Course contents of M. Sc. (Hort.)
in
Plantation, Spices, Medicinal and Aromatic Crops

Course Title: Production of Plantation Crops

Course code: PSM - 501 **Credit Hours:(2+1)**

I. Theory

Block 1: Importance of Plantation Crops

Unit 1: Role of plantation crops: Role of plantation crops in national economy, area-production statistics at national and international level, classification, clean development mechanism and carbon sequestration potential of plantation crops.

Unit 2: Export potential: Export potential, problems and prospects and IPR issues in plantation crops.

Unit 3: Promotional programmes: Role of commodity boards and directorates in the development programmes of plantation crops.

Block 2: Production Technology

Unit 1: Varietal wealth: Botany, taxonomy, species, cultivars and improved varieties in plantation crops

Unit 2: Propagation and nursery management: Plant multiplication including in-vitro multiplication, nursery techniques and nursery management in plantation crops.

Unit 3: Agro techniques: Systems of cultivation, cropping systems, multitier cropping, climate and soil requirements, systems of planting, high density planting, nutritional requirements, water requirements, fertigation, moisture conservation, role of growth regulators, macro and micro nutrients, nutrient deficiency symptoms, physiological disorders, shade regulation, weed management, training and pruning, crop regulation, plant protection, management of drought, precision farming.

Block 3: Harvest and Post-harvest management

Unit 1: Maturity indices and harvest: Maturity indices, harvesting methods, harvesting seasons and mechanized harvesting in plantation crops.

Unit 2: Post harvest management: Post harvest handling including primary processing, grading, packaging, storage and benefit cost analysis of plantation crops.

Crops: Coconut, Arecanut, Oil palm, Cashew, Coffee, Tea, Cocoa, Rubber, Palmyrah, Betel vine

II. Practical

Description of botanical and varietal features;
Selection of mother palms and seedlings;
Nursery techniques;
Soil and water conservation measures;
Nutrient deficiency symptoms;

Course Title: Production of Spice Crops

Course Code: PSM-502 **Credit Hours: 2+1**

I. Theory:

Block 1: Importance of spice crops

Unit 1: Role of Spice crops: Introduction, importance of spice crops, pharmaceutical significance, historical accent, present status – national and international, future prospects, role of Spices board and other development agencies.

Unit 2: Classification of spice crops: Major spices, minor spices, seed spices, tree spices, herbal spices.

Block 2: Production Technology

Unit 1: Varietal wealth: Botany and taxonomy, species, cultivars, commercial varieties/ hybrids in spice crops.

Unit 2: Propagation and nursery management: Seed, vegetative and micropropagation methods, nursery techniques and nursery management practices.

Unit 3: Agro techniques: Climatic and soil requirements, site selection, layout, sowing/ planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercropping, mixed cropping, intercultural operations, weed control, mulching, plant protection, precision farming, physiological disorders, protected cultivation.

Block 3: Harvest and Post-harvest management

Unit 1: Maturity indices and harvest: Maturity indices, harvesting methods, harvesting seasons, mechanized harvesting.

Unit 2: Post-harvest management: Post-harvest management including primary processing, grading, packaging and storage, GMP in major spice crops.

Crops: Black pepper, small and large Cardamom, Turmeric, Ginger, Garlic, Coriander, Fenugreek, Cumin, Fennel, Ajwain, Saffron, Vanilla, Nutmeg, Clove, Cinnamon, All spice, Tamarind, Garcinia

II. Practical

Identification of seeds and plants;
Botanical description of plant;
Varietal features;
Planting material production;
Field layout and method of planting;
Cultural practices;
Harvest maturity, harvesting;
Drying, storage, packaging;
Primary processing;
GAP in spice crops;
GMP in spice crops;
Short term experiments on spice crops;
Exposure visits to Spice farms and research institute

Course Title: Production of Medicinal and Aromatic Crops

Course code: PSM-503 **Credit Hours: 2+1**

I. Theory:

Block 1: Importance of Medicinal and Aromatic Crops

Unit 1: Classification of medicinal and aromatic crops: Importance of medicinal plants, Importance of aromatic plants, Role in national economy, utility sectors of medicinal and aromatic crops, classification of medicinal and aromatic crops, role of institutions, Medicinal Plant Board and NGO's in research and development of medicinal and aromatic crops.

Unit 2: Medicinal and plant-based industry: Indian system of medicine, traditional systems of medicine, tribal medicine, medicinal industry, source of medicinal plants, area, production, export and import of major crops, problems, prospects and challenges, IPR issues.

Unit 3: Aromatic plant-based industry: Essential oils, classification, physical and chemical properties and storage of essential oils. Indian perfumery industry, area, production, export and import status of major aromatic crops, history and advancements, problems, prospects and challenges, IPR issues.

Block 2: Production technology of medicinal and aromatic crops

Unit 1: Varietal wealth: Botany and taxonomy, species, cultivars, commercial varieties/hybrids in medicinal and aromatic crops.

Unit 2: Propagation and nursery management: Seed, vegetative and micropropagation methods, nursery techniques and nursery management practices.

Unit 3: Agro techniques: Climatic and soil requirements, site selection, layout, sowing/ planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, inter cropping, mixed cropping, intercultural operations, weed control, mulching, plant protection.

Block 3: Harvest and Post-harvest management

Unit 1: Maturity indices and harvest: Maturity indices, harvesting methods, harvesting seasons in medicinal and aromatic crops.

Unit 2: Post-harvest management: Post-harvest management including primary processing, extraction, grading, packaging and storage, GMP in medicinal and aromatic crops.

Crops:

Medicinal crops: Senna, periwinkle, medicinal coleus, aswagandha, glory lily, sarpagandha, *Dioscorea sp., Aloe vera, Andrographis paniculata,* Digitalis, medicinal solanum, isabgol, opium poppy, safed musli, *Stevia rebaudiana, Mucuna pruriens, Piper longum, Plumbago zeylanica*

Aromatic crops: Palmarosa, lemon grass, citronella, vetiver, mentha, patchouli, sweet flag, jasmine, geranium, artemisia, lavender, Ocimum sp., eucalyptus, sandal

II. Practical

Description of botanical and varietal features;
Nursery techniques;
Layout and planting;
Manuring practices;
Maturity standards;
Harvesting;
Primary processing;
Extraction of oils;
Herbarium preparation;
Project preparation for establishing herbal gardens;
GAP in medicinal and aromatic crops;
GMP in medicinal and aromatic crops;
Exposure visits to institutes, herbal gardens and industries.

Course title: Breeding of Plantation and Spice Crops

Course code: PSM-504 **Credit Hours: 2+**

I. Theory

Block 1: Genetic diversity

Unit 1: Species and cultivar diversity: Floral and reproductive biology, cytogenetics, ma sterility, incompatibility, wild and cultivated species, popular cultivars.

Unit 2: Germplasm evaluation: Survey, collection, conservation and evaluation germplasm.

Block 2: Crop improvement

Unit 1: Breeding objectives: Breeding objectives/goals on the basis of yield, quality, stre tolerance, adaptation.

Unit 2: Breeding methods: Approaches for crop improvement, introduction, selecti hybridization, mutation breeding, polyploidy breeding, improvement of quality trai resistance breeding for biotic and abiotic stresses.

Block 3: Breeding achievements and future thrusts

Unit 1: Breeding achievements: Breeding achievements in terms of Released varieties, parentage, salient features.

Unit 2: Future thrusts: Molecular breeding and biotechnological approaches, marker-assisted selection, bioinformatics, breeding for climate resilience

Crops:

Plantation crops: Coconut, Arecanut, Cashew, Cocoa, Rubber, Oil palm, Coffee, Tea, Palmyrah, Betel vine

Spice crops: Black pepper, small and large cardamom, Ginger, Turmeric, Fenugreek, Coriander, Fennel, Cumin, Ajwain, Garlic, Nutmeg, Cinnamon, Clove, All spice, Garcinia, Tamarind

II. Practical

Characterization and evaluation of germplasm;
Floral biology, anthesis; pollen behaviour, fruitset;
Practices in hybridization, selfing and crossing techniques;
Polyploidy breeding;
Mutation breeding;
Induction of somaclonal variation and screening the variants;
Evaluation of biometrical traits and quality traits;
Salient features of improved varieties and cultivars;
Screening for biotic and abiotic stresses;

Course Title: Breeding of Medicinal and Aromatic Crops

Course Code: PSM-505 **Credit Hours:1+1**

I. Theory

Block 1: Genetic diversity

Unit 1: Species and cultivar diversity: Floral and reproductive biology, cytogenetics, Male sterility, incompatibility, wild and cultivated species, popular cultivars.

Unit 2: Germplasm evaluation: Survey, collection, conservation and evaluation of germplasm, IPR issues.

Block 2: Crop improvement

Unit 1: Breeding objectives: Breeding problems in medicinal and aromatic crops. Genetics of active principles, breeding objectives/ goals on the basis of yield, quality, stress tolerance, adaptation.

Unit 2: Breeding methods: Approaches for crop improvement, introduction, selection, hybridization, mutation breeding, polyploidy breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses.

Unit 1: Breeding achievements: Breeding achievements in terms of released varieties, parentage, salient features.

Unit 2: Future thrusts: Molecular breeding and biotechnological approaches, marker-assisted selection, bioinformatics, breeding for climate resilience.

Course title: Growth and Development of Plantation, Spice, Medicinal and Aromatic Crops

Course code: PSM-509 **Credit Hours: 2+1**

Theory

Block 1: Growth, development, assimilate partitioning and plant bioregulators

Unit 1: Stages of growth: Growth and development, definitions, components, photosynthetic productivity, different stages of growth, growth curves, growth analysis, morphogenesis in PSMAs.

Unit 2: Growth pattern in annual,semi-perennial and perennial crops, growth dimorphism, environmental impact on growth and development: effect of light, temperature, photoperiod.

Unit 3: Assimilate partitioning: Assimilate partitioning during growth and development, influence of water and mineral nutrition.

Block 2: Canopy management

Unit 1: Canopy management: Canopy management for conventional and high density planting: pruning, training, chemicals, crop regulation for year round and off season production in PSMAs.

Unit 2: Plant bioregulators: plant bioregulators-auxins, gibberellins, cytokinins, ethylene, inhibitors and retardants, basic functions, biosynthesis and role in crop growth and development.

Unit 1: Vegetative phase: Developmental physiology and biochemistry during dormancy, bud break, juvenility.

Unit 2: Flowering and fruit set, Physiology of flowering, photoperiodism, vernalisation, effect of temperature, heat units, thermoperiodism, pollination, fertilisation, fruit set, fruit drop, fruit growth, ripening, seed development in PSMAs.

Unit 3: Growth and Development process during stress: Growth and development process during stress, production of secondary metabolites, molecular and genetic approaches in growth and development.

II. Practical

Dormancy mechanisms in seeds, seed rhizomes;
Techniques of growth analysis;
Evaluation of photosynthetic efficieney under different environments;
Technologies for crop regulation in cashew, coffee, cocoa, etc.;
Root shoot studies, flower thinning, fruit thinning;
Crop regulation for year-round production;
Use of growth regulators in PSMA crops.

Course Title: Biochemistry of Plantation, Spices, Medicinal and Aromatic Crops
Course Code: PSM-510 **Credit Hours: 2+1**
I. Theory

Block 1: Post-harvest physiology

Unit 1: Physiological and biochemical changes: Maturity indices, changes during ripening, processing, factors affecting quality. Secondary metabolites and their biosynthetic pathways, factors affecting production of secondary metabolites.

Unit 2: Contaminants: Adulterants, and substitutes, sourcesof contamination-microbial, heavy metal, pesticide residues in PSMAs.

Block 2: Value addition

Unit 1: Value added products: Fixed oils, essential oils, dyes, oleoresins, aroma chemicals and other value-added products, their content, storage, medicinal and pharmacological properties, use in the food, flavour perfumery and pharmaceutical industries.

Unit 2: Quality standards: Quality standards of raw materials and finished products.

Block 3: Extraction techniques

Unit 1: Extraction methods: Basic and advanced extraction techniques in PSMAs-Soxhlet, SCFE, Membrane extraction. Chemical characterization- HPTLC, GCMS, LCMS, NMR.

Unit 2: Plant tissue culture: Plant tissue cultures in the industrial production of bioactive plant metabolites. Cell suspension culture systems for large scale culturing of plant cells and production of secondary metabolites. Advantages of cell culture over conventional extraction techniques

II. Practical
Biochemical characterisation;
Detection of adulterants and substitutes;
Extraction and quantification of secondary metabolites;
Chromatographic separation of the products;
Quality assurance;
Testing the product;
Exposure visit to leading industries;

Course title: Processing of Plantation, Spices, Medicinal and Aromatic Crops
Course code: PSM – 512 **Credit Hours: 2 + 1**

I. Theory:

Block 1: Plantation Crops

Unit 1: Introduction, Developments in processing of Plantation crops, Principles and practices of post-harvest technology and Unit operations involved in processing of Plantation crops, commercial uses, Quality of raw materials and its impact on final product, Steps in processing of major products and by products, value addition, grading, storage and packaging of the products from plantation crops.

Crops: coconut, arecanut, cashew nut, oil palm, palmyrah, cocoa, tea, coffee, rubber, betel vine etc.

Block 2: Spice Crops

Unit 1: Major Spices, Commercial uses of major spice crops. Processing of major spices, Methods of drying and types of dryers used for drying of spices. Composition of spices and extraction of oleoresin and essential oils.

Crops: cardamom, black pepper, ginger, turmeric, chilli and paprika

Unit 2: Minor, Seed and Tree Spices, Commercial uses of spice crops. Steps in processing of different spices, Factors affecting quality of processed spices, Composition of spices.

Crops: vanilla, cinnamon, clove, nutmeg, allspice, coriander, fenugreek, curry leaf

Block 3: Medicinal and Aromatic Crops

Unit 1: Medicinal Crops, Processing of medicinal plants - Different methods of drying, grading and storage. Factors of drying and storage affecting the quality of product. Contamination of stored processed product. Influence of storage duration and temperature on active principles. Value added products of medicinal plants.

Crops: Dioscorea, Gloriosa, Stevia, Coleus, Ashwagandha, Tulsi, Isabgol, Safed Musli, Senna, Aloe, Catharanthus, etc.

Unit 2: Aromatic Crops, Distillation, solvent extraction from aromatic plants. Study of aroma compounds and value addition. Nano-processing technology in value addition aromatic plants.
Crops: Davana, mint, rosemary, rose, citronella, lavender, jasmine, etc

II. Practical:
Study of processing of different plantation crops and storage and the machineries/equipment used.
Different consumable products and value-added products from plantation crops.
Study of processing of different spices.
Study of processing of medicinal plants, their drying and storage.