# Department of Horticulture

## Course Structure of M. Sc. (Ag.) Horticulture

| S. No. | Course No. | Title of the Course | Course | Credit |
|---|---|---|---|---|
| | | **I$^{st}$ Semester** | | |
| 1. | HORT-101 | Propagation and Nursery Management of Horticultural Crops | Core | 6 |
| 2. | HORT-102 | Production Technology of Cool Season Vegetable Crops | Core | 6 |
| 3. | HORT-103 | Production Technology of Temperate Fruits | Core | 4 |
| 4. | HORT-104 | Post Harvest Management of Horticultural Crops | Elective (CBCS) | 4 |
| 5. | HORT-105 | Growth and Development of Horticultural Crops | Core | 4 |
| 6. | MPDC-105 | Remedial Language Course | Foundation | 1 |
| | | | **Total Credits** | **24** |
| | | **II$^{nd}$ Semester** | | |
| 1. | HORT-201 | Production Technology of Tropical and Dry Land Fruits | Core | 4 |
| 2. | HORT-202 | Production Technology of Warm Season Vegetables Crops | Core | 4 |
| 3. | HORT-203 | Landscaping and Ornamental Gardening | Core | 4 |
| 4. | HORT-299 | Pre-plan work of Thesis (PPWT) | Core | 4 |
| 5. | HORT-204 | Protected Cultivation of Horticultural Crops | Core | 4 |
| 6. | HORT-205 | Biotechnology of Horticultural Crops | Elective (CBCS) | 4 |
| 7. | MPDC-205 | Ambedkar Studies | Foundation | 1 |
| | | | **Total Credits** | **24** |
| | | **III$^{rd}$ Semester** | | |
| 1. | HORT-301 | Production Technology of Subtropical Fruits | Core | 4 |
| 2. | HORT-302 | Special Statistical Methods in Horticultural Research and Computer Application | Core | 4 |
| 3. | HORT-303 | Seminar | Core | 2 |
| 4. | HORT-399 | Research Methodology for thesis work | Core | 2 |
| 5. | HORT-304 | Organic farming for sustainable agricultural production | Core | 4 |
| 6. | HORT-305 | Production Technology of Medicinal and Aromatic Crops | Core | 4 |
| 7. | HORT-306 | Breeding of Horticultural Crops | Core | 4 |
| 8 | MPDC-305 | Gender Studies | Foundation | 1 |
| | | | **Total Credits** | **24** |
| | | **IV$^{th}$ Semester** | | |
| 1. | HORT-401 | Preservation and Value Addition in Fruits and Vegetables | Core | 4 |
| 2. | HORT-402 | Seed Production Technology of Vegetable Crops | Core | 4 |
| 3. | HORT-403 | Production Technology of Ornamental Plants | Core | 4 |
| 4. | HORT-499 | Thesis Research Trial<br>Thesis evaluation & Viva-Voce Exam | Core | 6<br>6 |
| 5. | MPDC-405 | Community Services | Foundation | 1 |
| | | | **Total Credits** | **24** |
| **Total Credits Requirement for M. Sc. (Ag) Horticulture** | | | | **96** |

# Department of Horticulture
## Syllabus of M. Sc. (Ag.) Horticulture Courses

### HORT-101: Propagation and Nursery Management of Horticultural Crops, 6 Cr. (4 + 2)

**Objective**

Familiarization with principles and practices of propagation and nursery management for Horticultural Crops.

**Theory**

**UNIT I:**

Introduction, cellular basis for propagation, sexual propagation, apomixis, polyembryony, chimeras. Principle factors influencing seed germination of horticultural crops, dormancy, hormonal regulation of germination and seedling growth.

**UNIT II:**

Asexual propagation-rooting of cuttings in hotbeds. Physiological, anatomical and biochemical aspects of root induction in cuttings. Layering-principle and methods.

**UNIT III:**

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

**UNIT IV:**

Micro-propagation-principles and concepts, commercial exploitation in horticultural crops. Techniques- in vitro clonal propagation, direct organogenesis, embryogenesis, micro- grafting, meristem culture. Hardening, packing and transport of micro-propagates.

**UNIT V:**

Nursery-types, structures, components, planning and layout. Nursery management practices for healthy propagule production, soil solarisation techniques, Plug tray nursery raising technology, Nursery Act of U.P.

**Practical:**

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

**Suggested Readings:**


Hartmann, H.T. and Kester, D.E., 1989. *Plant Propagation – Principles and practices.* Prentice Hall of India.

Bose, T.K., Mitra S.K. and Sadhu, M.K., 1991. *Propagation of Tropical and Subtropical Horticultural Crops.* Naya Prokash.

Peter, K.V., (Ed.). 2008. *Basic of Horticulture.* New India Publ. Agency.

Singh, S.P., 1989. *Mist Propagation.* Metropolitan Book Co.

Rajan, S. and Baby, L.M., 2007. *Propagation of Horticultural Crops.* New India Publ. Agency.

Radha, T., and Mathew, L., 2007. *Fruit Crops.* New India Publ. Agency.

Acquaah, G., *Principles and practices of Horticulture.*

Shanker, G., *Practical manual in Horticulture. Kitabistan Publication, Allahabad*

**HORT- 102: PRODUCTION TECHNOLOGY OF COOL SEASON VEGETABLE CROPS**

**6 Cr. (4 + 2)**

**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 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-**

Solanaceous crop, potato, production of TPS and Seed plot techniques

**UNIT II**

Cole corps- Cabbage, Cauliflower, Knol- Khol, Sprouting broccoli, Brussels sprout

**UNIT III**

Root crops- Carrot, Radish, Turnip and Beet root

**UNIT IV**

Bulb crops- Onion, Garlic and Leek

**UNIT V**

Peas and Broad bean, French bean, Cow pea, Green/ Leafy cool season vegetables, Salad crops viz., Celery, Parsley, Lettuce etc.

**Practical**

Cultural operation (Fertilizer application, Sowing, Mulching, Irrigation, Weed control) of cool season vegetable crops and their economics, Experiments to demonstrate the role of mineral elements, Plant growth substance and Herbicides, Study of physiological disorders, Preparation of cropping scheme for commercial farms, Seed plot techniques, Visit to commercial green house/ poly house.

**Suggested Readings**


Bose, T.K. and Som, M.G. (1986). Vegetables Crops in India. Naya Prokash.

Bose, T.K., Som, M.G. and Kabir, J. (2002). Vegetables Crops in India. Naya Prokash.

Bose, T.K., Som, M.G. and Kabir, J. (1993). Vegetables Crops in India. Naya Prokash.

Bose, T.K., Kabir, J., Maity, T.K., Parthasarathy, V.A. and Som, M.G. (2003). Vegetables Crops. Vols. I-III. Naya Udyog.

Chadha, K.L. and Kalloo, G. (1994). Advances in Horticulture Vol. V-X. Malhotra Publ. House.

Chadha, K.L., (2002). Hand Book of Horticulture. ICAR, New Delhi.

Chauhan, D.V.S., (1986). Vegetable Production in India. Ram Prasad and Sons.

Decoteau, D.R., (2000). Vegetable Crops. Prentice Hall.

Edmond, J.B., Musser,A . M. and Andrews, F.S. (1951). Fundamentals of Horticulture. Blakiston Co.

Fageria, M.S., Choudhary, B.R. and Dhaka, R.S.(2000). Vegetable Crops: Production Technology. Vol. II. Kalyani Publishers.

Gopalakrishanan, T.R.,( 2007). Vegetable Crops. New India Publ. Agency.

Hazra, P., and Som, M.G., (1999). Technology for Vegetable Production and Improvement. Naya Prokash.

Rana, M.K., (2008) Olericulture in India. Kalyani Publication.

Rana, M.K., (2008). Scientific Cultivation of Vegetables. . Kalyani Publication

Rabatzky, V.E. and Yamaguchi, M. (1997). World Vegetable: Principal, Production and Nutritive Values. Chapman and Hall.

Saini, G.S. (2001). A Text Book of Olericulture and Floriculture. Aman Publication House.

Salunkhe, D.K. and Kadam, S.S. (1998). Hand Book of Vegetables Science and Technology Production, Composition, Storage and processing. Marcel Dekker.

Shanmugavelu, K.G. 1989. Production Technology of Vegetable Crops. Oxford and IBH.

Singh, D.K., (2007). Modern Vegetable Varieties and Production Technology. International Book Distributing Co.

Singh, S.P., (1989). Production Technology of Vegetable Crops. Agril. Comm. Res. Centre.

Thamburaj, S. and Singh, N. (2004). Vegetables, Tuber Crops and Spices. ICAR.

Thompson, H.C. and Kelly, W.C., (1978). Vegetables Crops. Tata McGraw-Hill.

**HORT-103: PRODUCTION TECHNOLOGY OF TEMPERATE FRUITS**

**4 Cr. (3 + 1)**

**Objective**

To impart basic knowledge about the importance and management of temperate fruits grown in India.

**Theory**

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

**Crops**

**UNIT I:** Apple, pear, kiwi, persimmon

**UNIT II:** Plums, peach, apricot, cherries

**UNIT III:** Nuts-Walnut, almond, pistachio nut, pecan nut, hazelnut

UNIT IV: Berries- Strawberry, blackberry, blueberry, raspberry, cranberry, gooseberry, and Sebuckthorn

**Practical**

Identification of important cultivars, observations on growth and development, malady diagnosis, analysis of quality attribute, visit to temperate orchards, project preparation for establishing commercial orchards.

**Suggested Readings**

Bose, T.K., Mitra, S.K. and Sanyol, D., (Ed.). 2002. Temperate fruits. Naya Udyog.

Chadha, .K.L. and Pareek, O.P., 1996. (Eds.). Advance in Horticulture. Vol. II and VIII Malhotra Publ. House.

Chadha, K.L. and Shikhamany, S.D., 1999. The Grape: Improvement, Production and Post-Harvest Management. Malhotra Publ. House.

Janick, J. and Moore, J.N., 1996. Fruit Breeding. Vols. I-III. John Wiley and Sons.

Nijjar, G.S., 1977. (Eds.). Fruit Breeding in India. Oxford and IBH.

Radha, T., and Mathew, L., 2007. Fruit Crops. New India publ. Agency.

**HORT -104: POST HARVEST MANAGEMENT FOR HORTICULTURAL CROPS**

**4 Cr. (3 + 1)**

**Objective**

To facilitate deeper understanding on principles of postharvest management of horticultural crops.

**Theory**

**UNIT I**

Maturity indices, harvesting practices for specific market requirements, influence of pre and post-harvest practices, respiration, transpirational loss.

**UNIT II**

Physiology and biochemical change during ripening, senescence, ethylene evolution and ethylene management, factors leading to post-harvest loss and its control, pre-cooling.

**UNIT III**

Treatments prior to shipment, viz., chlorination, waxing, chemical treatment, biocontrol agents, use of natural plant products. Methods of storage, refrigerated, MAS, CA Storage, physical injuries and disorders.

**UNIT IV**

Packing methods and transport, principles and methods of preservation (fundamental), food safety standards.

**Practical**

Analysis maturity stages of commercially important horticultural crops, improved packing and storage of important horticultural commodities, physiological loss in weight of fruits and vegetables, estimation of transpiration, respiration rate, ethylene release and study of vase life extension in cut flower using chemicals, estimation of quality characteristics in stored fruit and vegetables , cold chain management – visit to cold storage and CA storage units, visit to fruit and vegetables processing units, project preparation, evaluation of processed horticultural products.

**Suggested Readings**

Bhutani, R.C., 2003. Fruit and vegetable preservation. Biotech Books.

Haid, N.F., and Salunkhe, S.K., 1997. Post Harvest Physiology and Handling of Fruits and Vegetables. Grenada Publ.

Mitra, S.K., 1997. Post Harvest Physiology and Storage of Tropical and Sub-Tropical fruits. CABI.

Ranganna, S., 1997. Hand Book of Analysis and Quality Control for Fruit and Vegetables products. Tata McGraw-Hill.

Sudheer, K.P. and Indira, V. 2007. Post Harvest Technology of Horticultural Crops. New India Publ. Agency.

Willis, R. Glassen, Mc., Graham, WB. D and Joyce, D. 1988. Post Harvest.An Introduction to the physiology and Handling of Fruits, Vegetables and Ornamaentals. CABI.

Sharma, L.R., and Joshi, V.K., (2009). Post harvest technology of fruits and vegetables.

**HORT-105: GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS**

**4 Cr. (3 + 1)**

**Objective**

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

**Theory**

**UNIT I**

Cellular structures and their function; definition of growth and development, growth analysis and its importance in Horticultural crops.

**UNIT II**

Physiology of dormancy and germination of seeds, tubers and bulbs; Role of auxins, gibberellilns, cytokinins and abscissic acid; Application of synthetic hormones, plant growth retardants and inhibitors and modern PBRs for various purposes in horticultural crops.

**UNIT III**

Role of light, temperature and photoperiod on growth, development and flowering in horticultural crops.

**UNIT IV**

Physiology of fruit set, fruit development, fruit growth, fruit drop, parthenocarpy and ripening in horticultural crops, senescence and abscission.

**UNIT V**

Plant growth regulators in relation to Horticultural crops, Tissue culture techniques in horticultural crops.

**Practical**

Preparation of solutions of plant growth substances and their application; experiments in breaking of dormancy by chemicals; fruit ripening; improving fruit set in horticultural crops, micro-propagation in Horticultural crops.

**Suggested Readings**

Acquaah, G. (2013). Principles and Practices of Horticulture. Published by PHI learning pvt. Ltd., New Delhi

Sandhu, M.K. (2014). Plant Propagation published by New Age International Publishers, Lucknow

Srivastava, H.N (2012). Plant Physiology published by Pradeep publishing, Jalandhar

Salisbury, F.B. and Rose, C.W (2017). Plant Physiology published by CBS publishers and distributors, Shahdara, Delhi

**HORT-201: PRODUCTION TECHNOLOGY OF TROPICAL AND DRY LAND FRUITS**

**4 Cr. (3 + 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 ecophysiological requirements, recent trends in propagation, rootstock influence, planting systems, cropping system, 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, harvest, grading, packing, storage and ripening techniques; industrial and export potential, Agri. Export Zones (AEZ) and industrial support.

**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, Phalsa and Ber, minor fruit of tropics

**Practical**

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

**Suggested Readings**

Bose, T.K., Mitra, S.K., and Rathore DS. (Eds.).1988. Temperate Fruits – Horticulture. Allied Publ.

Bose, T.K., Mitra S.K., 7 Sanyal D. 2001. (Eds.).Fruits- Tropical and Subtropical. Naya Udyog

Chadha, K.L., and Pareek, O.P., 1996 (Eds.). Advances in Horticulture. Vols. IIIV. Malhotra Publ. House.

Nakasone, H.Y., and Puul, R.E., 1998. Tropical Fruits. CABI.

Peter, K.V., 2008 (Ed.). Basic of Horticulture. New India Publ. Agency.

Pradeep K. T, Suma B Jyothibhaskar and Satheesan, K.N., 2008. Management of Horticultural Crops. Parts I, II. New India Publ. Agency.

Radha, T. and Mathew, L. 2007. Fruit Crops. New India Publ. Agency.

Singh, H.P., Negi, J.P. and Samuel, J.C., (Eds.). 2002. Approaches for sustainable Development of Horticulture. National Horticultural Board.

Singh, H.P., Singh, G., Samuel, J.C., and Pathak, R.K., (Eds.). 2003. Precision farming in Horticulture NCPAH, DAC/ PFDC, CISH, Lucknow.

**HORT-202: PRODUCTION TECHNOLOGY OF WARM SEASON VEGETABLE CROPS**

**4 Cr. (3 + 1)**

**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 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, cowpea and clusterbean

**UNIT III:** Cucurbitaceous crops, including river bed cultivation

**UNIT IV:** Tapioca and sweet potato

**UNIT V:** Green leafy warm season vegetables

**UNIT VI:** Gherkin, Chow-Chow, Tree tomato, Wild Karela , Mateera, Kachari and Summer Squash

**Practical**

Cultural operations (fertilizer application, sowing, mulching, irrigation, weed control) of summer vegetable crops and their economic; 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 substance and herbicides; seed extraction techniques; identification of important pests and diseases and their control; maturity standards; economic of warm season vegetable crops.

**Suggested Readings**


Bose, T.K., and Som, M.G., (Eds.). 1986. Vegetable Crops. Naya Prokash.

Bose, T.K., Kabir J, Maity T.K., Parthasarathy V.A. and Som M.G. 2003. Vegetable crops. Vols. I-III. Naya Udyog.

Bose, T.K., Som M.G. and Kabir, J. (Eds.). 2002. Vegetable Crops. Naya Prokash.

Brown H.D and Hutchison CS. Vegetable Science. JB Lippincott Co.

Cahdha, KL. (Ed.). 2002. Hand book of Horticulture. ICAR.

Chauhan, D.V.S.(Ed.) 1986. Vegetables Production in Indian. Ram Prasad and Sons.

Decoteau, D.R., 2000. Vegetable Crops. Prentice Hall.

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

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

Hazra, P and Som, MG. (Eds.). 1999. Technology for Vegetables production and Improvement. Naya Prokash.

Kalloo, G and Singh K (Ed.). 2000. Emerging Scenario in Vegetable Research and Development. Research periodicals and Book Publ. House.

Nayer, N.M., and More, T.A. 1998. Cucurbits. Oxford and IBH Publ.

Palaniswamy, and Peter KV. 2007. Tuber Crops. New India publ. Agency.

Pandey, A.K., and Mudranalay, V. (Eds.).vegetables production in India: Important Varieties and Development Techniques.

Rana, MK. 2008. Olerculture in Indian. Kalyani.

Rana, MK. 2008. Scientific cultivation of Vegetables.kalyani.

Salunkhe, GS and kadam SS. (Ed.). 1998. Hand Book of Vegetables Science and Technology: Production, Composition, Storage and processing. Marcel Dekker.

Shabmugavelu, K.G., 1989. Production Technology of Vegetables Crops. Oxford and IBH.

Singh, D.K. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co.

Singh, N.P., Bharadwaj AK, Kumar A and Singh KM. 2004. Modern Technology on Vegetable Production, International Book Distributing Co.

Singh, S.P., (Ed.). 1989. Production Technology of vegetable Crops. Agril. Comm. Res .Centre.

Thamburaj, S. and Singh, N. 2004. Vegetables, Tuber Crops and Spices. ICAR.

Thompson, H.C. and Kelly, W.C. (Eds.). 1978. Vegetable Crops. Tata Mc Graw Hill.

**HORT-203: LANDSCAPING AND ORNAMENTAL GARDENING**

**4 Cr. (3 + 1)**

**Objective**

Familiarization with principles and practices of landscaping and ornamental gardening.

**UNIT I**

Landscape designs, its principles and practices of landscaping and ornamental Gardening structure, features and adorments.

**UNIT II**

Styles of garden, types of gardens: English, Mughal, Japanese,Persian, Spanish, Italian, Vanams, Buddha garden, Popular gardens of India.

**UNIT III**

Bio-aesthetic planning, Lawns, its establishment and maintenance, Special types of gardens (vertical garden, roof garden, bog garden, sunken garden, rock garden, clock garden, temple garden & sacred groves, Therapeutic garden, indoor garden, miniature garden, terrariums), Bonsai.

**UNIT IV**

Urban landscaping for specific situations (institutions, industries, residents, hospitals, roadsides, traffic islands, domestics, IT parks, corporate etc.), eco-tourism, theme parks, xeriscaping.

**Practical**

Identification and selection of ornamental plants- Annuals, shrubs, trees, climbers, cacti and succulents, bulbous plants and aquatic plants, practices in preparing landscape designs for various places, planting herbaceous and shrubbery borders, bonsai making, practices in planning and preparation of special types of gardens (miniature gardens, bowl/dish garden, terrariums), lawn making, project preparation on landscaping for different situation, visit to famous parks and botanical gardens.

**Suggested Readings**

Bose, T.K., Maiti, R.G., Dhua, R.S., and Das, P., 1999. Floriculture and Landscaping. Naya Prokash.
Laurie, A., and Victor H.R., 2001. Floriculture-Fundumentals and practices. Agorbios.
Nambisan, K.M.P., 1992. Design Elements of Fandscape gardening. Oxford and IBH.
Randhawa, G.S., and Mukhhpadhyay, A., 1986. Floriculture in India. Allied Publ.
Sabina, G.T., and Peter, K.V., 2008. Ornamenatal plants for Gardens. New India Publ. Agency.
Kumari, V., et. al. 2008. Floriculture in India Publ. Agency.
Woodrow, M.G., 1999. Gardening in India. Biotech Books.
Bhattacharjee, S.K. (2006). Advances in Ornamental Horticulture (Vol:1-6), Pointer Publication.

**HORT-204: PROTECTED CULTIVATION OF HORTICULTRAL CROPS**

**4 Cr. (3 + 1)**

**Objective**

Understanding the principle, theoretical aspects and developing skills in protected cultivation of horticultural crops.

**Theory**

**UNIT I**

Prospects of protected horticulture in India; Types of protected structures-Greenhouse, poly house, shade houses, rain shelters etc. Low cost/Medium, cost/High cost structures, Location specific designs; Structural components; Suitable horticultural crops for protected cultivation.

**UNIT II**

Environmental control-management and manipulation of temperature, light, humidity, air and CO2, Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled green houses, light regulation.

**UNIT III**

Containers and substrates, soil decontamination, layout of drip and fertigation system, water and nutrient management, weed management, physiological disorders, IPM and IDM.

**UNIT IV**

Crop regulation by chemical methods and special horticultural practices (pinching disbudding, dishooting, deblossoming, etc.); Staking and netting, photoperiod regulation.

**UNIT V**

Harvest indices, Harvesting techniques, post-harvest handling techniques,

**UNIT VI**

Hydroponics

**Practical**

Study of various protected structures, practices in design, layout and erection of different types of structures, practices in preparatory operations, soil decontamination techniques, practices in environmental control systems, practices in drip and fertigation techniques, special horticultural practices, determination of harvest indices and harvesting methods postharvest handling, packing methods, project preparation, visit to commercial green house.

**Suggested Readings**

Bhattacharjee, SK. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.

Bose, TK and Yadav, LP. 1989. Commercial Flowers. Naya prokash.

Bose, TK, Malti, RG, Dhua RS and Das P. 1999. Floriculture and Landscaping. Naya Prokash.

Chadha, KL. 1995. Advances in Horticulture. Vol . XII. Malhotra Publ. House.

Lauria, A and Victor, HR. 2001. Floriculture –Fundamentals and practices Agrobios.

Nelson, PV. 1978. Green House Operation and Management. Reston Publ. Co.

Prasad, S and Kumar, U. 2003. Commercial Floriculture. Agrobios .

Randhawa, GS and Mukhopadhyay, A, 1986. Floriculture in India. Allied Publ.

Reddy, S, Janakiram B, Balaji, T. Kulkarni, S and Mishra, RL. 2007. High-tech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.

**HORT-205: BIOTECHNOLOGY OF HORTICULTURAL CROPS**

**4 Cr. (3 + 1)**

**Objective:** Understandings the principles, theoretical aspects and developing skills in biotechnology of horticultural crops

**Theory**

**UNIT I**

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

**UNIT II**

Callus culture types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis.

**UNIT III**

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

**UNIT IV**

Physiology of hardening- hardening and field transfer, organ culture- meristem, embryo, anther, ovule culture, embryo rescue, somaclonal variations, protoplast culture and fusion.

**UNIT V**

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

**UNIT-VI**

Exposure to commercial tissue culture industry/organizations. Visit to biotech park, project preparation to establish a commercial biotech laboratory.

**Practical**

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

**Suggested Readings**


Bajaj, YPS. (Ed.). 1989. *Biotechnology in Agriculture and Forestry.* Vol. V. Fruits. Springer.

Brown, TA. 2001. *Gene Cloning and DNA Analysis and Introduction.* Blackwell Publ.

Chopra, VL and Nasim, A. 1990. *Genetic Engineering and Biotechnology-Concepts, Methods and Applications.* Oxford and IBH.

Gorden, H and Rubsell, S. 1960. *Hormones and Cell Culture.* AB Book Publ.

Keshavachandran, R and Peter, KV. 2008. *Plant Biotechnology: Tissue Culture and Gene Transfer.* Orient and Longman (Universal Press).

Keshavachandran, R. Nazeem, P.A., Girija D, John PS and Peter KV. 2007. *Recent Trends in Biotechnology of Horticultural Crops.* Vols. I, II. New India Publ. Agency.

Parthasarathy, V.A., Bose, T.K., Deka, P.C., Das P, Mitra SK and Mohandas S. 2001. *Biotechnology of Horticultural Crops.* Vols. I-III. Naya Prokash.

Pierik, R.L.M., 1987. *In vitro Culture of Higher Plants.* Martinus Nijhoff Publ.

Skoog, F and Miller CO. 1957. *Chemical Regulation of Growth and Formation inPlant Tissue Culture in vitro. Symp. Soc. Exp. Biol.*11:118-131.

Vasil, TK, Vasi M, While DNR and Bery HR. 1979. *Somatic Hybridization and Genetic Manipulation in Plants. Plants Regulation and World Agricultural.* Planum Press.

Williamson, R. 1981-86. *Genetic Engineering.* Vols I-V. Academic Press.

**HORT-301: PRODUCTION TECHNOLOGY OF SUBTROPICAL FRUITS**

**4 Cr. (3 + 1)**

**Objective**

To impart basic knowledge about the importance and management of subtropical fruits grown in India.

**Theory**

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

**Crops**

**UNIT I:** Mango, Citrus

**UNIT II:** Litchi, Pomegranate,

**UNIT III:** Aonla, Bael, Woodapple

**UNIT IV:** Loquate, Jamun

**Practical**

Identification of important cultivars, observations on growth and development, practices in growth regulation, malady diagnosis, analysis of quality attributes, visit to subtropical, humid tropical orchards, project preparation for establishing commercial orchards.

**Suggested Readings**

Bose, TK, Mitra, SK and Sanyol, D. (Ed.). 2002. Fruits of India-Tropical and sub-Tropical. 3rd Ed. Vols. I,II. Naya Udyog.

Chadha, K.L. and Pareek, O.P., 1996. (Eds.). Advance in Horticulture. Vol. I. Malhotra Publ. House.

Chadha, K.L. and Shikhamany, S.D., 1999. The Grape: Improvement, Production and Post-Harvest Management. Malhotra Publ. House.

Janick, J. and Moore, J.N., 1996. Fruit Breeding. Vols. I-III. John Wiley and Sons.

Nijjar, G.S., 1977. (Eds.). Fruit Breeding in India. Oxford and IBH.

Radha, T. and Mathew, L., 2007. Fruit Crops. New India publ. Agency.

Singh, S., Shivankar, V.J., Srivastva, A.K., and Singh, I.P., (Eds.). 2004. Advances in Citriculture. Jagmander Book Agency.

**HORT-302: SPECIAL STATISTICAL METHODS IN HORTICULTURAL RESEARCH AND COMPUTER APPLICATION**

**4 Cr. (3 + 1)**

**Objective**

Understanding the principle, theoretical aspects and developing skills in special statistical methods in horticultural crops and computer application.

**Theory**

**UNIT I :** Quantitative treatments factors, site selection and characterization.

**UNIT II:** Replication of experiments units, plot structure, plot type, plot size, plot shape, Guards and borders, Interference between plots.

**UNIT III:** Sampling in experimental plots, Replication and within plot sampling, Random or systematic within plot sampling, Bulking, Strata within plots, presentation of data. Setting objective of experiments. Choosing treatments, contrasts, controls, factorials.

**UNIT IV:** Basic principles of experimental design in Replication, Randomization, Land control, different types of experimental design. Complete randomized block design (Advantage of the a CRD, analysis of CRD with/ several treatments and analysis using computer package). Latin square design (Advantage of a LSD and analysis of experimental data using computer package), factorial experiments (Advantage of the factorial experiments and analysis of experimental data using computer package).

**UNIT V:** Confounding (Two characters with two levels/three characters with three levels, principles, techniques of confounding, advantage of confounding). split plot design (Advantage of the a split plot design and analysis of experimental data using computer package).

**Practical**

Practice of different types of experimental design viz., RBD ,CRD, LSD, factorial experiments, confounding and split design. Design and analysis of experimental data using computer package. Experimental knowledge of optimum plot size for experimentation of horticultural crops (Fruits, vegetable and medicinal, aromatic and ornamental plants). visit of the some experimental farms. List of institutes and research workers involved in the field of agriculture science in general and horticulture in particular.

**HORT-304: ORGANIC FARMING FOR SUSTAINABLE AGRICULTURAL PRODUCTION**

**4 Cr. (3 + 1)**

## THEORY:

**Unit-I:** Organic Farming: Concepts and principles of organic farming
**Unit-II:** Key indicators of sustainable agriculture, organic farming and climate change
**Unit-III:** Input management; compost production, vermicomposting, Compost quality, Compost utilization and marketing
**Unit-IV:** Organic crop management: field crops, horticulture and plantation crops
**Unit-V:** Plant protection measures, biopesticides, natural predators, cultural practice
**Unit-VI:** Rotation design for organic system, Transition to organic agriculture, farming system
**Unit-VII:** Quality analysis of organic foods, Antioxidants and their natural source, organic food and human health
**Unit-VIII :** Standards of organic food and marketing

**PRACTICAL:**

Features of organics orchards, working out conversion plan, Input analysis- manures, nutrient status assessment of manures, bio-composting, Biofertilizers and their application, panchagavya preparation and other organic nutrients application, methods of preparation of neem products and application, BD preparation and their role, EM technology and products, biological/natural control of pests and diseases, soil solarisation, frame work for GAP, case studies, HACCP analysis, residue analysis in organic products, documentation for certification, visit to fields cultivated under organic practices.

**Suggested Readings:**


Claude, A., Vandana, S., Sultana, I., Vijaya, L., Korah, M. and Bernard, D., 2000. *The Organic Farming Reader*. Other Indian Press, Goa.

Gaur, A.C., Neblakantan, S. and Dargan, K.S., 1984. *Organic Manures.* ICAR.

Lampkin, N. and Ipswich. 1990. *Organic Farming.* Farming Press. London.

Lampkin, N.H. and Padel, S., 1992. *The Economic of Organic Farming-An International Perspective.* CABI.

Palaniappan and Annadural. 2008. *Organic Farming-Theory and Practise.* Scientific Publ.

Peter, K.V., 2008 (Ed.). *Basis of Horticulture.* New Indian Publ. Agency. New. Delhi.

Rao, S. 1977. *Soil Microorganism and Plant Growth.* Oxford and IBH.

**HORT-305: PRODUCTION TECHNOLOGY OF MEDICINAL AND AROMATIC CROPS**

**4 Cr. (3 + 1)**

**Objective**

To impart comprehensive knowledge about the production technology of medicinal and aromatic crops.

**Theory**

**UNIT I:** Herbal industry, Indian system of medicine, indigenous Traditional Knowledge, IPR issues, Classification of medicinal crops, Systems of cultivation, Organic Production, Role of institutions and NGO's in production, GAP in medicinal crops production.

**UNIT II:** Production technology for Senna, Periwinkle, Coleus, Aswagandha, Glory lily, Sarpagandha, Dioscorea sp., Aloe vera, Phyllanthus amarus , Andrographis paniculata.

**UNIT III:** Production technology for Medicinal plants solanum, Isabgol, Poppy ,Safed musli, Stevia rebaudiana, Mucuna pruriens, Ocimum sp. and Kesar.

**UNIT IV:** Production technology for Damaskrose, palmarosa, lemongrass, citronella, vettiver, geranium, Artemisia, menthol, ocimum, eucalyptus, rosemary, thyme, patchouli, lavender, marjoram, oreganum.

**UNIT V:** Post harvest handling –Drying, processing, Grading, Packing and Storage, Processing and value addition; GMP and Quality standards in herbal products.

**UNIT VI:** Influence of biotic and abiotic factors on the production of secondary metabolites, Regulations for herbal raw materials, Phytochemical extraction techniques.

**UNIT VII:** Aeromatic industry, WTO scenario, Export and import status, Indian perfumery industry, History, Advancements in perfume industry.

**UNIT VIII:** Post-harvest handling, Distillation methods, advanced methods, Solvent extraction process, steam distillation, perfumes from non-traditional plants, Quality analysis, Value addition, Aroma chemicals, quality standards and regulations.

**UNIT IX:** Institutional support and international promotion for essential oil and perfumery products.

**Practical**

Botanical description, Propagation techniques, Maturity standards, Digital documentation, Extraction of secondary metabolites, Project preparation for commercially important medicinal crops, Visit to medicinal crop fields, visit to herbal extraction units. Extraction of Essential oils, Project preparation for commercially important Aromatic crops, Visit to distillation and value addition units- Visit to CIMAP and other associated unit /organizations (including NGO).

**Suggested Readings**


Atal, C.K., and Kapur, B.M., 1982. Cultivation and Utilization of Aromatic Plants. RRL, CSIR, Jammu.

Farooqui, A.A., and Sriram, A.H., 2000. Cultivation Practices for Medicinal and Aromatic Crops. Orient Longman Publ.

Farooqui, A.A., Khan, M.M. and Vasundhara, M., 2001. Production Technology of Medicinal and Aromatic Crops. Natural Remedies Pvt, Ltd.

Hota, D., 2007. Bio Active Medicinal plants. National Book Trust.

Khan, I.A. and Khanum. Role of Bio Technology in Medicinal and Aromatic plants. Vol. IX. Vkaaz Publ.

Kurian, A., and Sankar, M., 2007. Medicinal Plants. Horticulture science series, New India Publ. Agency.

Panda, H., 2002. Medicinal Plants cultivation and their Uses. Asia pacific Business Press.

Prajapati, S.S., Paero, H., Sharma, A.K and Kumar, T., 2006. A Hand book of Medicinal Plants. Agro Bios.

Ramawat KG and Merillon JM. 2003. Bio Technology-Secondary Metabolites. Oxford and IBH.

Skaria P Baby, Samuel Mathew, Gracy Mathew, Ancy Joseph, Ragina.

Joseph. 2007. Aomatic Plants. New India Publ. Agency.

**HORT- 306: BREEDING OF HORTICULTURAL CROPS**

**4 Cr. (3 + 1)**

**Objective**

To update knowledge on the recent research trends in the field of breeding of fruit crops with special emphasis on tropical, subtropical and temperate crops grown in India.

**Theory**

Evolutionary mechanisms adaptation and domestication, Genetic resource, cytogenetics, cytomorphology, chemotaxonomy, genetics of important traits and their inheritance pattern, variation and natural selection, spontaneous mutations, incompatibility systems in fruits, recent advances in crop improvement efforts-introduction and selection chimeras, apomixes, clonal selection, intergeneric, interspecific and intervarietal hybridization, mutation and polyploidy breeding, resistance breeding to biotic and abiotic stresses, breeding for improving quality, molecular and transgenic approaches in improvement of selected fruit crops.

**Crops**

**UNIT I:** Mango and banana
**UNIT II:** Papaya, grapes and citrus
**UNIT III:** Guava and Sapota
**UNIT IV:** Pineapple and avocado
**UNIT V:** Apple, pear, plums, peaches, apricot, cherries and nuts, strawberry

**Practical**

Description and cataloguing of germplasm, pollen viability tests, pollen germination-isozyme techniques-survey and clonal selection, observations on pest, disease and stress reactions in inbreeds and hybrids, use of mutagenes and colchicines for inducing mutation and ploidy changes, practices in different methods of breeding fruit crops and in vitro breeding techniques.

**Suggested Readings**


Bose, T.K., Mitra, S.K. and Sanyol, D. (Ed.). 2002. *Fruits of India – Tropical and Sub-Tropical.* 3rd Ed. Vols. I, II, Naya Udyog.

Chadha, K.L. and Pareek, OP. (Eds.). 1996. *Advances in Horticulture.* Vol. I. Malhotra Publ. House.

Chadha, K.L. and Shikhamany, S.D. 1999. *The Grape: Improvement, Production and Post-Harvest Management.* Malhotra Publ. House.

Gowan, S. 1996. *Banana and Plantains.* Chapman and Hall.

Janick, J. and Moore, J.N. 1996.*Fruit Breeding.* Vols. I-III. John Wiley and Sons.

Nijjar, G.S. (Ed.). 1977. *Fruit Breeding in India.* Oxford and IBH

Radha, T and Mathew, L. 2007. *Fruit Crops.* New India Publ. Agency.

Singh, S., Shivankar, V.J., Srivastava, A.K. and Singh, I.P., (Eds.). 2004. *Advances in Citriculture.* Jagmander Book Agency.

Stover, R.H., and Simmonds, N.W., 1991. *Bananas.* Longman.

**HORT-401: PRESERVATION AND VALUE ADDITION IN FRUITS AND VEGETABLES**

**4 Cr. (3 + 1)**

**Objective**

To teach the physiology and principle of fruit and vegetable preservation.

**Theory**

**UNIT I:**

Fundamentals of preservation (principles and practices). Micro-organism associated with spoilage of fruits and vegetables. Source of micro-organism, conditions, infection and control.

**UNIT II:**

Low temperature preservation, refrigeration, cellar storage, freezing, vacuum freezing, high temperature preservation.

**UNIT III:**

Pasteurization, canning, drying and dehydration of fruits and vegetables.

**UNIT IV:**

Fermentation in the preservation of fruits and vegetables. chemical preservation, permissible essences and chemicals used in processing. Products; chemicals permitted and prohibited in India.

**UNIT V:**

Yeast and bacterial fermentation of interest in preservation. Irradiation of horticultural produce.

**UNIT VI:**

Nutritionally enriched products, processing waste management technology.

**Practical:**

Preservation of fruits and vegetable by freezing, pasteurization, canning. Dehydration of fruits and vegetable, chemical and fermentation; determination of thermal death, time curve; harvesting indices for fruit and vegetable crops for fresh and processing purposes. Examination of specified fruits and vegetable products. Visit to preservation units. List of institutes and research workers involved in fruit and vegetable preservation.

**Suggested Readings**

Bhutani, R.C., 2003. Fruit and vegetable preservation. Biotech Books.

Chadha, K.L. and Pareek, O.P. (Eds.). 1996. Advances in Horticulture. Vol. IV. Malhotra Publ. House.

Haid, N.F. and Salunkhe, S. K. 1997. Post Harvest Physiology and Handling of Fruits and Vegetables. Grenada Publ.

Mitra, S. K. 1997. Post Harvest Physiology and Storage of Tropical and Sub-Tropical fruits. CABI.

Ranganna, S., 1997. Hand Book of Analysis and Quality Control for Fruit and Vegetables products. Tata McGraw-Hill.

Sudheer, K.P. and Indira, V., 2007. Post Harvest Technology of Horticultural Crops. New India Publ. Agency.

Willis, R. Glassen, Mc, WB. Graham, D and Joyce, D. 1988. Post Harvest.An Introduction to the physiology and Handling of Fruits, Vegetables and Ornamaentals. CABI.

Srivastava, R.P., and Kumar, S., (2000). Fruits and vegetable preservation (principles and practices).

**HORT-402: SEED PRODUCTION TECHNOLOGY OF VEGETABLE**

**4 Cr. (3 + 1)**

**Objective:**

To educate principles 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 behaviour, 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 low enforcement, plant quarantine and quality control.

**UNIT IV:**

Physiological maturity for seed production in solanaceae vegetable, cucurbits, leguminous vegetables, Cole crops, bulb crops, leafy vegetable, okra, vegetative 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, P.K., and Dadlani, M., (Eds.). 1992. *Techniques in Seed Science and Technology.* South Asian Publ.

Agrawal, R.L., (Ed.). 1997. *Seed Technology.* Oxford and IBH.

Bendell, P.E., (Ed.). 1998. *Seed Science and Technology: Indian Forestry Species* .Allied Publ.

Fageria, M.S. Arya, P.S., and Choudhary, A.K., 2000.V*egetable Crops: Breeding and Seed Production.* Vol. I. Kalyani.

George, R.A.T., 1999. V*egetable Seed Production.*2nd Ed. CABI.

Kumar, J.C. and Dhailiwal, M.S., 1990. *Techniques of Development Hybrids in Vegetable Crops.* Agro Botanical Publ.

More, T.A., Kale, P.B. and Khule, B.W. 1996. V*egetable Seed Production Technology.* Maharashtra State Seed Corp.

Singh, N.P., Singh, D.K., Singh, Y.K., and Kumar, V. 2006. V*egetable Seed Production Technology.* International Book Distributing Co.

Singh, Sp. 2001. *Seed production of Commercial Vegetables.* Agrotech Publ. Academy.

## HORT-403: PRODUCTION TECHNOLOGIES OF ORNAMENTAL PLANTS

**4 Cr. (3 + 1)**

**Objective**

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

**Theory**

**UNIT I**

Scope of cut flowers in global trade, global scenario of cut flower production, Varietal wealth and diversity, area under cut flowers and production problem in India- Patent right, nursery management, media for nursery, special nursery practices.

**UNIT II**

Growing environment, open cultivation, protected cultivation, soil requirements, artificial growing media, soil decontamination techniques, planting methods, influence of environmental parameters, light, temperature, moisture, humidity and $CO_2$ on growth and flowering.

**UNIT III**

Flower production-water and nutrient management, fertigation, weed management, ratooning, training and pruning, disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies, IPM and IDM, production for exhibition purpose.

**UNIT IV**

Flower forcing and year round flowering through physiological interventions, chemical regulation, environmental manipulation.

**UNIT V**

Cut flower standards and grades, harvest indices, harvesting techniques, post-harvest handling, Methods of delaying flower opening, Pre-cooling, pulsing, packing, storage and transportation, markeing, export potential, institutional support, Agri Export Zones. Crops: cut rose, cut chrysanthemum, carnation, gerbera, gladiolus, tuberose, orchids, anthurium, lilium, birds of paradise, dahlia, 3cut foliages and fillers.

**UNIT VI**

Production technology of Agalea, Camelia, Magnolia, Tulip, Rhododendron, Tuberous Begonia, Brahma Kamal.

**Practical**

Botanical description of varieties, propagation techniques, mist chamber operations, training and pruning techniques, practices in manuring, drip and fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking, harvesting techniques, post-harvest handling, cold chain, project preparation for regionally important cut flowers, visit to commercial cut flower units and case study.

**Suggested Readings**


Arora, J.S., 2006. Introductory Ornamental Horticultural. Kalyani.

Bhattacharjee, S.K., 2006. Advances in Ornametal Horticulture. Vols. I-VI. Pointer Publ.

Bose, T.K., Maiti, R.G., Dhua RS and Das P. 1999. Floriculture and Landscaping. Naya prokash.

Chadha, K.L., 1995. Advances in Horticulture. Vol. XII. Malhotra Publ. House.

Chadha, K.L. and Chaudhury, B., 1992. Ornamental Horticulture in India. ICAR .

Lauria, A., and Ries, V.H., 2001. Floriculture-Fundamentals and Practices. Agrobios.

Prasad, S., and Kumar, U., 2003. Commercial Floriculture. Agrobios.

Randhawa, G.S., and Mukhopadhya, A. 1986. Floriculture in India. Allied Publ.

Reddy, S. Janakiram, B., Balaji, T., Kulkarni, S. and Misra, R.L., 2007. High-tech Floriculture. Indian Society of ornamental Horticulture, New Delhi.