, 5th Edition. Oxford University Press, UK.
4. Herrington, C.S and Oleary, J.J. 1998. PCR – 3 in situ Hybridization. IRC Press, New York.

Reference

1. Hawksworth, D.L. 2000. Plant Pathologist's Pocket Book. 3rd edition, CMI Kew, Surrey, England.
2. Zar, J. H. 1999. Bio-statistical Analysis, 4th Edition. Prentice Hall Inc. Upper Saddle River, NJ, USA.
3. Hollas, J.M, 1996 Modern Spectroscopy, 3rd.ed. John Wiley & Sons, USA.
4. Hardwood, L.M. and Claridge. T.D. W. 1996. Introduction to organic Spectroscopy. Oxford University Press. Inc. New York.
5. Ahmad I, Iftikhar S, and Bhutta A. R. 1992. Seedborne microorganisms in Pakistan-Checklist. PARC, Islamabad.

18. CLINICAL PLANT PATHOLOGY

Theory

Credit Hours. 3(1-2)

Plant disease clinic; the concept and farmers expectations. Expert-client interaction. Collection (labeling, designing and filling of performa for record keeping and history), handling, transport and preservation of disease specimens. Equipment, glassware, chemicals and reagents for plant disease clinic. Diagnostic protocols. Isolation and identification of plant pathogens from disease samples. Maintenance and preservation of cultures.

Practicals

Isolation, identification and characterization of the causal agents from disease samples (soil, roots, leaves, stem and fruits etc.). Recommendations and report preparation for the clients. Maintenance and preservation of cultures.

Books Recommended

Text

1. Aneja, K. R., 2003. Experiments in Microbiology, Plant Pathology and Biotechnology. New Age International (Pvt.) Ltd. New Delhi. India.
2. Bhutta, A. R and Ahmad I. 2001. Seed pathological techniques and their application. Published by National Book Foundation, Islamabad, Pakistan.
3. Fox, R.T.V. 1994. Principles of Diagnostic Techniques in Plant Pathology. CAB International, UK.

Reference

1. Hawksworth, D.L.2000. Plant pathologist pocket book 3rd edition. IMI. Egham. UK.
2. Bashir, M. and Hassan, S. 1998. Diagnostic Methods for Plant Viruses, PARC, Islamabad.
3. Walker J.M. 1998. Plant Clinic Handbook. CAB International. Ferry lane Kew UK.
4. Schots, A., F.M. Dewey and F. Oliver. 1994. Modern Detection Assays for Plant Pathogenic Fungi. CAB International, UK.
5. Ahmad, I., M. Aslam and A. Munir. 1992. Phytopathological Diagnostic Techniques. Pakistan Agricultural Research Council, Islamabad, Pakistan.
6. Hampton, R. Ball, E. and DeBoer,s 1990. Serological methods for detection and identification of viral and bacterial plant pathogens-A Laboratory Manual. Publ. by APS press, Saint Paul, Minnesota, USA.

19. INTRODUCTION TO MOLECULAR PLANT PATHOLOGY

Theory

Credit Hours 3(2-1)

Introduction to molecular biology; Molecular biology and plant pathology; Macro molecules in Plant pathology, Proteins, Carbohydrates, Lipids, Terpenoides, Nucleotides, Nucleosides and their role; Structure of DNA, RNA; Genes and Gene expression, Protein synthesis, Chromosomes, Mitotic and meiotic behaviour of genes, DNA replication & repair mechanism. Mutagenesis and sequences.

Practicals

DNA isolation and amplification. Isolation of Protein; Visits to research labs with related facilities.

Recommended Books

Text

1. Devi, P. 2005. Principles and Methods of Plant Molecular Biology, Biochemistry, Biotechnology and Genetics. Student Edition, India.
2. Pena, L. 2005. Transgenic Plants. Methods and Protocol. HUMANA, JN, USA.
3. Mathew, J. D., 2003. Molecular plant pathology. Bios Scientific Publishers, LTD., UK.
4. De Roberties, E.D.P. and DeRoberties, E.M.T. Jr. 1992. Cell and MSolecular Biology. 8th ed. John Willey & Sons, USA.

Reference

1. Hafeez, F, Y, Zafar, Y and Khalid, A. M. 2005. Modern techniques in Biotechnology. A theoretical Manual, NIBGE, Faisalabad.

2. Albert, B., Bray. D and Lewis Raff, M. Robert K. and Watson J.D. 1994. Molecular biology of cells 3rd ed. Garland Publications, New York.
3. Gardner, Simmons, Snusted 1991, Principles of genetics, 5th Edition, John Wiley & Sons Inc., Canada.

20. INTERNSHIP / PROJECT STUDY Credit Hours 20(0-40)

Proposal development, on spot field training and report writing and project presentation. (Format as per thesis manual of the university concerned).

Break up for internship grading Marks: 400

Particular	Marks
A. <u>Assessment by the host organization (public/private)</u>	
	<u>150</u>
1. Attendance	25
2. Behavior	25
3. Performance/achievement/report	100
B. <u>Assessment by the parent organization</u>	
	<u>250</u>
1. Evaluation of field performance/Report evaluation	150
2. Presentation	50
3. Reports of field tours	50

SCHEME OF STUDIES FOR POSTGRADUATE COURSES

LIST OF COURSES

S.NO.	TITLE OF COURSES	CREDIT HOURS
1.	Genesis of Phytopathological Concepts	3(3-0)
2.	Mycology-I (Lower Fungi and Basidiomycetes)*	3(2-1)
3.	Mycology-II (Ascomycetes and Deuteromycetes)*	3(2-1)
4.	Plant Virology*	3(2-1)
5.	Plant Bacteriology*	3(2-1)
6.	Plant Nematology*	3(2-1)
7.	A-Biotic Diseases of Plant	3(2-1)
8.	Plant Disease Epidemiology	3(2-1)
9.	Physiology of Diseased Plants	3(2-1)
10.	Ecology of Plant Pathogens	3(2-1)
11.	Genetics of Plant Pathogens	3(2-0)
12.	Seed Pathology and Seed Health Management	3(2-1)
13.	Plant Disease Management – I (Chemical Methods)	3(2-1)
14.	Plant Disease Management–II (Biological, Physical, Culture and Regulatory Methods)	3(2-1)
15.	Integrated Plant Disease Management	4(2-1)
16.	Post Harvest Pathology	3(2-1)
17.	Biology and Cultivation of Edible Fungi	3(2-1)
18.	Insects in Relation to Plant Diseases	3(2-1)
19.	Forest Pathology	3(2-1)
20.	Molecular Plant Pathology**	3(2-1)
21.	Biotechnology in Plant Pathology**	3(2-1)
22.	Urban Plant Pathology	3(2-1)
23.	Plant Quarantine and SPS measures	3(2-1)
24.	Environmental Plant Pathology	3(2-1)
25.	Advances in Plant Pathology**	3(2-1)
26.	Advances in Mycology**	3(2-1)
27.	General Plant Pathology (for M.Sc/Ph.D Botany & Biology)	3(2-1)
28.	Project Seminar	1(1-0)
29.	Special Problem	1(1-0)
30.	Research thesis	5(0-10)

* = Core courses for M.Sc. (Hons.)

** = Core courses for Ph.D.

Detail of Courses
For Post Graduate Studies in M.Sc. (Hons.)/Ph. D.
Plant Pathology

1. GENESIS OF PHYTOPATHOLOGICAL CONCEPTS

Theory

Credit Hours 3(3-0)

Historical developments of plant pathological concepts with special reference to Indo-Pak sub-continent. Man made hazards. Contributions of herbalists, systematists and mycologists to the science of plant pathology; doctrine of spontaneous/evolutionary generation. Discovery and development of fungicides, landmarks in the study of genetics of host-pathogen interaction; ecology, biochemistry, physiology, biotechnology and genetic engineering applications in plant pathology.

Books Recommended

1. Ahmad, I. and A. R., Bhutta. 2005. A Text Book of Introductory Plant Pathology. Published by National Book Foundation, Islamabad, Pakistan.
2. Vidayasekram, P. 2004. Concise Encyclopedia of Plant Pathology Food Product Press & Haworth Press. Inc. 10th Alice Street Binghamton, New York, USA.
3. Mathew, J.D. 2003. Molecular Plant Pathology, Bios Scientific Publisher Ltd. UK
4. Moore, D and Frazer, L.A.N. 2002. Essential Fungal Genetics Springer – Verlag, N.Y. USA.
5. Khan, J.A and Dijkstra, J. 2002. Plant Virus as Molecular Pathogens. The Haworth Press. Inc. USA.
6. Ghaffar, A. 1992. Status of Plant Pathology in Pakistan, University of Karachi, Karachi, Pakistan.
- Plant Pathological Classics e.g. Late Blight, Dutch elm, Southern Corn Blight, Chestnut Blight, Coffee Rust, Banana Bunchy Top, Blight of Rice, Gram blight, CLCV, rusts, red rot of sugarcane, bakanae disease of rice, citrus decline, Mango decline and shisham decline.

2. MYCOLOGY-I (Lower Fungi and Basidiomycetes)

Theory:

Credit Hours 3(2-1)

Morphology, biology, taxonomy and nomenclature of lower fungi. Types of Zoospores. General characteristics and systematic position of different phyla of cellular, endoparasitic and true slime molds. Introduction to Basidiomycetes; somatic structure, reproduction, basidiocarp developmental patterns, types of basidia and basidiospores. Classification of taxa of agricultural importance. Basidiolichens and their taxonomy.

Practicals:

Collection, preservation, culturing and identification of mycological specimens with special reference to taxa of agricultural importance. Use of keys for identification.

Books Recommended

1. Johri, R.M. 2005. A Text Book of Fungi. Dominant Publishers & Distributors India.
2. Nair, L.N. 2000. Vistas in Mycology and Plant Pathology. Common Wealth Publishers, New Delhi.
3. Deacon, J.W. 1997. Modern Mycology 3rd Edition Blackwell Science Ltd. Osney Mead Oxford, London.
4. Alexopoulos, C.J., C.W.Mims. and M. Blackwell.1996. Introductory Mycology. 4th edition, John Wiley and Sons. Inc., New York, USA.
5. Wells, R., and K. Wells. 1982. Basidium and Basidiocarp. Evolution, Cytology, Function and Development. Springer Verlag, New York, USA.
6. Mirza, J.H., S.M. Khan., S. Begum and S. Shagufta. 1979. Mucorales of Pakistan, University of Agriculture, Faisalabad, Pakistan.
7. Mirza, J.H. and M.S.A. Qureshi. 1978. Fungi of Pakistan. University of Agriculture, Faisalabad, Pakistan.
8. Ainsworth, G.C., S.K. Sparrow. and S.A. Sussman. 1973. The Fungi. An Advanced Treatise. Vol.IVB. Academic Press, New York, USA.

3. MYCOLOGY-II (Ascomycetes and Deuteromycetes)

Theory:

Credit Hours 3(2-1)

Morphology, reproduction, life cycle patterns, sexual compatibility and parasexuality. Types of asci, centra and ascocarps. Ascosporeogenesis and conidiosporeogenesis. Principles and systems of classification of Ascomycetes and Deuteromycetes. Classification of Ascomycetes up to order level with special reference to plant pathogenic species of agricultural importance in Pakistan. Ascolichens, general characters, anatomy and distribution in Pakistan.

Practicals:

Collection, preservation, culturing and identification of mycological specimens with special reference to taxa of agricultural importance. Use of keys for identification.

Books Recommended

1. Agrio, G.N. 2005. Plant Pathology. 5th Edition. Academic Press. Y.Y. USA.
2. Johri, R.M. 2005. A Text Book of Fungi. Dominant Publishers & Distributors India.
3. Swanton, E.W. 2004. Handbook of fungi. Reprint Publication, India.
4. Cangawane, C.V, Ganju, V, Thomas, S and Agarwal. S.K. 2000. Vistas in Mycology and Plant Pathology. Common Wealth Publishers, New Delhi.
5. Deacan, J.W. 1997. Modern Mycology. 3rd Ed. Blackwell Science Ltd. Osney Mead Oxford. London.
6. Barnett, H. L. and B.B. Hunter. 1996. Illustrated Genera of Imperfect Fungi, 4th edition, American Phytopathological Society Press, St. Paul, Minnesota, USA.
7. Moore-Landecker, E. 1996. Fundamentals fungi. 4th ed. Prentice Hall Inc., New Jersey, USA.
8. Hawksworth, D.I., Kirk, P.M., Sutton., B.C. and Pegler D.M. 1995. Anisworth and Bishby's Dictionary of fungi. 8th ed. IMI Egham. UK.
9. Reynolds, D.R. 1993. The Fungal Holomorph: Mitotic, Meiotic and Pleomorphic Speciation in Fungal Systematic. CMI, Kew, UK.
10. Arx, V. 1981. The Genera of Fungi-Sporulating in Pure Culture. 2nd edition, J.Cramer, Lehre, Germany.
11. Cole,, G.T. and B.Kendrick. 1981. Biology of Conidial Fungi. Vol-II. Academic Press, New York, USA.
12. Ahmad, S. 1978. Ascomycetes of Pakistan Vol.1 and II. Biological Society of Pakistan, Lahore, Pakistan.

4. PLANT VIROLOGY

Theory:

Credit Hours. 3(2-1)

History, scope, morphology, taxonomy and biology of plant viruses; Genome structure, replication and purification; Physical properties Virus-insects relationship; Physiology of virus infected plants. Movement of virus in plants; Resistance to infection; economically important viral diseases of Pakistan. Management of plant virus diseases.

Practicals:

Study of symptoms, isolation and purification of plant viruses. Basic virus characterization. Transmission tests (sap, graft & vector). Serological techniques: Electron microscopy. Visits to relevant public institutions.

Books Recommended

1. Misra, R. S. 2004. Virus and Plant Diseases, CBS Publishers and Distributors, India.
2. Verma, H. N. 2003. Basics of Plant Virology. Oxford & IBH Publishing Co. Pvt. Ltd. New Dehli.
3. Voyles, B.A. 2002. The Biology of Viruses. Mc. Graw Hill Book Co. N.Y. USA.
4. Khan, A. J and Dijkstra, J. 2002. Plant Viruses as Molecular Pathogen. CBS Publishers and Distributors, India.
5. Rager Hull.2002. Matthew's Plant Virology. (4th edition,). Academic Press, New York, USA
6. Khalid, S. 1999. Plant Virology Research in Pakistan. Pakistan Agricultural Research Council, Islamabad, Pakistan.
7. Boss, L.. 1999. Plant viruses: Unique and intriguing pathogens. Backhuys publishers Leiden.
8. Suitic. D.D. Ford R. E. and Tosie, M.T. 1999. Hand Book of Plant Virus Diseases CRC Press Boca Raton London
9. Bashir, M. and S. Hassan, 1998. Diagnostic Methods for Plant Viruses. Pakistan Agricultural Research Council, Islamabad, Pakistan.
10. Francki, R. I. B., Robert, G. M. and Hatta, T. 1993. Atlas of Plant Virus Vol. I & II CBS. Publishers and Distributors, New Dehli, India.
11. Brunt, A., Crebtree, K. and Gibbs, A (eds). 1990. Viruses of Tropical Plants, CAB International, UK.
12. Hampton, R., Ball, E. and DeBoer, S. 1990. Serological Methods for Detection and Identification of viral and bacterial plant pathogens. A Laboratory Manual. American Phytopathological Society Press, Saint Paul, Minnesota, USA.

5. PLANT BACTERIOLOGY

Theory:

Credit Hours. 3(2-1)

Economic importance and characteristics of plant pathogenic bacteria and mollicutes, taxonomy and nomenclature, morphology, nutrition, growth and reproduction. Bacterial and mollicute pathogenesis and symptomology, hypersensitive reaction and host-specificity. Ecology and spread of plant pathogenic bacteria and mollicutes. Symptomology, disease cycle and management of significant diseases. Transmission, modes of infection and management of important diseases caused by fastidious bacteria and mollicutes.

Practicals:

Isolation, purification and identification of plant pathogenic bacteria on the basis of morphological, cultural, biochemical and molecular techniques. Inoculation techniques and pathogenicity tests. Demonstration of plant disease symptoms exhibited by fastidious bacteria and mollicutes. Population and growth curves; Sensitivity tests; Characterization of bacteria using phages.

Books Recommended

1. Misra, R.S. 2003. Bacterial Plant Diseases. Discovery Publishers and Distributors, India.
2. Jayarman, J. and Verma, J.P. 2002. Fundamentals of Plant Bacteriology. Kalyani Publishers, Ludhiana, India.
3. Sigeo, D.C. 1992. Bacterial Plant Pathology. Cell and Molecular Aspects. Cambridge University Press New York, USA.
4. Klement, Z., K. Rudolph and D. C. Sands. 1990. Methods in Phytobacteriology. Akademiai Kiado, Budapest, Hungary.
5. Hampton, R., Ball, E. and DeBoer, S. 1990. Serological Methods for Detection and Identification of viral and bacterial plant pathogens. A Laboratory Manual. American Phytopathological Society Press, Saint Paul, Minnesota, USA.
6. Schaad. M.W. 1988. Laboratory Guide for Identification of Plant Pathogenic Bacteria, 2nd edition. American Phytopathological Society. Minnesota, USA.
7. Fahy, P.C. and G.J. Persley. (edi). 1983. Plant Bacterial Diseases: A Diagnostic Guide. Academic Press, New York, USA.

6. PLANT NEMATOLOGY

Theory:

Credit Hours: 3(3-1)

Importance of plant parasitic nematodes and threat to agriculture. Plant response to nematode. Environmental factors effecting survival and pathogenicity. Morphology, anatomy, and reproduction. Mode and mechanism of infection. Concepts and principles of population dynamics, genetics and estimation of crop losses. Nematode- microbe interactions. Control of plant parasitic nematodes (breeding, physical, chemical, biological and cultural practices) and integrated management.

Practicals:

Isolation, identification and permanent mounting of important plant parasitic nematodes. Pathogenicity tests. Field trips, Collection handling and diagnosis of diseased plants by symptomology. Use of nematicides for nematode management.

Recommended Books

1. Alam, M.M. and Sharma, N. 2002. Nematode Control in Crops. International Book Distributors, India.
2. Trivedi, P.C. 1998. Recent Advances in Plant Nematology CGS Publishers and Distributors, India
3. Perry, R.N. and Wright, D.T. 1998. The Physiology and biotechnology of free living and plant parasitic nematode. Willingford, CAB, Inc. UK.
Alden, A. 1973. Nematode Ecology and Plant Diseases. Mowbray Ltd, Alden Press Oxford, UK.
4. Dropkin, V. H. 1989. Introduction to Plant Nematology. John Wiley and Sons, Inc., New York, USA
5. Barker, K. R., Pederson, G.A. and Windham, G.L. 1985. An advanced treatise on Meloidogyne Vol. 1 & 11 Department of Plant Pathology, United State Agency for International Development, North Carolina State University, USA.
6. Siddiqi, M.R. 1986. Tylenchida: Parasites of plants and insects, CAB, UK.
7. Taylor, A. L. and Sasser, J. N. 1978. Biology, identification and control of root knot nematodes. Department of Plant Pathology, United State Agency for International Development, North Carolina State University, USA.

7. ABIOTIC DISEASES OF PLANTS

Theory:

Credit Hours 3(2+1)

Types of abiotic stresses (temperature, soil moisture and light conditions, lack of oxygen, pollution, mineral deficiencies and toxicities, soil pH and improper cultural practices). Symptomology (differentiating features from biotic diseases). Macro and micro nutrient elements and their effect on plant (whether their deficiency or excess). Management of major abiotic diseases.

Practical:

Collection of samples of abiotic diseased plants, identification and preservation. Studies on effect of abiotic factor on plants and their management.

Books Recommended

1. Hill, M.K. 2004. Understanding Environmental Pollution, 2nd Edition, Cambridge Press, UK.
2. Tandov, H. L. S and Roy, R. N. 2004. Integrated nutrient management. A Glossary of Terms. FAO, UN, Rome.
3. Bergstrom, L and Kirchmann, H. 1998. Carbon and nutrient dynamics in natural and agricultural tropical ecosystem. CAB. Inc. UK.
4. Haard, N.F and Salunkle, D.K. 1980. Symptoms on post harvest biology and handling of fruits and vegetables. The AUI Publishing Co. Inc. West Post Connecticut, USA.

8. PLANT DISEASE EPIDEMIOLOGY

Theory:

Credit Hours 3(2-1)

History and development of epidemiology. Principles and components of epidemics; influence of meteorological factors, host resistance and human interventions on development of epidemics; mapping of growth rate and growth curves. Geographic Information System (GIS) Analysis of epidemic growth curve and calculation of growth rate. Forecasting of epidemics and their modelling; computer simulation programmes for epidemic. Disease warning systems.

Practicals:

Use of different techniques to create artificial epidemics in greenhouse or growth chamber; calculation of severity of disease by different procedures to monitor epidemics: plotting growth curve by using different transformation procedures. Establishing prediction systems and executing management measures. Computer simulation programmes

Books Recommended

1. Agrios, G. N. 2005. Plant Pathology. 5th edition, Academic Press, New York, USA.
2. Leonard, J. F. and D. A. Neher. 1997. Exercises in Plant Disease Epidemiology. American Phytopathological Society Press, Saint Paul, Minnesota, USA.
3. Camphill, C.L. and L.V. Madden. 1990. Introduction to Plant Disease Epidemiology. John Wiley and Sons, Inc., New York, USA.
4. Kranz, J. 1990. Epidemics of Plant Diseases: Mathematical Analysis and Modeling. Springer Verlag, New York, USA.
5. Zadoks, J.C., and R.D. Schein. 1979. Epidemiology and Plant Disease Management. Oxford Univ. Press, London and New York, USA.

9. PHYSIOLOGY OF DISEASED PLANTS

Theory:

Credit Hours 3(2-1)

Infection process of fungi, bacteria, viruses and nematodes. Comparative analysis of disease physiology, influence of plant pathogens on photosynthesis, respiration, translocation, transpiration, cell wall composition and metabolism, nucleic acid and protein metabolism by biotic and abiotic factors. Changes on secondary metabolites, growth regulators and toxins. Effect of pathogens on trans-cellular and vascular transport. Nature of morphological and biochemical resistance in host plants.

Practicals:

Experiments to illustrate infection processes of plant pathogens, histopathology of infected plant tissue. Biochemical analysis to demonstrate changes induced by biotic and abiotic factors.

Books Recommended

1. Misra, J.R. 2004. Photosynthesis in Plants DPH. India.
2. Lawlor, W. D. 2001. Photosynthesis 3rd Ed. Viva Books (Pvt) Ltd. India
3. Petrini, O. and Ouellette. G.B. 1994. Host Wall Alterations by Parasitic Fungi. American Phytopathology Society Press, St., Paul. Minnesota, USA.
4. Fritig, B. and M. LeGrand. 1993. Mechanisms of Plant Defense Responses. Kluwer, Dordrecht, The Netherlands.
5. Goodman. R.N., Z. Kiraly, and K.R. Wood. 1986. The Biochemistry and Physiology of Plant Disease. Univ. of Missouri Press, Columbia, USA
6. Baily, J.A., and B.J. Deverall. 1983. The Dynamics of Host Defence. Academic Press, New York, USA.

10. ECOLOGY OF PLANT PATHOGENS

Theory:

Credit Hours3(2-1)

Impact of ecology on plant pathogens; temporal and spatial attributes of pathogens in plant populations. Population statistics, compensation and carrying capacity. Concepts of host-pathosystems, ecological patterns, and approaches for pathosystem management. Detailed study of environmental and nutritional factors in relation to pathogens and plant diseases.

Practicals:

Ecological Study of the important plant pathogens of Pakistan. Ecological factors influencing the growth and development of pathogens (gram blight, apple scab, wheat rust, cotton leaf curl virus) in plant populations. Detailed study of ecological patterns of pathogen-host ecosystems in relation to agro-ecosystems of Pakistan.

Books Recommended

1. Kormondy, E.J. 2004. Concepts of Ecology 4th Ed. Prentic Hall, India.
2. Karishna, K. R. 2003. Agro-sphere, Nutrient Dynamics, Ecology and Productivity. IBH & Oxford, UK/India.
3. Hall, R. 1996. Principles and Practices of Managing Soil-borne Plant Pathogens. American Phytopathological Society Press St. Paul, Minnesota, USA.

4. MacHardy, W.E. 1996. *Biology, Epidemiology and Management*. American Phytopathological Society Press, St. Paul, Minnesota, USA.
5. Wicklow, D.T. and B.E. Soderstrom. 1997. *Environmental and Microbial Relationships*. Volume IV. Springer-Verlag, Germany.

11. GENETICS OF PLANT PATHOGENS

Theory:

Credit Hours 3(3-0)

Mechanisms responsible for variation in plant pathogens, including mutation, hybridisation, heterokaryosis, parasexuality, adaptation, cytoplasmic inheritance and bacterial conjugation, transformation, and transduction. Physiological specialization especially in fungi. Formation of new races and biotypes. The gene-for-gene-concept. Genetics of host-pathogen interaction. Comprehensive review of the concepts and achievements in resistance. Study of various infection types on host differentials.

Books Recommended

1. Sadasivan, S. and Thayumana, B. 2003. *Molecular Host Plant Resistance to Pests*. Marcel Dekker, USA.
2. Singh, D.P. 2002. *Breeding for resistance to biotic stress*. International Books Distribution Co. India.
3. Moore, D. and Frazer, L.A.N. 2002. *Essential Fungal Genetics* Springer - Verlag, N.Y. USA.
4. Younl, L. 1999. *Genetic and Genetic Engineering*, Universities Press. India
5. Mills, D., H. Kunoh, N. Keen and S. Mayama. 1996. *Molecular Aspects of Pathogenecity and Resistance Requirements for signal Transduction*. American Phytopathology Society Press, St., Paul. Minnesota, USA
6. Singh, U.S., R.P. Singh and K. Kohmoto. 1995. *Pathogenesis and Host Specificity in Plant Disease*. Histopathological, Biochemical, Genetic and Molecular Bases. Vols. 1-3. Pergamon/Elsevier, Tarrytown, New York, USA.
7. Nester, E. W. and D. P. S. Verma. 1993. *Advances in Molecular Genetics of Plant-Microbe Interaction*. Vol. 2. Kluwer Dordrecht, The Netherlands.

12. SEED PATHOLOGY & SEED HEALTH MANAGEMENT

Theory:

Credit Hour 3(2-1)

Morphology and Histopathology of infected seeds and planting materials. Mechanism of infection and disease transmission. Physical and biochemical factors causing seed degradation.. Seed quality control systems and steps (cropping pattern, isolation distance and selection of cultivar) in disease free seed production, processing and certification (field inspection of seed crop, seed sampling and seed health testing) with special reference to Pakistan. Important seed-borne diseases and losses. Seed crops and seed standards. Seed treatment & equipments, seed processing & storage, Seed health testing of seed consignment during export/import.

Practical:

Seed-borne pathogens; identification, presentation, incidence and mode of seed transmission. Effect of different chemicals on seed-borne fungi and seed germination. Field crop inspection for disease assessment. Seed sampling according to ISTA (International Seed Testing Association) methods. Preparation of working sample for seed health test. Plating of healthy and diseased seeds. Observation of diseased symptoms of seeds and planting material. Visits to seed testing laboratories and seed processing plants.

Books Recommended

1. Bhutta, A.R. Hussain, A. and Rahman A.R.,2004. Seed Processing and Storage. Publishedby Federal Seed Certification and Registration Department. Islamabad
2. Kruse, M., 2004, ISTA Handbook on Seed Sampling. 2nd Ed. Switzerland.
3. Bhutta, A.R. and Bhatti, F.J., 2002. Seed Potato Certification in Pakistan. Published by Federal Seed Certification and Registration Department, Islamabad.
4. Bashir, M. ahmad, Z. and Murate N., 2000. Seed-borne Viruses, Detection, Identification and Control. Published by PARC, Islamabad.
5. Bhutta, A.R. and Ahmad, 1., 2001. Seed Pathological Techniques and their Application Published by National Book Foundation, Islamabad, Pakistan.
6. Agarwal, V.K. and J.B. Sindar, 1993. Principales of Seed Pathology Vol. 1 & 11. CBS Publishers and Distributors. New Delhi.
7. Ahmad, 1., Iftikhar, S. and Bhutta, A,R., 1992. Seed-borne Microorganisms in Pakistan, Checklist, Publishedby PARC, Islamabad.
8. Marena, D., 1993. Epidemiology & Geophytopathology of Selected Seed-borne Diseases ICARDA, Syria.

9. Mariena, D., 1993. Seed-borne Diseases in Seed Production, ICARDA, Syria.
10. Fiestritzer, W.P., 1983. Cereal Seed Technology. FAO, Rome.
11. Neergaard, P., 1979. Seed pathology Vol. 1 & 11 (Rev. Ed). The Macmillan Press Ltd. London.

13. PLANT DISEASE MANAGEMENT – I (CHEMICAL METHODS)

Theory:

Credit Hours 3(2-1)

History of fungicides, nematicides and bactericides, their classification and development; application of chemicals for the management of foliar seed and soilborne, vascular and postharvest diseases and their modes of action. Problems and prospects of chemicals. Chemical compatibility. Uptake and translocation of chemicals in plants. Development of resistance in fungi, bacteria and nematodes to chemicals. Use of chemicals based on disease tolerance limit.

Practical:

Use of chemicals for seed, foliar and soil application. Use of equipment and machinery for dispensing of chemicals. Sensitivity tests against different chemicals in fungi, bacteria and nematodes. Visit to biological control lab.

Books Recommended

1. Kapoor, B.B.S and Khatri, K.N. 2004. Management of Plant Diseases. Madhu Publications, Bikaner, India.
2. Baker, D.K and Umetsu, K.K. 2000. Agrochemical Discovery: Insect, Weed and Fungal Control. American Chemical Society, Washington D.C.
3. Alford, D. 2000. Pest and Disease Management, BCPC, UK.
4. Upadhyay, R.K. 1999. Integrated Pest and Disease Management, CAB, Kew, UK.
5. Lyr, D. (ed.). 1987. Modern Selective Fungicides: Properties, Applications, and Mechanisms of Actions. New York: John Wiley and Sons. Inc. USA.
6. Green, M. B. and D. A. Spilker. (eds). 1986. Fungicide Chemistry: Advances and Practical Applications. American Chemical Society, Washington D.C. USA.
7. Siegel, M. R and H. D. Sisler. (eds). 1977. Anti-fungal compounds Vol 1 and II. New York. Marcel Dekker, Inc. USA.

14. PLANT DISEASE MANAGEMENT–II (biological, physical, cultural and regulatory methods)

Theory:

Credit Hours 3(2-1)

Management of plant diseases by biological methods viz host resistance, cross protection, interference, hyperparasitism, tissue culture and genetic engineering, physical viz heat treatment, sterilization, refrigeration and radiation etc., Cultural viz host eradication, crop rotation, sanitation, etc., and regulatory (quarantine and inspection/certification) methods. Use of fungal and bacterial microbes as antagonists to plant pathogens (biotech crops such as Bt cotton and Bt corn).

Practical:

Demonstration for the management of diseases through biological, physical, cultural and regulatory methods. Visit to biological control lab.

Books Recommended

1. Nehra, S. 2005. Plant Microbes and Biotechnology, Pointer Publication, India.
2. Leonard, G.C. 2004. The Manual of Bio Control Agents, BCPC, UK.
3. Sadasivam, S. and Thayumanavan, B. 2003. Molecular biology of the biological control of pests and diseases of plants. Marcel Dekker.
4. Hajek, A. 2003. Natural Enemies, An Introduction to Biological Control, Cambridge University Press, UK.
5. Lentefen, J.C.V. 2003. Quality Control and Production of Biological Control CAB. International Wallingford Oxon. UK.
6. Samuel, S.G. 2002. Biological Control of Crop Diseases, Dekker, UDA.
7. Alford, D. 2000. Pest and Disease Management Handbook, BCPC, Publication UK.
8. Johnson, R. and G.J. Jellis. 1993. Breeding for Disease Resistance. Kluwer, Hingham, Massachusetts, USA.
9. Jarris, W.R. 1992. Managing Diseases of Green House Crops, American Phytopathological Society Press, St. Paul, Minnesota, USA.
10. Hornby, E. 1990. Biological Control of Plant Pathogens, CAB International. Oxon, UK.

15. INTEGRATED DISEASE MANAGEMENT

Theory:

Credit Hours 4(3-1)

Integrated disease management (IDM); History, concepts, prospects, principles and components. Biological & environmental monitoring for sustainable agriculture. Resurgence and outbreak of diseases. Role of transgenic technology in IDM. Formal vs informal education, empowerment of farmers for decision making. Master trainers; training of trainers (TOT's) and Farmer Field Schools (FFS), Community Education, Curriculum development for FFS. Concepts and role of community IPM/IDM. Policies and their impact on community.

Practical:

Agroecosystem analysis (AESAs). Field practical regarding disease forecasting procedure. Demonstration of informal education methods; curriculum development, exercises for FFS; familiarization/visits in conducting TOFs, TOT's and FFS's.

Books Recommended

1. Ahmad, I and Bhutta, A.R. 2005. Textbook of Introductory Plant Pathology, National Book Foundation, Islamabad, Pakistan.
2. Perry, J (eds), 2005. The Pesticide Detox Towards a More Sustainable Agriculture Earth Scan. London, UK. PP-19,
3. Ool, P, Echols, G.W, Weidong, D, Abubakar, M.A.L. Soon, G.L., Packagounder, P, Soomro, M.H, Calvin, C, Mancini, F, Peterson, R and Kamp, K (eds) 2004. Environmental Education for the poor farmers FAO, EU, IPM Programme for cotton in Asia. FAO, UN. FAO ROAP, Bangkok, PP-62.
4. Zadoks, J.C. 2004. Modern Crop Protection Int. Book Distribution Co. India.
5. Kazmi, M.R. and Zada R. 2003. Facilitation skills. A Resource Book. National IPM Programme, NARC, Islamabad.
6. Helyer, N, Brown, K and Cattlin, N.D. 2003. Biological Control in Plant Protection (A coloured handbook). Manson Publishing Ltd. London. UK.
7. Pontius, J, Dilt, R. and Bartlett, A (eds), 2002. From farmer field school to community IPM. Ten years of IPM Training in Asia. Publ. FAO Community IPM Programme, FAO, UN. Regional Office for Asia & Pacific. Phra Atit, Road, Bangkok, Thailand. PP-106.
8. Anonymous 2000. A Training Manual for farmers Field School. International Integrated Pest Management Programme, Katmando, Nepal.
9. George G. K. and S.B.Turner. 2000. Emerging Technologies for Integrated Pest Management Concepts Research and Implementation. UK.

10. Soejituo, J. 1999. Integrated Pest Management in Rice in Indonesia. Asia Pacific Association of Agricultural Research Institutions, FAO, Regional Office for Asia and the Pacific Bangkok, Thailand.
11. Montague, Yudelma., Annu, Ratta., and D. Nygaard. 1998. Pest Management and Food Production, Looking to the Future. International Food Policy Research Institute, Washington DC, USA.
12. Greg, J.B, David. L and Kyukendall, 1998. Plant Microbes Interaction and Biological Control. Publ. Marcel Dekker, Inc. 270. Modison Avenue. N.Y. USA.

16. POST HARVEST PATHOLOGY

Theory:

Credit Hours 3(2-1)

Microorganisms and abiotic factors associated with grains and perishables (fruits, vegetables and others) in storage and transit. Extent and estimation of losses (harvesting, threshing, drying, grain storage and handling environmental factors, influencing, grain quality). Physiological and biochemical changes due to postharvest pathological problems in transit and storage; role of mycotoxins on human and animal health, hazards and possible solution; management of post harvest losses. Use of radiation, waxing and other methods and their effect on product health and quality.

Practicals:

Isolation and identification of microorganisms from diseased seeds and perishables; estimation of losses and their management by chemical and physical means i.e. fungicide, waxing treatment, radiation and temperature. Visit to cargo centre.

Books Recommended

1. Bhutta, A. R, Hussain, A and Rehman, M. R. 2004. Handbook on Seed Processing and Storage, Federal Seed Certification and Registration Department, Islamabad. Pakistan.
2. Bhutani, R.C. 2003. Fruits and Vegetables Preservation, Biotech Books, India.
3. Chakraverty, A., Mujundar, A.S., Raghavan, G.S. and Ramaswamy, H.S. 2003. Handbook of Post harvest Technology. Publ. by Marcel Dekker/NC. New York, USA. P-864.
4. Dasgupta, M.K. and N.C. Mandal. 1986. Post Harvest Pathology of Perishables. Oxford and IBH Publ. Co. New Delhi, India
5. Dennis, C. 1983. Postharvest pathology of fruits and vegetables, Academic Press, New York, USA
6. Naard, N.F. and D.K. Salunkhe. 1980. Postharvest Biology and Handling of Fruits and Vegetables. The AVI Publ. Co., Inc., Connecticut, USA.

17. BIOLOGY AND CULTIVATION OF EDIBLE FUNGI

Theory:

Credit Hours 3(2-1)

History of edible fungi; Wild fleshy fungi of Pakistan; Biology and cultivation of edible fungi. Differences between poisonous and edible. fungi. Nutritional and medicinal value of mushrooms. Cultivation of button, oyster, straw/chinese and Shiitake and medicinal mushrooms. Growth rooms, pasteurization methods, spawn types and processing techniques. Pests and diseases of mushrooms and their management.

Practical

Identification of wild mushrooms. Construction of model mushroom houses; preparation of spawn, composts and beds from different agricultural and industrial wastes. Control of pests and weed fungi.

Books Recommended

1. Chang, S. T. and Miles, P. G. 2004. Mushroom cultivation, nutritional value, medicinal effect and environmental impact. CRC Press, NYC, USA.
2. Bahl, N. 1988. Handbook on mushroom. 2nd edition. Oxford and IBH Publ. Co. New Delhi, India.
3. Atkins, P.C. 1972. Mushroom growing today. Faher and Faher Ltd. London, UK.

18. INSECTS IN RELATION TO PLANT DISEASES

Theory:

Credit Hours 3(2-1)

Insects as vectors of plant diseases. Modes of transmission and dissemination of plant pathogens by insects. Ecology and insect-plant relationship. Factors affecting insect transmission. Symptomatology, etiology, epidemiology and management of fungal, bacterial and viral plant diseases transmitted by vectors through traditional and transgenic technologies.

Practical

Identification of insects as vectors of plant pathogens; methods of rearing and handling insect vectors for plant pathogenic studies; demonstration of modes of transmission of plant pathogens by insects etc.

Books Recommended

1. Vanemden, H.F and Service, M. 2004. Pest and Vector Control. Cambridge University Press, UK.

2. Vaishali, J. P and Satte, T.V. 2003. Insect Predator and Pest Management. Daya Publishing House, Delhi.
3. Glare, T. R. and Maureen, O.C. 2000. Bacillus thuringiensis: Biology, ecology and safety, John Wiley and Sons. USA.
4. Leach, J. G. 1997. Insect transmission of Plant diseases. Biotech Books, Delhi, India.
5. Basu, A.N., and B.K. Giri, 1993. The Essentials of Viruses, Vectors and Plant Diseases. Wiley Eastern Ltd., New Delhi, India

19. FOREST PATHOLOGY

Theory:

Credit Hours 4(3-1)

Disease of seed and seedlings of trees and their control/management. Study of the development, epidemiology and management of important forest and shade tree diseases caused by biotic and abiotic agents. Advances in control and management principles for ornamental, shade and forest tree diseases. Mycorrhiza and its significance in forestry. Study of various important phanerogamic parasites of forests/plantation. Decay in standing, stored and used broad leaved and coniferous trees wood. Review of applied researches on tree diseases and their status.

Practicals:

Study of symptoms and identification of causal agents of important diseases and different types of mycorrhizae. Identification and preservation of fruiting bodies of decay causing fungi associated with forest and shade trees. Management of various diseases through chemical and cultural practices. Visit to forest research station.

Books Recommended

1. Sharma, U.K. 2004. Trees and Protection of Environment. Deep and Deep Publications (Pvt) Ltd. India.
2. Singh, R.S. 2003. Plant Diseases. 7th ed. Pak Book Corp. Lahore.
3. Duggar, B.M. 2002. Fungal Diseases of Plants. Agrobious, India.
4. Hutchins, J.D. and Reeves, J.C. 1997. Seed Health Testing. Progress Towards the 21st Century. CABI International.
5. Khan A. H. 1989. Pathology of Trees Vol-II, University of Agriculture, Faisalabad, Pakistan.

20. MOLECULAR PLANT PATHOLOGY

Theory:

Credit Hours 3(2-1)

Genome structure and gene expression, molecular events in plant infection and pathogenesis; plant pathogen interaction, elicitors and signal transduction, quorum sensing, signaling in plant disease resistance mechanism. Understanding of defense mechanisms in host plants. Molecular basis of genetic variability in plant pathogens.

Practicals:

DNA extraction, purification and quantification; DNA Hybridization, Pathogenic variability on the basis of isozymes/PCR analysis.

Books Recommended

1. Devi, P. 2005. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Student Edition, India.
2. Methew, J.D. 2003. Molecular Plant Pathology. Bios Scientific Publishers Ltd. UK.
3. Scheel, D. and Wasternach, C. 2002. Plant signal transduction. Oxford University Press Inc. NYC, USA.
4. Yount, L. 1999. Genetics and Genetic Engineering Universities Press, India.
5. Christopher, H. 1995. Gene Cloning and Manipulation. Cambridge University Press. N.Y. USA.
6. Erich, H. 1992. PCR Technology, Principles and Applications for amplification W.H. Freeman & Company, New York.
7. Kosuge, T. and Nester, E.W. (eds). 1984. Plant Microbe Interactions. Molecular and Genetic Perspectives Volumes I and II, 1984. Macmillan Publ. Co. New York, USA.

21. BIOTECHNOLOGY IN PLANT PATHOLOGY

Theory:

Credit Hours 3(2-1)

Definition, history and development of biotechnology in relation to plant pathology, tissue and cell culture methods. Genetic engineering and its application in plant pathology; use of tissue culture for production of disease free plants; transfer of resistance through genetic engineering approaches.

Practicals:

Tissue and cell culture; Propagation of disease free planting material. Demonstration of various *in vitro* culture methods. Mass production and commercialization of potential plant pathogen antagonists. Visits to private/public sector biotechnological institutions.

Books Recommended

1. Pena, L. 2005. Transgenic Plants, Methods and Protocols, Humana. NJ. USA.
2. Srivastava, H.S. 2005. Plant Physiology, Biochemistry and Biotechnology.
3. Srivastav, M and Sharma R.R. 2004. Plant Propagation and Nursery Management, Int Book Distribution, India.
4. Nester, E., Gordon, M. P. and Kerr, A. 2004. *Agrobacterium tumefaciens*: from plant pathology to biotechnology., APS, USA.
5. Purohit, S.S. 2003. Plant Tissue Culture. Student Edition, India. Rastogi Publishers, India.
6. Primrose, S.R. 2001. Molecular Biotechnology. 2nd Ed. Panima Publ. Corp. India.
7. Campbell, C.L. 1991. Biotechnology in Plant Pathology: Potential for Change. *Phytopathology News* 25:30.
8. Lindsey, K. and Jones, M.g.K. 1989. Plant Biotechnology in Agriculture. Open University Press, Milton Keynes, U.K.

22. URBAN PLANT PATHOLOGY

Theory:

Credit Hours 3(2-1)

Detailed study of symptoms, etiology, nature and extent of losses, disease cycle, methods of perpetuation, epidemiology and management of nursery, green house/tunnels, landscape ornamentals/parks, indoor plants, kitchen gardens, turfs, green belts and roadside (linear) plantations.

Practicals

Identification of diseases on the basis of symptoms and isolation of the pathogens. Collection and preservation of diseased specimens; preparation of permanent mounts. Visits for disease plant sampling and management observation of healthy plantation and nursery seedlings.

Books Recommended

1. Chang, S.T and Miles, P.G. 2004. Mushrooms: Cultivation, Nutritional Value, Medicinal Effect and Environmental Impact. CRC Press. N.Y. USA.
2. Chase, A. R. 1997. Foliar plant diseases: Diagnosis and control. The American Phytopathological Society, Saint Paul, Minnesota, USA.
3. Chase, A. R. 1987. Compendium of Ornamental Foliage Plant Diseases. The American Phytopathological Society, Saint Paul, Minnesota, USA.

4. Fletcher, J.H. 1984. Diseases of Greenhouse Plants. John Wiley and Sons, Inc. New York. USA.
5. Pirone, P.P. 1978. Diseases and Pests of Ornamental Plants. John Wiley and Sons, Inc., New York, USA.

23. PLANT QUARANTINE AND SANITARY & PHYTOSANITARY MEASURES

Credit Hours 3(2-1)

Theory:

Introduction, concept and principles of plant quarantine and SPS measures, WTO Regime, Plant and seed related issues. International and domestic quarantine standards and rules, biosecurity, disease reporting, legislative framework, contaminants outbreaks of some important diseases introduced into Pakistan and elsewhere through import of seed and food items by poor adoption of quarantine rules. Impact of SPS and quarantine measures. Quarantine legislations for food and non-food commodities. Detection methodology used for quarantine object pathogens in import/export consignment.

Practicals

Analysis of various seed and fruit samples obtained from exportable and importable lots by using modern techniques. Visits to port of entry or dry port. Demonstration of working strategy of Quarantine Department and Federal Seed Certification Agency for seed import/export.

Books Recommended.

1. Khan, K.M. and Khan M.A, 2005. Sanitary and Phytosanitary Measures in Wake of Trade Liberalization: Challenges to Agriculture in Developing Countries. A proceedings of International Workshop (12-14 January, 2005), held at University of Arid Agriculture, Rawalpindi.
2. Bhutta, A.R and Ahmad, I. 2001. Seed Pathological Techniques and their Application, National Book Foundation, Islamabad. Pakistan.
3. FAO, 2000. Multilateral Trade Negotiations on Agriculture - A Resource Manual-III – SPS and TBT Agreement. Publ. by FAO-UN Rome. 226-P.
4. Erbicsh, F.H. and Marcelia, K.M. 1998. Intellectual Property Rights in Agri. Biotechnology. Uni. Press. CAB. Int. UK.
5. Ahmad, I., Iftikhar, S. and Bhutta, A.R. 1992. Seed borne microorganisms in Pakistan-checklist, PARC, Islamabad.
6. Hewitt, W. B. and Chiarapa, L, 1978. Plant Health and Quarantine in International Transfer of Genetic Resources. CPC Press, USA.
7. Plant Quarantine Act, 1976. Govt. of Pakistan.
8. Seed Act, 1976, Govt. of Pakistan.

Reference literature.

- Bhutta, A. R. 2005. Plant Quarantine and SPS Measures. Published in Proceedings of the Int. Workshop on “SPS Measure in the wake of trade Liberalization challenges to Agriculture in developing countries. Organized by University of Arid Agriculture, Rawalpindi (12-14 Jan, 2005).
- Bhutta, A.R., Hussain, A and Ahmed, 1. 2003. An Overview of Plant Quarantine Regulation and Legislation in Pakistan. Science Technology and Development 2 (2): 26-32.

24. ENVIRONMENTAL PLANT PATHOLOGY

Theory:

Credit Hours 3(2-1)

Introduction to environmental complex. Importance of ecological factors like soil, water, light, temperature wind and fire in relation to plant distribution. Pollution dynamics, solid toxic and hazardous wastes. Introduction to concept of environment impact assessment (EIA). Air pollution. Acid rain, water pollution, soil deterioration. Agricultural pollution, fertilizer and pesticide pollution and their impact on human and plant health. Important diseases caused due to environmental pollution and their management.

Practical

Analysis of soil and water for important chemical characteristics. Study of impact of polluted water on germination and seedling growth. Visit to sites of land and water polluted areas and observations of symptoms of various pollutants on plant. Collection of sewage and sludge water and isolation of microorganisms.

Recommended Books

1. Bhatt, S. 2004. Environment Protection and Sustainable Development. APH. Publishing Corp. India.
2. Goel, P.K. and Pathode, G.R. 2004. Biotechnological Applications in environment and agriculture, USB, India.
3. Hill, M.K. 2004. Understanding Environmental Pollution. 2nd Edition, Cambridge Press, UK.
4. Kumar, A. 2004. Environmental Contamination and Bio-reclamation APH. Publ. Crop. India.
5. Saleem, M.A. 2004. Environmental pollution and Agricultural B.Z. University Press. Multan.
6. Trivedi, P.C. 2004. Environment Pollution and Control. APB Publishing House, India.
7. Eugene, E.D and Smith, B.F.2000. Environmental Science. A study of interrelationship. McGraw Hill. USA.
8. Wicklow, D.T. and Soderstorm, B.E. 1997. Environmental and Microbial Relationship. Vol IV. Springer, Verlag, Germany.

25. ADVANCES IN PLANT PATHOLOGY

Theory:

Credit Hours 3(3-0)

Modern trends and recent developments in different fields of plant pathology, review of developments and future prospects of plant pathology. Pathogenesis and host parasite specificity in bacteria, Rhizobia, nematodes, fungi and viruses. Molecular and biological techniques for identification of plant pathogens. Mechanism of genetic variability in pathogens.

Books Recommended

1. Agrios, G.N. 2005. Plant Pathology 5th Edition. Academic Press N.Y. USA.
 2. Ahmad, I and Bhutta, A.R. 2005. A Textbook of Introductory Plant Pathology, National Book Foundation, Islamabad, Pakistan.
 3. Yazdani, S.S. 2005. Essentials of Scientific Crop Protection, Kalyani Publisher, India.
 4. Johri, R.M. 2005. A Textbook of Fungi. Dominant Publishers & Distributors, India.
 5. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Food Product Press & Haworth Press. Bringhamton. N.Y. USA.
 6. Durrett, R. 2002. Probability Models for DNI Sequences Evolution, Springer Verlag, New York.
 7. Horsfall, J.G. and Dimond, A.L. 1960. Plant Pathology, Advanced treatise. Vols. I, II and III. Academic Press, New York, USA.
- Technical Journals. Phytopathology, Mycologia, Transactions British Mycological Society. Annal of Applied Biology, Experimental Botany.

26. ADVANCES IN MYCOLOGY

Theory:

Credit Hours 3(2-1)

Principles of taxonomy in different groups of fungi, new trends and recent developments in systematic mycology, theories about the origin and evolution of various groups of fungi and their merits and demerits.

Practicals

Familiarization with the principles of taxonomy for various groups of fungi and pertinent literature for identification. Use of molecular techniques for the identification and differentiation of different groups of fungi.

Books Recommended

1. Johri, R.M. 2005. A Text Book of Fungi. Dominant Publishers & Distributors India.
2. Nair, L.N. 2000. Vistas in Mycology and Plant Pathology. Common Wealth Publishers, New Delhi, India.

3. Deacan, J.W. 1997. Modern Mycology. 3rd Ed. Blackwell Science Ltd. Osney Mead Oxford, London, UK.
 4. Ainsworth, G.C. and A. S. Sussman, 1965-73. The Fungi, An Advanced Treatise, Vol. I-IV. Academic Press, New York, USA.
 5. Hawksworth, D.I., P.M. Kirk, B.C. Sutton and D. M. Pegler. 1995. Ainsworth and Bisby's Dictionary of the Fungi. 8th edition, International Mycological Institute, Egham, United Kingdom.
 6. Cook, R.C. and M. J. Whipps. 1993. Ecophysiology of Fungi. Blackwell Scientific, London, UK.
- Technical Journals: Phytopathology, Mycologia, Transactions of British Mycological Society, Annals of Applied Biology, etc.

27. GENERAL PLANT PATHOLOGY

Theory:

Credit Hours 3(2-1)

Introduction and history of plant pathology with special reference to description of epidemics of plant diseases. Classification and causes of plant diseases with emphasis on potential plant pathogens. Characteristics of plant pathogenic fungi, bacteria, nematodes and viruses, their morphology, nutrition, reproduction, ecology and spread. Classification of plant pathogenic fungi and bacteria with examples of representative genera and organisms of economic importance. Symptoms of plant diseases caused by plant pathogens. Etiology, symptoms, disease cycle, epidemiology and management of various diseases of plants. Principles of plant disease management.

Practicals:

General acquaintance with fungus, bacterium, nematode and virus as plant pathogens. Isolation and purification of cultures of plant pathogens. Identification of plant pathogens. Reproduction of plant diseases (Demonstration of Koch's postulates). Collection and preservation of disease specimens and plant pathogens. Chemotherapeutic control of plant diseases.

Books Recommended

1. Agrios, G.N. 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.
2. Ahmad I, and Bhutta A. R. 2005. A text Book of introductory plant pathology. National Book Foundation Islamabad.
3. Vidhyasekram, P. 2004. Concise Encyclopedia of Plant Pathology. Food Product Press and Haworth Press, Binghamton, N.Y. USA.
4. Alexopoulos, C. J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley and Sons, Inc., New York, USA

5. Singh, R.S. 1982. Plant Pathogens: The Fungi. Oxford and IBH Publishing Company, New Delhi, India

28. SEMINAR **Credit Hour 1(1-0)**

29. SPECIAL PROBLEM **Credit Hour 1(1-0)**

30. RESEARCH THESIS **Credit Hour 5(0-10)**

(Presentation of research work and submission of thesis).

RECOMMENDATIONS

1. The HEC is requested to provide five copies of the books and one copy of each journal (list attached) to all relevant departments of Universities/Colleges and research organizations for ready reference. The list of books has been recommended during the meeting of the experts in Plant Pathology (Annex-I).
2. NCRC recommends HEC to approach the Vice Chancellors of University of Malakand, Chakdara, Dir and Gomal University, D.I Khan to introduce plant pathology at graduate and post graduate level.
3. Plant pathology as Major subject should be introduced at University College of Agriculture BZ University Multan and Agriculture College D.G. Khan for graduate and post graduate level.
4. Disciplines of Plant pathology should be strengthened in the form of manpower and laboratory equipments, especially for bacteriology, virology and molecular plant pathology.
5. In service short training/study tours (1-3 months) to senior University Teachers in foreign universities/institutions for refreshing of their knowledge and familiarization with modern trends in plant pathology.
6. Establish academy for college/university teacher's training in teaching methodologies and acquaintance with the latest knowledge.
7. Short term training programs with the assistance of HEC on emerging problems especially in the fields of Integrated Disease Management (IDM), Molecular Plant Pathology and Diagnostic Techniques.
8. It was the concern of representative of R & D that the scientists working in allied institutions/organizations acting as co-supervisors for HEC indigenous M.Sc. (Hons.)/Ph.D. awardees thesis research may also be paid honoraria for their services.
9. Expert and student exchange program within Universities and research organizations in different disciplines of plant pathology should be further encouraged through HEC.
10. Examination system at different Universities should be made uniform.
11. Following core courses will be offered for Ph.D. in the discipline of plant pathology:
 - Molecular Plant Pathology
 - Biotechnology in Plant Pathology
 - Advances in Plant Pathology
 - Advances in Mycology

(Total credit hours=12)

12. Following core courses will be offered for M.Sc. (Hons.) in the discipline of plant pathology:
 Mycology-I (Lower Fungi and Basidiomycetes)
 Mycology-II (Ascomycetes and Deuteromycetes)
 Plant Virology
 Plant Bacteriology
 Plant Nematology

(Total credit hours=15)
13. For effective teaching and research in Plant Pathology, good Plant Pathology Herbaria should be established at each Agriculture University
14. An evaluation committee may be constituted within the respective department to evaluate the question papers according to the course contents.
15. To avoid plagiarism, a copy of title with abstract of M.Sc. (Hons.) and Ph.D. Thesis/dissertation may be placed in HEC Library.
16. A National conference may be organized to devise road map for long term policies on Agriculture education, Research, development and structural reforms.
17. Establishment of Agriculture Council like other professional Councils such as Pakistan Engineering Council & PMDC.
18. The minimum qualification for entry at university level should be assistant professor with Ph.D.

List of Foreign Scientific Research Journals

1. Phytopathology, APS, USA
2. Plant Disease, APS, USA.
3. Plant Pathology, UK
4. Molecular Plant Pathology, UK
5. Mycologia, USA.

Local Scientific Research Journals

1. Pakistan Journal of Botany, Karachi.
2. Pakistan Journal of Phytopathology, Faisalabad.
3. Pakistan Journal of Seed Technology, Islamabad.
4. Mycopath, Lahore.

LIST OF BOOKS

1. Agrios, G.N. 2005. Plant Pathology, 5th edition, Academic Press, New York, USA.
2. Alexopoulos, C. J., C.W. Mims and M. Blackwell. 1996. Introductory Mycology. 4th edition, John Wiley and Sons, Inc., New York, USA.
3. Alford, D. 2000. Pest and Disease Management, BCPC, UK.
4. Barnett, H. L. and B.B. Hunter. 1996. Illustrated Genera of Imperfect Fungi, 4th edition, American Phytopathological Society Press, St. Paul, Minnesota, USA.
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