POST GRADUATE SYLLABUS

(Prepared from ICAR PG Syllabus of Horticulture)

Degree to be awarded

M. Sc. (Hort.) in Vegetable and Spice Crops

DEPARTMENT OF VEGETABLE AND SPICE CROPS
FACULTY OF HORTICULTURE
UTTAR BANGA KRISHI VISWAVIDYALAYA
PUNDIBARI, COOCH BEHAR

Tentative distribution of courses

Masters' Degree

COURSE NO.	COURSE NAME	CREDIT
Semester –I		
VSC 501*	PRODUCTION TECHNOLOGY OF COOL SEASONVEGETABLE CROPS	2+1
VSC 504*	GROWTH AND DEVELOPMENT OF VEGETABLE CROPS	2+1
VSC 506	SYSTEMATICS OF VEGETABLE CROPS	1+1
VSC 510*	PRODUCTION TECHNOLOGY OF SPICE CROPS	2+1
M. Sc. Semester –II		
VSC 502*	PRODUCTION TECHNOLOGY OF WARM SEASONVEGETABLE CROPS	2+1
VSC 505	SEED PRODUCTION TECHNOLOGY OF VEGETABLECROPS	2+1
VSC 511*	BREEDING OF SPICES	2+1
Semester –III		
VSC 503*	BREEDING OF VEGETABLE CROPS	2+1
VSC 507	PRODUCTION TECHNOLOGY OF UNDEREXPLOITEDVEGETABLE CROPS	1+1
VSC 508	ORGANIC VEGETABLE PRODUCTION TECHNOLOGY	1+1
VSC 513	ORGANIC SPICE PRODUCTION TECHNOLOGY	2+1
Semester –IV		
VSC 509	FUNDAMENTALS OF PROCESSING OF VEGETABLES	1+1
VSC 512*	PROCESSING OF SPICES	1+1
VSC 591*	MASTER'S SEMINAR	1+0
VSC 599*	MASTER'S RESEARCH	**20**

* Compulsory for Master's programme;

Ph. D

COURSE NO.	COURSE NAME	CREDIT
Semester-I		
VSC 601**	ADVANCES IN VEGETABLE PRODUCTION	2+1
VSC607**	ADVANCES IN SPICE PRODUCTION	2+1
VSC 691**	DOCTORAL SEMINAR-I	1+0
Semester-II		
VSC 602**	ADVANCES IN BREEDING OF VEGETABLE CROPS	2+1
VSC608	ADVANCES IN BREEDING OF SPICE CROPS	2+1
Semester-III		
VSC 603**	PROTECTED CULTIVATION OF VEGETABLE CROPS	1+1
VSC 605	SEED CERTIFICATION, PROCESSING AND STORAGE OFVEGETABLE CROPS	1+1
Semester-VI		
VSC 604	BIOTECHNOLOGY OF VEGETABLE CROPS	2+1
VSC 606	ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS	2+1
VSC609	BIOTECHNOLOGY IN SPICES	1+1
Last Semester		
VSC 692**	DOCTORAL SEMINAR	1+0
VSC 699**	DOCTORAL RESEARCH	45

**Compulsory for Doctoral programme

Code Numbers

• All courses are divided into two series: 500-series courses pertain to Master's level, and 600-series to Doctoral level. A Ph. D. student must take a minimum of two 600 series courses, but may also take 500-series courses if not studied during Master's programme.
• Credit seminar for Master's level is designated by code no. 591, and the two seminars for Doctoral level are coded as 691 and 692, respectively.
• Similarly, 599 and 699 codes have been given for Master's research and Doctoral research, respectively.

Course Contents

The contents of each course have been organized into:
• Objective – to elucidate the basic purpose.
• Theory units – to facilitate uniform coverage of syllabus for paper setting.
• Suggested Readings – to recommend some standard books as reference material. This does not unequivocally exclude other such reference material that may be recommended according to the advancements and local requirements.
• A list of journals pertaining to the discipline is provided at the end which may be useful as study material for 600-series courses as well as research topics.
• E-Resources - for quick update on specific topics/events pertaining to the subject.
• Broad research topics provided at the end would facilitate the advisors for appropriate research directions to the PG students.

Minimum Credit Requirements

Subject	Master's programme	Doctoral programme
Major	20	15
Minor	09	08
Supporting	05	05
Seminar	01	02
Research	20	45
Total Credits	**55**	**75**

Compulsory Non Credit Courses See relevant section

Major subject: The subject (department) in which the students takes admission
Minor subject: The subject closely related to students major subject (e.g., if the majorsubject is Entomology, the appropriate minor subjects should be Plant Pathology & Nematology).
Supporting subject: The subject not related to the major subject. It could be anysubject considered relevant for student's research work.
Non-Credit Compulsory Courses: Please see the relevant section for details. Sixcourses (PGS 501-PGS 506) are of general nature and are compulsory for Master'sprogramme. Ph. D. students may be exempted from these courses if already studiedduring Master's

COURSES OF VEGETABLE CROPS
Course Structure – at a Glance

CODE COURSE TITLE CREDITS

VSC 501* PRODUCTION TECHNOLOGY OF COOL SEASONVEGETABLE CROPS2+1
VSC 502* PRODUCTION TECHNOLOGY OF WARM SEASONVEGETABLE CROPS2+1
VSC 503* BREEDING OF VEGETABLE CROPS 2+1
VSC 504* GROWTH AND DEVELOPMENT OF VEGETABLE CROPS 2+1
VSC 505 SEED PRODUCTION TECHNOLOGY OF VEGETABLECROPS2+1
VSC 506 SYSTEMATICS OF VEGETABLE CROPS 1+1
VSC 507 PRODUCTION TECHNOLOGY OF UNDEREXPLOITEDVEGETABLE CROPS1+1
VSC 508 ORGANIC VEGETABLE PRODUCTION TECHNOLOGY 1+1
VSC 509 FUNDAMENTALS OF PROCESSING OF VEGETABLES 1+1
VSC 591* MASTER'S SEMINAR 1+0
VSC 599* MASTER'S RESEARCH 20
VSC 601** ADVANCES IN VEGETABLE PRODUCTION 2+1
VSC 602** ADVANCES IN BREEDING OF VEGETABLE CROPS 2+1
VSC 603** PROTECTED CULTIVATION OF VEGETABLE CROPS 1+1
VSC 604BIOTECHNOLOGY OF VEGETABLE CROPS 2+1
VSC 605 SEED CERTIFICATION, PROCESSING AND STORAGE OF VEGETABLE CROPS1+1
VSC 606 ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS 2+1
VSC 691** DOCTORAL SEMINAR I 1+0
VSC 692** DOCTORAL SEMINAR II 1+0
VSC 699** DOCTORAL RESEARCH 45

COURSES OF SPICE CROPS

VSC 510* PRODUCTION TECHNOLOGY OF SPICE CROPS 2+1
VSC 511*BREEDING OF SPICES 2+1
VSC 512* PROCESSING OF SPICES 1+1
VSC 513ORGANIC SPICE PRODUCTION TECHNOLOGY 2+1
VSC607**ADVANCES IN SPICE PRODUCTION 2+1
VSC608ADVANCES IN BREEDING OF SPICE CROPS 2+1
VSC609BIOTECHNOLOGY IN SPICES 1+1

* Compulsory for Master's programme; **Compulsory for Doctoral programme

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1
PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1
PGS 503(e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 1+0
PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1
PGS 505 (e-Course) AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0
PGS 506 (e-Course) DISASTER MANAGEMENT 1+0

VEGETABLE CROPS

Course Contents

VSC 501 PRODUCTION TECHNOLOGY OFCOOL SEASON VEGETABLE CROPS2+1

Objective

To educate production technology of cool season vegetables.

Theory

Introduction, botany and taxonomy, climatic and soil requirements,commercial varieties/hybrids, sowing/planting times and methods, seed rateand seed treatment, nutritional and irrigation requirements, interculturaloperations, weed control, mulching, physiological disorders, harvesting,post-harvest management, plant protection measures and seed productionof:

UNIT IPotato

UNIT IICole crops: cabbage, cauliflower, knoll kohl, sprouting broccoli, Brusselssprout

UNIT IIIRoot crops: carrot, radish, turnip and beetroot

UNIT IVBulb crops: onion and garlic

UNIT VPeas 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; Experimentsto demonstrate the role of mineral elements, plant growth substances andherbicides; study of physiological disorders; preparation of cropping scheme for commercial farms; visit to commercial greenhouse/ polyhouse.

Suggested Readings

Bose TK &Som MG. (Eds.). 1986. *Vegetable Crops in India*. NayaProkash.

Bose TK, Som G &Kabir J. (Eds.). 2002. *Vegetable Crops*. NayaProkash.

Bose TK, Som MG &Kabir J. (Eds.). 1993. *Vegetable Crops*. NayaProkash.

Bose TK, Kabir J, Maity TK, Parthasarathy VA &Som MG. 2003.
Vegetable Crops. Vols. I-III. NayaUdyog.

Chadha KL &Kalloo G. (Eds.). 1993-94. *Advances in Horticulture* Vols.V-X. Malhotra Publ. House.

Chadha KL. (Ed.). 2002. *Hand Book of Horticulture*. ICAR.

Chauhan DVS. (Ed.). 1986. *Vegetable Production in India*. Ram Prasad &Sons.Decoteau DR. 2000. *Vegetable Crops*.Prentice Hall.

Edmond JB, Musser AM & Andrews FS. 1951. *Fundamentals ofHorticulture*. Blakiston Co.

Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops:Production Technology*. Vol. II. Kalyani.

Gopalakrishanan TR. 2007. *Vegetable Crops*.New India Publ. Agency.

Hazra P &Som MG. (Eds.). 1999. *Technology for Vegetable Productionand Improvement*. NayaProkash.

Rana MK. 2008. *Olericulture in India*.Kalyani Publ.

Rana MK. 2008. *Scientific Cultivation of Vegetables*.Kalyani Publ.

Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables:Principles, Production and Nutritive Values*. Chapman & Hall.

Saini GS. 2001. *A Text Book of Oleri and Flori Culture*. AmanPubl.House.

Salunkhe DK &Kadam SS. (Ed.). 1998. *Hand Book of Vegetable Scienceand Technology: roduction, Composition, Storage and Processing*.Marcel Dekker.

Shanmugavelu KG. 1989. *Production Technology of Vegetable Crops*.Oxford & IBH.

Singh DK. 2007. *Modern Vegetable Varieties and Production Technology*.International Book Distributing Co.

Singh SP. (Ed.). 1989. *Production Technology of Vegetable Crops*. Agril.Comm. Res. Centre.

Thamburaj S & Singh N. (Eds.). 2004. *Vegetables, Tuber Crops andSpices*. ICAR.

Thompson HC & Kelly WC. (Eds.). 1978. *Vegetable Crops*. Tata McGraw-Hill.

VSC 502 PRODUCTION TECHNOLOGY OF WARM SEASON 2+1
VEGETABLE CROPS

Objective

To teach production technology of warm season vegetables.

Theory

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

UNIT ITomato, eggplant, hot and sweet peppers
UNIT IIOkra, beans, cowpea and clusterbean
UNIT IIICucurbitaceous crops
UNIT IVTapioca and sweet potato
UNIT VGreen leafy warm season vegetables

Practical

Cultural operations (fertilizer application, sowing, mulching, irrigation,weed control) of summer vegetable crops and their economics; study ofphysiological disorders and deficiency of mineral elements, preparation ofcropping schemes for commercial farms; experiments to demonstrate the role of mineral elements, physiological disorders; plant growth substancesand herbicides; seed extraction techniques; identification of important pestsand diseases and their control; maturity standards; economics of warmseason vegetable crops.

Suggested Readings

Bose TK &Som MG. (Eds.). 1986. *Vegetable Crops in India*. NayaProkash.
Bose TK, Kabir J, Maity TK, Parthasarathy VA &Som MG. 2003.*Vegetable Crops*. Vols. I-III. NayaUdyog.
Bose TK, Som MG &Kabir J. (Eds.). 2002. *Vegetable Crops*. NayaProkash.
Brown HD & Hutchison CS. *Vegetable Science*. JB Lippincott Co.
Chadha KL &Kalloo G. (Eds.).1993-94.*Advances in Horticulture*. Vols.V-X. Malhotra Publ. House.
Chadha KL. (Ed.). 2002. *Hand Book of Horticulture*. ICAR.
Chauhan DVS. (Ed.). 1986. *Vegetable Production in India*. Ram Prasad &Sons.
Decoteau DR. 2000. *Vegetable Crops*.Prentice Hall.
Edmond JB, Musser AM & Andrews FS. 1964. *Fundamentals ofHorticulture*. Blakiston Co
Fageria MS, Choudhary BR & Dhaka RS. 2000. *Vegetable Crops:Production Technology*. Vol. II. Kalyani.
Gopalakrishanan TR. 2007. *Vegetable Crops*.New India Publ. Agency.
Hazra P &Som MG. (Eds.). 1999. *Technology for Vegetable Productionand Improvement*. NayaProkash.
Kalloo G & Singh K (Ed.). 2000. *Emerging Scenario in VegetableResearch and Development*. Research Periodicals & Book Publ.House.
Nayer NM & More TA 1998.*Cucurbits*. Oxford & IBH Publ.
Palaniswamy& Peter KV. 2007. *Tuber Crops*. New India Publ. Agency.
Pandey AK &Mudranalay V. (Eds.).*Vegetable Production in India:Important Varieties and Development Techniques.*
Rana MK. 2008. *Olericulture in India*.Kalyani.
Rana MK. 2008. *Scientific Cultivation of Vegetables*.Kalyani.
Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables:Principles, Production and Nutritive Values*. Chapman & Hall.
Saini GS. 2001. *A Text Book of Oleri and Flori Culture*. AmanPubl.House.
Salunkhe DK &Kadam SS. (Ed.). 1998. *Hand Book of Vegetable Scienceand Technology: Production, Composition, Storage and Processing*.Marcel Dekker.
Shanmugavelu KG. 1989. *Production Technology of Vegetable Crops*.Oxford & IBH.
Singh DK. 2007. *Modern Vegetable Varieties and Production Technology*.International Book Distributing Co.

Singh NP, Bharadwaj AK, Kumar A & Singh KM. 2004.*ModernTechnology on Vegetable Production*.International BookDistributing Co.
Singh SP. (Ed.). 1989. *Production Technology of Vegetable Crops*. Agril.Comm. Res. Centre.
Thamburaj S & Singh N. 2004.*Vegetables, Tuber Crops and Spices*.ICAR.
Thompson HC & Kelly WC. (Eds.). 1978. *Vegetable Crops*. Tata McGrawHill.

VSC 503 BREEDING OF VEGETABLE CROPS 2+1

Objective

To educate principles and practices adopted for breeding of vegetablecrops.

Theory

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

UNIT IPotato and tomato

UNIT IIEggplant, hot pepper, sweet pepper and okra

UNIT IIIPeas and beans, amaranth, chenopods and lettuce

UNIT IVGourds, melons, pumpkins and squashes

UNIT VCabbage, cauliflower, carrot, beetroot, radish, sweet potato and tapioca

Practical

Selection of desirable plants from breeding population observations andanalysis of various qualitative and quantitative traits in germplasm, hybridsand segregating generations; induction of flowering, palanologicalstudies,selfing and crossing techniques in vegetable crops; hybrid seed production of vegetable crops in bulk. screening techniques for insect-pests, diseaseand environmental stress resistance in above mentioned crops,demonstration of sib-mating and mixed population; molecular markertechniques to identify useful traits in the vegetable crops and specialbreeding techniques. Visit to breeding blocks.

Suggested Readings

Allard RW. 1999. *Principles of Plant Breeding*. John Wiley & Sons.
Basset MJ. (Ed.). 1986. *Breeding Vegetable Crops*. AVI Publ.
Dhillon BS, Tyagi RK, Saxena S. &Randhawa GJ. 2005. *Plant GeneticResources: Horticultural Crops*. Narosa Publ. House.
Fageria MS, Arya PS &Choudhary AK. 2000. *Vegetable Crops: Breedingand Seed Production*. Vol. I. Kalyani.
Gardner EJ. 1975. *Principles of Genetics*. John Wiley & Sons.
Hayes HK, Immer FR & Smith DC. 1955. *Methods of Plant Breeding*.McGraw-Hill.
Hayward MD, Bosemark NO &Romagosa I. (Eds.). 1993. *Plant Breeding-Principles and Prospects*. Chapman & Hall.
Kalloo G. 1988. *Vegetable Breeding*. Vols. I-III. CRC Press.
Kalloo G. 1998. *Vegetable Breeding*. Vols. I-III (Combined Ed.). PanimaEdu. Book Agency.
Kumar JC &Dhaliwal MS. 1990.*Techniques of Developing Hybrids inVegetable Crops*.Agro Botanical Publ.
Paroda RS &Kalloo G. (Eds.). 1995. *Vegetable Research with SpecialReference to Hybrid Technology in Asia-Pacific Regio*n. FAO.
Peter KV &Pradeepkumar T. 2008.*Genetics and Breeding of Vegetables*.Revised, ICAR.
Rai N &Rai M. 2006.*Heterosis Breeding in Vegetable Crops*.New IndiaPubl. Agency.
Ram HH. 1998. *Vegetable Breeding: Principles and Practices*. Kalyani.
Simmonds NW. 1978. *Principles of Crop Improvement*.Longman.
Singh BD. 1983. *Plant Breeding*.Kalyani.
Singh PK, Dasgupta SK &Tripathi SK. 2004.*Hybrid VegetableDevelopment*.International Book Distributing Co.
Swarup V. 1976.*Breeding Procedure for Cross-pollinated VegetableCrops*.ICAR.

VSC 504 GROWTH AND DEVELOPMENT OF VEGETABLE CROPS 2+1
Objective

To teach the physiology of growth and development of vegetable crops.

Theory
UNIT ICellular structures and their functions; definition of growth anddevelopment, growth analysis and its importance in vegetable production.
UNIT IIPhysiology of dormancy and germination of vegetable seeds, tubers andbulbs; Role of auxins, gibberellilns, cyktokinins and abscissicacid;Application of synthetic hormones, plant growth retardants and inhibitorsfor various purposes in vegetable crops; Role and mode of action ofmorphactins, antitranspirants, anti-auxin, ripening retardant and plantstimulants in vegetable crop production.
UNIT IIIRole of light, temperature and photoperiod on growth, development ofunderground parts, flowering and sex expression in vegetable crops; apicaldominance.
UNIT IVPhysiology of fruit set, fruit development, fruit growth, flower and fruitdrop; parthenocarpy in vegetable crops; phototropism, ethylene inhibitors,senescence and abscission; fruit ripening and physiological changesassociated with ripening.
UNIT VPlant growth regulators in relation to vegetable production; morphogenesisand 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 and fruit ripening; application of plant growthsubstances for improving flower initiation, changing sex expression incucurbits and checking flower and fruit drops and improving fruit set insolanaceous vegetables; growth analysis techniques in vegetable crops.

Suggested Readings
Bleasdale JKA. 1984. *Plant Physiology in Relation to Horticulture*. 2nd Ed.MacMillan.
Gupta US. (Ed.). 1978. *Crop Physiology*. Oxford &IBH.Krishnamoorti HN. 1981. *Application Plant Growth Substances and TheirUses in Agriculture*. Tata-McGraw Hill.
Peter KV. (Ed.). 2008. *Basics of Horticulture*. New India Publ. Agency.
Saini RS, Sharma KD, Dhankhar OP &Kaushik RA. (Eds.). 2001.*Laboratory Manual of Analytical Techniques in Horticulture*.Agrobios.
Wien HC. (Ed.). 1997. *The Physiology of Vegetable Crops*. CABI.

VSC 505 SEEDPRODUCTION TECHNOLOGY OF VEGETABLE CROPS2+1

Objective
To educate principles and methods of quality seed and planting material
production in vegetable crops.
Theory
UNIT IDefinition of seed and its quality, new seed policies; DUS test, scope ofvegetable seed industry in India.
UNIT IIGenetical and agronomical principles of seed production; methods of seedproduction; use of growth regulators and chemicals in vegetable seedproduction; floral biology, pollination, breeding behaviour, seeddevelopment and maturation; methods of hybrid seed production.
UNIT IIICategories of seed; maintenance of nucleus, foundation and certified seed;seed certification, seed standards; seed act and law enforcement, plantquarantine and quality control.

UNIT VIPhysiological maturity, seed harvesting, extraction, curing, drying, grading,seed processing, seed coating and pelleting, packaging (containers/packets),storage and cryopreservation of seeds, synthetic seed technology.
UNIT VAgro-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 notificationprocedures of varieties; floral biology; rouging of off-type; methods ofhybrid seed production in important vegetable and spice crops; seedextraction 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 testinglaboratory and seed production farms.

Suggested Readings
Agrawal PK &Dadlani M. (Eds.). 1992. *Techniques in Seed Science andTechnology*. South Asian Publ.
Agrawal RL. (Ed.). 1997. *Seed Technology*. Oxford & IBH.
Bendell PE. (Ed.). 1998. *Seed Science and Technology: Indian ForestrySpecies*. Allied Publ.
Fageria MS, Arya PS &Choudhary AK. 2000. *Vegetable Crops: Breedingand Seed Production*. Vol. I. Kalyani.
George RAT. 1999. *Vegetable Seed Production*. 2nd Ed. CABI.
Kumar JC &Dhaliwal MS. 1990.*Techniques of Developing Hybrids inVegetable Crops*.Agro Botanical Publ.
More TA, Kale PB &Khule BW. 1996. *Vegetable Seed productionTechnology*. Maharashtra State Seed Corp.
Rajan S & Baby L Markose. 2007. *Propagation of Horticultural Crops*.New India Publ. Agency.
Singh NP, Singh DK, Singh YK & Kumar V. 2006.*Vegetable Seed Production Technology*.International Book Distributing Co.
Singh SP. 2001. *Seed Production of Commercial Vegetables*.AgrotechPubl.Academy.

VSC 506 SYSTEMATICS OF VEGETABLE CROPS 1+1

Objective
To teach morphological, cytological and molecular taxonomy of vegetable crops.

Theory
UNIT IPrinciples of classification; different methods of classification; salientfeatures of international code of nomenclature of vegetable crops.
UNIT IIOrigin, history, evolution and distribution of vegetable crops, botanicaldescription offamilies, genera and species covering various tropical,subtropical and temperate vegetables.
UNIT IIICytological level of various vegetable crops; descriptive keys for importantvegetables.
UNIT IVImportance 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 vegetablespecies and varieties; survey, collection of allied species and genera locallyavailable; preparation of keys to the species and varieties; methods ofpreparation of herbarium and specimens.

Suggested Readings
Chopra GL. 1968. *Angiosperms - Systematics and Life Cycle*. S. Nagin
Dutta AC. 1986. *A Class Book of Botany*.Oxford Univ. Press.
Pandey BP. 1999. *Taxonomy of Angiosperm*. S. Chand & Co.
Peter KV &Pradeepkumar T. 2008.*Genetics and Breeding of Vegetables*.(Revised), ICAR.

Soule J. 1985. *Glossary for Horticultural Crops*.John Wiley & Sons.
Srivastava U, Mahajan RK, Gangopadyay KK, Singh M &Dhillon BS.
2001. *Minimal Descriptors of Agri-Horticultural Crops*. Part-II:*Vegetable Crops*. NBPGR, New Delhi.
Vasistha. 1998. *Taxonomy of Angiosperm*. Kalyani.
Vincent ER & Yamaguchi M. 1997.*World Vegetables*.2nd Ed. Chapman &Hall.

VSC 507 PRODUCTION TECHNOLOGY OF UNDEREXPLOITEDVEGETABLE CROPS 2+1

Objective

To educate production technology of underutilized vegetable crops.

Theory

Introduction, botany and taxonomy, climatic and soil requirements,commercial varieties/hybrids, sowing/planting times and methods, seed rateand seed treatment, nutritional and irrigation requirements, interculturaloperations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed productionof:

UNIT IAsparagus, artichoke and leek

UNIT IIBrussels's sprout, Chinese cabbage, broccoli, kale and artichoke.

UNIT IIIAmaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathu(chenopods) and chekurmanis.

UNIT IVElephant foot yam, lima bean, winged bean, vegetable pigeon pea, jackbean and sword bean.

UNIT VSweet gourd, spine gourd, pointed gourd, Oriental pickling melon and littlegourd (kundru).

Practical

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

Suggested Readings

Bhat KL. 2001. *Minor Vegetables - Untapped Potential*. Kalyani.
lndira P & Peter KV. 1984. *Unexploited Tropical Vegetables*. KeralaAgricultural University, Kerala.
Peter KV. (Ed.). 2007-08. *Underutilized and Underexploited HorticulturalCrops*. Vols. I-IV. New India Publ. Agency.
Rubatzky VE & Yamaguchi M. (Eds.). 1997. *World Vegetables:Principles, Production and Nutritive Values*. Chapman & Hall
Srivastava U, Mahajan RK, Gangopadyay KK, Singh M &Dhillon BS.2001.*Minimal Descriptors of Agri-Horticultural Crops*. Part-II:*Vegetable Crops*. NBPGR, New Delhi.

VSC 508 ORGANIC VEGETABLE PRODUCTION TECHNOLOGY 1+1

Objective

To educate principles, concepts and production of organic farming invegetable crops.

Theory

UNIT IImportance, principles, perspective, concept and component of organicproduction of vegetable crops.

UNIT IIOrganic production of vegetables crops, *viz.*, solanaceous crops, cucurbits,cole crops, root and tuber crops.

UNIT IIIManaging soil fertility, pests and diseases and weed problems in organicfarming system; crop rotation in organic horticulture; processing andquality control for organic foods.

UNIT IVMethods for enhancing soil fertility, mulching, raising green manure crops.Indigenous methods of compost, Panchagavvya, Biodynamics, preparationetc Pest and disease management in organic farming; ITK's in organicfarming.Role of botanicals and bio-control agents.

UNIT VGAP and GMP- Certification of organic products; organic production andexport - opportunity and challenges.

Practical

Method of preparation of compost, vermicomposting, biofertilizers, soilsolarization, bio pesticides in horticulture, green manuring, mycorrhizaeand organic crop production, waster management, organic soil amendmentfor root disease, weed management in organic horticulture. Visit to organicfields and marketing centers.

Suggested Readings

Dahama AK. 2005. *Organic Farming for Sustainable Agriculture*. 2nd Ed.Agrobios.
Gehlot G. 2005. *Organic Farming; Standards, Accreditation CertificationandInspection*.Agrobios.
Palaniappan SP &Annadorai K. 2003.*Organic Farming, Theory andPractice*.Scientific Publ.
Pradeepkumar T, Suma B, Jyothibhaskar&Satheesan KN. 2008.
Management of Horticultural Crops.New India Publ. Agency.
Shivashankar K. 1997. *Food Security in Harmony with Nature*. 3rd IFOAMASIA,Scientific Conf..1-4 December, 1997, UAS, Bangalore.

VSC 509 FUNDAMENTALS OF PROCESSING OF VEGETABLES 2+1

Objective

To educate principles and practices of processing of vegetable crops.

Theory

UNIT IHistory of food preservation. Present status and future prospects ofvegetable preservation industry in India.

UNIT IISpoilage of fresh and processed horticultural produce; biochemical changesand enzymes associated with spoilage of horticultural produce; principalspoilage organisms, food poisoning and their control measures. Role ofmicroorganisms in food preservation.

UNIT IIIRaw materials for processing.Primary and minimal processing; processingequipments; Layout and establishment of processing industry, FPO licence.Importance of hygiene; Plant sanitation.

UNIT IVQuality assurance and quality control, TQM, GMP.Food standards – FPO,PFA, etc.Food laws and regulations.

UNIT VFood safety – Hazard analysis and critical control points (HACCP).Labeling and labeling act, nutrition labeling.

UNIT VIMajor value added products from vegetables.Utilization of byproductsofvegetable processing industry; Management of waste from processingfactory.

UNIT VIIInvestmentanalysis.Principles and methods of sensory evaluation of freshand processed vegetables.

Practical

Study of machinery and equipments used in processing of horticulturalproduce; Chemical analysis for nutritive value of fresh and processedvegetables; Study of different types of spoilages in fresh as well asprocessed horticultural produce; Classification and identification ofspoilage organisms; Study of biochemical changes and enzymes associatedwith spoilage; Laboratory examination of vegetable products; Sensoryevaluation of fresh and processed vegetables; Study of food standards –National, international, CODEX Alimentarius; Visit to processing units tostudy the layout, equipments, hygiene, sanitation and residual / wastemanagement.

Suggested Readings

Arthey D & Dennis C. 1996.*Vegetable Processing*. Blackie/Springer-Verlag.
Chadha DS. 2006. *The Prevention of Food Adulteration Act*. Confed. ofIndian Industry.
Desrosier NW. 1977. *Elements and Technology*. AVI Publ. Co.
FAO. 1997. *Fruit and Vegetable Processing*. FAO.
FAO.*CODEX Alimentarius*: Joint FAO/WHO Food Standards Programme.2nd Ed. Vol. VB. *Tropical Fresh Fruits and Vegetables*. FAO.
FAO.*Food Quality and Safety Systems – Training Manual on FoodHygiene and HACCP*.FAO.
Fellow's P. 1988. *Food Processing Technology*.EllisHorwood International.
Frazier WC &Westhoff DC. 1995. *Food Microbiology*. 4th Ed. TataMcGraw Hill.
Giridharilal GS, Siddappa&Tandon GL. 1986.*Preservation of Fruits andVegetables*.ICAR.
Gisela J. 1985. *Sensory Evaluation of Food – Theory and Practices*.EllisHorwood.

Graham HD. 1980. *Safety of Foods*. AVI Publ. Co.
Hildegrade H & Lawless HT. 1997.*Sensory Evaluation of Food*.CBS.
Joslyn M &Heid.*Food Processing Operations*. AVI Publ. Co.
Mahindru SN. 2004. *Food Safety: Concepts and Reality*. APH Publ. Corp.
Ranganna S. 1986. *Handbook of Analysis and Quality Control for Fruitand Vegetable Products*.2nd Ed. Tata-McGraw Hill.
Shapiro R. 1995. *Nutrition Labeling Handbook*. Marcel Dekker.
Srivastava RP & Kumar S. 2003.*Fruit and Vegetable Preservation:Principles and Practices*. 3rd Ed. International Book Distri.Co.
Tressler& Joslyn MA. 1971. *Fruit and Vegetable Juice ProcessingTechnology*. AVI Publ. Co.
Verma LR & Joshi VK. 2000. *Post-harvest Technology of Fruits andVegetables: Handling, Processing, Fermentation and WasteManagement*. Indus Publ. Co.

VSC 601 ADVANCES IN VEGETABLE PRODUCTION 2+1

Objective

To keep abreast with latest developments and trends in productiontechnology of vegetable crops.

Theory

Present status and prospects of vegetable cultivation; nutritional andmedicinal values; climate and soil as critical factors in vegetableproduction; choice of varieties; nursery management; modern concepts inwater and weed management; physiological basis of growth, yield andquality as influenced by chemicals and growth regulators; role of organicmanures, inorganic fertilizers, micronutrients and biofertilizers; responseof 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 costpolyhouse; net house production; crop modeling, organic gardening;vegetable production for pigments, export and processing of:
UNIT ITomato, brinjal, chilli, sweet pepper and potato
UNIT IICucurbits, cabbage, cauliflower and knol-khol
UNIT IIIBhendi, onion, peas and beans, amaranthus and drumstick
UNIT IVCarrot, beet root and radish
UNIT VSweet potato, tapioca, elephant foot yam and taro

Practical

Seed hardening treatments; practices in indeterminate and determinatevegetable growing and organic gardening; portrays and ball culture; diagnosis of nutritional and physiological disorders; analysis of physiological factors like anatomy; photosynthesis; light intensity indifferent cropping situation; assessing nutrient status, use of plant growthregulators; practices in herbicide application; estimating waterrequirements in relation to crop growth stages, maturity indices; drylandtechniques for rainfed vegetable production; production constraints;analysis of different cropping system in various situation like cold and hotset; vegetable waste recycling management; quality analysis ;marketing
survey of the above crops; visit to vegetable and fruit mals and packinghouses.

Suggested Readings

Bose TK &Som NG. 1986. *Vegetable Crops of India*. NayaProkash.
Bose TK, Kabir J, Maity TK, Parthasarathy VA &Som MG. 2003.*Vegetable Crops*. Vols. I-III. NayaUdyog.
Brewster JL. 1994. *Onions and other Vegetable Alliums*. CABI.
FFTC.*Improved Vegetable Production in Asia*.Book Series No. 36.
Ghosh SP, Ramanujam T, Jos JS, Moorthy SN & Nair RG. 1988. *Tuber Crops*.Oxford & IBH.
Gopalakrishnan TR. 2007. *Vegetable Crops*.New India Publishing Agency.
Kallo G & Singh K. (Ed.). 2001. *Emerging Scenario in Vegetable Researchand Development*. Research Periodicals & Book Publ. House.
Kurup GT, Palanisami MS, Potty VP, Padmaja G, Kabeerathuma S &Pallai SV. 1996. *Tropical Tuber Crops, Problems, Prospects andFuture Strategies*. Oxford & IBH.
Sin MT &Onwueme IC. 1978. *The Tropical Tuber Crops*. John Wiley &Sons.

Singh NP, Bhardwaj AK, Kumar A & Singh KM. 2004.*ModernTechnology on Vegetable Production*. International Book Distr. Co.
Singh PK, Dasgupta SK &Tripathi SK. 2006.*Hybrid VegetableDevelopment*. International Book Distr. Co.

VSC 602 ADVANCES IN BREEDING OF VEGETABLE CROPS 2+1

Objective

To update knowledge on the recent research trends in the field of breedingof vegetable crops with special emphasis on tropical, subtropical andtemperate crops grown in India.

Theory

Evolution, distribution, cytogenetics, genetic resources, genetic divergence,types of pollination and fertilization mechanisms, sterility andincompatibility, anthesis and pollination, hybridization, inter-varietal, interspecificand inter-generic hybridization, heterosis breeding, inheritancepattern of traits, qualitative and quantitative, plant type concept andselection indices, genetics of spontaneous and induced mutations, problemsand achievements of mutation breeding, ploidy breeding and itsachievements, *in vitro* breeding; breeding techniques for improving qualityand processing characters; breeding for stresses, mechanism and genetics ofresistance, breeding for salt, drought; low and high temperature; toxicityand water logging resistance, breeding for pest, disease, nematode and multiple resistance of:

UNIT I Tomato, brinjal, chilli, sweet pepper and potato
UNIT IICucurbits, Cabbage, cauliflower and knol-khol
UNIT IIIBhendi, onion, peas and beans, amaranthus and drumstick
UNIT IVCarrot, beet root and radish
UNIT VSweetpotato, tapioca, elephant foot yam and taro

Practical

Designing of breeding experiments, screening techniques for abioticstresses, screening and rating for pest, disease and nematode resistance,estimation of quality and processing characters, screening for-qualityimprovement, estimation of heterosis and combining ability, induction andidentification of mutants and polyploids, distant hybridization and embryorescue techniques.

Suggested Readings

ActaHorticulture.Conference on Recent Advance in Vegetable Crops.Vol. 127.
Chadha KL, Ravindran PN &Sahijram L. 2000.*Biotechnology inHorticultural and Plantation Crops*.Malhotra Publ. House.
Chadha KL. 2001. *Hand Book of Horticulture*. ICAR.
Dhillon BS, Tyagi RK, Saxena S &Randhawa GJ. 2005. *Plant GeneticResources: Horticultural Crops*. Narosa Publ. House.
Janick JJ. 1986. *Horticultural Science*. 4th Ed. WH Freeman & Co.
Kaloo G & Singh K. 2001.*Emerging Scenario in Vegetable Research andDevelopment*.Research Periodicals and Book Publ. House.
Kaloo G. 1994. *Vegetable Breeding*. Vols. I-III. Vedams eBooks.
Peter KV &Pradeep Kumar T. 2008. *Genetics and Breeding of Vegetables*.(Revised Ed.). ICAR.
Ram HH. 2001. *Vegetable Breeding*. Kalyani.

VSC 603 PROTECTED CULTIVATION OF VEGETABLE CROPS 1+1

Objective

To impart latest knowledge in growing of vegetable crops under protectedenvironmental condition.

Theory

Crops: Tomato, capsicum, cucumber, melons and lettuce

UNIT IImportance and scope of protected cultivation of vegetable crops; principlesused in protected cultivation, energy management, low cost structures;training methods; engineering aspects.

UNIT IIRegulatory structures used in protected structures; types ofgreenhouse/polyhouse/nethouse, hot beds, cold frames, effect ofenvironmental factors, *viz*. temperature, light, CO2 and humidity on growthof different vegetables, manipulation of CO2, light and temperature forvegetable production, fertigation.

UNIT IIINursery raising in protected structures like poly-tunnels, types of benchesand containers, different media for growing nursery under cover.
UNIT IVRegulation of flowering and fruiting in vegetable crops, technology forraising tomato, sweet pepper, cucumber and other vegetables in protectedstructures, training and staking in protected crops, varieties and hybrids forgrowing vegetables in protected structures.
UNIT VProblem of growing vegetables in protected structures and their remedies,insect and disease management in protected structures; soil-less culture, useof protected structures for seed production.

Practical

Study of various types of structures, methods to control temperature, CO2light, media, training and pruning, maintenance of parental lines and hybridseed production of vegetables, fertigation and nutrient management, controlof insect-pests and disease in greenhouse; economics of protected cultivation, visit to established green/polyhouse/net house/shade house inthe region.

Suggested Readings

Anonymous 2003.*Proc. All India Seminar on Potential and Prospects for Protective Cultivation*. Organised by Institute of Engineers,Ahmednagar. Dec.12-13, 2003.
Chandra S &SomV. 2000. *Cultivating Vegetables in Green House*. *IndianHorticulture* 45: 17-18.
Prasad S & Kumar U. 2005.*Greenhouse Management for HorticulturalCrops*.2nd Ed. Agrobios.
Tiwari GN. 2003. *Green House Technology for Controlled Environment*.Narosa Publ. House.

VSC 604 BIOTECHNOLOGY IN VEGETABLE CROPS 2+1

Objective

To teach advances in biotechnology for improvement of vegetable crops.

Theory

Crops: Tomato, eggplant, hot and sweet pepper, potato, cabbage,cauliflower, tapioca, onion, cucurbits.
UNIT I*In vitro* culture methods and molecular approaches for crop improvementin vegetables, production of haploids, disease elimination in horticulturalcrops, micro grafting, somoclones and identification of somaclonalvariants, *in vitro* techniques to overcome fertilization barriers, *in vitro* production of secondary metabolites.
UNIT IIProtoplast culture and fusion; construction, identification andcharacterization 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 DNAmethodology, gene transfer methods, tools, methods, applications of rDNAtechnology.
UNIT IVQuality improvement, improvement for biotic and abiotic stresses,transgenic plants.
UNIT VRole of molecular markers in characterization of transgenic crops,fingerprinting of cultivars etc., achievements, problems and future thrustsin 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 celllines; *in vitro* mutant selection for biotic and abiotic stresses, *In vitro*production and characterization of secondary metabolites, isolatedmicrospore culture, isolation and amplification of DNA, gene transfermethods, molecular characterization of transgenic plants.

Suggested Readings

Bajaj YPS. (Ed.). 1987. *Biotechnology in Agriculture and Forestry*.Vol.XIX. *Hitech and Micropropagation*.Springer.
Chadha KL, Ravindran PN &Sahijram L. (Eds.). 2000. *Biotechnology ofHorticulture and Plantation Crops*. Malhotra Publ. House.
Debnath M. 2005. *Tools and Techniques of Biotechnology*.Pointer Publ.
Glover MD. 1984. *Gene Cloning: The Mechanics of DNA Manipulation*.Chapman& Hall.
Gorden H &Rubsell S. 1960.*Hormones and Cell Culture*. AB Book Publ.
Keshavachandran R & Peter KV. 2008. *Plant Biotechnology: TissueCulture and Gene Transfer*. Orient & Longman (Universal Press).

Keshavachandran R et al. 2007. *Recent Trends in Biotechnology ofHorticultural Crops*.New India Publ. Agency.
Panopoulas NJ. (Ed.). 1981. *Genetic Engineering in Plant Sciences*.Praeger Publ.
Parthasarathy VA, Bose TK, Deka PC, Das P, Mitra SK &Mohanadas S.2001. *Biotechnology of Horticultural Crops*. Vols. I-III. NayaProkash.
Pierik RLM. 1987. *In vitro Culture of Higher Plants*. MartinusNijhoffPubl.
Prasad S. 1999. *Impact of Plant Biotechnology on Horticulture*.2nd Ed.AgroBotanica.
Sharma R. 2000. *Plant Tissue Culture*. Campus Books.
Singh BD.2001. *Biotechnology*.Kalyani.
Skoog Y & Miller CO. 1957.*Chemical Regulation of Growth andFormation in Plant Tissue Cultured in vitro*.Attidel. II Symp. OnBiotechnology Action of Growth Substance.
Vasil TK, Vasi M, While DNR &Bery HR. 1979. *Somatic Hybridizationand Genetic Manipulation in Plants.Plant Regulation and WorldAgriculture*.Planum Press.
Williamson R. 1981-86. *Genetic Engineering*. Vols. I-V.

VSC 605 SEED CERTIFICATION, PROCESSING AND STORAGE OF VEGETABLE CROPS2+1

Objective

To educate the recent trends in the certification, processing and storage ofvegetable crops.

Theory

UNIT ISeed certification, objectives, organization of seed certification, minimumseed certification standards of vegetable crops, field inspection,specification for certification.

UNIT IISeed processing, study of seed processing equipments seed cleaning andupgrading, Seed packing and handling, equipment used for packaging ofseeds, procedures for allocating lot number.

UNIT IIIPre-conditioning, seed treatment, benefits, types and products, generalprinciples of seed storage, advances in methods of storage, quality controlin storage, storage containers, seed longevity and deterioration, sanitation,temperature and relative humidity control.

UNIT IVSeed testing; ISTA rules for testing, moisture, purity germination, vigortest, seed sampling, determination of genuineness of varieties, seedviability, seed health testing; seed dormancy and types of dormancy,factors responsible for dormancy.

UNIT VSeed marketing, demand forecast, marketing organization, economics ofseed production; farmers' rights, seed law enforcement, seed act and seedpolicy.

Practical

Seed sampling, purity, moisture testing, seed viability, seed vigortests,seed health testing, seed cleaning, grading and packaging; handling of seedtesting equipment and processing machines; seed treatment methods, seedpriming and pelleting; field and seed inspection, practices in rouging, seed storage, isolation distances, biochemical tests, visit to seed testinglaboratories and processing plants, mixing and dividing instruments, visit toseed processing unit and warehouse visit and know about sanitationstandards.

Suggested Readings

Agrawal PK &Dadlani M. 1992.*Tecniques in Seed Science andTechnology*.South Asian Publ.
Singh N, Singh DK, Singh YK & Kumar V. 2006.*Vegetable SeedProduction Technology*. International Book Distr. Co.
Singh SP. 2001. *Seed Production of Commercial Vegetables*.AgrotechPubl.Academy.
Tanwar NS & Singh SV. 1988. *Indian Minimum Seed CertificationStandards*. Central Seed Certification Board, GOI, New Delhi.
Rajan S & Baby L Markose 2007.*Propagation of Horticultural Crops*.New India Publ. Agency.

VSC 606 ABIOTIC STRESS MANAGEMENT IN VEGETABLE CROPS2+1

Objective

To update knowledge on the recent research trends in the field of breedingof vegetable crops with special emphasis on tropical, subtropical andtemperate crops grown in India.

Theory

UNIT IEnvironmental stress and its types, soil parameters including pH,classification of vegetable crops based on susceptibility and tolerance tovarious types of stress; root stock, use of wild species, use of antitranspirants.

UNIT IIMechanism and measurements of tolerance to drought, water logging, soilsalinity, frost and heat stress in vegetable crops.

UNIT IIISoil-plant-water relations under different stress conditions in vegetablecrops production and their management practices.

UNIT IVTechniques of vegetable growing under water deficit, water logging,salinity and sodicity.

UNIT VTechniques of vegetable growing under high and low temperatureconditions, use of chemicals in alleviation of different stresses.

Practical

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

Suggested Readings

Dwivedi P &Dwivedi RS. 2005. *Physiology of Abiotic stress in Plants*.Agrobios.

Lerner HR (Ed.). 1999. *Plant Responses to Environmental Stresses*. MarcelDecker.

Maloo SR. 2003.*Abiotic Stresses and Crop Productivity*.AgrotechPubl.Academy.

VEGETABLE SCIENCE

List of Journals

- American Journal of Horticultural Sciences
- American Potato Growers
- American Scientist
- Annals of Agricultural Research
- Annual Review of Plant Physiology
- California Agriculture
- Haryana Journal of Horticultural Sciences
- HAU Journal of Research
- Horticulture Research
- HortScience
- IIVR Bulletins
- Indian Horticulture
- Indian Journal of Agricultural Sciences
- Indian Journal of Horticulture
- Indian Journal of Plant Physiology
- Journal of American Society for Horticultural Sciences
- Journal of Arecanut and Spice Crop
- Journal of Food Science and Technology
- Journal of Plant Physiology
- Journal of Post-harvest Biology and Technology
- Post-harvest Biology and Technology
- ScientiaHorticulturae
- Seed Research
- Seed Science

- South Indian Horticulture
- Vegetable Grower
- Vegetable Science

SPICE CROPS

VSC 510* PRODUCTION TECHNOLOGY OF SPICE CROPS 2+1
VSC 511* BREEDING OF SPICES 2+1
VSC 512*PROCESSING OF SPICES 1+1
VSC 513 ORGANIC SPICE PRODUCTION TECHNOLOGY 2+1
VSC607** ADVANCES IN SPICE PRODUCTION 2+1
VSC608 ADVANCES IN BREEDING OF SPICE CROPS 2+1
VSC609BIOTECHNOLOGY IN SPICES 1+1

Course Contents

VSC510 PRODUCTION TECHNOLOGY OF SPICE CROPS 2+1

Objective

To impart basic knowledge about the importance and production technology of spices grown in India.

Theory

Introduction, importance of spice crops-historical accent, present status - national and international, future prospects, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, 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, physiological disorders,harvesting, post harvest management, plant protection measures and seed planting material and micro-propagation, precision farming, organic resource management, organic certification, quality control, pharmaceutical significance and protected cultivation of:

UNIT IBlack pepper, cardamom
UNIT IIClove, cinnamon and nutmeg, allspice
UNIT IIITurmeric, ginger and garlic
UNIT IVCoriander, fenugreek, cumin, fennel, ajowain, dill, celery
UNIT VTamarind, garcinia and vanilla

Practical

Identification of seeds and plants, botanical description of plant;preparation of herbarium, propagation, nursery raising, field layout andmethod of planting, cultural practices, harvesting, drying, storage,packaging and processing, value addition; short term experiments on spicecrops.

Suggested Readings

Agarwal S, Sastry EVD & Sharma RK. 2001. *Seed Spices: Production,Quality, Export*. Pointer Publ.
Arya PS. 2003.*Spice Crops of India*. Kalyani.
Bhattacharjee SK. 2000. *Hand Book of Aromatic Plants*. Pointer Publ.
Bose TK, Mitra SK, Farooqi SK & Sadhu MK (Eds.). 1999. *TropicalHorticulture*. Vol.I. NayaProkash.

Chadha KL &Rethinam P. (Eds.). 1993. *Advances in Horticulture*. Vols.IX-X. *Plantation Crops and Spices*.Malhotra Publ. House.
Gupta S. (Ed.). *Hand Book of Spices and Packaging with Formulae*.Engineers India Research Institute, New Delhi.
Kumar NA, Khader P, Rangaswami&Irulappan I. 2000. *Introduction toSpices, Plantation Crops, Medicinal and Aromatic Plants*.Oxford& IBH.
Nybe EV, Miniraj N & Peter KV. 2007. *Spices*. New India Publ. Agency.
Parthasarthy VA, Kandiannan V &Srinivasan V. 2008.*Organic Spices*.New India Publ. Agency.
Peter KV. 2001. *Hand Book of Herbs and Spices*. Vols. I-III. WoodheadPubl. Co. UK and CRC USA
Pruthi JS. (Ed.). 1998. *Spices and Condiments*. National Book Trust
Pruthi JS. 2001. *Minor Spices and Condiments- Crop Management andPost Harvest Technology*. ICAR.
Purseglove JW, Brown EG, Green CL & Robbins SRJ. (Eds.). 1981.*Spices*. Vols.I, II.Longman.
Shanmugavelu KG, Kumar N & Peter KV. 2002. *Production Technology ofSpices and Plantation Crops*. Agrobios.
Thamburaj S & Singh N. (Eds.). 2004. *Vegetables, Tuber Crops andSpices*. ICAR.
Tiwari RS &Agarwal A. 2004.*Production Technology of Spices*.
International Book Distr. Co.
Varmudy V. 2001.*Marketing of Spices*.Daya Publ. House.

VSC511BREEDING OF SPICES 2+1

Objective

To impart comprehensive knowledge about the principles and practices ofbreeding of spices.

Theory

Species and cultivars, cytogenetics, survey, collection, conservation andevaluation, blossom biology, breeding objectives, approaches for cropimprovement, introduction, selection, hybridization, mutation breeding,polyploid breeding, improvement of quality traits, resistance breeding forbiotic and abiotic stresses, molecular aided breeding and biotechnologicalapproaches, marker-assisted selection, bioinformatics, IPR issues,achievements and future thrusts.

Crops

UNIT I: Black pepper and cardamom
UNIT II: Ginger and turmeric
UNIT III: Fenugreek, coriander, fennel, celery and ajwoain
UNIT IV: Nutmeg, cinnamon, clove and allspice

Practical

Characterization and evaluation of germplasm accessions, Blossombiology, studies on pollen behaviour, practices in hybridization, ploidybreeding, mutation breeding, evaluation of biometrical traits and qualitytraits, screening for biotic and abiotic stresses, haploid culture, protoplastculture and fusion- induction of somaclonal variation and screening thevariants. Identification and familiarization of spices; floral biology anthesis;fruit set; selfing and crossing techniques; description of varieties. Salientfeatures of improved varieties and cultivars from public and private sector,bioinformatics, visit to radiotracer laboratory, national institutes forplantation crops and plant genetic resource centers, genetic transformationin plantation crops for resistance to biotic stress/quality improvement etc.

Suggested Readings

Anonymous 1985.*Rubber and its Cultivation*.The Rubber Board of India.Chadha KL &Rethinam P. (Eds.).1993.*Advances in Horticulture*.Vol. IX.*Plantation Crops and Spices*.Part-I.Malhotra Publ. House.

Chadha KL, Ravindran PN &Sahijram L. 2000.*Biotechnology inHorticultural and Plantation Crops*.Malhotra Publ. House.

Chadha KL. 1998. *Advances in Horticulture*. Vol. IX. *Plantation andSpicesCrops*.Malhotra Publishing House, New Delhi.

Chopra VL & Peter KV. *Handbook of Industrial Crops*.HaworthPress.Panama International Publishers, New Delhi (Indian Ed.).

Damodaran VK, Vilaschandran T &.Valsalakumari PK. 1979.*Research onCashew in India*. KAU, Trichur.

Ferwerden FP & Wit F. (Ed.). 1969. *Outlines of Perennial Crop Breedingin the Tropics*. H. Veenman&Zonen.

Harver AE. 1962. *Modern Coffee Production*. Leonard Hoff.Raj PS &Vidyachandra B. 1981.*Review of Work Done on Cashew*. UASResearch Series No.6, Bangalore.

Thampan PK 1981. *Hand Book of Coconut Palm*. Oxford & IBH.

VSC512PROCESSING OF SPICES 2+1

Objective

To facilitate deeper understanding on principles and practices of postharvest technology of spices

Theory

Commercial uses of spices. Processing of major spices- cardamom, black pepper, ginger, turmeric, chilli and paprika,vanilla,cinnamon, clove, nutmeg, allspice, coriander, fenugreek, curry leaf.Extraction of pigments, oleoresin and essential oils.

Practical

Study of processing of different spices.

Extraction of active ingredients from different spices and herbs using TLC, HPLC,GC/CG-MS technology.Identification of different odoriferous factors in essential oil with GLC/GCMS.Physico-chemical and sensory evaluation of oils and oleoresin. Valueadded products from spices.

Suggested Readings

Chadha KL et al. (Eds.). 1993-95. *Advances in Horticulture*. Vol. IX. *Plantation Crops and Spices*.Malhotra Publishing House, New Delhi.

Fellows PJ. 1988. *Food Processing Technology*. Ellis Horwood International. Switzerland.

Fennema OR. 1985. *Food Chemistry*. Marcel Dekker.

Kumar N, Abdul Khader ML, Rangaswamy P &Ikrulappan I. 1994. *Spices, Plantation Crops, Medicinal and Aromatic Plants*.Rajalakshmi Publ.

Mandal RC. 1996. *Coconut Production and Processing Technology*. Agro.Bot.

Mandal RC. 1997. *Cashew: Production and Processing Technology*. Agro.Bot.

Masada Y.1986.*Analysis of Essential Oil by Gas Chromatograph and Mass Spectrometry*.John Wiley & Sons.

Paine FA. 1987. *Modern Processing, Packaging and Distributions Systems for Food*. AVI Publ.

Peter KV. (Ed.). 2001. *Handbook of Herbs and Spices*. Vols.I-III. Wood Head Publishing Co., UK & CRC, USA.

Sudheer KP & Indira V. 2008.*Post-Harvest Technology of Horticultural Crops*.Horticulture Science Series.New India Publ. Agency.

Thampan PK. 1981. *Handbook of Coconut Palm*.Oxford & IBH.

VSC513 ORGANIC SPICE PRODUCTION TECHNOLOGY 2+1

Objective

To educate principles, concepts and production of organic farming in spice.

Theory

UNIT IImportance, principles, perspective, concept and component of organicproduction of spices.

UNIT IIOrganic production of spice crops, *viz.* pepper,cardamom, turmeric, ginger, cumin, vanilla.

UNIT IIIManaging soil fertility, pests and diseases and weed problems in organicfarming system; crop rotation in organic horticulture; processing andquality control for organic foods.

UNIT IVMethods for enhancing soil fertility, mulching, raising green manure crops.Indigenous methods of compost, Panchagavvya, Biodynamics, preparationetc.; Pest and disease management in organic farming; ITK's in organicfarming.Role of botanicals and bio-control agents.

UNIT VGAP and GMP- Certification of organic products; organic production andexport - opportunity and challenges.

Practical

Method of preparation of compost, vermicomposting, biofertilizers, soil solarization, bio pesticides in horticulture, green manuring, mycorrhizae and organic crop production, waster management, organic soil amendment for root disease, weed management in organic horticulture. Visit to organic fields and marketing centers.

Suggested Readings

Dahama AK. 2005. *Organic Farming for Sustainable Agriculture*. 2nd Ed. Agrobios.

Gehlot G. 2005. *Organic Farming: Standards, Accreditation, Certification and Inspection*. Agrobios.

Palaniappan SP &Annadorai K. 2003.*Organic Farming: Theory and Practice*. Scientific Publ.

Pradeepkumar T, Suma B, Jyothibhaskar&Satheesan KN. 2008.*Management of Horticultural Crops*. New India Publ. Agency.

Shivashankar K. 1997. *Food Security in Harmony with Nature*. 3rd IFOAMASIA, Scientific Conference.1-4 Dec., 1997, UAS, Bangalore.

VSC607 ADVANCES IN SPICE PRODUCTION 2+1

Objective

To educate advances in production technology of spice crops.

Theory

Spices- current status on area and production, state, national and global scenario of spices, global trade, problems encountered in spices productivity, systems of cultivation, varieties, soil and climate, propagation techniques and nursery management, planting systems and methods, cropping pattern, permanent floor management concepts in mulching and weed management, canopy and root studies under different spice-based cropping systems, shade and basin management, INM practices, irrigation and fertigation techniques, chemical regulation of crop productivity, IPM, clean cultivation strategies, harvesting, Post-harvest and quality management for value added spices, quality standards, GAP and GMP for spices production, quality control and certification. Protected cultivation of high value spice crops.Value addition and byproductutilization.Pricision farming and organic farming in spice crops. Commodity Boards in spices development

UNIT I: Pepper and cardamom

UNIT II: Nutmeg, clove, cinnamon and allspice

UNIT III: Turmeric, ginger, garcinia, tamarind and garlic
UNIT IV: Coriander, fenugreek, fennel, cumin and vanilla
UNIT V: Paprika and important herbal spices

Suggested Readings

Chadha KL. 2001. *Hand book of Horticulture*. ICAR
George CK. (Ed.). 1989. *Proceedings of First National Seminar on Seed Spices*. Spices Board, Ministry of Commerce, Govt. of India, Kochi.
Marsh AC, Moss MK & Murphy EW. 1977. *Composition of Food Spices and Herbs, Raw, Processed and Prepared*. Agric. Res. Serv. Hand Book 8-2.Washinton DC.
Parry JW. 1969. *Spices and Condiments*. Pitman.
Peter KV. 2001. *Hand Book of Herbs and Spices*. Vols. I-III. Woodhead Publ. Co., UK & CRC, USA.
Purseglove JW. 1968. *Tropical Crops – Dicotyledons*. Longman.
Purseglove JW, Brown EG, Green CL & Robbins SRJ. 1984. *Spices.* Vols.I, II.Longman.
Ridley HM. 1972. *Spices*.MacMillan.
Rosengarten F Jr. 1969. *The Book of Spices*.Wynnewood; Livingston Publ. Co.
Ravindran PN. 2001. *Monograph on Black Pepper*. CRC Press.
Ravindran PN &Madhusoodanan KJ. 2002. *Cardamom, The Genus Elettaria*.Series - *Medicinal and Aromatic Plants – Industrial Profiles*.Routledge, UK.
Agarwal S, DivkaraSastry EV & Sharma RK. 2001. Seed Spices, Production, Quality and Export. Pointer Publ.
Shanmugavelu KG, Kumar N & Peter KV. 2002. *Production Technology of Spices and Plantation Crops*. Agrobios.
Winton AL & Winton KB. 1931. The Structure and Composition of Food. John Wiley & Sons.
Yagna Narayan Ayer AK. 1960. *Cultivation of Cloves in India*. ICAR.
Nybe EV, Mini Raj N & Peter KV. 2007. *Spices*. New India Publ. Agency.
Varmudy V. 2001.*Marketing of Spices*.Daya Publ. House.

VSC608 ADVANCES IN BREEDING OF SPICE CROPS 2+1

Objective

To update knowledge on the recent research trends in the field of breeding of spices.

Theory

Evolutionary mechanisms, adaptation and domestication, genetic resources, genetic divergence, cytogenetics, variations and natural selection, types of pollination and fertilization mechanisms, sterility and incompatibility system, recent advances in crop improvement efforts, introduction and selection, chimeras, clonal selections, intergeneric, interspecific and intervarietal hybridization, heterosis breeding, mutation and polyploidy breeding, resistance breeding to biotic and abiotic stresses, breeding for improving quality, genetics of important traits and their inheritance pattern, molecular and transgenic approaches and other biotechnological tools in improvement of selected spice and plantation crops.

Crops

UNIT I: Pepper and cardamom
UNIT II: Nutmeg, clove, cinnamon and allspice
UNIT III: Turmeric, ginger, garcinia, tamarind and garlic
UNIT IV: Coriander, fenugreek, fennel, cumin and vanilla

Practical

Description and cataloguing of germplasm, pollen viability tests, pollengermination, survey and clonal selection, screening techniques for abioticstresses, screening and rating for pest, disease and stress resistance ininbreds and hybrids, estimation of quality and processing characters forquality improvement, use of mutagenes and colchicine for inducingmutation and ploidy changes, practices in different methods of breedingand *in vitro* breeding techniques.

Suggested Readings

Chadha KL. 1998. *Advances in Horticulture*. Vol. IX, X. *Plantation andSpicesCrops*.Malhotra Publ. House.

Chadha KL, Ravindran PN &Sahijram L. 2000.*Biotechnology inHorticultural and Plantation Crops*.Malhotra Publ. House.

Chadha KL. 2001. *Hand book of Horticulture*. ICAR.

Chopra VL & Peter KV. 2002. *Handbook of Industrial Crops*. HaworthPress, USA &. Panama International Publ. (Indian Ed.).

Damodaran VK, Vilaschandran T &Valsalakumari PK.1979.*Research onCashew in India*. KAU, Trichur.

George CK. (Ed.). 1989. *Proceedings of First National Seminar on SeedSpices*. Spices Board, Ministry of Commerce, Govt. of India, Kochi.

Harver AE. 1962. *Modern Coffee Production*. Leonard Hoff (Book) Ltd.Purseglove JW. 1968. *Tropical Crops – Dictyledons*. Longman.

Purseglove JW, Brown EG, Green CL & Robbins SRJ. 1984. *Spices*. Vols.I, II.Longman.

Peter KV. 2001-04. *Handbook of Herbs and Spices*.Vols.I-III.WoodheadPubl. Co., UK & CRC, USA.

Raj PS &Vidyachandra B. 1981.*Review of Work Done on Cashew*. UASResearch Series No.6, Bangalore.

Ravindran PN. 2001. *Monograph on Black Pepper*. CRC Press.

Ravindran PN &Madhusoodanan KJ. 2002. *Cardamom, TheGenusElettaria*Series on *Medicinal and Aromatic Plants – IndustrialProfiles*. Routledge, UK

Rosengarten F Jr. 1969. *The Book of Spices*.Wynnewood; Livingston Publ.Co.

Shanmugavelu KG, Kumar N & Peter KV. 2002. *Production Technology of Spices and Plantation Crops*.Agrobios.

VSC609 BIOTECHNOLOGY IN SPICES 1+1

Objective

To teach advances in biotechnology for improvement ofspices.

Theory

Crops: pepper, cardamom, turmeric,ginger, vanilla

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

UNIT IIProtoplast culture and fusion, construction, identification and characterization of somatic hybrids and cybrids, wide hybridization,embryo rescue of recalcitrant species, *in vitro* conservation of spices andplantation crops.

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

UNIT IVQuality improvement; improvement for biotic and abiotic stresses; transgenic plants.

UNIT VRole 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.

Suggested Readings

Bajaj YPS. (Ed.). 1987. *Biotechnology in Agriculture and Forestry*. Springer.
Chadha KL, Ravindran PN &Sahijram L. (Eds.). 2000. *Biotechnology of Horticulture and Plantation Crops*. Malhotra Publ. House.
Debnath M. 2005. *Tools and Techniques of Biotechnology*.Pointer Publ.
Glover MD. 1984. *Gene Cloning: The Mechanics of DNA Manipulation*. Chapman & Hall.
Gorden H &Rubsell S. 1960.*Harmones and Cell Culture*. AB Book Publ.
Keshavachandran R & Peter KV. 2008. *Plant Biotechnology: TissueCulture and Gene Transfer*. Orient & Longman (Universal Press).
Keshavachandran R, Nazim PA, Girija D. & Peter KV 2007. *Recent Trends in Biotechnology of Horticultural Crops*.New India Publ. Agency.
Panopoulas NJ. (Ed.). 1981. *Genetic Engineering in Plant Sciences*. Praeger Publ.
Parthasarathy VA., Bose TK, Deka PC, Das P, Mitra SK &Mohanadas S. 2001. *Biotechnology of Horticultural Crops*. Vols. I-III. NayaProkash.
Pierik RLM. 1987. *In vitro Culture of Higher Plants*. MartinusNijhoff Publ.
Prasad S. 1999. *Impact of Plant Biotechnology on Horticulture*.2nd Ed. Agro Botanica.
Sharma R. 2000. *Plant Tissue Culture*. Campus Books, International.
Singh BD. 2001. Biotechnology.Kalyani.
Skoog F & Miller CO. 1957.*Chemical Regulation of Growth and Formation in Plant Tissue Culture in vitro.*Symp. Soc. Exp. Biol. 11: 118-131.
Vasil TK, Vasi M, While DNR &Bery HR. 1979. *Somatic Hybridization and Genetic Manipulation in Plants.Plant Regulation and World Agriculture*.Plenum Press.
Williamson R. 1981-86. *Genetic Engineering*. Vols. I-V. Academic Press.

SPICE CROPS

List of Journals & Magazines

- Indian Spice
- Spice India

Suggested Broad Topics for Master's and Doctoral Research

- Micro-propagation of spice crops
- Application of genetic engineering in spice crops
- Use of molecular markers in spice crops
- spice crops improvement
- Crop selection for biotic and abiotic stresses
- Diagnostic and recommended integrated system in cultivation of spices,
- Precision farming in spices,
- Root distribution studies in spices,
- Organic production of spices,
- Post harvest management of spices,
- Value addition in spices,
- Rejuvenation of spice garden

Research on burning problems in spices- foot rot of black pepper, katte disease of cardamom etc.

COMPULSORY NON-CREDIT COURSES

(Compulsory for Master's programme in all disciplines; Optional for Ph.D. scholars)

CODE	COURSE TITLE	CREDITS
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATIONS SKILLS	0+1
PGS 503(e-Course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-Course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-Course)	DISASTER MANAGEMENT	1+0

Course Contents

PGS 501 LIBRARY AND INFORMATION SERVICES 0+1

Objective

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services

(Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; eresources access methods.

PGS 502 TECHNICAL WRITING AND COMMUNICATIONS SKILLS 0+1

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical Writing **-** Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of

numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills **-** Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Suggested Readings

Chicago Manual of Style.14th Ed. 1996.Prentice Hall of India.
Collins' Cobuild English Dictionary. 1995. Harper Collins.
Gordon HM & Walter JA. 1970. *Technical Writing*. 3rd Ed. Holt, Rinehart & Winston.
Hornby AS. 2000. *Comp. Oxford Advanced Learner's Dictionary of Current English*. 6th Ed. Oxford University Press.
James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. Affiliated East-West Press.
Mohan K. 2005. *Speaking English Effectively*.MacMillan India.
Richard WS. 1969. *Technical Writing*. Barnes & Noble.
Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*. Abhishek.
Sethi J &Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed. Prentice Hall of India.
Wren PC & Martin H. 2006.*High School English Grammar and Composition*. S. Chand & Co.

PGS 503 (e-Course) INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 1+0

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives;Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Suggested Readings

Erbisch FH &Maredia K.1998.*Intellectual Property Rights in Agricultural Biotechnology*. CABI.
Ganguli P. 2001.*Intellectual Property Rights: Unleashing Knowledge Economy*. McGraw-Hill.
Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies.Ministry of Agriculture, Government of India. 2004. *State of Indian Farmer*. Vol. V. *Technology Generation and IPR Issues*.Academic Foundation.

Rothschild M & Scott N. (Ed.). 2003. *Intellectual Property Rights in Animal Breeding and Genetics*. CABI.
Saha R. (Ed.). 2006. *Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies*. Daya Publ. House.
The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000;
Trademarks Act, 1999; The Copyright Act, 1957 and amendments; LayoutDesign Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques ofsolutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath,waterbath, oilbath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy

Suggested Readings

Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press.
Gabb MH &Latchem WE. 1968. *A Handbook of Laboratory Solutions*.
Chemical Publ. Co.

PGS 505 (e-Course) AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development rogrammes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, pportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): InternationalAgricultural Research Centres (IARC), partnership with NARS, role as apartner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfareof animals used in research, computer ethics, standards and problems inresearch ethics.

UNIT III

Concept and connotations of rural development, rural development policiesand strategies. Rural development programmes: Community DevelopmentProgramme, Intensive Agricultural District Programme, Special group –Area Specific Programme, Integrated Rural Development Programme(IRDP) Panchayati Raj Institutions, Co-operatives, VoluntaryAgencies/Non-Governmental Organisations. Critical evaluation of ruraldevelopment policies and programmes.Constraints in implementation ofrural policies and programmes.

Suggested Readings

Bhalla GS & Singh G. 2001.*Indian Agriculture - Four Decades ofDevelopment*.Sage Publ.
Punia MS. *Manual on International Research and Research Ethics*.CCS,Haryana Agricultural University, Hisar.
Rao BSV. 2007. *Rural Development Strategies and Role of Institutions -Issues, Innovations and Initiatives*. Mittal Publ.Singh K.. 1998. *Rural Development - Principles, Policies and Management.*Sage Publ.

PGS 506 (e-Course) DISASTER MANAGEMENT 1+0

Objectives

To introduce learners to the key concepts and practices of natural disastermanagement; to equip them to conduct thorough assessment of hazards,and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types andeffects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Globalwarming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biologicaldisasters, building fire, coal fire, forest fire. Oil fire, air pollution, waterpollution, deforestation, Industrial wastewater pollution, road accidents, railaccidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national andglobal levels. International Strategy for Disaster reduction. Concept ofdisaster management, national disaster management framework; financialarrangements; role of NGOs, Community-based organizations, and media.Central, State, District and local Administration; Armed forces in Disasterresponse; Disaster response: Police and other organizations.

Suggested Readings

Gupta HK. 2003. *Disaster Management*. Indian National ScienceAcademy.OrientBlackswan.
Hodgkinson PE & Stewart M. 1991.*Coping with Catastrophe: AHandbook of Disaster Management*.Routledge.
Sharma VK. 2001. *Disaster Management*. National Centre for DisasterManagement, India.

e - Resources in Horticulture

Australian Society for Horticultural Science http://www.aushs.org.au/
Agricultural & Processed Food Products Export Development Authority (APEDA) http://www.apeda.com/

American Society for Horticultural Science http://www.ashs.org/
Asian Vegetable Research and Development Center (AVRDC) http://www.avrdc.org.tw/
Australian Society for Horticultural Science http://www.aushs.org.au/
Central Food Technological Research Institute (CFTRI) http://www.cftri.com/
Central Institute of Medicinal & Aromatic Plants(CIMAP)http://www.cimap.org/
Central Institute of Post harvest Engineering and Technology http://www.icar.org.in/ciphet.html
Central Plantation Crops Research Institute(CPCRI), Kasaragod, Kerala http://cpcri.nic.in/
Central Tuber Crops Research Institute (CTCRI), Thiruvananthapuram, Kerala http://www.ctcri.org/
Consultative Group on International AgriculturalResearch, CGIAR http://www.cgiar.org/
Coffee Board, India http://indiacoffee.org/
Department of Agriculture and Co-operation, India http://agricoop.nic.in/
Department of Bio-technology, India http://dbtindia.nic.in
Department of Scientific and Industrial Research,India http://dsir.nic.in/
FAO http://www.fao.org/
Global Agribusiness Information Network: http://www.fintrac.com/gain/:
Greenhouse Vegetable Information: http://www.ghvi.co.nz/
Indian Agricultural Research Institute (IARI) http://www.iari.res.in/
Indian Council of Agricultural Research (ICAR) http://www.icar.org.in
Indian Institute of Horticultural Research (IIHR) www.iihr.res.in
Indian Institute of Spices Research (IISR),Calicut, Keralahttp://www.iisr.org/
Indo-American Hybrid Seeds www.indamseeds.com
Institute of Vegetable and Ornamental Crops http://www.igzev.de/
Institute for Horticultural Development, Victoria, Australia http://www.nre.vic.gov.au/agvic/ih/
Kerala Agricultural University www.kau.edu
Iowa State University Department of Horticulture http://www.hort.iastate.edu/
National Bureau of Plant Genetic Resources (NBPGR), India http://nbpgr.delhi.nic.in/
National Horticulture Board (NHB), India http://hortibizindia.nic.in/
National Institute of Agricultural Extension Management (MANAGE), India http://www.manage.gov.in/
National Research Centre for Cashew (NRCC), http://kar.nic.in/cashew/India
National Research Centre for Mushroom (NRCM), India http://www.nrcmushroom.com/
National Research Centre for Oil Palm (NRCOP),India http://www.ap.nic.in/nrcop
North Carolina State University, Dept. of Horticulture http://www2.ncsu.edu/cals/hort_sci/
Oregon State University, Dept. of Horticulture http://osu.orst.edu/dept/hort
Pineapple News http://agrss.sherman.hawaii.edu/pineapple/pineappl.htm
Pomology Resources Centerhttp://www.bsi.fr/pomologie/english /pomology:
Rubber board, India http://rubberboard.org.in/
Spice Paprika web site http://www.paprika.deltav.hu/:
Spices Board, India http://www.indianspices.com/
Sri Lanka Agribisness on-line http://www.agro-lanka.org/
Sustainable Apple Production: http://orchard.uvm.edu/
Tea Board, India http://tea.nic.in/
The Horticultural Taxonomy Group http://www.hortax.org.uk/
The International Society of Citriculture: http://www.lal.ufl.edu/isc_citrus_homepage.htm
The Internet Garden http://www.internetgarden.co.uk/
The Rose Resource http://rose.org/

The USDA Agricultural Research Service http://www.ars.usda.gov/
University of Florida, Dept. of Environmental Horticulture http://hort.ifas.ufl.edu/
University of California, Fruit&Nut Research http://fruitsandnuts.ucdavis.edu/
US Environmental Protection Agency http://www.epa.gov/:
USDA http://www.usda.gov/