

DEPARTMENT OF HORTICULTURE
Semesters wise distribution of courses for
M. Sc. Ag. Horticulture (Vegetable Science)

Semester-I			
S. No.	Course Title	Code	Credits
Major Courses			
1.	Production Technology of Cool Season Vegetable Crops	VSC501	3(2+1)
2.	Production Technology of Warm Season Vegetable Crops	VSC502	3(2+1)
3.	Breeding of Vegetable Crops	VSC503	3(2+1)
4.	Growth and Development of Vegetable Crops	VSC504	3(2+1)
Minor Courses			
1.	Tropical and Dry-land Fruit production	FSC501	3(2+1)
2.	Propagation and Nursery Management for fruit crops	FSC505	3(2+1)
Supporting Courses			
1.	Statistical Methods for Applied Sciences	STAT511	4(3+1)
Compulsory Non-Credit Courses			
1.	Library and Information Services	PGS501	1(0+1)
2.	Technical Writing and Communication Skills	PGS502	1(0+1)
3.	Intellectual Property and its Management in Agriculture	PGS503	1(1+0)

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Semester-II			
S. No.	Course Title	Code	Credits
Major Courses			
1.	Seed Production Technology of Vegetable Crops	VSC505	3(2+1)
2.	Production Technology of Under Exploited Vegetable Crops	VSC507	3(2+1)
3.	Organic Vegetable Production Technology	VSC508	2(1+1)
Minor Courses			
1.	Canopy management in fruit crops	FSC504	2(1+1)
2.	Growth and Development of Horticulture crops	FSC508	3(2+1)
Supporting Courses			
1.	Experimental Design	STAT512	3(2+1)
Non Credit Courses			
1.	Basic concept in laboratory technology	PGS504	1(0+1)
2.	Agricultural Research, Research Ethics and Rural Development Programmes	PGS505	1(1+0)
3.	Disaster management	PGS506	1(1+0)
Semester-III			
1.	Written Comprehensive Examination (for Major & Minor courses)		
2.	Seminar	FLA591	1(0+1)
3.	Master's Research	FLA599	10(0+10)
Semester-IV			
1.	Master's Research	FLA599	10(0+10)

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Major Courses

VSC 501 Production Technology of cool season Vegetable Crops 2+1

Objective

To educate production technology of cool season vegetable.

Theory

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

UNIT I

Potato

UNIT II

Cole crops: cabbage, cauliflower, knol khol, sprouting broccoli and 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; 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.

Suggested Readings

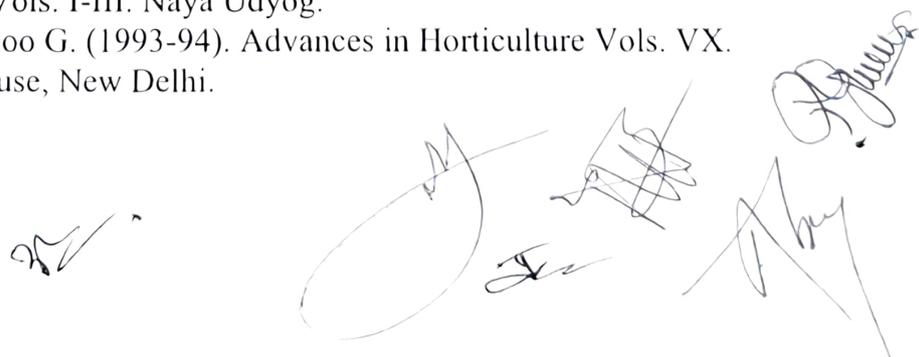
Bose TK & Som MG. (1986). Vegetable Crops in India. Naya Prokash, Calcutta

Bose TK, Som G & Kabir J. (2002). Vegetable Crops. Naya Prokash, Kolkata.

Bose TK, Som MG & Kabir J. (1993). Vegetable Crops. Naya Prokash, Kolkata.

Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. (2003). Vegetable Crops. Vols. I-III. Naya Udyog.

Chadha KL & Kalloo G. (1993-94). Advances in Horticulture Vols. VX. Malhotra Publ. House, New Delhi.



- Chadha KL. (2002). Hand Book of Horticulture. ICAR, New Delhi.
- Chauhan DVS. (1986). Vegetable Production in India. Ram Prasad & Sons.
- Decoteau DR. (2000). Vegetable Crops. Prentice Hall.
- Edmond JB, Musser AM & Andrews FS. (1951). Fundamentals of Horticulture. Blakiston Co.
- Fageria MS, Choudhary BR & Dhaka RS. (2000). Vegetable Crops: Production Technology. Vol. II. Kalyani Publisher, New Delhi.
- Gopalakrishanan TR. (2007). Vegetable Crops. New India Publ. Agency, New Delhi.
- Hazra P & Som MG. (1999). Technology for Vegetable Production and Improvement. Naya Prokash, Kolkata.
- Rana MK. (2008). Olericulture in India. Kalyani Publ., New Delhi.
- Rana MK. (2008). Scientific Cultivation of Vegetables. Kalyani Publ., New Delhi.
- Rubatzky VE & Yamaguchi M. (1997). World Vegetables: Principles, Production and Nutritive Values. Chapman & Hall.
- Saini GS. (2001). A Text Book of Oleri and Flori Culture. Aman Publ. House.
- Salunkhe DK & Kadam SS. (1998). Hand Book of Vegetable Science and 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. Lucknow
- Singh SP. (1989). Production Technology of Vegetable Crops. Agril. Comm. Res. Centre, Karnal
- Thamburaj S & Singh N. (2004). Vegetables, Tuber Crops and Spices. ICAR, New Delhi.
- Thompson HC & Kelly WC. (1978). Vegetable Crops. Tata McGraw-Hill.



VSC 502 Production Technology of warm season Vegetable Crops 2+1

Objective

To teach production technology of warm season vegetable.

Theory

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 crop production and seed production of:

UNIT I

Tomato, eggplant, hot and sweet peppers

UNIT II

Okra, beans (French bean, Indian bean and cluster bean), cowpea

UNIT III

Cucurbitaceous crop

UNIT IV

Tapioca, sweet potato and colocasia

UNIT V

Green leafy warm season vegetables

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 techniques; identification of important pests and diseases and their control; maturity standards; economics of warm season vegetable crops.

Suggested Readings

Bose TK & Som MG. (1986). *Vegetable Crops in India*. Naya Prokash, Calcutta.

Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. (2003). *Vegetable Crops*. Vols. I-III. Naya Udyog.

Bose TK, Som MG & Kabir J. (2002). *Vegetable Crops*. Naya Prokash, Kolkata.

Brown HD & Hutchison CS. *Vegetable Science*. JB Lippincott Co.

Chadha KL & Kallou G. (1993-94). *Advances in Horticulture*. Vols.VX.

Malhotra Publ. House, New Delhi.

Chadha KL. (2002). *Hand Book of Horticulture*. ICAR, New Delhi.



- Chauhan DVS. (1986). *Vegetable Production in India*. Ram Prasad & Sons.
- Dccoteau DR. (2000). *Vegetable Crops*. Prentice Hall, New Delhi.
- Edmond JB, Musser AM & Andrews FS. (1964). *Fundamentals of Horticulture*. Blakiston Co
- Fageria MS, Choudhary BR & Dhaka RS. (2000). *Vegetable Crops: Production Technology*. Vol. II. Kalyani publishers, New Delhi.
- Gopalakrishanan TR. (2007). *Vegetable Crops*. New India Publ. Agency, New Delhi.
- Hazra P & Som MG. (1999). *Technology for Vegetable Production and Improvement*. Naya Prokash, Kolkata
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- Kaloo G & Singh K. (2000). *Emerging Scenario in Vegetable Research and Development*. Research Periodicals & Book Publishing House, Houston, Texas, USA.
- Nayer NM & More TA (1998). *Cucurbits*. Oxford & IBH Publ. Co., New Delhi.
- PalaniswamyM.S. & Peter KV. (2007). *Tuber Crops*. New India Publ. Agency, New Delhi.
- Rana MK. (2008). *Olericulture in India*. Kalyani Publishers, New Delhi.
- Rana MK. (2008). *Scientific Cultivation of Vegetables*. Kalyani Publishers, New Delhi.
- Rubatzky VE & Yamaguchi M. (1997). *World Vegetables: Principles, Production and Nutritive Values*. Chapman & Hall.
- Saini GS. (2001). *A Text Book of Oleri and Flori Culture*. Aman Publ. House.
- Salunkhe DK & Kadam SS. (1998). *Hand Book of Vegetable Science and Technology: Production, Composition, Storage and Processing*. Marcel Dekker Inc., New York.
- Shanmugavelu KG. (1989). *Production Technology of Vegetable Crops*. Oxford & IBH Publishing Co., New Delhi.
- Singh DK. (2007). *Modern Vegetable Varieties and Production Technology*. International Book Distributing Co., Lucknow
- Singh NP, Bharadwaj AK, Kumar A & Singh KM. (2004). *Modern Technology on Vegetable Production*. International Book Distributing Co., Lucknow.
- Singh SP. (1989). *Production Technology of Vegetable Crops*. Agril. Comm. Res. Centre, Karnal.
- Thamburaj S & Singh N. (2004). *Vegetables, Tuber Crops and Spices*. ICAR, New Delhi.



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



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VSC 503 Breeding of Vegetable Crops 2+1

Objective

To educate principal and practices adopted for breeding of vegetable crops.

Theory

Origin, botany, taxonomy, cytogenetics, genetics, breeding objectives, 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 and tomato

UNIT II

Brinjal, 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, sweet potato and tapioca

Practical

Selection of desirable plants from breeding population, observation and analysis of various qualitative and quantitative traits in germplasm, hybrids and segregating generations; induction of flowering, palanological studies, selfing and crossing techniques in vegetable crops; hybrid seed production of vegetable crops in bulk. Screening techniques for insect-pests, disease and environmental stress resistance in above mentioned crops, demonstration of sib-mating and mixed population; molecular marker techniques to identify useful traits in the vegetable crops and special breeding techniques. Visit to breeding blocks.

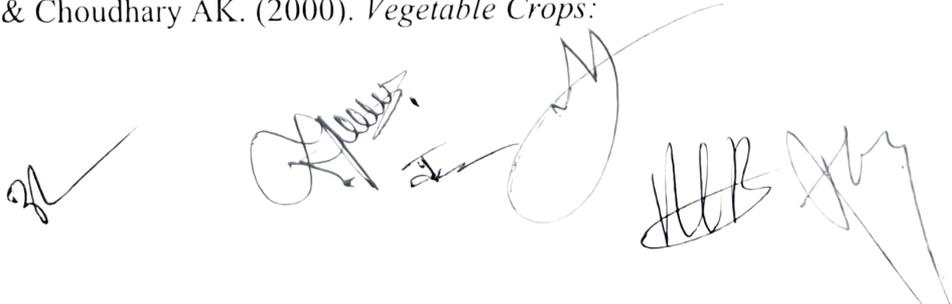
Suggested Readings

Allard RW (1999). *Principles of Plant Breeding*. John Wiley & Sons, Inc., New York.

Basset MJ. (1986). *Breeding Vegetable Crops*. AVI Publ.

Dhillon BS, Tyagi RK, Saxena S. & Randhawa GJ (2005). *Plant Genetic Resources: Horticultural Crops*. Narosa Publishing House, New Delhi.

Fageria MS, Arya PS & Choudhary AK. (2000). *Vegetable Crops:*



- Breeding and Seed Production*. Vol. I. Kalyani publishers, New Delhi.
- Gardner EJ. (1975). *Principles of Genetics*. John Wiley & Sons Inc., New York.
- Hayes HK, Immer FR & Smith DC. (1955). *Methods of Plant Breeding*. McGraw-Hill Book Co. Inc., New York.
- Hayward MD, Bosemark NO & Romagosa I (1993). *Plant Breeding-Principles and Prospects*. Chapman & Hall, New York.
- Kaloo G. (1988). *Vegetable Breeding*. Vols. I-III. CRC Press, Inc. BocaRaton, Florida (USA).
- Kaloo G. (1998). *Vegetable Breeding*. Vols. I-III (Combined Ed.). Panima Educational Book Agency, New Delhi.
- Kumar JC & Dhaliwal MS. (1990). *Techniques of Developing Hybrids in Vegetable Crops*. Agro Botanical Publ.
- Paroda RS & Kaloo G. (1995). *Vegetable Research with Special Reference to Hybrid Technology in Asia-Pacific Region*. FAO.
- Peter KV & Pradeep Kumar T. (2008). *Genetics and Breeding of Vegetables*. Revised, ICAR., New Delhi.
- Rai N & Rai M. (2006). *Heterosis Breeding in Vegetable Crops*. New India Publ. Agency, New Delhi.
- Ram HH. (1998). *Vegetable Breeding: Principles and Practices*. Kalyani Publishers, New Delhi.
- Simmonds NW. (1978). *Principles of Crop Improvement*. Longman, London
- Singh BD. (1990). *Plant Breeding*. Kalyani Publishers, New Delhi.
- Singh PK, Dasgupta SK & Tripathi SK. (2004). *Hybrid Vegetable Development*. International Book Distributing Co. Lucknow
- Swarup V. (1976). *Breeding Procedure for Cross-pollinated Vegetable Crops*. ICAR, New Delhi.



VSC 504 Growth and Development of Vegetable Crops 2+1

Objective

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

Theory

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, tubers and bulbs; Role of auxins, gibberellins, cytokinins 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

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; 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 and fruit 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.

Suggested Readings

Bleasdale JKA. (1984). *Plant Physiology in Relation to Horticulture*.

2nd Ed. MacMillan.

Gupta US. (1978). *Crop Physiology*. Oxford & IBH.

Krishnamoorti HN. (1981). *Application Plant Growth Substances and Their Uses in Agriculture*. Tata-McGraw Hill.

Peter KV. (2008). *Basics of Horticulture*. New India Publ. Agency,



New Delhi.

Saini RS, Sharma KD, Dhankhar OP & Kaushik RA. (2001).
Laboratory Manual of Analytical Techniques in Horticulture.
Agrobios.

Wien HC. (1997). *The Physiology of Vegetable Crops.* CABI.

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Kaushik

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VSC 505 Seed Production Technology of Vegetable Crops 2+1

Objective

To educate principal and methods of quality seed and planting material production in vegetable crops.

Theory

UNIT I

Definition of seed and its quality, new seed policies; DUS test, scope of vegetable seed industry in India.

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 behavior, seed development and maturation; methods of hybrid seed production.

UNIT III

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 VI

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.

UNIT V

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 and spice crops; 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.

Suggested Readings

- Agrawal PK & Dadlani M. (1992). *Techniques in Seed Science and Technology*. South Asian Publ.
- Agrawal RL. (1997). *Seed Technology*. Oxford & IBH.
- Bendell PE. (1998). *Seed Science and Technology: Indian Forestry Species*. Allied Publ.
- Fageria MS, Arya PS & Choudhary AK. (2000). *Vegetable Crops: Breeding and Seed Production*. Vol I. Kalyani Publishers, New Delhi.
- George RAT. (1999). *Vegetable Seed Production*. 2nd Ed. CABI.
- Kumar JC & Dhaliwal MS. (1990). *Techniques of Developing Hybrids in Vegetable Crops*. Agro Botanical Publ.
- More TA, Kale PB & Khule BW. (1996). *Vegetable Seed Production Technology*. 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.,

Lucknow,
Singh SP, (2001). *Seed Production of Commercial Vegetables*.
Agrotech Publ. Academy.

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VSC 507 Production Technology of Underexploited Vegetable 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 rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post harvest management, plant protection measures and seed production of:

UNIT I

Asparagus, Jerusalem artichoke, leek and drumstick

UNIT II

Brussels's sprout, Chinese cabbage, broccoli, kale, Globe artichoke, tannia and curry leaf.

UNIT III

Amaranth, celery, parsley, parsnip, lettuce, rhubarb, spinach, basella, bathua (chenopods) and chekurmanis.

UNIT IV

Elephant foot yam, dioscorea (greater yam, lesser yam and white yam), yam bean, lima bean, winged bean, vegetable pigeon pea, jack bean and sword bean.

UNIT V

Sweet gourd, spine gourd, pointed gourd, oriental pickling melon, little gourd (kundru), arrowroot and chinese potato.

Practical

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

Suggested Readings

Bhat KL. (2001). *Minor Vegetables - Untapped Potential*. Kalyani Publishers, New Delhi.

Indira P & Peter KV. (1984). *Unexploited Tropical Vegetables*. Kerala Agricultural University, Kerala.

Peter KV. (2007-08). *Underutilized and Underexploited Horticultural Crops*. Vols. I-IV. New India Publ. Agency, New Delhi.

Rubatzky VE & Yamaguchi M. (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.

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VSC 508 Organic Vegetable Production Technology 1+1

Objective

To educate principals, concepts and production of organic farming in vegetable crops.

Theory

UNIT I

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

UNIT II

Organic production of vegetables crops, viz., solanaceous crops, cucurbits, cole crops, root and tuber crops.

UNIT III

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 IV

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 V

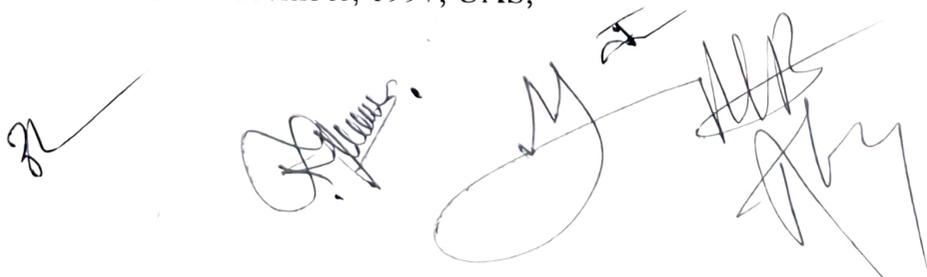
GAP and GMP- Certification of organic products; organic production and export - opportunity and challenges.

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, Jodhpur.
- Gehlot G. (2005). *Organic Farming; Standards, Accreditation Certification and Inspection*. Agrobios, Jodhpur.
- Palaniappan SP & Annadorai K. (2003). *Organic Farming, Theory and Practice*. Scientific Publisher, Jodhpur.
- Pradeep Kumar T, Suma B, Jyothibhaskar & Satheesan KN. (2008). *Management of Horticultural Crops*. New India Publ. Agency, New Delhi.
- Shivashankar K. (1997). *Food Security in Harmony with Nature*. 3rd IFOAMASIA, Scientific Conf.. 1- 4 December, 1997, UAS,



Bangalore.

Singh HP and Thomas GV (2010). Organic Horticulture- Principles,
Practices & Technologies. Westville Publishing House,
New Delhi.

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Minor courses-

FSC 501 Tropical and Dry Land Fruit Production (2+1)

Objective

To impart basic knowledge about the importance and management of tropical and dry land fruits grown in India.

Theory

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

Crops

UNIT I: Mango and Banana

UNIT II: Citrus and Papaya

UNIT III: Guava, Sapota and Jackfruit

UNIT IV: Pineapple, Annonas and Avocado

UNIT V: Aonla, Pomegranate, Phalsa and Ber, minor fruits of tropics

Practical

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

Suggested Readings

Bose T.K., Mitra S.K. & Rathore D.S. (Eds.). 1988. Temperate Fruits - Horticulture. Allied Publ.

Bose T.K., Mitra SK & Sanyal D. 2001. (Eds.). Fruits -Tropical and Subtropical. Naya Udyog.



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