

Paper 17-MIHT 508
PLANT PATHOLOGY

THEORY

Marks: 100

Unit 1 Introduction and History of plant pathology (Ch 1 Agrios) (4 periods)

Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases.

Significant landmarks in the field of plant pathology- Contributions of Anton De Bary, Millardet, Burrill, E. Smith, Adolph Mayer, Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank, molecular Koch's postulates. Contributions of eminent Indian plant pathologists.

Unit 2 Stages in development of a disease (Ch 2 Agrios) (1 period)

Infection, invasion, colonization, dissemination of pathogens and perennation.

Unit 3 Plant disease epidemiology (Ch 8 Agrios) (3 periods)

Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases and its relevance in Indian context.

Unit 4 Host Pathogen Interaction

A. Microbial Pathogenicity (Ch 3, 5 Agrios)

Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. **(4 periods)**

Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction). **(3 periods)**

B. Genetics of Plant Diseases (Ch 4 Agrios) (3 periods)

Concept of resistance (R) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance: true resistance- horizontal & vertical, apparent resistance.

C. Defense Mechanisms in Plants (Ch 6 Agrios) (4 periods)

Concepts of constitutive defense mechanisms in plants, inducible structural defenses (histological-cork layer, abscission layer, tyloses, gums), inducible biochemical defenses [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

Unit 5 Control of Plant Diseases (Ch 9 Agrios) (7 periods)

Principles & practices involved in the management of plant diseases by different methods, viz.

regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material

cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches

chemical - protectants and systemic fungicides, antibiotics, resistance of pathogens to chemicals.

biological - suppressive soils, antagonistic microbes-bacteria and fungi, trap plants
genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes

Unit 6 Specific Plant diseases (Agrios, Singh)

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control

A. Important diseases caused by fungi (9 periods)

- White rust of crucifers - *Albugo candida*
- Downy mildew of onion - *Peronospora destructor*
- Late blight of potato - *Phytophthora infestans*
- Powdery mildew of wheat - *Erysiphe graminis*
- Ergot of rye - *Claviceps purpurea*
- Black stem rust of wheat - *Puccinia graminis tritici*
- Loose smut of wheat - *Ustilago nuda*
- Wilt of tomato - *Fusarium oxysporum* f.sp. *lycopersici*
- Red rot of sugarcane - *Colletotrichum falcatum*
- Early blight of potato - *Alternaria solani*

B. Important diseases caused by phytopathogenic bacteria (3 periods)

Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus

C. Important diseases caused by phytoplasmas (1 period)

Aster yellow, citrus stubborn

D. Important diseases caused by viruses (2 periods)

Papaya ring spot, tomato yellow leaf curl, banana bunchy top, rice tungro

E. Important diseases caused by viroids (1 period)

Potato spindle tuber, coconut cadang cadang

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PLANT PATHOLOGY

PRACTICALS

Marks: 50

1. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
2. Study of important diseases of crop plants by cutting sections of infected plant material - *Albugo*, *Puccinia*, *Ustilago*, *Fusarium*, *Colletotrichum*.

SUGGESTED READINGS

1. Agrios GN. (2006). *Plant Pathology*. 5th edition. Academic press, San Diego,
2. Lucas JA. (1998). *Plant Pathology and Plant Pathogens*. 3rd edition. Blackwell Science, Oxford.
3. Mehrotra RS. (1994). *Plant Pathology*. Tata McGraw-Hill Limited.
4. Rangaswami G. (2005). *Diseases of Crop Plants in India*. 4th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
5. Singh RS. (1998). *Plant Diseases Management*. 7th edition. Oxford & IBH, New Delhi.

Paper 18-MIHT 509

IMMUNOLOGY

THEORY

Marks: 100

- Unit 1 Introduction** (Ch 1 Goldsby *et al.*) (3 periods)
Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa
- Unit 2 Immune Cells and Organs** (Ch 2 Goldsby *et al.*) (6 periods)
Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT
- Unit 3 Antigens** (Ch 4 Goldsby *et al.*) (3 periods)
Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants
- Unit 4 Antibodies** (Ch 4, 5 Goldsby *et al.*) (6 periods)
Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies
- Unit 5 Major Histocompatibility Complex** (Ch 8 Goldsby *et al.*) (5 periods)
Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways)
- Unit 6 Complement System** (Ch 7 Goldsby *et al.*) (3 periods)
Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement activation
- Unit 7 Generation of Immune Response** (Ch 10-11, 14 Goldsby *et al.*) (7 periods)
Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance

Unit 8 Immunological Disorders and Tumor Immunity

(Ch 15-16, 20, 21 Goldsby *et al.*) (6 periods)

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak-Higashi syndrome, Leukocyte adhesion deficiency, CGD; Characteristics of tumor antigens

Unit 9 Immunological Techniques

(Ch 6 Goldsby *et al.*) (6 periods)

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescence, Flow cytometry, Immunoelectron microscopy, RIST, RAST, MLR

Paper 18-MIHP 509

IMMUNOLOGY

PRACTICALS

Marks: 50

1. Identification of human blood groups.
2. To perform Total Leukocyte Count of the given blood sample.
3. To perform Differential Leukocyte Count of the given blood sample.
4. To separate serum from the blood sample (demonstration).
5. To perform immunodiffusion by Ouchterlony method.
6. To perform DOT ELISA.
7. To perform immunoelectrophoresis.

SUGGESTED READINGS

1. Abbas AK, Lichtman AH, Pillai S. (2007). *Cellular and Molecular Immunology*. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). *Roitt's Essential Immunology*. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). *Kuby's Immunology*. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). *Janeway's Immunobiology*. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). *Basic and Clinical Immunology*. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Richard C and Geiffrey S. (2009). *Immunology*. 6th edition. Wiley Blackwell Publication.

Paper 19-MIHT 510
INDUSTRIAL MICROBIOLOGY

THEORY

Marks: 100

- Unit 1 Introduction to industrial microbiology**
(Ch 1 Casida, Ch 1 Stanbury *et al.*) (2 periods)
Brief history and developments in industrial microbiology
- Unit 2 Fermentation processes** (Ch 2 Stanbury *et al.*) (4 periods)
Solid-state and liquid-state (stationary and submerged) fermentations; Batch, fed-batch and continuous fermentations
- Unit 3 Bioreactors/fermenters** (Ch 3 Casida, Ch 7 Stanbury *et al.*) (7 periods)
Components of a typical bioreactor, types of bioreactors-Laboratory, pilot- scale and production fermenters; constantly stirred tank fermenter, tower fermenter, fixed bed and fluidized bed bioreactors and air-lift fermenter.
- Unit 4 Measurement and control of fermentation parameters**
(Ch 8-9 Stanbury *et al.*) (4 periods)
pH, temperature, dissolved oxygen, foaming and aeration
- Unit 5 Isolation of industrially important microbial strains**
(Ch 4 Casida, Ch 3 Patel) (4 periods)
Primary and secondary screening, strain development, preservation and maintenance of industrial strains
- Unit 6 Media and ingredients for industrial fermentations**
(Ch 7 Casida, Ch 4 Stanbury *et al.*) (3 periods)
Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey and yeast extract.
- Unit 7 Down-stream Processing** (Ch 10 Stanbury *et al.*) (5 periods)
Filtration, centrifugation, cell disruption, solvent extraction, precipitation and ultrafiltration, lyophilization, spray drying
- Unit 8 Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses)**
(Ch 8-9, 11-13, 15 Crueger and Crueger; Ch 17-18, 23-25 Casida) (13 periods)
Citric acid, ethanol, penicillin, glutamic acid, riboflavin, enzymes (amylase, cellulase, protease, lipase, glucose isomerase, glucose oxidase), wine, beer, bioinsecticides (Bt) and Steroid transformations

(Ch 11 Crueger and Crueger) (5 periods)

Unit 9 Enzyme immobilization

Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase)

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INDUSTRIAL MICROBIOLOGY

PRACTICALS

Marks: 50

1. Microbial fermentations for the production and estimation (qualitative and quantitative) of:
 - (a) Enzyme: Amylase
 - (b) Amino acid: Glutamic acid
 - (c) Organic acid: Citric acid
 - (d) Alcohol: Ethanol
 - (e) Antibiotic: Penicillin
2. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.

SUGGESTED READINGS

1. Casida LE. (1991). *Industrial Microbiology*. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). *Biotechnology: A textbook of Industrial Microbiology*. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). *Industrial Microbiology*. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). *Principles of Fermentation Technology*. 2nd edition, Elsevier Science Ltd.

Paper 20-GGHT 501
GENETICS AND GENOMICS-I

THEORY

Marks: 100

Unit 1. Introduction to Genetics **(Ch 1 Klug and Cummings)**

Mendel's work on transmission of traits, Genetic Variation, Molecular basis of Genetic Information.

Unit 2. Mitosis and Meiosis **(Ch 2 Klug and Cummings)**

Interrelation between the cell structure and the genetics function, Mitosis, Meiosis (explaining Mendel's ratios).

Unit 3. Mendelian Genetics and its Extension **(Ch 3-4 Klug and Cummings)**

Principles of Inheritance, Chromosome theory of inheritance, Laws of Probability, Pedigree analysis, Incomplete dominance and codominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Environmental effects on phenotypic expression, sex linked inheritance.

Unit 4. Linkage, Crossing Over and Chromosomal Mapping

(Ch 5 Klug and Cummings, Ch 7, Gardner)

Linkage and crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell genetics – an alternative approach to gene mapping.

Unit 5. Mutations **(Ch 8 Klug and Cummings/ Ch 11 Gardner)**

Chromosomal Mutations: Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy. Gene mutations: Induced versus Spontaneous mutations, Back versus Suppressor mutations, Molecular basis of Mutations in relation to UV light and chemical mutagens, Detection of mutations: CLB method, Attached X method, DNA repair mechanisms.

Unit 6. Sex Determination **(Ch 7 Klug and Cummings)**

Chromosomal mechanisms, Environmental factors effecting sex determination, Barr bodies, Dosage compensation.

Unit 7. Extrachromosomal Inheritance

(Ch 9 Klug and Cummings/ Ch 20 Gardner)

Chloroplast mutation/Variation in Four o' clock plant and *Chlymodomonas*, Mitochondrial mutations in *Neurospora* and yeast, Maternal effects, Infective heredity- Kappa particles in *Paramecium*.

Unit 8. Quantitative Genetics (Ch 25 Klug and Cummings/ Ch 21, Gardner)
Quantitative and multifactor inheritance, Transgressive variations, Heterosis.

Paper 20-GGHP 501

GENETICS AND GENOMICS-I

PRACTICALS

Marks: 50

1. Mendelian laws and gene interaction using *Drosophila* crosses.
2. Chi-square and probability.
3. Study of Linkage, recombination, gene mapping using marker based data from *Drosophila*.
4. Study of Human and *Phlox/ Allium* Karyotype (normal and abnormal).
5. Pedigree analysis of some human inherited traits.
6. Study of Hardy-Weinberg Law using simulations (seeds).

SUGGESTED READINGS

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). VIII ed. Principles of Genetics. Wiley India.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. XI Edition. Benjamin Cummings.
4. Russell, P. J. (2009). *iGenetics- A Molecular Approach*. III Edition. Benjamin Cummings.
5. Glick, B.R., Pasternak, J.J. (2003). *Molecular Biotechnology- Principles and Applications of recombinant DNA*. ASM Press, Washington.
6. Pevsner, J. (2009). *Bioinformatics and Functional Genomics*. II Edition. John Wiley & Sons.
7. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. *Introduction to Genetic Analysis*, W. H. Freeman & Co.

ADDITIONAL READINGS

Both students as well as teachers of genetics can further benefit from knowledge of following topics as given below-

- **Epigenetics-** <http://www.nature.com/nrg/focus/epigenetics/index.html>
- **Tetrad Analysis in fungi**
- **Centromere Mapping**
- **Cytogenetic Mapping**