BOT 401: GENETICS, PLANT BREEDING AND EVOLUTION

UNIT I
A brief history, scope and significance of genetics.
Mendel's law of inheritance.
Lethality and Interaction of genes.
Quantitative inheritance: polygenic inheritance.
Nature and concept of chemical basis of heredity.

UNIT II
Multiple alleles.
Self sterility.
Linkage and its measurement.
Crossing over: theories of crossing over.
Mapping of genes on chromosomes.

UNIT III
Genetic recombination in bacteria: conjugation, transformation and transduction.
Cytoplasmic inheritance.
Mutations : types, methods of artificial induction, method of detection of mutants.
Biochemical genetics of Neurospora.

UNIT IV
Origin of life.
Mutation and evolution.
Genetics and evolution.
Genetic drift.
Speciation.

UNIT V
Method of plant breeding, plant introduction, mass, pure line and clonal selection.
Aims and objectives of hybridization types: inter specific and intergeneric; back crossing.
Grafts hybrids, chimeras and bud spot.
Heterosis: theories and applications with reference to maize.
Plant breeding work done in India with reference to wheat and rice.

PRACTICAL 401:
1. Determination of probability of tossing for one coin.
2. Determination of probability for the throw of dice.
3. Determination of probability for tossing of two coins.
4. $X^2$ test as applied to the result of above three experiments.
5. Determination of size of the leaves on a specific size of two population of a species and calculation of standard deviation and standard error.
6. Permutation and combination.
7. Correlation analysis.
8. Determination of genotype from the data provided.
9. Determination of linkage values from the data provided and preparation of chromosome map.
10. Determination of various mendelian ratio by checker board as well as by binomial equation.
11. Study of gene frequency in the populations.
12. Use of Anderson's scatter diagrams in the differentiation of the genetic population.
13. Emasculation of flower.
14. The working of the instruments used in various experiments must also explained./ At least 60% of the above mentioned exercises be performed and must be handed over to the external examiner who will select out the exercise to be distributed among at the time examination.
BOT 402: PLANT BIOTECHNOLOGY: IN VITRO CULTURE, GENETIC ENGINEERING AND IPR ISSUE

UNIT I
Concept and scope of Biotechnology.
Techniques of tissue culture, cell culture and organ culture.
Sterilization culture media.
In-vitro auxotrophs, disease resistance, salt and drought resistance, nutritional quality and herbicide resistance.

UNIT II
Micropropagation.
Production of haploids: anther culture and pollen culture
Somatic embryogenesis, somaclonal variation.
Protoplast culture: isolation, culture and fusion of protoplast.
IPR-general idea about patents. Copyright, trademark and geographical indication.

UNIT III
Biotransformation: production of useful compounds through cell culture; factors affecting yield: bioreactors.
Strategies of microbial strain improvement.
The recombinant DNA concept and principle of cloning.
Isolation and purification of DNA.

UNIT IV
Restriction endonuclease: properties and types.
Blotting southern, northern and western
Selection and screening of recombinant clone.
Cloning vehicles salient features: plasmid, cosmid & Tiplasmid.

UNIT V
Single stranded DNA viruses CaMV Lambda phage vectors M13 vectors.
Expression vectors.
Cloning construction of genomic and DNA libraries
Application of r- DNA technology in plant improvement.

PRACTICAL 402:
1. Selection of salt tolerance / amino acid analogue resistance through cell culture.
2. Isolation and culture of protoplast.
3. Isolation and screening of industrially important microorganism.
4. Isolation of plant DNA, plasmid DNA, bacteriophage DNA.
5. Genetics colonization and tumour induction Agrobacterium Ti plasmid.
6. Restriction analysis and molecular weight DNA.
7. Sequencing and polymerase Chain Reaction.
ELECTIVE PAPERS (OPTIONAL)

BOT E01: INDUSTRIAL MICROBIOLOGY

UNIT I

UNIT II
Use of microorganisms in industries through ages.
Strategies for isolation and screening of industrially important microorganism.
Strategies for improvement of industrially important microbial strains.

UNIT III
Industrial product of vinegar.
Industrial product of citric acid.
Industrial product of antibiotics; penicillin and streptomycin.
Industrial product of amino acids; glutamic acid and lysine.

UNIT IV
Microbes as a source of Single Cell protein (SCP).
Mushrooms and food value of mushrooms.
Dairy product from microorganisms; butter, yogurt and cheese.
Hygiene and safety in fermentation industries.

UNIT V
Biopesticides: bacterial, fungal and viral control of insect pests.
Biofertilizer: production and method of application.
Bioremediation.

PRACTICALS E01:
1. Isolation and identification of bacteria, yeast and fungi from bakeries and fermenters of distilleries.
2. Inoculation of fungi and bacteria on sterilized glucose and sucrose solutions and identification of the different types of amino acids and organic acids in filtrate during different incubation periods. (Chromatography)
3. Isolation and identification of different types of fungi and bacteria from curd, rotten fruits and vegetables.
4. Collection of different types of mushrooms from local area/ region: inventory and analysis of the amino acid contents. (Chromatography)
5. Preparation of spawn for cultivation of edible mushrooms.
6. Observation of the antagonism of three antibiotics against common plant pathogens in Petri plate. (disc methods).
BOT E03: ETHNOBOTANY AND ISOLATION OF NATURAL PRODUCTS

UNIT I
Ethnobotany, its scope, interdisciplinary approaches.
Ethnic groups of India: major and minor tribes, life styles of ethnic tribes, conservation practices of biodiversity, taboos and totems.
World centers of Ethnobotany with special reference to India.

UNIT II
Role of Ethnobotany in national priorities, health care and development of cottage industries in India.
History and principles of Ayurveda, Homeopathy, Allopathy, Unani and Siddha system of medicines.
A general idea of active principles of plants and plant parts their extraction and preparation of medicines in different systems.

UNIT III
Scope and uses of essential oil from plants as perfumes, cosmetics and as flavoring agents.
Preparation of perfumes from aromatic plants with special reference to the following Lemon grass, Palm-rosa, Mint, Lavender, Rose, Eucalyptus and Vetiver.

UNIT IV
Plants used in medicine with special reference to following.
Adhatoda vasica, Asparagus racemosus, Hollariahina antidysenterica, Tinospora cordifolia
Terminalia arjuna, Terminalia bellerica, Terminalia chebula, Pterocarpus marsupium, Commiphora wightii.
Regional relevance and credibility of medicinal plants used by tribals of M. P.

UNIT V
Plants used in medicine with special reference to following.
Argemone mexicana, Boerhaavia diffusa, Eclipta prostrata, Psoralea corallifolia, Withania sominifera,
Tylophora indica, Rauwolfia serpentina, Dioscorea deltoids.
Plants used in scarcity, emergency and as supplementary foods by tribals of India.

PRACTICAL E03:
1. Visit to tribal area and study of plant material used tribal.
2. Identification and description of important plants of ethno botanical importance.
3. Identification of important aromatic plants of the locality.
4. Extraction of active ingredients of plant and plant parts.
5. Extraction of perfumes of aromatic plants.
8. Diseases of some common medicinal plant of the locality.
9. Identification and description of 10 plants used by tribal for household purpose.
BOT E04: STRESS PHYSIOLOGY

UNIT I
Plants and water: Chemical and water potential gradients.
Determination of water potential of plants and tissues by Chardakov’s, pressure chamber and psychrometric methods.
Stomatal size, frequency and measurements of stomatal aperture, porometry. Mechanism of stomatal opening and closing.
Physiological principles of dry land farming.
Wilting coefficient, water use efficiency, stress - degree - day concept, plant water - stress index and their relationship to several plant physiological processes.
Availability of soil water and determination of soil water potential.

UNIT II
Drought and drought tolerance mechanisms: drought escape, drought tolerance with high tissue water potential; drought tolerance with low tissue water potential.
Morphological, physiological and biochemical parameters of drought resistance.
Screening methods to study drought resistance.

UNIT III
Antitranspirants: Different types, mode of action and their use in alleviation of water stress.
Nitrogen fixation and drought.
Ultra structural consequences of drought

UNIT IV
C₄ photosynthesis as CO₂ concentrating mechanism and its comparison with C₃ fixation
Elementary idea about chilling stresses.
Ultra violet stresses: Different band of UV radiations. Sensitivity of various bio-organic molecules; resistance mechanisms and measurement of resistance.

UNIT V
Salinity and plant growth.
Saline and alkali soils
Salt tolerance: Halophytes; physiological aspects of salt tolerance,
Screening methods for salt tolerant varieties.
Elementary idea about temperature stresses.

PRACTICALS E04
1. Estimation of free proline in leaves subjected to water stress.
3. NR assay.
4. Determination of relative water content (RWC).
5. Determination of potassium and sodium using flame photometer.
6. To determine soil water potential using Tensiometer.
7. Determination of leaf water potential by using Chardakov’s method.
8. Determination of water potential using pressure chamber.
9. Discussion on the working of colorimeter, flame photometer tensiometer and pressure chamber:
10. Separation of amino acid by TLC method.

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BOT E02: BIOCHEMISTRY AND METABOLISM IN PLANTS

UNIT I
Lipid: General structure, classification.
Synthesis of fatty acid.
β-Oxidation.
Synthesis of carbohydrates from fatty acids.
Protein: Amino acid structure and Biosynthesis; protein conformation, protein synthesis.

UNIT II
Secondary plant products: General structure of important phenolic compound groups in plants.
Shikimic acid pathway and phenolic compound synthesis.
General structure and synthesis of alkaloids from amino acids.
Growth regulators: structure and biosynthesis of Ethylene, Jasmonates and Brassinolides.

UNIT III
Cell wall components.
Cellulose: structure and model for biosynthesis, structure and operation of the model for synthesis plasma membrane level.
Lignin: structure and biosynthesis in plants.
Cyanogenesis: a general account of cyanogenic compounds as glycosides.

UNIT IV
DNA and RNA: structure
DNA replication.
Transcription in prokaryotes and eukaryotes, transcript modification.
Regulation of translation.

UNIT V
Nitrate metabolism in plants.
Nitrogen fixation, Nitrogenase system.
Ammonium assimilation.
GS-GOGAT system.
BOT E05: PLANT PATHOLOGY AND MYCOTOXICOLOGY

UNIT I
History and principles of plant pathology.
Milestones in phytopathology with particular reference to India.
Historical development of chemicals, legislative, culture and biological protection measures including classification of plant diseases.
Parasitism and Disease developments. Growth, reproduction, survival and dispersal of plant pathogens. Factors influencing infection, colonization and development of symptoms.

UNIT II
Physiological and molecular plant pathology.

UNIT III
Management of plant Diseases: General principles of plant quarantine.
Production of disease free seeds and planting materials. Seed certification. Fungicide and antibiotics: Important culture practices and their role in disease management, solarization, integrated disease management.

UNIT IV
History of Mycotoxins, mycotoxic fungi and related mycotoxins in food and feed, aflatoxins, factors influencing the production of aflatoxins, mycotoxicosis and aflatoxicosis. Detoxification and Regulatory aspects of control of Mycotoxins.

UNIT V

PRACTICALS E05
1. Preparation of different types of media: solid liquid synthetic, semi synthetic.
2. Isolation of fungi from infected plant material and stored material.
3. Identification of fungi, and micrometry
5. Preparation of TLC plate.
6. Extraction of aflatoxin from stored seed samples.
8. Demonstration of slides/photograph showing important histopathological changes in liver, kidney and intestine of affected animals/birds.
BOT E06: AGROECOSYSTEM

UNIT I
Introduction and concept of agroecosystem.
Agroclimatic zones of India.
Various types of Indian field and plantation crops.
Various types of Indian commercial and horticultural crops.

UNIT II
Various agronomic practices, adapted in cropland ecosystem.
Weed control-normal, Mechanical and biological.
Insects and pests of cropland ecosystem-any five forms.
Green evolution.

UNIT III
Structure of biotic and abiotic community of a cropland ecosystem-a case study.
Herbicide degradation and accumulation in a cropland ecosystem.
Sink source relationship.

UNIT IV
Influence of irrigation cycling on cropland ecosystem.
Crop geometry.
Influence of mineral cycling on cropland ecosystem.
Phytoallelopathy in croplands.

UNIT V
Input-output ratio in agroecosystem.
Energy flow in a cropland ecosystem.
Biofertilizers.
Farm management.

PRACTICALS E06:
1. To compare the density of a cropland with that of a natural ecosystem.
2. To compare the frequency of a cropland with that of a natural ecosystem.
3. To compare the Abundance of a cropland with that of a natural ecosystem.
4. To compare the soil texture, colour and consistency of a cropland ecosystem with that of a natural ecosystem.
5. To compare a natural and cropland ecosystem by calculating community-coefficient.
6. To calculate and comment upon the following at three different levels of a cropland i.e. top crop, middle level of the crop and base of the crop.
   a. Solar intensity.
   b. Relative humidity.
   c. Atmosphere temperature.
7. To calculate the temperature of soil at two different depths i.e. 10 cm. in cropland and compare it with a natural ecosystem.
8. To prepare a random design of an experiment to study the effects of three levels of fertilizer and three levels of irrigation in a cropland.
9. To determine the pH of cropland soil and compare with natural ecosystem.
10. To determine the nitrate, carbonate and base deficiency of a cropland soil and compare with natural ecosystem soil, using rap test method.
BOT EO6: AGROECOSYSTEM

UNIT I
Introduction and concept of agroecosystem.
Agroclimatic zones of India.
Various types of Indian field and plantation crops.
Various types of Indian commercial and horticultural crops.

UNIT II
Various agronomic practices, adapted in cropland ecosystem.
Weed control-normal, Mechanical and biological.
Insects and pests of cropland ecosystem-any five forms.
Green evolution.

UNIT III
Structure of biotic and abiotic community of a cropland ecosystem-a case study.
Herbicide degradation and accumulation in a cropland ecosystem.
Sink source relationship.

UNIT IV
Influence of irrigation cycling on cropland ecosystem.
Crop geometry.
Influence of mineral cycling on cropland ecosystem.
Phytoallelopathy in croplands.

UNIT V
Input-output ratio in agroecosystem.
Energy flow in a cropland ecosystem.
Biofertilizers.
Farm management.

PRACTICALS EO6:
1. To compare the density of a cropland with that of a natural ecosystem.
2. To compare the frequency of a cropland with that of a natural ecosystem.
3. To compare the Abundance of a cropland with that of a natural ecosystem.
4. To compare the soil texture, colour and consistency of a cropland ecosystem with that of a natural ecosystem.
5. To compare a natural and cropland ecosystem by calculating community-coefficient.
6. To calculate and comment upon the following at three different levels of a cropland i.e. top of the crop, middle level of the crop and base of the crop.
   a. Solar intensity.
   b. Relative humidity.
   c. Atmosphere temperature.
7. To calculate the temperature of soil at two different depths i.e. 10cm. in cropland and compare it with a natural ecosystem.
8. To prepare a random design of an experiment to study the effects of three levels of fertilizer and three levels of irrigation in a cropland.
9. To determine the pH of cropland soil and compare with natural ecosystem.
10. To determine the nitrate, carbonate and base deficiency of a cropland soil and compare with natural ecosystem soil, using rapid test method.