UNIVERSITY OF SARGODHA
OFFICE OF THE REGISTRAR
(ACAD BRANCH)

NOTIFICATION

On the recommendations of Academic Council made in its 21st (2/2024) meeting held on 07.06.2024, the Syndicate in its 67th (3/2024) meeting held on 12.07.2024 approved the revised curricula of following programs for implementation w.e.f. Fall 2024:

i.	M.Sc (Hons.) in Horticulture	(Annex-**'A'**)
ii.	Ph.D in Horticulture	(Annex-**'B'**)

(WAQAR AHMAD)
Additional Registrar (General)

No. SU/Acad/25/970

Dated: 17.09.2025

Distribution:

- Chairman, Department of Horticulture
- Controller of Examinations
- Director Academics

C.C:

- Principal, College of Agriculture
- Director, QEC
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

M.Sc. (Hons.) Horticulture

1. **Nomenclature :**

M.Sc. (Hons.) Horticulture

2. **Department brief:**

The College of Agriculture was established in October 2005 as a constituent college of the University of Sargodha. Horticulture was introduced as a major subject in March 2007, followed by the start of MSc (Hons.) Horticulture in 2010 and Ph.D. Horticulture in 2013. On January 7, 2012, the syndicate officially declared Horticulture as an independent department. The Department of Horticulture is committed to dissemination knowledge about pomology, olericulture, and floriculture crops that are cultivated for food, export, and the overall benefit of society. Its mission is achieved through a strong integration of teaching, research, and extension/outreach activities.

3. **Program Learning Objective**

- Provide quality education in horticultural sciences.
- Undertake basic, applied, and adaptive research in horticulture.
- Collaborate with national and international organizations for academic and research excellence.
- Develop strategies through training programs, workshops, and demonstrations.
- Produce employable graduates with the highest professional and ethical standards.

4. **Scope**

This degree program is designed to train professional horticulturists to meet the needs of stakeholders. It opens diverse career opportunities in both the public and private sectors. Career options include:

- **Academic Institutions**: Teaching and research roles in universities and colleges.
- **Horticultural Extension Services**: Advising farmers on improved practices and technologies.
- **Government Departments**: Employment in agricultural and horticultural development departments.
- **Nurseries and Landscaping Firms**: Production of ornamental plants and design of gardens and green spaces.
- **Seed and Agrochemical Companies**: Working in product development, sales, and technical support.
- **Food Processing and Post-Harvest Industries**: Involvement in value addition, quality control, and packaging.
- **Biotechnology and Protected Cultivation Industries**: Developing and managing high-tech horticulture.
- **Research Institutes**: National and international research organizations such as PARC, NARC, CRI, NIBGE and NIAB.

5. **Program structure.**

Duration	Minimum 2-Years (4-Semesters) , Maximum 4-Years (8-Semester)
Entry requirements	The candidates having CGPA ≥ 2.50 out of 4.0 in B.Sc.(Hons.) Horticulture (4-Years) or equivalent degree program (with 16 years of education in any discipline/major of Agriculture from HEC recognized institution shall be eligible for admission. The candidates shall only be considered eligible who shall pass: a) The departmental entry test with minimum 50% marks and interview conducted by the Graduate Program Committee of the relevant Department/College/Institute/School of the University.
Intra-disciplinary fields allowed for admission	Candidates having B.Sc.(Hons.) or equivalent degree program (16 years of Education) in the discipline of Agronomy, PBG, Entomology, Forestry, Plant Pathology, Agri-Extension, Agri-Economics and Environmental Sciences Horticulture related degrees BS Botany BS Biotechnology
Degree Completion Requirements	<u>For disciplinary admission</u> Total credit hours of Course Work: 34 Credit Hours of Compulsory Courses: 14 Credit Hours of Elective Courses: 12 Credit Hours of General Courses: 02 Credit Hours of Thesis (Compulsory): 06 <u>For intra-disciplinary admission</u> Total credit hours of Course Work: 43 Credit Hours of Compulsory Courses: 14 Credit Hours of Elective Courses: 12 Credit Hours of General Courses: 02 Credit Hours of Thesis (Compulsory): 06 Minimum Credit Hours of Deficiency Courses 09
Specialization (if any)	Not Applicable

*In case of admission on Intra-disciplinary basis the candidates will be required to pass a separate GRE-Subject / equivalent test (at least 50% marks) in addition to University Entry Test.

6. List of Courses

A. List of deficiency Courses

Course Code	Course Title	Credit Hours
HORT-6603	Principles of Fruit Production	3(2+1)
HORT-6604	Principles of Vegetables Production	3(2+1)
HORT-6605	Principles of Ornamental Crop Production	3(2+1)
HORT- 6609	Tropical and Sub-Tropical Fruits	3(2+1)
HORT- 6613	Post-Harvest Horticulture	3(2+1)
HORT- 6621	Vegetable and Flower Seed Production	3(2+1)

B. List of Mandatory/ Compulsory / Core courses

Course Code	Course Title	Credit Hours
HORT-7101	Mineral Nutrition of Horticultural Crops	3(2+1)
HORT-7104	Rootstocks for Horticultural Crops	3(2+1)
HORT-7113	Landscape Designs	3(2+1)
HORT-7109	Special Problem	1(1+0)
HORT-7110	Seminar	1(1+0)
STAT-7151	Statistical Methods for Agricultural Research-I	3(3+0)

C. List of Elective Courses

Course Code	Course Title	Credit Hours
HORT-7102	Plant Tissue Culture	3(1+2)
HORT-7103	Prospective Horticultural Crops	3(2+1)
HORT-7105	Citriculture	3(2+1)
HORT-7106	Mango and Date Palm Culture	3(2+1)
HORT-7107	Minor Fruits	3(2+1)
HORT-7108	Solanaceous Crops	3(2+1)
HORT-7111	Spices and Condiments	3(2+1)
HORT-7112	Mushroom Biology and Technology	3(2+1)
HORT-7114	Horticultural Seed Science and Technology	3(2+1)
HORT-7115	Physiology of Horticultural Crops	3(2+1)
HORT-7116	Post-Harvest Physiology	3(2+1)
HORT-7117	Nursery Management of Horticultural Plants	3(2+1)

D. General Education Courses

Course Code	Course Title	Credit Hours
URGC-5129	Understanding of Holy Quran / Fehm-e-Quran-I	1(1+0)
URGC-5130	Understanding of Holy Quran / Fehm-e-Quran-II	1(1+0)

7. Semester Wise Breakup

Semester -I

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Deficiency-1*	HORT-66xx	To be selected from list	3(2+1) 3 (3+0)	
Compulsory-1	HORT-71xx	To be selected from list	3(2+1)	
Compulsory-2	HORT-71xx	To be selected from list	3(2+1)	
Elective-1	HORT-71xx	To be selected from list	3(2+1) 3 (3+0)	
Elective-2	HORT-71xx	To be selected from list	3(2+1) 3 (3+0)	
General	URGC-5129	Understanding of Holy Quran Fehm-e-Quran-I	1(1+0)	

Semester Credit Hours: 13-16

Semester- II

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Deficiency-2*	HORT-66xx	To be selected from list	3(2+1) 3 (3+0)	
Compulsory-3	STATT-7151	Statistical Methods for Agricultural Research-I	3(3+0)	
Compulsory-4	HORT-71xx	To be selected from list	3(3+0)	
Compulsory-5	HORT-7109	Special Problem	1 (1+0)	
Elective-3	HORT-71xx	To be selected from list	3(2+1) 3 (3+0)	
General	URGC-5130	Understanding of Holy Quran Fehm-e-Quran-II	1(1+0)	

Semester Credit Hours: 11-14

Semester -III

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Deficiency-3	HORT-66xx	To be selected from list	3(2+1) 3 (3+0)	
Compulsory-6	HORT-7110	Seminar	1(1+0)	
Elective-4	HORT-71xx	To be selected from list	3(2+1)/3 (3+0)	

Semester Credit Hours: 4-7

Semester -IV

Compulsory -7		Thesis	6	Completion of course work

8. **Program Summary**

Category	Minimum Number of Credit Hours
Compulsory Courses	14
Elective Courses	12
General Courses	02
Deficiency Courses *(For Intra-disciplinary admission only)*	09
Thesis	06

Note:

1. Mandatory and elective courses will be decided from the above lists, respectively, by the Department at the start of every semester following current HEC graduate policy and UOS graduate rules and regulations 2023. Further, maximum credit hours of deficiency courses will be decided by the Department.
2. The Regulations related to MS/M.Phil./M.Sc.(Hons) or equivalent approved by the Syndicate from time to time shall also be applicable.
3. Deficiency Courses are to be decided by Graduate Program Committee in start of each session.
4. Department can change the order of Core/Compulsory and Elective Courses as per availability of resources or demand.
5. Department can change the course offering as per available resources but shall be uniform for one session.

Ph.D. Horticulture

1. **Nomenclature :**

Ph.D. Horticulture

2. **Department brief:**

The College of Agriculture was established in October 2005 as a constituent college of the University of Sargodha. Horticulture was introduced as a major subject in March 2007, followed by the start of MSc (Hons.) Horticulture in 2010 and Ph.D. Horticulture in 2013. On January 7, 2012, the syndicate officially declared Horticulture as an independent department. The Department of Horticulture is committed to disseminating knowledge about pomology, olericulture, and floriculture crops that are cultivated for food, export, and the overall benefit of society. Its mission is achieved through a strong integration of teaching, research, and extension/outreach activities.

3. **Program Learning Objective**

- Provide quality education in horticultural sciences.
- Undertake basic, applied, and adaptive research in horticulture.
- Collaborate with national and international organizations for academic and research excellence.
- Develop strategies through training programs, workshops, and demonstrations.
- Produce employable graduates with the highest professional and ethical standards.

4. **Scope**

This degree program is designed to train professional horticulturists to meet the needs of stakeholders. It opens diverse career opportunities in both the public and private sectors. Career options include:

- **Academic Institutions**: Teaching and research roles in universities and colleges.
- **Horticultural Extension Services**: Advising farmers on improved practices and technologies.
- **Government Departments**: Employment in agricultural and horticultural development departments.
- **Nurseries and Landscaping Firms**: Production of ornamental plants and design of gardens and green spaces.
- **Seed and Agrochemical Companies**: Working in product development, sales, and technical support.
- **Food Processing and Post-Harvest Industries**: Involvement in value addition, quality control, and packaging.
- **Biotechnology and Protected Cultivation Industries**: Developing and managing high-tech horticulture.
- **Research Institutes**: National and international research organizations such as PARC, NARC, CRI, NIBGE and NIAB.

5. **Program structure.**

Duration	Minimum 3-Years (6-Semesters) , Maximum 8-Years (16-Semester)
Entry requirements	The candidates having CGPA ≥ 3.0 out of 4.0 (in the semester system) or minimum 60% marks (in the annual system) in MS/M.Sc.(Hons.) or equivalent degree program (with 18 years of education with minimum 24 and 06 credit hours for course and research work, respectively) in any discipline/major of Agriculture from HEC recognized institution shall be eligible for admission. The candidates shall only be considered eligible who shall pass: a) The entry test equivalent to GRE/HAT General Test (minimum 60% marks) conducted by the University and interview conducted by the Graduate Program Committee of the relevant Department/College/Institute/School of the University. b) The applicants having minimum 60% GRE/HAT General Test Score issued by the HEC accredited test bodies shall be exempted from the University test for admissions in PhD program. c) In addition to GRE/HAT General Test, the university may conduct subject test for admission to PhD program with the approval of the Vice Chancellor on the recommendations of University Admission Committee. As part of the application for admission to PhD programs, applicants shall be required to submit a statement of purpose, which shall form an integral part of the application. The Graduate Program Committee shall use the information provided to ascertain the preparedness and interest of the candidate in pursuing doctoral studies whether the department has desired resources to supervise the doctoral research of the candidates in the sub-specialty in which the applicant is interested. A statement of purpose shall, at least, include the following: a) Title of the potential research proposal b) Clear articulation of the current understanding of the intended field and ideas for the potential research c) Explanation of the intended impact of the proposed research
Intra-disciplinary fields allowed for admission	Candidates having MS/M.Sc.(Hons.) or equivalent degree program (18 years of Education) in the discipline of Agronomy, PBG, Entomology, Forestry, Plant Pathology, Agri-Extension, Agri-Economics. MS Environmental Sciences Horticulture related degrees MS Botany MS Biotechnology

Degree Completion Requirements	<u>For disciplinary admission</u> Total credit hours of Course Work: 23 Credit Hours of Compulsory Courses: 12 Credit Hours of Elective Courses: 09 Credit Hours of General Courses: 02 <u>For intra-disciplinary admission</u> Total credit hours of Course Work: 32 Credit Hours of Compulsory Courses: 12 Credit Hours of Elective Courses: 09 Minimum Credit Hours of Deficiency Courses 09 Credit Hours of General Courses: 02 *Note: Deficiency courses will be offered form M.Sc. (Hons.) Horticulture. courses (Level-07) as per decision of the Graduate Program Committee of the department.*
Specialization (if any)	Not Applicable

*In case of admission on Intra-disciplinary basis the candidates will be required to pass a separate GRE-Subject / equivalent test (at least 50% marks) in addition to University Entry Test.

6. List of Courses

A. List of Deficiency Courses

Course Code	Course Title	Credit Hours
HORT-7101	Mineral Nutrition of Horticultural crops	3(2-1)
HORT-7104	Rootstocks for Horticultural Crops	3(2-1)
HORT-7113	Landscape Designs	3(2-1)
HORT-7115	Physiology of Horticultural Crops	3(2-1)
HORT-7117	Nursery Management of Horticultural plants	3(2-1)

B. List of Compulsory Courses

Course Code	Course Title	Credit Hours
HORT-8101	Plant Growth Regulators	3(2-1)
HORT-8105	Vegetables Seed Production and Marketing	3(2-1)
HORT-8109	Special Problem	1(1-0)
HORT-8110	Seminar-I	1(1-0)
HORT-8114	Seminar-II	1(1-0)
STAT-8131	Statistical Methods for Agricultural Research-II	3(3-0)

C. List of Elective Courses

Course Code	Course Title	Credit Hours
HORT-8102	Environmental Horticulture	3(2-1)
HORT-8103	Fruit Breeding	3(2-1)
HORT-8104	Vegetable Breeding	3(2-1)
HORT-8106	Turf grass Management	3(2-1)
HORT-8107	Advanced Fruit Science	3(2-1)
HORT-8108	Advanced Vegetable Science	3(2-1)
HORT-8111	Landscape Ecology	3(3-0)
HORT-8112	Biotechnology in Horticultural Crops	3(2-1)
HORT-8113	Horticultural Production under Abiotic Stresses	3(2-1)

D. General Education Courses

Course Code	Course Title	Credit Hours
URGC-5129	Understanding of Holy Quran / Fehm-e-Quran-I	1(1+0)
URGC-5130	Understanding of Holy Quran / Fehm-e-Quran-II	1(1+0)

7. Semester Wise Breakup

Semester –I

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Deficiency-1*	HORT-71xx	To be selected from list	3(2+1)/3 (3+0)	
Compulsory-1	HORT-81xx	To be selected from list	3(2+1)	
Compulsory- 2	HORT-81xx	To be selected from list	3(2+1)	
Elective-1	HORT-81xx	To be selected from list	3(2+1)/3 (3+0)	
General	URGC-5129	Understanding of Holy Quran / Fehm-e-Quran-I	1(1+0)	

Semester Credit Hours: 10-13

Semester- II

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Deficiency-2*	HORT-71xx	To be selected from list	3(2+1)/3 (3+0)	
Compulsory-3	STAT -8131	Statistical Methods for Agricultural Research-II	3(3+0)	
Compulsory- 4	HORT-8110	Seminar-I	1(1+0)	
Elective-2	HORT-81xx	To be selected from list	3(2+1)/3 (3+0)	
Elective-2	HORT-81xx	To be selected from list	3(2+1)/3 (3+0)	
General	URGC-5130	Understanding of Holy Quran / Fehm-e-Quran-II	1(1+0)	

Semester Credit Hours: 11-14

Semester -III

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Deficiency-3*	HORT-71xx	To be selected from list	3(2+1) 3 (3+0)	
Compulsory-5	HORT-8109	Special Problem	1(1+0)	
Compulsory-6	HORT-8114	Seminar-II	1(1+0)	

For intra-disciplinary admitted candidates only Semester Credit Hours: 2-5

Semester -IV-VI

Compulsory -7		Research and Thesis		

8. Program Summary

Category	Minimum No. of Credit Hours
Compulsory Courses	12
Elective Courses	09
Deficiency Courses *(For Intra-disciplinary admission only)*	09
General courses	02
Thesis	--

Note:

1. Mandatory and elective courses will be decided from the above lists, respectively, by the Department at the start of every semester following current HEC graduate policy and UoS graduate rules and regulations 2023. Further, maximum credit hours of deficiency courses will be decided by the Department.
2. The Regulations related to MS/M.Phil./M.Sc.(Hons)/ Ph.D. or equivalent approved by the Syndicate from time to time shall also be applicable.
3. Deficiency Courses are to be decided by Graduate Program Committee in start of each session.
4. Department can change the order of Core/Compulsory and Elective Courses as per availability of resources or demand.
5. Department can change the course offering as per available resources but shall be uniform for one session.

MSc
(Hons)
HORTICULTURE

HORT-7101 **Mineral Nutrition of Horticultural Crops** **3(2+1)**

The aim of this course is to develop understanding among students about role of nutrients, their uptake and utilization in horticultural crops. In addition to water, sunlight, and carbon dioxide from the air, plants require 13 mineral nutrients that are typically derived from the soil. The macronutrients nitrogen (N), phosphorus (P), potassium (K) are needed by plants in relatively large amounts and often have to be added to the soil. Intermediate amounts of secondary nutrients magnesium (Mg), calcium (Ca), and sulfur (S) are needed by plants. Trace or micronutrients [boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo) and zinc (Zn)] are needed in small amounts Nutrition has important role for the production, yield and quality of horticultural crop. The students will be able to diagnose specific nutrient deficiency and toxicity symptoms and suggest their remedies.

Contents

1. Nutrient elements in plants and their classification
2. Criteria of essentiality and role of mineral nutrients in plants
3. Requirements and plant composition
4. Mechanism and factors affecting absorption and translocation of nutrients
5. Ion interactions
6. Nutrient concepts
7. Methods for evaluation of nutrients and their application
8. Deficiencies and toxicities
9. Growth yield and quality as affected by nutrient status

Practical

1. Relevant field and laboratory studies
2. Survey for deficiency/toxicity symptoms (Identification and sample collection) of fruits, vegetables and ornamental plants
3. Techniques for evaluations of nutrients
4. Practice of nutrient application (spreading, dressing, foliar application, fertigation etc.), Visit of nutrient analytical laboratories

Recommended Texts

1. Alloway, B. J. (2008). *Micronutrient Deficiencies in Global Crop Production*. UK: CPL Scientific Publishing.
2. Emanuel E., & Arnold. J.B. (2005). *Mineral Nutrition of Plants: Principles and Perspectives*. Sunderland, USA: Academic Press.

Suggested Readings

1. Mengel, K., &. Kirkby, E.A. (2001). *Principles of Plant Nutrition*. Bern, Switzerland: International Potash Institute.
2. Kumar, D.D. (2000). *Micronutrients-Their Behaviour in Soil and Plants*. New Delhi: Kalyani Publisher.
3. Allen, V.B., & Pilbeam, D.J. (2007). *Handbook of Plant Nutrition*. Boca Raton, Florida: CRC Somerset Press.

HORT-7102 **Plant Tissue Culture** **3(1+2)**

The objective of this course is to acquaint students with modern techniques of plant multiplication. Students will understand the basic tissue culture techniques for in vitro propagation of horticultural crops and its commercial applications. Additionally, this course will help understand the basic requirements to establish a tissue culture laboratory. Students will be able to grow plants through tissue culture technology. They will be able to utilize these learnt techniques for their research work during higher leaning. Students will be able to choose crops for tissue culture. They will be able to use tissue culture to solve problem related with horticultural crops propagation on a commercial scale. Taking this is course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. Introduction, history and importance
2. Tissue culture media, Asepsis
3. Types of culture (organ, callus, cell suspension, protoplast culture etc.)
4. Types of regeneration (Callogenesis, organogenesis and embryogenesis), Micro-propagation, micro-grafting
5. Synthetic seed technology, indexing of tissue cultured plants for pathogens
6. Physiology and anatomy of tissue cultured plants
7. Germplasm conservation, Secondary plant products

Practical

1. Laboratory equipment and supplies
2. Stock solutions and media preparation
3. Maintenance of asepsis
4. Different types of explants culture (shoot-tip, nodal segments, leaf disks, embryo, ovule, anther/pollen, callus, cell suspension
5. Protoplast fusion, Plantlet regeneration)
6. *In vitro* grafting, Production and testing of virus free plants
7. Transfer of plantlets from tissue culture to greenhouse and field
8. Preparation of synthetic seeds
9. Visits to tissue culture laboratories

Recommended Texts

1. Kumar, U. (2005). *Methods in Plant Tissue Culture*. Jodhpur, India: Agrobios.
2. Lindsey, K. (2007). *Plant Tissue Culture Manual*. New Delhi, India.: Springer – Kluwer Academic Publishers.

Suggested Readings

1. Kumar, B. (2014). *Culture of Plant Cells, Tissues and Organs*. New Delhi, India: Random Publications.
2. Scoggins, H., & M. Bridgen. (2014). *Plants from Test Tubes: An Introduction to Micro propagation* (4th ed.). New York: Tiber Press.

HORT- 7103 **Prospective Horticultural Crops** **3(2+1)**

The objective of this course is to familiarise students with basic principles and practices of horticultural crop production. Students are expected to understand various stages of fruit plants phenology and physiology in order to solve related problems for fruits crops. After completing this course student will be able to grow and manage fruits crops successfully on a commercial scale. This course would help understand students regarding the key phenomena related with minor fruits such as soil and climatic requirements, propagation and cultural practices as well as physiological problems such as incompatibility, fruits set, and biennial bearing. This course will help students to identify the key issues being faced by the growers such as alternate bearing, fruit drop and possible options to control these issues using different approaches. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level

Contents

1. Introduction, importance, present status and future scope
2. Soil and climatic requirements
3. Propagation
4. Cultural operations
5. Harvesting, processing and marketing of following crops: oil palm, jojoba, amla, avocado, pecans, hazel nut, jack fruit, cashew nut, kiwi fruit, kronda, tea, saffron, leek, celery, asparagus, and Brussel's sprout etc.

Practical

1. Identification of plants
2. Propagation, raising of nursery
3. Management practices
4. Harvesting and handling

Recommended Texts

1. Bose, T.K., & S.K. Mitra. (1990). *Fruits: Tropical and Subtropical*. Calcutta: Naya Prokash.
2. Mazumdar, B.C. (2004). *Minor Fruit crops of India: Tropical and Subtropical*. India: Daya Publishing.

Suggested Readings

1. Singh, A.P. (2002). *Vegetable Growing in India*. New Delhi: Kalyani Publisher.
2. Das, P.C. (2003). *Vegetable Crops of India*. New Delhi: Kalyani Publisher.
3. Das, B.C., & Das, S. N. (2000). *Cultivation of Minor Fruits*. New Delhi: Kalyani Publisher.

DR. RASHID MUKHTAR BALAL
Professor (Horticulture)

HORT-7104 **Rootstocks for Horticultural Crops** **3(2+1)**

Rootstocks play a crucial role in determining orchard efficiency in fruit crops. Combining the desirable attributes of two different plants by budding or grafting can produce different growth effects. The effect of rootstock on fruit quality in terms of physical traits and internal chemical compositions is well demonstrated in temperate fruit crops (Apple, Pears, Cherry etc.) as compared to tropical and subtropical fruit crops. This difference can be illustrated by comparing the relative importance of rootstocks for precocity, yield, and tree size control, and through contrasts in annual phonological cycles, fruit respiratory behavior, crop load and canopy management techniques. But these effects on physiological, biochemical and molecular fronts are still not understood. The course will make students familiar with various rootstocks and stionic interaction in horticultural crops.

Contents

1. Introduction and importance
2. Types of rootstocks, Role of rootstocks in fruits and ornamental plants
3. Factors affecting stock-scion relationship
4. Compatibility and incompatibility, types and their impact on rootstock efficiency
5. Rootstock adaptability under various soils and climatic conditions
6. Rootstock of major fruits and ornamental plants in relation to vigor, quality, longevity, fruitfulness and resistance to drought, salinity, pest and diseases
7. Improvement of rootstocks in changing climate scenario
8. Role of rootstocks in high density plantation

Practical

1. Identification, selection and multiplication of important rootstocks
2. Identification of different types of incompatibility
3. Survey of rootstocks used in various commercial gardens, research stations and plant nurseries

Recommended Texts

1. Adriance, G.W., & Brison, F.R. (2000). *Propagation of Horticultural Plants*. Delhi, India: Biotech Books.
2. Hartmann, H.T., Kester, D.E., Davies, E.T., & Geneve, R.L. (2009). *Plant Propagation: Principles and Practices* (7th ed.). New Delhi, India: Prentice-Hall India Learning.

Suggested Readings

1. Rajan, S., & Markose, P.L. (2007). *Propagation of Horticultural Crops*. India: New India Publishing Agency.
2. Sharma, R.R. (2002). *Propagation of Horticultural Crops: Principles and Practices*. Ludhiana, New Delhi, India: Kalyani Publishers.
3. Sharma, R.R., & Srivastav, M. (2004). *Plant Propagation and Nursery management*. Lucknow, India: International Book.

HORT-7105 **Citriculture** **3(2+1)**

This course is very important for citrus growing region such as Sargodha. Citrus is a major fruit crop of Sargodha as well as Pakistan. All the processing units are established in Sargodha. This course will help students to identify the key issues being faced by the growers such as alternate bearing, fruit drop, unfruitfulness and possible options to control these issues using different approaches. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues. This course will help students to identify the key issues being faced by the citrus industry of Pakistan and possible options to control these issues using different approaches. The course will inculcate awareness of scientific knowledge about citrus fruits and induce aptitude of research.

Contents

1. Introduction; Present status and future prospects, history and species concept
2. Botany; Pomological classification; Phenology
3. Mineral nutrition; Rootstocks; Spacing of trees
4. Water relations
5. Pests, disease and weed control
6. Pre and Post -harvest physiology
7. Production problems (decline, alternate bearing, fruit drop and unfruitfulness) and export issues
8. Varietal improvement
9. Modern trends in Citriculture
10. Measures for the improvement of Citrus Industry in Pakistan

Practical

1. Morphological studies of flowers, leaves and fruits of different citrus species and their varieties
2. Identification of different physiological disorders
3. Diagnosing various nutritional deficiencies
4. Insects and diseases effect
5. Crossing for inter- and intra-specific hybridization

Recommended Texts

1. Albrigo, L.G., Timmer, L.W., & Rogers, M.E. (2014). *Citrus, Vol: II, Crop Production Science in Horticulture*. Wallingford, UK: Centre for Agriculture and Bioscience International.
2. Davies, F.S., & Albrigo, L.G. (2003). *Citrus Fruits*. Wallingford, UK: CAB International.

Suggested Readings

1. Mukhopadhyay, S. (2004). *Citrus Production, Postharvest, Diseases and Pest Management*. New Delhi, India: Oxford and IBH Publishing.
2. Khan, I. (2007). *Citrus Genetics, Breeding and Biotechnology*. CAB International, London, UK.
3. Singh, S., Shivanker, V.J., Srivastava, A.K., & Singh, I.P. (2004). *Advances in Citriculture*. New Delhi, India: Jagmander Book Agency.

HORT- 7106 **Mango and Date Palm Culture** **3(2+1)**

Mango and date palm are two major fruit crop of Pakistan. Both fruits are growing in tropical and sub-tropical area of Pakistan. Mango and date palm also have postharvest issues. However, Pakistan is the largest producer of mango and Date palm. To equip the students with scientific knowledge about the most important fruits of the region. This course will help students to identify the key issues being faced by the growers such as alternate bearing, fruit drop and possible options to control these issues using different approaches. This course will help students to identify the key issues being faced mango and date palm industry of Pakistan and possible options to control these issues using different approaches. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. History and distribution: Importance
2. Present status and future prospects
3. Botany, classification, phenology, climate and environments
4. Vegetative and reproductive physiology
5. Orchards management operations and practices
6. Curing and post-harvest handling
7. Post-harvest chemistry and physiology
8. Physico-chemical changes
9. Production problems and disorders
10. Export issues

Practical

1. Identification of different varieties of mango and date palm
2. Fruit description Propagation techniques
3. Date palm pollination
4. Maturity indices and Curing of mango and date palm
5. Preparation for export market

Recommended Texts

1. Singh, H.S., Nath, V., Singh, A., & Mandal, S. (2008). *Mango: Preventive Practices and Curative Measures*. Delhi, India: Satish Serial Publishing House.
2. Yadav, P.K. (2007). *Fruit Production Technology*. Lucknow, India: International Book.

Suggested Readings

1. Srivastava, R.P. (1998). *Mango Cultivation*. Lucknow, India: International Book.
2. Litz, R.E. (2009). *The Mango: Botany, Production and Uses* (2nd ed.). Wallingford, UK: CAB International.
3. Ahmad, S. (2004). *Mangoes in Pakistan*. Islamabad: The Horticultural Foundation of Pakistan.

HORT-7107 **Minor Fruits** **3(2+1)**

The objective of this course is to familiarize students with production technology of minor fruits of Pakistan. There are many minor fruits of Pakistan such as ber, berries, chiku, coconut, custard apple, fig, falsa, jaman, loquat, mulberry, olive, papaya, pecan pineapple and quince etc. Pakistan has great potential of these fruits, but we have to focus on these fruits. By taking this course, students will become familiar with the minor fruits of Pakistan that can be grown, their climatic and cultural requirements. They will be able to grow and introduce/suggest new unexplored fruits to the farming community to help them uplift their economic status. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. Introduction and importance
2. Acreage, production, botany
3. Composition and uses
4. Climate, soil, propagation, rootstocks, cultural practices, cultivars
5. Important insect-pests and diseases
6. Harvesting, post-harvest handling and marketing of fruits such as ber, berries, chiku, coconut, custard apple, fig, falsa, jaman, loquat, mulberry, olive, papaya, pecan pineapple and quince etc.

Practical

1. Identification of minor fruit plants and their fruits
2. Layout systems
3. Propagation methods
4. Pruning, harvesting and handling techniques

Recommended Texts

1. Alford, D.V. (2007). *Pests of Fruit Crops*. Delhi, India: Manson Publishing.
2. Das, D.C., & Das, S.N. (2006). *Cultivation of Minor Fruits*. Ludhiana, New Delhi, India: Kalyani Publishers.

Suggested Readings

1. Philip, S. (2002). *Fruit Crops*. Ludhiana, New Delhi, India: Kalyani Publishers.
2. Singh, S.P. (2005). *Commercial Fruits*. Ludhiana, New Delhi, India: Kalyani Publishers.
3. Steferud, A. (2005). *Diseases of Fruits and Nuts*. Delhi, India: Publisher Biotech Books.

HORT-7108 **Solanaceous Crops** **3(2+1)**

The objective of this course is to develop understanding among the students regarding principles and physiology of Solanaceous vegetables production. The production practices, common problems and their solutions. At the end students will be familiar with basic principles behind successful vegetable production on a commercial scale. Students will get theoretical as well as practical knowledge regarding the vegetables growing. They will become familiar with the common vegetables being grown in the country and can compare those with the vegetable grown internationally. Students will be able to diagnose problems with vegetable plants and can suggest possible solutions to the farmers. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues

Contents

1. Introduction, Botany
2. Classification
3. Centers of origin
4. Distribution in the world
5. Physiology
6. Nursery raising and crop establishment
7. Production problems
8. Seed production and supply of certified seed
9. Breeding and improvement of the following crops: potato, tomato, brinjal (aubergine), chilies and peppers

Practical

1. Morphology
2. Identification and handling of the seed materials
3. Seed diseases
4. Planting methods
5. Varietal evaluation
6. In vitro pre-basic seed production

Recommended Texts

1. Rai N., & Yadav, D.S. (2005). *Advances in Vegetable Production*. New Delhi: Research Co. Book Centre.
2. Singh, D.K. (2007). *Modern Vegetable Varieties and Production Technology*. Lucknow, India: International Book.

Suggested Readings

1. Razdan, M.K. & Mattoo, A. K. (2005). *Genetic Improvement of Solanaceous Crops, Vol. 1: Potato*. Enfield, NH: Science Publishers.
2. Razdan, M.K. & Mattoo, A. K. (2006). *Genetic Improvement of Solanaceous Crops, Vol. 2: Tomato*. Enfield, NH: Science Publishers.
3. Libner, N.S. (2006). *Vegetable Production*. New Delhi, India: Vedams Books.

HORT-7109 **Special Problem** **1(1+0)**

The special problem is intended to instruct students on proper techniques for scientific research and methodologies. The students are expected to prepare directed assignment and collect information and material related to current research interest. Special problem means an assignment that is expected to be temporary and is designated as a special assignment by the academic supervisor in its sole discretion. The main purpose of special problem is to increase the learning capabilities of students. The more we use our brains, the more they develop. Students learn a lot more when they read or practice something by themselves. Similarly, the purpose of assignments is to increase the practical skills of students. The main objectives of special problem assigned to students are to enhance the knowledge of a subject, develop writing skills, enhance time management and organizing skills. The special problem makes you do your work by prioritizing the needs and time frames completing all your tasks peacefully avoiding panic. Special problem writing work provides students a lot of scope to improve themselves.

HORT- 7110 **Seminar** **1(1+0)**

The seminar is intended to instruct students on proper techniques for presentation of scientific material. Each student is expected to prepare and present a scientific seminar and to submit written documentation supporting that seminar. A seminar is a form of academic instruction, either at an academic institution or offered by a commercial or professional organization. It has the function of bringing together small groups for recurring meetings, focusing each time on some particular subject, in which everyone present is requested to participate. Seminars provide a chance to interact with experts from the specific field. Discussing about the relevant topics of the particular subject, students tend to learn about the latest information and new skills related to the concerned subject. Seminars are important and beneficial for those who have difficulty learning in a typical classroom setting where reading and writing are required. There is often a sense of friendship associated with seminar attendance, because everyone is attending with an interest in learning about a subject important to them. Attending a seminar has numerous benefits, including improving communication skills, gaining expert knowledge, networking with others and renewing motivation and confidence.

HORT-7111 **Condiments and Spices** **3(2+1)**

Spice means any dried, fragrant, aromatic or pungent, edible vegetable or plant substance, in the whole, broken or ground form, which contributes flavor; whose primary function in food is seasoning rather than nutrition, and which may contribute relish or piquancy to foods or beverages that is true to name, and from which no portion of any volatile oil or other flavoring principle has been purposely removed, or which no additive or spent spice has been added. Spices may be either the dried, bark, buds, bulbs, flowers, fruit, leaves, rhizome, roots, seeds, stigmas and styles or the entire plant tops. To create awareness of the potential spices and condiments in our daily life, this course will help students to identify the key issues being faced by the growers of condiments and spices as well as possible options to control these issues using different approaches. Taking this course would broaden their vision regarding the condiments and spices industry at domestic and international level.

Contents

1. Introduction and importance
2. Individual condiment and spices (History, distribution, cultivation, diseases, pests, improvement)
3. Products and end use
4. Processing and manufacturing
5. Standard specification, production
6. Trade and marketing of following condiments and spices: Chilies, coriander, garlic, ginger, mint, onion, tamarind, turmeric, black pepper, cardamom, cinnamon, clove, cumins etc.

Practical

1. Identification, cultivation
2. harvesting, drying, cleaning, processing and storage of spices
3. Visits to relevant markets and Spices manufacturing units

Recommended Texts

1. Shanmughavelu, K.G., Kumar, N., & Peter, K.V. (2005). *Production Technology of Spices and Plantation Crops*. India: Agrobios Publishers.
2. Das, P.C. (2014). *Spice Crops Production Technology*. Jodhpur, India: Scientific publisher.

Suggested Readings

1. Paul W, B., & Votava, E. J. (2012). *Peppers: Vegetable and spice capsicum*. Wallingford, UK: CAB International.
2. Serdar, O. & Milan, M. (2007). *Medicinal and Aromatic Crops*. New York: Haworth Food & Agric. Products Press.
3. Bogers, R.J., Craker, L.E., & Lange, D. (2006). *Medicinal and Aromatic Plants*. New York: Haworth Food & Agric. Products Press.

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Chairman
Horticulture

HORT- 7112 **Mushroom Biology and Technology** **3(2+1)**

The mushroom industry world-wide currently has a turnover of £3,000 million. This industry is by far the most economically important industry based on a solid-state fermentation. This industry is also developing in Pakistan. We need to introduce this industry to our farmers, processor and producers and impart knowledge about the mushrooms and develop skills about production technology of commercially important mushrooms. Mushroom industry of Pakistan is improving and farmers as well as processor are taking interest for growing mushroom because it has nutritional as well as medicinal value. Taking this course would broaden students vision regarding the mushroom industry at domestic and international level. Students will be able to grow mushroom and identify problems as well as production gaps and will be trained to solve those issues.

Contents

1. Introduction: present status and future prospects, Nutritional and medicinal values
2. Classification, morphology and general biology
3. Spawn preparation
4. Growing structures and systems
5. Substrates; Fruiting body formation
6. Cultivation technology with emphasis on *Agaricus, Pleurotus, Lentinus and Volvariella* species etc.
7. Production problems and disorders
8. Postharvest handling and value addition
9. Economics of mushroom production

Practical

1. Media and substrate preparation
2. Isolation of pure culture for spawn
3. Structural demonstration of mushroom houses
4. Environmental control systems
5. Compost preparation
6. Practices in growing methods of different cultivated mushrooms

Recommended Texts

1. Biswas, S., Datta, M., & Ngachan, S.V. (2011). *Mushrooms: A Manual for Cultivation.* New Delhi, India: PHI learning.
2. Chang, S.T., & Miles, P.G. (2004). *Mushrooms. Cultivation, Nutritional Value, Medicinal Effects, and Environmental Impact* (2nd ed.). Boca Raton, Florida, USA: CRC Press.

Suggested Readings

1. Stamets, P. (1993). *Growing Gourmet & Medicinal Mushrooms.* Berkeley, CA: Ten Speed Press.
2. Bahl, N. (1994). *Handbook on Mushrooms* (3rd ed.). New Delhi: Oxford & IBH Publishing.

HORT- 7113 **Landscape Designs** **3(2+1)**

The objective of this course is to provide knowledge of basic principles and physiology of ornamental crop production to the students of Horticulture. Students are expected to have knowledge of basic principles of ornamental crop production and their utilization. Students will be familiar with the ornamental flowers being grown in the country and can compare those with the flowers grown in other flowers producing countries across the world. They will be able to identify problems of commercial flowers and will be able to suggest farmers about the problems. They will learn all basic steps involved in commercial flower growing ranging from nursery growing till be harvest and postharvest and marketing of flowers. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. Importance of landscape gardening and design
2. Principles and elements of landscape design
3. Landscape design materials
4. Types of designs; formal and informal garden designs
5. Rockeries, terrace, roof and aquatic gardens, different landforms and their manipulation; functional, architectural and aesthetic uses of plants
6. landscape design for parks, play fields, highway and roadside plantations
7. Efficient irrigation system
8. Cost estimates for landscape
9. Recent trends in modern landscape

Practical

1. Design process; site inventory and analysis; client interview; base map; master plan; scale drawings
2. Introduction to computer added designs
3. Small projects of landscape design (self-designed and executed)
4. Water features (ponds, fountains, waterfalls) design and execution
5. Demonstration of water efficient irrigation systems
6. Visits to different parks and gardens

Recommended Texts

1. Biondo, R.J., & Schroeder, C.B. (2006). *Introduction to Landscaping Design, Construction and Maintenance* (3rd ed.). Lucknow, India: International Book.
2. Simonds, J.O., & Strake, B. (2006). *Landscape Architecture: A Manual of Land Planning and Design* (4th ed.). New York, USA: McGraw Hill.

Suggested Readings

1. Robinson, P. (2005). *The Practical Rock and Water Garden.* London, UK: Anness Publishing.
2. Bhattacharjee, S.K. (2004). *Landscape Gardening and Design with Plants.* Jaipur, India: Aavishkar Publishers.
3. Sovinski, R.W. (2009). *Materials and their applications in Landscape Design.* Hoboken, New Jersey, USA: John Wiley and Sons.

HORT- 7114 **Horticultural Seed Science and Technology** **3(2+1)**

The objective of this course is to provide knowledge of basic principles of seed production of horticultural crops. The seeds of some species perish at low temperatures and on drying these are classified as 'recalcitrant'. The economies of many developing countries depend on such crops. Because of the short life span of recalcitrant seeds, short term storage presents great problems and long-term storage is not at present possible. The students will learn about modern seed production, processing and handling techniques. They will learn all the basic steps involved in commercial flower growing ranging from nursery growing till the harvest and postharvest and marketing of flowers. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. Introduction and importance
2. Seed classification
3. Pre and post-harvest factors affecting seed quality
4. Seed harvesting techniques
5. Conditioning and handling
6. Quality control
7. Seed dormancy, after ripening and their treatments
8. Seed moisture and desiccation in relation to seed quality
9. Storage and longevity
10. Seed testing; Ageing and deterioration
11. Priming, Coating, their merits and demerits
12. Seed certification and registration systems

Practical

1. Seed identification of horticultural crops
2. Demonstration on cross sectional diagrams of seed structures
3. Harvesting and extraction
4. Handling of seed
5. Drying and storage of seed
6. Seed desiccation and moisture determination methods
7. Seed viability and vigor tests

Recommended Texts

1. Basra, A.S. (2006). *Handbook of Seed Science and Technology* (1st ed.). Boca Raton, Florida, USA: CRC Press.
2. Chakrabarti, S.K. (2010). *Seed Production and Quality Control*. Ludhiana, India: Kalyani Publishers.

Suggested Readings

1. McDonald, M.B., & F.Y. Kwong. (2005). *Flower Seeds: Biology and Technology*. Wallingford, UK: CAB International.
2. Vanangamudi, K., Natarajan, N., Bharathi, A., Umarani, R., Natrajan, K., & Saravanan, T. (2006). *Advances in Seed Science and Technology, Vol. 1: Recent Trends in Seed Technology and Management*. India: Agrobios.
3. George, R.A.T. (2009). *Vegetable Seed Production* (3rd ed.). Wallingford, UK: CAB International.

HORT-7115 **Physiology of Horticultural Plants** **3(2+1)**

The objective of this course is to equip students with the techniques to prolong shelf-life of perishable horticultural produce. Students will have the knowledge of produce physiology and its application to ensure quality and shelf life of horticultural crops such as fruits, vegetables and ornamentals. Students will become familiar with the basic concepts of postharvest handling, starting from the harvest, temporary storage, washing, waxing, drying, sorting and grading and packing. Students will learn about the packing and packaging materials, and storage, and types of stage. They will learn about the different options of storage and underlying mechanisms. They will become familiar with the storage conditions for different fruits, vegetables and ornamental plants. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. Introduction and importance
2. Physiological basis of growth and crop productivity
3. Crop responses to various environmental factors (light, temperature, water and nutrient regimes etc.)
4. Source-sink relationship
5. Dormancy; important types, mechanism and management
6. Floral development mechanism
7. Physiology of fruit setting, development, maturation, ripening, abscission and senescence
8. Pigmentation, Physiology of climacteric and non-climacteric commodities in relations to respiration
9. Photosynthetic efficiency of C_3, C_4 and CAM plants
10. Physiological responses in relation to drought, water logging, temperature and salinity. Crop responses to CO_2 fertilization

Practical

1. Experiments to study the effects of drought, water logging, temperature (high and low) and salinity on germination, growth, yield and quality
2. Study of cell membrane stability under stress conditions through conductivity meter, Studies on vegetative and reproductive buds development stages in various horticultural crops
3. Physiology of ripening stages of fruits and vegetables
4. Visit to horticulture fields and laboratories of advance research

Recommended Texts

1. Bleasdale, J.K.A. (2014). *Plant Physiology in Relation to Horticulture* (2nd ed.). Jodhpur, India: Scientific publishers.
2. Dugger, B.M. (2009). *Plant Physiology with special reference to plant production*. Charleston, South Carolina: Bibliobazaar.

Suggested Readings

1. Salisbury, F.B., & Ross, C.W. (2007). *Plant Physiology* (4th ed.). Noida UP, India: Thomson Wadsworth; Anubha printers.
2. Trivedi, P.C. (2006). *Advances in Plant Physiology*. Ludhiana, India: ICAR, Punjab Agricultural University.
3. Taiz, L., & Zeiger, E. (2002). *Plant physiology* (4th ed.) Sunderland, Massachusetts: Sinauer Associates.

HORT- 7116 **Post-Harvest Physiology** **3(2+1)**

The objective of this course is to equip students with the techniques to prolong shelf-life of perishable horticultural produce. Students will have the knowledge of produce physiology and its application to ensure quality and shelf life of horticultural crops such as fruits, vegetables and ornamentals. Students will become familiar with the basic concepts of postharvest handling, starting from the harvest, temporary storage, washing, waxing, drying, sorting and grading and packing. Students will learn about the packing and packaging materials, and storage, and types of stage. They will learn about the different options of storage and underlying mechanisms. They will become familiar with the storage conditions for different fruits, vegetables and ornamental plants. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. Introduction, Factors affecting produce quality and shelf-life
2. Perishable and non-perishable commodities
3. Compositional changes
4. Physiological and biochemical processes in horticultural commodities under different types of storage in relations to maturation, ripening and senescence
5. Role of ethylene in ripening
6. Ethylene scrubbers
7. Role and regulation of environmental factors in storage, temperature, humidity, oxygen, carbon dioxide and ethylene
8. Physiological and pathological disorders in storage

Practical

1. Methods of assessing maturity indices of horticultural produce
2. Starch iodine test
3. Firmness, TSS, sugars and ascorbic acid
4. Calculation of titratable acidity
5. Vase life of cut flowers
6. Identification of postharvest physiological disorders
7. Electrolyte Leakage
8. Packaging methods of different horticultural commodities
9. Other Relevant field and laboratory studies
10. Visit of grading and processing plant and cold stores

Recommended Texts

1. Bleasdale, J.K.A. (2014). *Plant Physiology in Relation to Horticulture* (2nd ed.). Jodhpur, India: Scientific publishers.
2. Kader, A.A. (2002). *Postharvest Technology of Horticultural Crops*. California: Oakland University of California, Division of Agriculture and Natural Resources Publication.

Suggested Readings

1. Kays, S.J. (1998). *Postharvest Physiology of Perishable Plant Products*. New Delhi, India: CBS Publishers.
2. Kumar, P.S., & Kanwat, M. (2009). *Post-harvest Physiology and Quality Management of Fruits and Vegetables*. India: Agrotech Books.
3. Sadiq M., J. Ahmed, Lobo, M.G., & Ozadali, F. (2012). *Tropical and Subtropical Fruits: Postharvest Physiology, Processing and Packaging*. New Jersey: Wiley-Blackwell Publisher.

Hort-7117 **Nursery Management of Horticultural Plants** **3(2+1)**

The objective of this course is to impart technical knowledge about nursery management and certification procedures. Students will be able to manage nurseries and propagate healthy horticultural plants on a commercial scale. This course will help students to start their own business of nurseries as and enterprise. They will learn about the requirements of establishing a nursery, and all the basic steps required for nursery establishment. The selection of plants, growing and establishing and selling out those prepared plants. Nurseries offer a good business and can be taken as an enterprise. This course will help students think and establish their own business, thus improving them livelihood. Taking this course would broaden their vision regarding the horticulture industry at domestic and international level. Students will be able to identify existing gaps and will be trained to solve those issues.

Contents

1. Introduction to plant propagation; Methods of propagation
2. Sexual and asexual methods of propagation
3. Techniques of seed production and propagation
4. Seed production system, Nurseries for transplant production
5. Asexual propagation; Clonal propagation, Cutting, Grafting, Layering Propagation Clonal propagation by specialized structures (root and stem), Micro propagation
6. Propagation structure
7. Choosing a green house, shade house and their application
8. Nursery establishment and management: establishing a modern nursery, Record keeping of plants, managing business

Practical

1. Practices in cutting, grafting, layering, propagation by specialized structures (roots and sterns)
2. Training in green house production, micro propagation
3. Visits of commercial nurseries, visits of commercial green house

Recommended Texts

1. Hartmann, H. 1(996). *Plant Propagation: Principles and Practices*. India: Prentice Hall of India.
2. Hawthorne, L., Bird, R., Brown, D., Stickland, S., & Arbury, J. (2004). *The complete book of plant propagation*. London.

Suggested Readings

1. Kays, S.J. (1998). *Postharvest Physiology of Perishable Plant Products*. New Delhi, India: CBS Publishers.
2. Kumar, P.S. & Kanwat, M. (2009). *Post-harvest Physiology and Quality Management of Fruits and Vegetables*. India: Agrotech Books.
3. Sadiq M., Ahmed, J., Lobo, M.G., & Ozadali, F. (2012). *Tropical and Subtropical Fruits: Postharvest Physiology, Processing and Packaging*. New Jersey: Wiley-Blackwell Publisher.

STAT-7151 **Statistical Methods for Agricultural Research-I** **3(3-0)**

This course designed for MSc (Hons)/MPhil programs of agriculture sciences provides the applied statistics background for survey and experimental work in Agriculture. Case studies and critical examples are used to work through commonly experienced research problems (from sampling designs to the ethical consideration) and to explain how they may be approached, solved or prevented with statistical means. The importance of statistical science in agriculture is obvious, where the collection, analysis and interpretation of numerical data are concerned. Statistical principles apply in all areas of experimental work and they have a very important role in agricultural experiments. Statistics plays an important role in experimentation as many scientific problems could be solved by different statistical procedures. Furthermore, some statistical software knowledge will be provided to the students to improve their analytical skills. These activities will further support the student's research.

Contents

1. Importance of Statistics in agriculture research
2. Selection of statistical tools based on scale of measurements
3. Analysis of Count and Frequency data
4. Measures of central tendency and dispersion
5. Some concepts of hypothesis testing. T, Z, Chi-square and F tests. Contingency Tables
6. Diversity Indices
7. Concept of ANOVA and its types
8. Correlation Analysis: Simple correlation, multiple correlation, and Partial correlation
9. Regression Analysis: Simple and multiple regression
10. Generalized linear models: logistic regression, Poisson regression, Gamma regression, Inverse Gaussian regression
11. Non-linear regression
12. Dose Response Curves

Recommended Texts

1. Montgomery, D. C. (2017). *Design and analysis of experiments* (9th ed.). New York: John Wiley & Sons.
2. Rao, G. N. (2007). *Statistics for agricultural sciences* (2nd ed.). Hyderabad: BS Publication.

Suggested Readings

1. Lawal, B. (2014). *Applied statistical methods in agriculture, health and life sciences*. USA: Springer.
2. Sahu, P. K. (2016). *Applied statistics for agriculture, veterinary, fishery, dairy and allied fields*. USA: Springer.
3. Gbur, E. E., Stroup, W. W., McCarter, K. S., Durham, S., Young, L. J., Christman, M., West, M., & Kramer, M. (2012). *Analysis of generalized linear mixed models in the agricultural and natural resources sciences*. USA: Soil Science Society of America.