

Fruits and Orchard Management

M.Sc. Programme

Course No.	Title of the Courses	Credits
1st Semester		
FSC 501	Propagation and Nursery Management for Fruit Crops	2+1
FSC 502	Canopy Management in Fruit Crops	2+1
FSC 503	Biodiversity and Conservation of Fruit Crops	2 +1`
FSC 504	Growth and Development of Fruit Crops	2 + 1
FSC 505	Nutrition of Fruit Crops	1 + 1
2nd Semester		
FSC 551	Tropical Fruit Production	1+1
FSC 552	Subtropical Fruit Production	1 +1
FSC 553	Temperate Fruit Production	1+1
FSC 554	Breeding of Fruit Crops	2 +1
3rd Semester		
FSC 601	Air and Dry Land Fruit Management	1 +1
FSC 602	Biotechnology of Fruit Crops	2+1
FSC 603	Organic Fruit Culture	1+1
*FSC 604	Protected Fruit Culture	2+1
FSC 649	Seminar I	1+0
4th Semester		
*FSC 651	GAP for Fruit Crops	1+0
FSC 699	Seminar II	1+0
FSC 700	Master's Research	0+20

* Courses are optional

Department of Fruits and Orchard Management

M. Sc. Programme

FSC 501 Propagation and Nursery Management for Fruit Crops 2+1

UNIT :I Introduction, life cycles in plants, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras. Principles factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth

UNIT II: Seed quality, treatment, packing, storage, certification, testing. Asexual propagation – rooting of soft and hard wood cutting under mist by growth regulators. Rooting of cuttings in hotbeds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering – principle and methods.

UNIT III: Budding and grafting – selection of elite mother plants, methods. Establishment of bud wood bank, stock, scion and inter stock, relationship – Incompatibility. Rejuvenation through top working – Progeny orchard and scion bank.

UNIT IV: Micro-propagation – principles and concepts, commercial exploitation in horticultural crops. Techniques - in vitro clonal propagation, direct organogenesis, embryogenesis, micrografting, meristem culture. Hardening, packing and transport of micro-propagules.

UNIT V: Nursery – types, structures, components, planning and layout. Nursery management practices for healthy propagule production.

Practical: Anatomical studies in rooting of cutting and graft union, construction of propagation structures, study of media and PGR. Hardening – case studies, micropropagation, explant preparation, media preparation, culturing –in vitro clonal propagation, meristem culture, shoot tip culture, axillary bud culture, direct organogenesis, direct and indirect embryogenesis, micro grafting, hardening. Visit to TC labs and nurseries.

FSC 502 Canopy Management in Fruit Crops 1+1

UNIT I: Canopy management - importance and advantages; factors affecting canopy development.

UNIT II: Canopy types and structures with special emphasis on geometry of planting, canopy manipulation for optimum utilization of light. Light interception and distribution in different types of tree canopies.

UNIT III: Spacing and utilization of land area - Canopy classification; Canopy management through rootstock and scion.

UNIT IV: Canopy management through plant growth inhibitors, training and pruning and management practices.

UNIT V: Canopy development and management in relation to growth, flowering, fruiting and fruit quality in temperate fruits, grapes, passion fruits, mango, sapota, guava, citrus and ber.

Practical: Study of different types of canopies, training of plants for different canopy types, canopy development through pruning, use of plant growth inhibitors, geometry of planting; study on effect of different canopy types on production and quality of fruits.

FSC 503 Biodiversity and Conservation of Fruit Crops 2+1

UNIT I: Biodiversity and conservation; issues and goals, centers of origin of cultivated fruits; primary and secondary centers of genetic diversity.

UNIT II: Present status of gene centers; exploration and collection of germplasm; conservation of genetic resources – conservation *in situ* and *ex situ*.

UNIT III: Germplasm conservation- problem of recalcitrancy - cold storage of scions, tissue culture, cryopreservation, pollen and seed storage; inventory of germplasm, introduction of germplasm, plant quarantine.

UNIT IV: Intellectual property rights, regulatory horticulture. Detection of genetic constitution of germplasm and maintenance of core group.

UNIT V: GIS and documentation of local biodiversity, Geographical indication.

Crops: Mango, sapota, citrus, guava, banana, papaya, grapes, jackfruit, custard, apple, ber, aonla, *Prunus* sp, litchi and nuts.

Practical: Documentation of germplasm – maintenance of passport data and other records of accessions; field exploration trips, exercise on *ex situ* conservation – cold storage, pollen/seed storage, cryopreservation, visits to National Gene Bank and other centers of PGR activities. Detection of genetic constitution of germplasm, core sampling, germplasm characterization using molecular techniques.

FSC 504 Growth and Development of Fruit Crops 2+1

UNIT I: Growth and development- definition, parameters of growth and development, growth dynamics, morphogenesis.

UNIT II: Annual, semi-perennial and perennial horticultural crops, environmental impact on growth and development, effect of light, photosynthesis and photoperiodism vernalisation, effect of temperature, heat units, thermoperiodism.

UNIT III: Assimilate partitioning during growth and development, influence of water and mineral nutrition during growth and development, biosynthesis of auxins, gibberellins, cytokinins, abscissic acid, ethylene, brassinosteroids, growth inhibitors, morphactins, role of plant growth promoters and inhibitors.

UNIT IV: Developmental physiology and biochemistry during dormancy, bud break, juvenility, vegetative to reproductive interphase, flowering, pollination, fertilization and fruit set, fruit drop, fruit growth, ripening and seed development.

UNIT V: Growth and developmental process during stress - manipulation of growth and development, impact of pruning and training, chemical manipulations in horticultural crops, molecular and genetic approaches in plant growth development.

Practical: Understanding dormancy mechanisms in seeds, tubers and bulbs and stratification of seeds, tubers and bulbs, visit to arid, subtropical and temperate horticultural zones to identify growth and development patterns, techniques of growth analysis, evaluation of photosynthetic efficiency under different environments, study of growth regulator functions, hormone assays, understanding ripening phenomenon in fruits and vegetables, study of impact of physical manipulations on growth and development, study of chemical manipulations on growth and development, understanding stress impact on growth and development.

FSC 505 Nutrition of Fruit Crops 1+1

Brief study of physiological processes involved in uptake of plant nutrients from the soil and from foliar spray. Role of different nutrient elements in plants with special references to fruit crops. Effects of deficiencies and toxicity of nutrients in fruit plants and visual symptoms produced. Methods of determining nutrient requirements. Mechanism of nutrient movement and accumulation in plants. Critical nutrient content in different stages of growth. Foliar analysis and its significance in fruit crops.

Practical: Collection of leaf and soil samples for nutrient estimation. Estimation of soil pH, estimation of leaf and soil nitrogen, phosphorus, potassium, calcium and magnesium. Studies on deficiency symptoms of citrus banana, mango and litchi. Leaf nutrient standards using DRIS norms. Yields forecasting following the leaf nutrient standards.

FSC 551 Tropical Fruit Production 1+1

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bioregulators in crop regulation and growth manipulation, abiotic factors limiting fruit production, flowering and physiology of flowering, pollination fruit set and development, honeybees in cross pollination, physiological disorders- causes and remedies, quality improvement by management practices; fruit drop, maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones(AEZ) and industrial supports.

Crops

UNIT I: Mango and Banana

UNIT II: Citrus, Papaya and Mangosteen

UNIT III: Guava, Sapota and Jackfruit

UNIT IV: Pineapple, Passion fruit and Rambutan

Practical: Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to tropical and humid tropical orchards, Project preparation for establishing commercial orchards.

FSC 552 Subtropical Fruit Production 1+1

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, bioregulation in crop regulation and growth manipulation abiotic factors limiting fruit production, flowering and physiology of flowering, fruit set and development, abiotic factors limiting production, physiological disorders-causes and remedies, quality improvement by management practices; fruit drop, maturity indices, harvesting, grading, packing, pre-cooling, storage, transportation and ripening techniques; industrial and export potential, Agri Export Zones(AEZ) and industrial support.

Crops

UNIT I: Litchi, longan and loquat.

UNIT II: Grapes, Strawberry and Avocado.

UNIT III: Persimmon, Carambola and Jalpai.

Practical: Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to subtropical fruit orchards, Project preparation for establishing commercial orchards.

FSC 553 Temperate Fruit Production 1+1

Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, bioregulation in crop regulation and growth manipulation abiotic factors limiting fruit production, physiology of flowering, fruit set and development, abiotic factors limiting production, physiological disorders-causes and remedies, quality improvement by management practices; fruit drop, maturity indices, harvesting, grading, packing, precooling, storage, transportation and ripening techniques; industrial and export potential, Agri Export Zones(AEZ) and industrial support.

Crops

UNIT I: Apple, pear, quince and olive.

UNIT II: Plums, peach, apricot, cherries, hazelnut.

UNIT III: Nuts-walnut, almond, pistachio, pecan

Practical: Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to temperate fruit orchards, Project preparation for establishing commercial orchards.

FSC 554 Breeding of Fruit Crops 2+1

Origin and distribution, taxonomical status - species and cultivars, cytogenetics, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement -introduction, selection, hybridization, mutation breeding, polyploidy breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions, achievements and future thrust in the following selected fruit crops.

Crops

UNIT I : Mango, banana and pineapple.

UNIT II: Citrus, grapes, guava and sapota.

UNIT III: Jackfruit, papaya, custard apple, aonla, avocado and ber

UNIT IV: Mangosteen, litchi, jamun, phalsa, mulberry, raspberry, kokam and nuts

UNIT V : Apple, pear, plums, peach, apricot, cherries and strawberry

Practical: Characterization of germplasm, blossom biology, study of anthesis, estimating fertility status, practices in hybridization, ploidy breeding, mutation breeding, evaluation of biometrical traits and quality traits, screening for resistance, developing breeding programme for specific traits, visit to research stations working on tropical, subtropical and temperate fruit improvement

FSC 601 Arid and Dry Land Fruit Production 1+1

Characteristics features of arid zone and dryland area. Major problems and constraints of fruit production in arid and dry land zones. Features of fruit trees suitable for cultivation in arid and dry land zones. Commercial varieties of regional, national and international importance, ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping systems, root zone and canopy management, nutrient management, water management, fertigation, role of bioregulators in crop regulation and growth manipulation abiotic factors limiting fruit production, physiology of flowering, pollination fruit set and development, honeybees in cross pollination, physiological disorders- causes and remedies, quality improvement by management practices; fruit drop, maturity indices, harvesting, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones(AEZ) and industrial supports.

Crops

UNIT I: Pomegranate and Ber

UNIT II: Annonas and Jamun

UNIT III: Fig, Bael and wood apple

UNIT IV: Phalsa and Aonla

Practical: Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analyses of quality attributes, visit to dry land orchards , Project preparation for establishing commercial orchards.

FSC 602 Biotechnology of Fruit Crops 2+1

UNIT I: Harnessing bio-technology in fruit crops, influence of plant materials, physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture.

UNIT II: Callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis.

UNIT III: Use of bioreactors and in vitro methods for production of secondary metabolites, suspension culture, nutrition of tissues and cells, regeneration of tissues, ex vitro, establishment of tissue cultured plants.

UNIT IV: Physiology of hardening - hardening and field transfer, organ culture –meristem, embryo, anther, ovule culture, embryo rescue, somaclonal variation, protoplast culture and fusion.

UNIT V: Construction and identification of somatic hybrids and cybrids, wide hybridization, In vitro pollination and fertilization, haploids, in vitro mutation, artificial seeds, cryopreservation, rapid clonal propagation, genetic engineering in horticulture crops, use of molecular markers. In vitro selection for biotic and abiotic stress, achievements of biotechnology in fruit crops.

Practical: An exposure to low cost, commercial and homestead tissue culture laboratories, media preparation, inoculation of explants for clonal propagation, callus induction and culture, regeneration of plantlets from callus, sub-culturing, techniques on anther, ovule, embryo culture, somaclonal variation, in vitro mutant selection against abiotic stress, protoplast culture, fusion technique, development of protocols for mass multiplication, project development for establishment of commercial tissue culture laboratory.

FSC 603 Organic Fruit Culture 1+1

UNIT I: Organic fruit culture – definition, synonyms and misnomers, principles, methods, merits and demerits.

UNIT II: Organic farming systems, components of organic horticultural systems, different organic inputs, their role in organic fruit culture, role of biofertilizers, biodynamics and the recent developments.

UNIT III: EM technology and its impact in organic fruit culture, indigenous practices of organic farming, sustainable soil fertility management, weed management practices in organic farming, biological/natural control of pests and diseases, organic horticulture in quality improvement.

UNIT IV: GAP - Principles and management, HACCP exercise, certification of organic products and systems, agencies involved at national and international levels, standards evolved by different agencies.

UNIT V: Constraints in certification, organic fruit culture and export, IFOAM and global scenario of organic movement, post-harvest management of organic produce.

Practical: Features of organic orchards, working out conversion plan, Input analysis-manures, nutrient status assessment of manures, biocomposting, biofertilizers and their application, panchagavya preparation and other organic nutrients application, methods of preparation of compost, vermicompost,

green manuring, preparation of neem products and application, BD preparations and their role, EM technology and products, biological/natural control of pests and diseases, soil solarization, frame work for GAP, case studies, HACCP analysis, residue analysis in organic products, documentation for certification, visit to fields cultivated under organic practices

***FSC 604 Protected Fruit Culture 2+1**

UNIT I: Greenhouse – World scenario, Indian situation: present and future, Different agro-climatic zones in India, Environmental factors and their effects on plant growth.=

UNIT II: Basics of greenhouse design, different types of structures – glasshouse, shade net, poly tunnels - Design and development of low cost greenhouse structures.

UNIT III: Interaction of light, temperature, humidity, CO₂, water on crop regulation -Greenhouse heating, cooling, ventilation and shading.

UNIT IV: Types of ventilation- Forced cooling techniques - Glazing materials – Micro irrigation and Fertigation.

UNIT V: Automated greenhouses, microcontrollers, waste water recycling, Management of pest and diseases – IPM.

Practical: Designs of greenhouse, low cost poly tunnels, nethouse- Regulation of light, temperature, humidity in greenhouses, media, greenhouse cooling systems, ventilation systems, fertigation systems, special management practices, project preparation for greenhouses, visit to greenhouses.

***FSC-651 GAP for Fruit Crops (1+0)**

UNIT I: Genesis of GAP – definition/description, components listed by FAO, frame work.

UNIT II: Management of site history and soil, crop and fodder production, IPM, INM, IWM, irrigation water, crop production and protection. Identification of ways of improving the productivity profitability, and resource efficiency. harvest and post-harvest handling.

UNIT III: Animal production, product certification, animal waste management, animal health and welfare, harvest.

UNIT IV: On farm processing, storage, energy and waste management, human health, welfare, safety, wild life benefits.

UNIT V: Institutions involved in GAP certification. Indian agencies, EUREPGAP (European Retail Producers Group- Good Agricultural Practices), EUREP etc.