

Department of Vegetable Sciences

M.Sc. Programme

Course No.	Title of the Courses	Credits
1st Semester		
VSC 501	Fundamental of Vegetable Management	2+1
VSC 502	Nursery Management of Vegetable Crops	2+1
VSC 503	Production Technology of Cool season Vegetable Crops	2 + 1
VSC 504	Principles of Breeding Vegetable Crops	2 + 1
VSC 505	Seed Production Technology of Vegetable Crops	2 + 1
2nd Semester		
VSC 551	Growth and Development of Vegetable Crops	2 + 1
VSC 552	Production Technology of Underexploited Vegetable Crops	2 + 1
3rd Semester		
VSC 601	Systematic of vegetable Crops	1 + 1
VSC 602	Organic Vegetable Production Technology	1 + 1
VSC 649	Seminar I	1 + 0
4th Semester		
VSC 651	Production Technology of Warm Season Vegetable Crops	2+1
VSC 699	Seminar II	1+0
VSC 700	Master's Research	0+20

Ph.D Programme

Course No.	Title of the Courses	Credits
1st Semester		
VSC 701	Advances in Vegetable Production	2 + 1
VSC 702	Advances in Breeding of Vegetable Crops	2 + 1

2nd Semester		
VSC 751	Protected Cultivation of Vegetable Crops	1 + 1
VSC 752	Biotechnology of Vegetable Crops	2 + 1
VSC 753	Seed Certification, Processing and Storage of Vegetables	2 + 1
VSC 799	Seminar I	1 + 0
3rd Semester		
VSC 801	Abiotic Stress Management in Management in Vegetable crops	2 + 1
VSC 802	Breeding Vegetable Crops for Quality Traits	2 + 0
VSC 849	Seminar II	1 + 0
4th semester		
	Nil	
5th Semester		
	Nil	
6th Semester		
VSC 999	Seminar III	1+0
VSC 1000	Doctoral Research	0+45

M.Sc. Programme

VSC 501 Fundamental of Vegetable Management

2+1

Unit I: Importance and classification of vegetables, Mulching, cropping system in vegetable crops, Plant protection, storage, marketing and export of vegetables

Unit II: Essential plant nutrients – functions and deficiency and toxicity symptoms in vegetable crops, sources of plant nutrients, manures, inorganic fertilizers and biofertilizers, methods and time of application of manures and fertilizers in vegetable crops, INM in vegetable crops

Unit III: Weed classification and characteristics, Different methods of weed control, Herbicides – classifications and properties, mode of action, important weeds associated with vegetable crops and their management, integrated weed management in vegetable crops.

Unit IV: Classification of soil water , soil moisture constants , forces acting on soil water , soil water tension , soil water plant relationship, factors affecting absorption of soil water , water requirements of crops , scheduling of irrigation , critical stages of irrigation , water use efficiency , quality of irrigation water

Practical: Identification of common weeds, preparation of weed album , demonstration of mulching, disease and pest in vegetable crops , Identification of nutritional disorders in vegetable crops , calculation of fertilizers and herbicides requirement , soil moisture measurements in oven dry method, demonstration of different systems of irrigation. Visit to nearest whole sale and retail markets to study marketing systems of vegetables.

VSC 502 Nursery Management of Vegetable Crops

2+1

Unit I: Nursery- definition , types , qualities of a good nursery, selection of site for vegetable nursery , commercial venture in nursery business , establishment of nursery , fencing , irrigation , drainage , beds , nursery structures , roads and paths, etc.

Unit II: Seed bed preparation for rainy, winter and summer seasons, nursery raising of direct sown vegetables ,growing media soil and seed treatment, seed sowing, seed germination, Hardening .

Unit III: General nursery management –transplanting, nutrient management, water management, packing and transportation

Unit IV: Seedling raising under control conditions, seedling raising in different containers, earthen, wooden, bamboo, metal, plug tray and poly containers, Seedling raising under protected structures, Uses of plastics in raising vegetable nursery. Important diseases and insect pest of vegetable nursery and their management.

UnitV: Propagation of vegetable crops by sexual and asexual methods, Micropagation in vegetable crops, Grafting and its application in vegetable crops

Practical: Preparation of nursery beds for raising vegetable seedlings , seed treatment , sterilization of soil for seed sowing , seedling raising in different containers and media , hardening of seedlings , transplanting of vegetable seedlings , Calculation of seed germination percentage and other related germination parameters, methods of planting of asexually propagated vegetable crops like pointed gourd , sweet potato , Elephant foot yam , potato , onion , garlic , etc cost of seedling production in different vegetable crops , cost of establishing a commercial vegetable seedling nursery , grafting techniques in vegetable crops

VSC 503 Production Technology of Cool Season Vegetable Crops

2 + 1

Unit I: Potato.

Unit II: Cole crops : cabbage, cauliflower, knol kohl, sprouting broccoli, Brussels sprout.

Unit III: Root crops : carrot, radish, turnip and beetroot.

Unit IV: Bulb crops : onion and garlic.

Unit V: Peas and broad bean, green leafy cool season vegetables.

Practical: Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of winter vegetable crops and their economics. Project preparation for commercial cultivation of above vegetables including cost-benefit ratio. Experiments to demonstrate the role of mineral elements, plant growth substances and herbicides; study of physiological disorders; preparation of cropping scheme for commercial farms; visit to commercial greenhouse/polyhouse.

VSC 504 Principles of Breeding Vegetable Crops

2 + 1

Evolution, distribution, cytogenetics, genetic resources, genetic divergence, types of pollination and fertilization mechanisms, sterility and incompatibility, anthesis and pollination, hybridization, inter-varietal, inter-specific and inter-generic hybridization, heterosis breeding, inheritance pattern of traits, qualitative and quantitative, plant type concept and selection indices, genetics of spontaneous and induced mutations, problems and achievements of mutation breeding, ploidy breeding and its achievements, breeding, ploidy breeding and its achievements, breeding techniques for improving quality and processing characters; breeding for stresses, mechanism and genetics of resistance, breeding for salt, drought; low and high temperature; toxicity and water logging resistance, breeding for pest, disease, nematode and multiple resistance, genomics, molecular marker, marker assisted breeding; use of *in vitro* culture techniques in breeding, PPVFR act, issues of patenting.

Practical: Designing of breeding experiments, assessment of components of genetic variability, screening techniques for abiotic stresses, screening and rating for pest, disease and nematode resistance, estimation of quality and processing characters, screening for quality improvement, demonstration of male sterility and self incompatibility, estimation of heterosis and combining ability, scaling test and analysis of generation means, induction and identification of mutants and polyploids, distant hybridization and embryo rescue techniques.

VSC 505 Seed production Technology of Vegetable Crops

2 + 1

UNIT I: Definition of seed and its quality, new seed policies; DUS test, scope of vegetable seed

industry in India. Causes of deterioration of a variety.

UNIT II: Genetical and agronomical principles of seed production; methods of seed production; use of growth regulators and chemicals in vegetable seed production; floral biology, pollination, breeding behaviour, seed development and maturation; methods of hybrid seed production.

UNIT III: Hybrid technology and methods of hybrid seed production.

UNIT IV: Categories of seed; maintenance of nucleus, foundation and certified seed; seed certification, seed standards; seed act and law enforcement, plant quarantine and quality control.

UNIT V: Physiological maturity, seed harvesting, extraction, curing, drying, grading, seed processing, seed coating and pelleting, packaging (containers/packets), storage and cryopreservation of seeds, synthetic seed technology.

UNITVI: Agro-techniques for seed production in solanaceous vegetables, cucurbits, leguminous vegetables, Cole crops, bulb crops, leafy vegetables, okra, vegetatively propagated vegetables.

Practical: Seed sampling, seed testing (genetic purity, seed viability, seedling vigour, physical purity) and seed health testing; testing, releasing and notification procedures of varieties; floral biology; rouging of off-type; methods of hybrid seed production in important vegetable; seed extraction techniques; handling of seed processing and seed testing equipments; seed sampling; testing of vegetable seeds for seed purity, germination, vigour and health; visit to seed processing units, seed testing laboratory and seed production farms.

VSC 551 Growth and Development of Vegetable Crops 2 + 1

UNIT I: Cellular structures and their functions; definition of growth and development, growth analysis and its importance in vegetable production.

UNIT II: Physiology of dormancy and germination of vegetable seeds, tuber and bulbs; Role of auxins, gibberellins and abscissic acid; Application of synthetic hormones, plant growth retardants and inhibitors for various purposes in vegetable crops; Role and mode of action of morphactins, antitranspirants, anti-auxin, ripening, retardant and plant stimulants in vegetable crop production.

UNIT III: Photosynthesis , Role of light, temperature and photoperiod on growth, development of underground parts, flowering and sex expression in vegetable crops; apical dominance.

UNIT IV: Physiology of fruit set, fruit development, fruit growth, flower and fruit drop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors, senescence and abscission,

maturity and edible maturity, maturity standards, fruit ripening and physiological changes associated with ripening.

UNIT V: Plant growth regulators in relation to vegetable production; morphogenesis and tissue culture techniques in vegetable crops.

Practical: Preparation of solutions of plant growth substances and their application; experiments in breaking and induction of dormancy by chemicals; induction of parthenocarpy, fruit maturity and ripening; application of plant growth substances for improving flower initiation, changing sex expression in cucurbits and checking flower and fruit drops and improving fruit set in solanaceous vegetables; growth analysis techniques in vegetable crops.

VSC 552 Production Technology of Under Exploited Vegetable Crops

2+1

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties, hybrids, sowing, planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures .

UNIT I: Asparagus, artichoke , parsnip, drumstick and leek.

UNIT II: Red cabbage , Chinese cabbage, kale and Pak choi

UNIT III: Celery, parsley, ,lettuce, spinach , bathua (chenopods) and chekurmanis,

UNIT IV: lima bean, winged bean , jack bean, sword bean and cluster bean

UNIT V: Elephant foot yam , sweet gourd, spine gourd, , Chayote and little gourd (kundru).

Practical: Identification of seeds; botanical description of plants; layout and planting; cultural practices; short-term experiments of underexploited vegetables.

VSC 601 Systematics of Vegetable Crops 1+ 1

UNIT I: Principles of classification; different methods of classification; salient features of international code of nomenclature of vegetable crops.

UNIT II: Origin, history, evolution and distribution of vegetable crops, botanical description of families, genera and species covering various tropical, subtropical and temperate vegetables.

UNIT III: Cytological level of various vegetable crops; descriptive keys for important vegetables.

UNIT IV: Importance of molecular markers in evolution of vegetable crops; molecular markers as an aid in characterization and taxonomy of vegetable crops.

Practical: Identification, description, classification and maintenance of vegetable species and varieties; survey, collection of allied species and genera locally available; preparation of keys to the species and varieties; methods of preparation of herbarium and specimens.

VSC 602 Organic Vegetable Production Technology 1+1

UNIT I: Importance, principles, perspective, concept and component of organic production of vegetable crops.

UNIT II: Managing soil fertility, pests and diseases and weed problems in organic farming system; crop rotation in organic horticulture; processing and quality control for organic foods.

UNIT III: Methods for enhancing soil fertility, mulching, raising green manure crops. Indigenous methods of compost, Panchagavya, Biodynamics, preparation etc. Pest and disease management in organic farming; ITK's in organic farming. Role of botanicals and bio-control agents.

UNIT IV: Organic production of vegetable crops, viz., solanaceous crops, cucurbits, cole crops, root and tuber crops.

UNIT V: GAP and GMP – Certification of organic products; organic production and export-opportunity and challenges.

Practical: Method of preparation of compost and vermicomposting, application of biofertilizers, bio pesticides in vegetables, organic soil amendment for root disease, weed management in organic vegetable production. Visit to organic fields and marketing centers.

**VSC 651 Production Technology of Warm season Vegetable Crops
2 +1**

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties, hybrids, sowing, planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures, economics of crops production and seed production of :

UNIT I: Tomato, eggplant, hot and sweet peppers.

UNIT II: Okra, French bean, Hyacinth bean and cowpea

UNIT III: Cucurbitaceous crops

UNIT IV: Tapioca and sweet potato

UNIT V: Green leafy warm season vegetables(Amaranthus , Basella , etc)

Practical: Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of summer vegetable crops and their economics; study of physiological disorders and deficiency of mineral elements, preparation of cropping schemes for commercial farms; experiments to demonstrate the role of mineral elements, physiological disorders; plant growth substances and herbicides; seed extraction technique; identification of important pests and diseases and their control, maturity standards; economics of warm season vegetable crops.

VSC 701

ADVANCES IN VEGETABLE PRODUCTION

2 + 1

Present status and prospects of vegetable cultivation; nutritional and medicinal values; climate and soil as critical factors in vegetable production; choice of varieties; nursery management; modern concepts in water and weed management; physiological basis of growth, yield and quality as influenced by chemicals and growth regulators; role of organic manures, inorganic fertilizers, micronutrients and biofertilizers; response of genotypes to low and high nutrient management, nutritional deficiencies, disorders and correction methods; different cropping systems; mulching; containerized culture for year round vegetable production; low cost polyhouse; net house production; crop modeling, organic gardening; vegetable production for pigments, export and processing of :

UNIT I: Tomato, brinjal, chilli, sweet pepper and potato.

UNI II: Cabbage, cauliflower and knol-khol, sprouting broccoli.

UNIT III: Bhindi , onion, peas and beans, amaranthus and drumstick.

UNIT IV: Carrot, beet root and radish.

UNIT V: Sweet potato, tapioca, elephant foot yam and taro.

UNIT VI: Cucurbits.

Practical: Seedling hardening treatments; practices in indeterminate and determinate vegetable growing and organic gardening; Standardization of growing media , seedling raising in portraits; diagnosis of nutritional and physiological disorders; analysis of physiological factors like anatomy; photosynthesis; light intensity in different cropping situation; assessing nutrient status, use of plant growth regulators; practices in herbicide application; estimating water requirements in relation to crop growth stages, maturity indices; dryland techniques for rainfed vegetable

production; production constraints; analysis of different cropping system in various situation like cold and hot set; vegetable waste recycling management; quality analysis; marketing survey of the above crops; visit to vegetable mals and packing houses.

VSC 702 Advances in Breeding Vegetable Crops
2 +1

Origin, botany, taxonomy, cytogenetics, genetics, breeding objective, alteration of ploidy, breeding methods (introduction, selection, hybridization , mutation), varieties and varietal characterization, resistance breeding for biotic and abiotic stress, quality improvement, molecular marker, genomics, marker assisted breeding and QTLs, biotechnology and their use in breeding in vegetable crops-Issue of patenting, PPVFR act.

UNIT I: Potato, Sweet Potato, Tapioca.

UNIT II: Tomato, Eggplant, hot pepper, sweet pepper and okra.

UNIT III: Peas and beans, amaranth, chenopods and lettuce.

UNIT IV: Gourds, melons, pumpkins and squashes.

UNIT V: Cabbage, cauliflower, carrot, beetroot, radish.

Practical: Selection of desirable plants from breeding population, observations and analysis of various qualitative and quantitative traits in germplasm, hybrids and determination of heterosis, study on segregating generations; induction of flowering, palanological studies, selfing and crossinjing techniques in vegetable crops; hybrid seed production of vegetable crops. Screening techniques for insect-pests, disease and environmental stress resistance, demonstration of sib-mating and mixed population. Assessment of genetic variability through biochemical and DNA marker; molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques. Visit to breeding blocks.

VSC 751 Protected Cultivation of Vegetable Crops
1 + 1

Crops : Tomato, capsicum, cucumber, melons and lettuce.

UNIT I: Importance and scope of protected cultivation of vegetable crops; principles used in protected cultivation, energy management, low cost structures; training methods; engineering aspects.

UNIT II: Regulatory structures used in protected structures; types of greenhouse, polyhouse,

nethouse, hot beds, cold frames, effect of environmental factors, viz. temperature, light, CO₂ and humidity on growth of different vegetables, manipulation of CO₂, light and temperature for vegetable production, fertigation.

UNIT III: Nursery raising in protected structures like poly-tunnels, types of benches, poly bag and containers, different media for growing nursery under cover.

UNIT IV: Regulation of flowering and fruiting in vegetable crops, technology for raising tomato, sweet pepper, cucumber and other vegetables in protected structures, soil-less culture

UNIT V: Problems of growing vegetables in protected structured and their remedies, insect and disease management in protected structures; use of protected structures for seed production.

Practical: Study of various types of structures, methods to control temperature, moisture, CO₂, light, media, training and pruning, fertigation and nutrient management, control of insect-pests and disease in greenhouse; economics of protected cultivation, visit to established green/polyhouse/net house/shade house in the region.

VSC 752 Biotechnology in Vegetable Crops

2 + 1

Crops : Tomato, eggplant, hot and sweet pepper, potato, cabbage, cauliflower, tapioca, onion, cucurbits.

UNIT I: *In vitro* culture methods and molecular approaches for crop improvement in vegetables, production of haploids, disease elimination in horticultural crops, micro grafting, somocloning and identification of somaclonal variants, *in vitro* techniques to overcome fertilization barriers, *in vitro* production of secondary metabolites.

UNIT II: Protoplast culture and fusion; construction, identification and characterization of somatic hybrids and cybrids, wide hybridization, embryo rescue of recalcitrant species, *In vitro* conservation.

UNIT III: *In vitro* mutation for biotic and abiotic stresses, recombinant DNA methodology, gene transfer methods, tools, methods, applications of DNA technology.

UNIT IV: Quality improvement, improvement for biotic and abiotic stresses, transgenic plants.

UNIT V: Role of molecular markers in characterization of transgenic crops, fingerprinting of cultivars etc., achievements, problems and future thrusts in horticultural biotechnology.

Practical: Establishment of axenic explants, callus initiation and multiplication, production of suspension culture, cell and protoplast culture, fusion, regeneration and identification of somatic hybrids and cybrids; Identification of embryonic and non-embryonic calli, development of cell

lines; *in vitro* mutant selection for biotic and abiotic stresses, *in vitro* production and characterization of secondary metabolites, isolated microspore culture, isolation and amplification of DNA, gene transfer methods, molecular characterization of transgenic plants.

VSC 753 Seed Certification, Processing and Storage of Vegetable Crops

2 + 1

UNIT I: Seed certification, objectives, organization of seed certification, minimum seed certification standards of vegetable crops, field inspection, specification for certification.

UNIT II: Seed processing, study of seed processing equipments seed cleaning and upgrading, seed packing and handling equipment used for packaging of seeds, procedures for allocating lot number.

UNIT III: Pre-conditioning, seed treatment, benefits, types and products, general principles of seed storage, advances in methods of storage, quality control in storage, storage containers, seed longevity and deterioration, sanitation, temperature and relative humidity control.

UNIT IV: Seed testing; ISTA rules for testing, moisture, purity germination, vigor test, seed sampling, determination of genuineness of varieties, seed viability, seed health testing; seed dormancy and types of dormancy, factors responsible for dormancy.

UNIT V: Seed marketing, demand forecast, marketing organization, economics of seed production; farmers' rights, seed law enforcement, seed act and seed policy.

Practical: Seed sampling, purity, moisture testing, seed viability, seed vigor tests, seed health testing, seed cleaning, grading and packaging; handling of seed testing equipment and processing machines; seed treatment methods, seed

priming and pelleting; field and seed inspection, practices in rouging, seed storage, isolation distances, biochemical tests, visit to seed testing laboratories and processing plants, mixing and dividing instruments, visit to seed processing unit and warehouse visit and know about sanitation standards.

VSC 801 Abiotic Stress Management in Vegetable Crops

2 + 1

UNIT I: Environmental stress and its types, soil parameters including pH, classification of vegetable crops based on susceptibility and tolerance to various types of stress; root stock, use of wild species, use of anti-transpirants.

UNIT II: Mechanism and measurements of tolerance to drought, water logging, soil salinity, frost and heat stress in vegetable crops.

UNIT III: Soil-plant-water relations under different stress conditions in vegetable crops production and their management practices.

UNIT IV: Techniques of vegetable growing under water deficit, water logging, salinity and sodicity.

UNIT V: Techniques of vegetable growing under high and low temperature conditions, use of chemicals in alleviation of different stresses.

Practical: Identification of susceptibility and tolerance symptoms to various types of stress in vegetable crops, measurement of tolerance to various stresses in vegetable crops, short term experiments on growing vegetable under water deficit, water-logging, salinity and sodicity, high and low temperature conditions, and use of chemicals for alleviation of different stresses.

VSC 802 Breeding Vegetable Crops for Quality Traits

2 + 0

Unit I: Concept of functional foods, Nutritional contribution of fruits and vegetables, Vegetable groups according to the primary type of nutrients they provide (carbohydrate, protein, fat, vitamins, minerals). Different Antioxidant and photochemical Potential of different Vegetables (carotenoids, ascorbic acid, vitamin K, flavonoids, polyphenols, etc.)

Unit II: Cosmetic and taste qualities of different vegetables (Appearance, color, flavor, odor, sweetness, texture, flesh color, soluble solids, soluble solids to titratable acids, etc.)

Unit III: Breeding different vegetable crops (tomato, brinjal, chilli, sweet pepper, melons, carrot, pumpkin, lettuce, onion , garlic, etc.) for different quality traits.

Unit IV: Hybrid technology for enhanced quality, Utilization of wild relatives in breeding for quality traits. Utilization of mutants in breeding for quality traits.

Unit V: Important enzymes in the bio-synthetic pathway of carotenoids, anthocyanin and ascorbic acid. Utilization of biotechnological tools in breeding for quality traits.