

Introductory Agriculture

Art, Science and business of crop production, Basic elements of crop production. History of Agricultural development; Ancient Indian Agriculture in Civilization Era, Chronological Agricultural Technology development in India. Different agricultural related revolutions in India (green, yellow, blue, white, silver etc). Present and past basic statistical data of area, production, productivity, fertilizer consumption, livestock, irrigation in India and Chhattisgarh. Cropping system and soil groups formed in different parts of the country as defined by ICAR. Innovation in agriculture: definition and concept; hitech agriculture, precision farming, sustainable agriculture, contract farming, crop modeling, GIS and Remote sensing technology. Women in Agriculture: multifaceted roles and tasks, work stress factors, nutritional and rural life standards, role in house hold design making, drudgery reduction for farm women, women friendly agricultural technology, empowerment of women, group dynamics for farm women and rural women.

Field Crops

Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield of kharif crops, Cereals & rice, maize, sorghum, pearl millet and minor millets; Pulses : pigeonpea, mungbean and urdbean; Oilseeds: soybean, groundnut, sesame, niger and castor; Fibre crops: cotton, jute and sunhemp; and Forage crops: sorghum, maize, cowpea, cluster bean and napier.

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of rabi crops Cereals: wheat, barley; Pulses: chickpea, lentil, peas, french bean, lathyrus; Oilseeds: rapeseed and mustard, sunflower, safflower and linseed; Sugar crops: sugarcane and sugarbeet, Medicinal and aromatic crops such as mentha, lemon grass, citronella, palma rosa, isabgol and safed musli; Commercial crops: potato and tobacco, Forage crops: berseem, lucerne and oat.

Principles of Agronomy

Agronomy - Definition, scope and importance, its relationship with other sciences, historical sketch of agronomy. Agro-climatic zones of India and Chhattisgarh State. National and International Agricultural Research Organizations in India. Classification of Crops. Factors affecting crop production. Essential plant nutrients their role in crop growth. Manures and fertilizers- classification and nutrient content. Tillage- objectives, classification and function of tillage implements. Crop stand establishment seed bed preparation and seeding methods. Planting geometry and its effect on growth and yield. Cropping system- different types of

cropping system: intercropping, mixed cropping, intensive cropping, relay cropping, Alley cropping etc., definition and advantages with examples. Crop Rotation objectives types and advantage. Harvesting and post harvest operation.

Principles of Agronomy and Agricultural Heritage

Agriculture – Definition – Importance and scope - Branches of agriculture - Evolution of man and agriculture – Development of scientific agriculture - National and International Agricultural Research Institutes. Indian agriculture - Indian economy – National income – per capita income – Agricultural income in GDP - Women in agriculture and empowerment. History of agricultural development in the world and India. Agriculture heritage –Agriculture in ancient India. Stages of agriculture development - Era of civilization- Importance of Neolithic Civilization. Chronology of Agricultural technology development in India. Kautilya’s Arthasasthra - Sangam literature - rainfall prediction – ITK .

Agronomy – definition – meaning and scope. Agro-climatic zones of India – Agro ecological zones of India. Crops and major soils - Classification – Economic and agricultural importance in India. Factors affecting crop production – climatic – edaphic - biotic- physiographic and socio economic factors. Tillage – Definition – objectives – types of tillage - modern concepts of tillage –main field preparation.

Seeds - Seed rate - Sowing methods - Germination - Crop stand establishment -Planting geometry Role of manures and fertilizers in crop production – agronomic interventions for enhancing FUE - Inter cultivation - Thinning - Gap filling and other intercultural operations. Irrigation - Time and methods - Modern techniques of irrigation - Drainage and its importance. Planting Geometry and its Effect on Growth and Yield.

Cropping pattern and cropping system - Intensive cropping- Sustainable agriculture –Organic / eco-friendly agriculture - Dry farming - Concepts and principles Agro-climatic zones of India .Agro meteorology. Weather and climate, micro-climate Weather elements and their influence on different crops. Monsoon. Clouds. Weather aberrations. Weather forecasting. Weather modification -Artificial rain making and cloud seeding. Remote sensing.

Principles of Genetics

Mendel’s laws of inheritance and exceptions to the laws; Types of gene action, Multiple alleles, Pleiotropism, Penetrance and expressivity; Quantitative traits, Qualitative traits and differences between them; Multiple factor hypothesis; Cytoplasmic inheritance, its characteristic features and difference between chromosomal and cytoplasmic inheritance; Mutation and its

characteristic features; Methods of inducing mutations and C I B technique. Gene expression and differential gene activation; Lac operon and Fine structure of Gene; Ultra structure of cell and cell organelles and their functions; Study of chromosome structure, morphology, number and types, Karyotype and Idiogram; Mitosis and meiosis, their significance and differences between them; DNA and its structure, function, types, modes of replication and repair. RNA and its structure, function and types; Transcription, Translation, Genetic code and outline of protein synthesis; Crossing over and factors affecting it; Mechanism of crossing over and Cytological proof of crossing over; Linkage, Types of linkage and estimation of linkage; Numerical chromosomal aberrations (Polyploidy) and evolution of different crop species like Cotton, Wheat, Tobacco, Triticale and Brassicas; Structural chromosomal aberrations.

Classification of plants, Botanical description, Floral biology, Emasculation and Pollination techniques in cereals, millets, pulses, oil seeds, fibers, plantation crops etc. Aims and objectives of Plant Breeding; Modes of reproduction, Sexual, Asexual, Apomixis and their classification; Significance in plant breeding; Modes of pollination, genetic consequences, differences between self and cross pollinated crops; Methods of breeding –introduction and acclimatization. Selection, Mass selection Johansson's pure line theory, genetic basis, pure line selection; Hybridization, Aims and objectives, types of hybridization; Methods of handling of segregating generations, pedigree method, bulk method, back cross method and various modified methods; Incompatibility and male sterility and their utilization in crop improvement; Heterosis, inbreeding depression, various theories of Heterosis, exploitation of hybrid vigour development of inbred lines, single cross and double cross hybrids; Population improvement programmes, recurrent selection, synthetics and composites; Methods of breeding for vegetatively propagated crops; Clonal selection; Mutation breeding; Ploidy breeding; Wide hybridization, significance in crop improvement.

Crop Physiology

Introduction, Importance in Agriculture. Seed Physiology, Seed structures, Morphological, physiological and biochemical changes during seed development, Physiological maturity – Morphological and physiological changes associated with physiological maturity in crop, Harvestable maturity, Seed viability and vigour, Factors affecting seed viability and vigour. Methods of testing seed viability and vigour, Germination, Utilization of seed reserves during seed germination, Morphological, physiological and biochemical changes during seed germination, Factors affecting seed germination. Growth and Development, Definition, Determinate and Indeterminate growth, Monocarpic and Polycarpic species with examples. Measurement of growth, Growth analysis Growth characteristics, Definitions and mathematical formulae. Crop Water Relations, Physiological importance of water to plants, Water potential and its components, measurement of water status in plants. Transpiration, significance, Transpiration in relation to crop productivity, Water Use Efficiency, WUE in C3, C4 and CAM

plants, Factors affecting WUE. Photosynthesis, Energy synthesis, Significance of C3, C4 and CAM pathway, Relationship of Photosynthesis and crop productivity, Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, Source and sink concept, Photorespiration, Factors affecting Photosynthesis and productivity, Methods of measuring photosynthesis, Photosynthetic efficiency, Dry matter partitioning, Harvest index of crops. Respiration and its significance, Brief account of Growth respiration and maintenance respiration, Alternate respiration – Salt respiration – wound respiration – measurement of respiration. Nutriophysiology – Definition – Mengel’s classification of plant nutrients – Physiology of nutrient uptake – Functions of plant nutrients – Deficiency and toxicity symptoms of plant nutrients – Foliar nutrition – Hydroponics. Introduction of Photoperiodism and Vernalisation in relation to crop productivity – Photoperiodism Plant Growth Regulators – Occurrence – Biosynthesis – Mode of action of Auxins, Gibberellins, Cytokinins, ABA, Ethylene. Novel plant growth regulators, Commercial application of plant growth regulators in agriculture. Senescence and abscission – Definition – Classification – Theories of mechanism and control of senescence – Physiological and biochemical changes and their significance. Post Harvest Physiology – Seed dormancy – Definition – types of seed dormancy – Advantages and disadvantages of seed dormancy – Causes and remedial measures for breaking seed dormancy, Optimum conditions of seed storage – Factors influencing seed storage (ISTA standards). Fruit ripening – Metamorphic changes – Climateric and non-climateric fruits – Hormonal regulation of fruit ripening (with ethrel, CCC, Polaris, paclobuterozole).

Principles of Seed Technology

Introduction & Importance of Seed Production, Seed policy, Seed demand forecasting and planning for certified, foundation and breeder seed production, Deterioration of crop varieties, Factors affecting deterioration and their control; Maintenance of genetic purity during seed production, Seed quality; Definition, Characters of good quality seed, Different classes of seed, Production of nucleus & breeder’s seed, Maintenance and multiplication of pre-release and newly released varieties in self and cross-pollinated crops; Seed Production, Foundation and certified seed production in maize (varieties, hybrids, synthetics and composites); rice (varieties & hybrids); cotton and sunflower (varieties and hybrids); tomato, brinjal (varieties and hybrids), chillies and bhendi (varieties and hybrids) onion, bottle gourd and ridge gourd /Sponge gourd varieties and hybrids); Seed certification, phases of certification, procedure for seed certification, field inspection and field counts etc.; Seed Act and Seed Act enforcement, Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories; Duties and powers of seed inspectors, offences and penalties; Seed control order: Seed Control Order 1983, Seed Act 2000 and other issues related to seed quality regulation. Intellectual Property Rights, Patenting, WTO, Plant Breeders Rights, Varietal Identification through Grow-Out Test and Electrophoresis; Seed Drying: Forced air seed drying,

principle, properties of air and their effect on seed drying, moisture equilibrium between seed and air, Heated air drying, building requirements, types of air distribution systems for seed drying, selection of crop dryers and systems of heated air drying, recommended temperature and depth of the seeds, management of seed drying, Planning and layout of seed processing plant; Establishment of seed processing plant. Seed processing: air screen machine and its working principle, different upgrading equipments and their use, Establishing a seed testing laboratory. Seed testing procedures for quality assessment, Seed treatment, Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist-O-matic treater), Seed packing and seed storage, stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage, General principles of seed storage, constructional features for good seed warehouse, measures for pest and disease control, temperature control, Seed marketing, marketing structure, marketing organization, sales generation activities, promotional media, pricing policy; Factors affecting seed marketing.

History, concept, role and aim of Seed Technology. Seed –Definition, Types, Characteristics of good seed. Difference between seed and grain. Seed development programme – Basis of seed programme, Types of seed programme, National seed programme. Role of following agencies in the development of India seed Industry – National Seed Corporation, State Farm Corporation, Tarai Development Corporation. Structure of flower. Microsporangium, microsporogenesis and development of male gametophyte. Megasporangium, megasporogenesis and development of female gametophyte (polygonum type). Pollination. Fertilization and Apomixis. Development of Embryo, Endosperm and Fruit.

Farming Systems and Sustainable Agriculture

Farming system- definition, principles advantages and components. Factors affecting farming system. Farming system model for rainfed and irrigated situations. Crop diversification- definition, scope and advantages. Sustainable agriculture- Introduction, definition, goal and current concepts, factors affecting sustainable agriculture. Judging the agricultural sustainability by ecological, economical and social means. Land, water and crop production related problems and its management for sustainable agriculture. Problems and technologies developed for High External Input Agricultural (HEIA) and Low External Input Agriculture (LEIA) areas in India.

Rainfed Agriculture

Rainfed farming : Definition, importance and Charactersitics. Dry farming : Definition, importance and extent. Factors affecting crop production under rainfed and dry farming areas – Climatic factor, Soil Factors, Plant factors and management factors. Management of rainfed and dryland farming – Water management, Soil management, Crop management, Efficient crop and

verities for the region, Organic and bio fertilizer management and Social management. Important cropping system.

Technology for dryland farming – Agronomical methods of water conservation, Tillage, Mulching, contouring, Trenching and pitting, Terracing, Waterways, Farm ponds Crop planning based on storage moisture capacity of the soils and moisture availability period land use capability classification. Moisture conservation practices to increase infiltration and reduce water losses and runoff, Runoff collection and its effective utilization for crops and cropping systems. Contingent plans for aberrant weather conditions, moisture stress, drought, excess moisture etc.

Introductory Nematology

Introduction: History of phytonematology. Economic importance. General characteristics of plant pathogenic nematodes. Nematode general morphology and biology. Classification of nematodes upto family level with emphasis on groups containing economically important genera. Classification of nematodes by habitat. Identification of economically important plant nematodes upto generic level with the help of keys and description. Symptoms caused by nematodes with examples. Study of White tip of paddy, ear cockle of wheat, root knot of tomato & brinjal .Interaction between plant parasitic nematodes and disease causing fungi, bacteria and viruses. Different methods of nematode management. Cultural methods (crop rotation, fallowing, soil amendments, other land management techniques), physical methods (soil solarisation, hot water treatment) Biological methods, Chemical methods (fumigants, non fumigants). Resistant varieties. IDM.

Plant Pathogens and Principles of Plant Pathology

Introduction, Important plant pathogenic organisms, different groups, fungi, bacteria, fastidious vesicular bacteria, phytoplasmas, spiroplasmas, viruses, virioids, algae, protozoa and phanerogamic parasites with examples of diseases caused by them. General Characters of fungi, Definition of fungus, somatic structures, types of fungal thalli, fungal tissues, modifications of thallus, reproduction in fungi (asexual and sexual). Nomenclature, Binomial system of nomenclature, rules of nomenclature. Classification of fungi and bacteria. Key to divisions and sub-divisions. Introduction: Definition and objectives of Plant Pathology. History of Plant Pathology. Terms and concepts in Plant Pathology. Survival and Dispersal of Plant Pathogens. Phenomenon of infection – pre-penetration, penetration and post penetration. Pathogenesis. Defense mechanism in plants– Structural and Bio-chemical (pre and post-infection). Plant disease epidemiology. Plant Disease Forecasting – Remote sensing – General principles of plant diseases management –Importance, general Principles – Avoidance, exclusion, protection – Plant Quarantine and Inspection – Quarantine Rules and Regulations. Cultural methods – Rouging, eradication of alternate and collateral hosts, crop rotation, manure and fertilizer management,

mixed cropping, sanitation, hot weather ploughing, soil amendments, time of sowing, seed rate and plant density, irrigation and drainage. Role and mechanisms of biological control and PGPR. Physical Methods – Heat and Chemical methods – Methods of application of fungicides. Host plant resistance. Integrated plant disease management (IDM) – Concept, advantages and importance.

Field Crop Diseases and Management

Economic importance, symptoms, cause, epidemiology and disease cycle and integrated management of diseases of rice (blast, brown spot, sheath blight bacterial blight), sorghum (smuts), bajra (green ear, ergot), maize (leaf blight) wheat (rusts, loose smut karnal bunt), sugarcane (red rot, whip smut), turmeric (leaf spot), tobacco (mosaic), groundnut (leaf spot, rust, bud necrosis), sesamum (phyllody), sunflower (head rot, alternaria blight) mustard (white rust, leaf spot) linseed (powdery mildew, rust wilt), cotton (angular leaf spot, wilt) redgram (wilt, sterility mosaic), bengalgram (wilt collar rot, root rot), blackgram (powdery mildew, mosaic), greengram (powdery mildew, yellow mosaic, leaf spot) pea (rust, powdery mildew), and soybean (bacterial pustule, yellow mosaic bud necrosis).

Weed Management

Weeds: Introduction, harmful and beneficial effects, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy (crop weed interference). Concepts of weed prevention, control and eradication; Methods of weed control: physical, cultural, chemical and biological methods. Integrated weed management; Herbicides: advantages and limitation of herbicide usage in India, Herbicide classification, formulations, methods of application; Introduction to Adjuvants and their use in herbicides; herbicide absorption, movement/translocation in soil and plants. Mode of action and mechanism of action of herbicides- definition and differences. Introduction to selectivity of herbicides; Compatibility of herbicides with other agro chemicals; Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic and problematic weeds and their control. Indices of weeds and weed management.