

III Year V Semester

PBG 301 Principles and Methods of Plant Breeding 2 + 1

Aim

- ❖ To expose the students to basic and applied principles of plant breeding in horticultural crops.

Theory

Unit I Reproductive systems and plant breeding

Introduction to plant breeding - objectives and role - historical perspective- centres of origin – germplasm – conservation -plant introduction - reproduction in plants- systems of mating - self incompatibility – sterility- apomixes.

Unit II Breeding methods of self pollinated crops

Breeding methods: self pollinated crops- genetic basis – pureline selection – mass selection – hybridization and selection - pedigree breeding – bulk breeding - single seed descent - backcross breeding – multiline.

Unit III Breeding methods of cross pollinated crops

Breeding methods: cross pollinated crops - genetic structure – Hardy Weinberg law - mass selection – modified mass selection; Heterosis breeding – use of male-sterility systems – types of hybrids; recurrent selection - synthetics - composites; asexual breeding system: genetic structure – breeding methods

Unit IV Special breeding methods

In vitro selection techniques; mutation breeding - polyploidy breeding and distant hybridization - – Introduction to markers – morphological – biochemical- DNA markers – Use of markers for crop improvement

Unit V Maintenance breeding

Maintenance breeding - procedure for release of new varieties – stages in multiplication – certification – Nucleus and breeder seed production techniques - Current trends in plant breeding

Practical

Observation on reproductive and pollination systems in plants – Alternation of generation and life cycle – Description and drawing of different pollination systems – Mechanisms enforcing self and cross pollination – Morphology of pollengrains – Assessment of pollen fertility and sterility in A, B, and R line – Maintenance of A, B lines. Emasculation technique – Selfing and crossing techniques – Breeder kit – Layout of different trials – Irradiation – dosimetry – Half life period – Procedure for irradiation – Chemical mutagenesis – Molar solution – Procedure for treatment – Calculation of heterosis, PCV, GCV, heritability, genetic advance – genetic divergence – Records maintained – Wild species maintenance and utilization - screening method for specific traits – marker assisted selection.

Lecture schedule

1. Objectives and role of plant breeding - historical perspective – activities in Plant Breeding.
2. Centres of origin – contribution of Vavilov, Harlan, Zhukovsky – law of homologous series.

3. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation – agencies – quarantine.
4. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine.
5. Modes of reproduction – sexual – asexual - self and cross fertilization – significance of pollination.
6. Self incompatibility – classifications – mechanisms – application – measures to over come and limitations.
7. Sterility – male sterility – introduction – classification – CMS,GMS,CGMS -inheritance and applications.
8. TGMS,PGMS, Gametocides, Transgenic Male sterility and applications.
9. Apomixis-introduction-classification-applications.
10. Basic biometrics-nature and significance of qualitative and quantitative variation-phenotypic, genotypic and environmental-heritability and genetic advance
11. Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits.
12. Genetic basis of self pollinated crops – Vilmorin principle of progeny selection - Johannsen's pure line theory.
13. Breeding methods for self pollinated crops – pure line selection – procedure – merits and demerits – achievements; Mass selection in self pollinated crops – procedure - types – comparison of mass and pureline selection – achievements.
14. Creating variability in self pollinated crops - Hybridization and selection – objectives types – choice of parents – combining ability - combination breeding and transgressive breeding.
15. Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements.
16. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits.
17. Mid semester examination
18. Backcross breeding – genetic principles – pre-requisites – procedures for transferring dominant and recessive genes.
19. Back cross breeding – merits – demerits – multi lines and multi blends - population improvement approach in self-pollinated crops.
20. Genetic structure of a population in cross pollinated crop – Hardy Weinberg law – gene frequencies in random mating population – principles in population improvement.
21. Mass selection in cross pollinated crops – modified mass selection – unit selection – mass selection with progeny testing – half sib family selection – full sib family selection.
22. Recurrent selection principles – types – merits and demerits.
23. Heterosis breeding – genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression – development of inbreds.
24. Heterosis breeding – procedure – use of male-sterility systems – types of hybrids – achievements – merits and demerits.
25. Steps in development of synthetics and composites – achievements – merits and demerits.
26. Genetic characters of asexual reproduction – breeding methods – clonal selection – hybridization and clonal selection – merits and demerits – achievements.
27. *In vitro* selection techniques – somaclonal variation – utilization in crop improvement ; Use of double haploids in crop improvement.
28. Mutation breeding: mutation – types – mutagens – breeding procedure – applications – achievements – limitations.
29. Polyploidy breeding – classification – induction of polyploidy – achievements – limitations.
30. Wide hybridization-history-importance-barriers and techniques for overcoming barriers-utilization

31. Introduction to markers – morphological – biochemical- DNA markers – uses of marker assisted selection - major genes – merits – demerits – achievements.
32. Types of cultivars – procedure for release of new varieties – stages in seed multiplication – certification.
33. Maintenance Breeding: General seed production techniques – steps in nucleus and breeder seed production – varietal rundown and renovation.
34. Breeding for biotic and abiotic stresses; Current trends in plant breeding - Marker assisted breeding - Transgenic crops - Varietal protection .

Practical schedule

1. Pollination and reproduction in plants - Alternation of generation and life cycle.
2. Description and drawing different pollination systems - Mechanisms enforcing self and cross pollination in crops.
3. Pollen morphology - Exine structure of different crops. Fertility and sterility in A, B, R and TGMS lines.
4. Breeder kit and its components – uses; Principles of selfing and crossing techniques
5. Emasculation, and pollination techniques in horticultural crops.
6. Emasculation, and pollination techniques in horticultural crops.
7. Layout of different yield trials - Observing the experimental plots.
8. Calculation of PCV, GCV, heritability, genetic advance
9. Estimation of heterosis.
10. Maintenance of A, B and R line and TGMS lines. Hybrid seed production techniques
11. Studies on segregating generations and maintenance of records.
12. Irradiation - dosimetry - half life period - procedure for irradiation. Chemical mutagenesis - molar solution preparation - procedure for chemical mutagenesis.
13. Studies on different wild species in crop plants and wide hybridization.
14. Screening methods – laboratory and field – for biotic and abiotic stresses.
15. Observation on germplasm preservation – evaluation - records maintained in research stations
16. Procedure for marker assisted selection
17. Practical examination

References

Text books

1. Singh, B.D. 2005. Plant breeding - Principles and methods. Kalyani Publishers, New Delhi.
2. Phundhan Singh. 2001. Essentials of plant breeding, Kalyani publishers, New Delhi.
3. Daniel Sundararaj, G. Thulasidas and M. Stephen Dorairaj. 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot. Chennai – 15.

Further reading

- a. Chopra, V. L., 1994. Plant breeding theory and practice. Oxford and IBH Publishing Co. Pvt. Ltd.
- b. Sharma, J. R. 1994. Principles and practice of plant breeding Tata McGraw-Hill publishing Co., New Delhi.
- c. Allard, R. 1989. Principles of plant breeding. John Wiley and Sons, New Delhi.
- d. Russell, G. E. 1985. Progress in Plant Breeding. Butter Worths, England.
- e. Chaudhary, H. K. 1980. Elementary principles of plant breeding. Oxford and IBH publication Co., New Delhi

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- http://en.wikipedia.org/wiki/Plant_breeding
- <http://www.edugreen.teri.res.in/explore/bio/breed.htm>
- <http://cuke.hort.ncsu.edu/gpb/>
- <http://www.stumbleupon.com/tag/plant-breeding/>
- <http://www.iaea.org/>

VSC 302 Breeding of Horticultural Crops 2 + 1

Aim

- ❖ To study the basics of floral biology, pollination mechanism, breeding strategies, methods of crossing in horticultural crops.

Theory

Unit I Breeding of self and cross pollinated and asexually propagated crops

Methods of breeding and achievements in crop improvement of self and cross pollinated and asexually propagated crops

Unit II Fruit crops

Floral biology, methods of breeding and achievements in crop improvement of fruit crops : mango, banana, acid lime, mandarin orange, sweet orange, grapes, sapota, papaya, aonla, guava, pomegranate and custard apple.

Unit III Vegetable crops

Floral biology, methods of breeding and achievements in crop improvement of vegetable crops : tomato, brinjal, chilli, bhendi, bitter gourd, cucumber, watermelon, bottle gourd, peas, beans, potato, tapioca, sweet potato, onion, amaranth, moringa, carrot, cabbage and cauliflower.

Unit IV Spices and plantation crops

Floral biology, methods of breeding and achievements in crop improvement of spice crops: black pepper, cardamom, clove, nutmeg, coriander, garlic, turmeric and ginger and plantation crops : tea, coffee, cocoa ,cashew, coconut, arecanut and palmyrah.

Unit V Flower crops, medicinal and aromatic crops

Floral biology, methods of breeding and achievements in crop improvement of flower crops: rose, jasmine, chrysanthemum, marigold, tuberose, crossandra, carnation and tropical orchids, medicinal crops :senna, gloriosa and coleus and aromatic crops: mint and cymbopogon.

Practical

Floral biology and pollination mechanism- study of wild relatives-practices in selfing and crossing procedures in the crops: mango, banana, citrus, sapota, pomegranate papaya, guava, aonla, custard apple, tomato, chilli, brinjal , bhendi, tapioca , sweet potato, peas, beans, bitter gourd, watermelon and cucumber, onion, amaranth, annual moringa, coriander, coconut and gloriosa - Exploitation of heterosis and techniques of F₁ hybrid production-Mutation and mutagenic treatments-Methods of induction of polyploidy- Identification of elite trees – Procedure for release of new varieties DUS testing.

Lecture schedule

1. Breeding strategies, with its of self pollinated crops merits and demerits and methods of improvement
2. Breeding strategies, merits and demerits and methods of improvement of cross pollinated crops
3. Breeding strategies, merits and demerits and methods of improvement of asexually propagated crops
4. Floral biology, breeding strategies and achievements made in crop improvement of Mango.
5. Floral biology, breeding strategies and achievements made in crop improvement of banana.
6. Floral biology, breeding strategies and achievements made in crop improvement of acid lime, sweet orange, mandarin orange.
7. Floral biology, breeding strategies and achievements made in crop improvement of grapes

8. Floral biology, breeding strategies and achievements made in crop improvement of sapota
9. Floral biology, breeding strategies and achievements made in crop improvement of papaya
10. Floral biology, breeding strategies and achievements made in crop improvement of pomegranate and aonla
11. Floral biology, breeding strategies and achievements made in crop improvement of guava and custard apple
1. Floral biology, breeding strategies and achievements made in crop improvement of tomato
2. Floral biology, breeding strategies and achievements made in crop improvement of brinjal.
3. Floral biology, breeding strategies and achievements made in crop improvement of chilli
4. Floral biology, breeding strategies and achievements made in crop improvement of bhendi.
5. Floral biology, breeding strategies and achievements made in crop improvement of onion
6. Mid semester examination
7. Floral biology ,breeding strategies and achievements made in crop improvement of bitter gourd and cucumber
8. Floral biology ,breeding strategies and achievements made in crop improvement of watermelon and bottle gourd
9. Floral biology ,breeding strategies and achievements made in crop improvement of moringa and amaranth
10. Floral biology ,breeding strategies and achievements made in crop improvement of tapioca and sweetpotato
11. Floral biology ,breeding strategies and achievements made in crop improvement of peas and beans
12. Floral biology ,breeding strategies and achievements made in crop improvement of potato
13. Floral biology ,breeding strategies and achievements made in crop improvement of carrot, cabbage and cauliflower
14. Floral biology ,breeding strategies and achievements made in crop improvement of black pepper and cardamom
15. Floral biology, breeding strategies and achievements made in crop improvement of clove, nutmeg, coriander and garlic.
16. Floral biology ,breeding strategies and achievements made in crop improvement of turmeric and ginger
17. Floral biology ,breeding strategies and achievements made in crop improvement of tea and coffee
18. Floral biology, breeding strategies and achievements made in crop improvement of cocoa and cashew.
19. Floral biology, breeding strategies and achievements made in crop improvement of coconut, arecanut and palmyrah.
20. Floral biology ,breeding strategies and achievements made in crop improvement of rose and jasmine
21. Floral biology ,breeding strategies and achievements made in crop improvement of chrysanthemum and marigold
22. Floral biology ,breeding strategies and achievements made in crop improvement of tuberose, crossandra, carnation and tropical orchids
23. Floral biology ,breeding strategies and achievements made in crop improvement of senna, gloriosa, coleus ,mint and cymbopogon

Practical schedule

1. Study of floral biology and pollination mechanism, practices in selfing and crossing in mango and banana.
2. Study of floral biology and pollination mechanism, practices in selfing and crossing in citrus, sapota and pomegranate.
3. Study of floral biology and pollination mechanism, practices in selfing and crossing in papaya, guava and aonla.

4. Study of floral biology and pollination mechanism, practices in selfing and crossing in tomato and chillies
5. Study of floral biology and pollination mechanism, practices in selfing and crossing in brinjal and bhendi
6. Study of floral biology and pollination mechanism, practices in selfing and crossing in tapioca and sweet potato
7. Study of floral biology and pollination mechanism, practices in selfing and crossing in peas and beans
8. Study of floral biology and pollination mechanism, practices in selfing and crossing in bitter gourd, watermelon and cucumber.
9. Study of floral biology and pollination mechanism, practices in selfing and crossing in onion, amaranth and annual moringa
10. Study of floral biology and pollination mechanism, practices in selfing and crossing in coriander, coconut and gloriosa.
11. Study of mutagenic treatments and various methods of mutation
12. Study of polyploidy and methods of development of polyploids.
13. Exploitation of heterosis and techniques of F₁ hybrid production in self-pollinated crops.
14. Exploitation of heterosis and techniques of F₁ hybrid production in cross-pollinated crops.
15. Identification of elite or plus trees in major fruit crops.
16. Variety release, procedures involved and DUS testing.
17. Practical examination.

References

Text Books

1. Chahal, G. S. and S. S. Gosal. 2002. Principles and procedures of plant breeding. Biotechnological and conventional approaches. CRC Press, U.K.
2. Kalloo, 1990. Vegetable Breeding, Vol. I II and III CRC Press, Florida.
3. Kumar, N. 2006. Breeding of Horticultural Crops Principles and Practices. New India Publishing Agency, PitamPura, New Delhi.

Further Reading

1. Kuckkuck, M, Kobafe, G and Wenzal, G. 1991. Fundamentals of Breeding, Springer- Verlage, London.
2. Singh B. D, 2002. Plant Breeding, Principles and Methods. Fifth Edition, Kalyani Publishers, New Delhi.
3. Prem Singh Arya, 2003. Vegetable breeding, production and seed production, Kalyani publishers, New Delhi.
4. Chahal, G. S. and S. S. Gosal. 2002. Principles and procedures of plant breeding. Biotechnological and conventional approaches. CRC Press, U.K.
5. Kuckkuck, M, Kobafe, G and Wenzal, G. 1991. Fundamentals of Breeding, Springer- Verlage, London.
6. Singh B. D, 2002. Plant Breeding, Principles and Methods. Fifth Edition, Kalyani Publishers, New Delhi.
7. Daniel Sundarraj, G. Thulasidas and M. Stephen Dorariraj. 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot, Chennai.
7. Harihar Ram. 1998. Vegetable Breeding – Principles and Practices. Kalyani publishers, New Delhi.

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- <http://treephys.oxfordjournals.org/cgi/reprint/6/3/347.pdf>
- http://www.ilvo.vlaanderen.be/EN/Research/ResearchAppliedGeneticsandBreeding_new/ProductQualityImprovement/Breedingofagriculturalandhorticulturalcrops/tabid/2314/Default.aspx
- <http://www.agricultureinformation.com/forums/jobs-resumes-projects/7081-vegetable-breeding-research-job-required.html>
- <http://www.agron.iastate.edu/faculty/fehr/BVC/00BVC.PDF>
- <http://www.amazon.com/Genetic-Improvement-Vegetable-Crops-Kaloo/dp/0080408265>

Journals

- J of cytogenetics
- Economic botany
- Acta Horticulture

FLG 307 Protected and Precision Horticulture 2 + 1

(Team teaching – Horticulture & Remote Sensing)

Aim

- ❖ To impart knowledge on the protected cultivation of vegetables, fruits and flower crops.
- ❖ To sensitize the students on hi-tech production technology of fruits, vegetables and flower crops.

Theory

Unit I Importance and methods of protected culture in horticultural crops

Importance and scope of protected cultivation – different growing structures of protected culture viz., green house, poly house, net house, poly tunnels, screen house, protected nursery house - study of environmental factors influencing green house production – cladding / glazing / covering material – ventilation systems – cultivation systems including nutrient film technique / hydroponics / aeroponic culture – growing media and nutrients – canopy management – micro irrigation and fertigation systems.

Unit II Protected cultivation technology for vegetable crops

Hi-tech protected cultivation techniques for tomato, capsicum nursery, cucumber, gherkins strawberry and melons – integrated pest and disease management – postharvest handling.

Unit II Protected cultivation technology for flower crops

Hi-tech protected cultivation of cut roses, cut chrysanthemum, carnation, gerbera, asiatic lilies, anthurium, orchids, cut foliage and fillers – integrated pest and disease management – postharvest handling.

Unit IV Concept and introduction of precision horticulture

Importance of precision horticulture – definition, principles and concepts – Role of geographic information systems (GIS) – global positioning systems (GPS) - Mobile mapping system and its application in precision farming – design, layout and installation of drip and fertigation in horticultural crops - role of computers in developing comprehensive systems needed in site specific management (SSM) – georeferencing and photometric correction – Sensors for information gathering – geostatistics – robotics in horticulture - postharvest process management (PPM) – remote sensing - information and data management and crop growth models – GIS based modeling.

Unit V Precision farming techniques for horticultural crops

Precision farming techniques for tomato, chilli, bhendi, bitter gourd, bottle gourd, cauliflower, cabbage, grapes, banana, rose, jasmine, chrysanthemum, marigold, tuberose, china aster, turmeric, coriander, coleus and gloriosa.

Practical

Study of different kinds of protected structures – designs, components and construction – types and structures of auto control systems in green house – study of heating and cooling systems – study of different media, solarization and fumigation – study of special horticultural practices for vegetables / flowers under protected cultivation – visit to protected cultivation units. Positioning systems viz., GPS and positioning accuracy – understanding GPS Specifications – utilization of GIS software – soil salinity and compaction – Soil test crop response (STCR) – Gird soil sampling – canopy management in precision farming – water use efficiency in annuals, perennials and landscape horticulture – visit to commercial unit – searching internet resources for precision horticulture.

Lecture schedule

1. Importance and scope of protected cultivation.
2. Different growing structures of protected culture viz., poly house, net house, poly tunnels and screen house.
3. Study of environmental factors influencing protected culture, roofing materials and ventilation systems.
4. Cladding / glazing / covering and roofing materials and ventilation systems.
5. Nutrient film techniques, hydroponics, aeroponic culture
6. Growing media and nutrients for protected cultivation.
7. Micro irrigation and fertigation management in protected culture.
8. Protected cultivation techniques for tomato
9. Green house cultivation techniques for cucumber, gherkins and melons.
10. Protected cultivation techniques for capsicum and strawberry
11. Integrated pest and disease management for vegetable crops in protected cultivation.
12. Integrated pest and disease management for flower crops in protected cultivation.
13. Protected cultivation techniques for roses and gerbera
14. Protected cultivation techniques for chrysanthemum and carnation.
15. Protected cultivation techniques for anthurium and orchids.
16. Protected cultivation techniques for cut foliage and fillers.

17. Mid semester examination
18. Precision horticulture – definition, principles and concepts.
19. Geographic information system (GIS) and its application in precision farming.
20. Global positioning system (GPS) and its application in precision farming.
21. Mobile mapping systems and its application in precision farming.
22. Precision equipments for seeding and chemical application
23. Role of computers in developing comprehensive system needed in site specific management (SSM) system and postharvest process management (PPM)
24. Remote sensing and its application in precision farming.
25. Georeferencing and photometric correction
26. Sensors for information gathering, geostatistics and robotics in horticulture
27. Design, layout and installation of drip and fertigation in precision farming
28. Information and data management, crop growth models and GIS based modeling.
29. Precision farming techniques for grapes and banana.
30. Precision farming techniques for tomato, chilli and bhendi.
31. Precision farming techniques for bitter gourd, bottle gourd, cauliflower and cabbage.
32. Precision farming techniques for coleus and gloriosa.
33. Precision farming techniques for rose, jasmine, chrysanthemum marigold china aster and tube rose
34. Precision farming techniques for turmeric and coriander.

Practical schedule

1. Study of different protected structures – designs, components, orientation and construction of greenhouse.
2. Types and structures of auto control system in green house.
3. Study of heating and cooling systems in green house.
4. Study of different media, solarization and fumigation for green house cultivation.
5. Study of special cultural practices for production of vegetable crops under protected cultivation.
6. Study of special cultural practices for flower crops under protected cultivation.
7. Visit to protected culture units.
8. Project preparation of protected cultivation of important horticultural crops.
9. Positioning systems understanding of GPS, positioning accuracy specifications and utilization of GIS software.
10. Study of soil salinity, soil compaction, soil test crop response (STCR) and grid soil sampling.
11. Practicing design and layout of precision farming system

12. Canopy management in precision farming
13. Water use efficiency in annual, perennials and landscape horticulture
14. Visit to commercial computerized irrigation control unit.
15. Project preparation of precision cultivation in important horticultural crops
16. Searching internet resources for precision horticulture
17. Practical examination

References

1. Joe.J.Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.
2. Paul V. Nelson. 1991. Green house operation and management. Ball publishing USA.

Further reading

1. Lyn. Malone, Anita M. Palmer, Christine L. VIoghat Jach Dangeermond. 2002. Mapping out world: GIS lessons for Education. ESRI press.
2. David Reed. 1996. Water, media and nutrition for green house crops. Ball publishing USA.
3. Adams, C.R. K.M. Bandford and M.P. Early. 1996. Principles of Horticulture. CBS publishers and distributors. Darya ganj, New Delhi.

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- www.icar.org.in/ciphet.html
- www.jains.com
- www.gisdevelopment.net
- www.lasercladding.com
- www.epa.gov.

Journals

- Hort. Science
- Horticultural Technology
- Floriculture Today
- Hi-tech Horticulture

FLG 301 Production Technology of Commercial Flower Crops 2 + 1

Aim

- ❖ To educate the students on commercial cultivation of loose flowers, protected cultivation of cut flowers and value addition in flower crops.

Theory

Unit I Principles of growing commercial flowers

History- importance and scope – distribution – area and production – export potential – international and national floral industry. Institutions and developmental agencies involved in promotion of floriculture. Soil and climate – Botany – species and varieties - propagation –principles and practices – planting systems and methods – pinching, training and pruning practices – nutrient and water management – role of growth regulators – intercultivation – Harvest and yield of rose, jasmine, chrysanthemum and tuberose.

Unit II Loose flowers

Soil and climate – botany – species and varieties - propagation –principles and practices – planting systems and methods – pinching, training and pruning practices – nutrient and water management – role of growth regulators – inter cultivation – Harvest and yield of crossandra, marigold, nerium, gomphrena, celosia and china aster.

Unit III Principles of protected cultivation

Protected structures - controlled environmental conditions –Soil sterilization - factors influencing protected cultivation – cut flower production- flower forcing.

Soil and climate – Botany – species and varieties - propagation –principles and practices – planting systems and methods – pinching, training and pruning practices – nutrient and water management – role of growth regulators – inter cultivation – Harvest and yield of cut roses, carnation, gerbera, cut chrysanthemum and gladiolus.

Unit IV Cut flowers

Soil and climate – botany – species and varieties - propagation –principles and practices – planting systems and methods – pinching, training and pruning practices – nutrient and water management – role of growth regulators – inter cultivation – Harvest and yield of orchids, anthurium, china aster, bird of paradise, Asiatic lily, heliconias, alstromeria and flowering fillers viz., limonium, asparagus, ivy, gypsophila and baby eucalyptus.

Unit V Post harvest handling of flowers

Postharvest handling – principles and methods of extension of shelf life – methods of extraction of floral concrete from rose, jasmine and tuberose – natural dye extraction from flowers crops - uses - grading - export standards – packaging - marketing - constraints in flower production - future thrust.

Practical

Botany - description and identification of species and varieties in rose, jasmine, crossandra, chrysanthemum, tuberose, marigold, nerium, gomphrena, celosia, cut rose, carnation, gerbera, gladiolus, orchids and anthurium – propagation and planting–seed treatment and sowing–planting of tubers and suckers–lay out and planting of rose and jasmine–media preparation and potting of orchids and anthurium – After culture practices in rose, jasmine, chrysanthemum, marigold and dahlia-harvesting, postharvest handling and storage–extraction of floral concrete from rose, jasmine and tuberose-visit to commercial fields, extraction units and flower markets-working out benefit cost ratio for loose flowers and cut flowers-preparation of project reports for fresh flower production and floral concrete extraction.

Lecture schedule

1. History and importance–area and production–export potential-industrial importance–floriculture industry in India and Tamil Nadu
2. Rose-importance and uses–origin and history- area and production – botany – species and varieties– classification.
3. Rose - propagation – soil climate season and planting-nutrition and irrigation –management practices - role of growth regulators-pruning – plant protection -harvest and yield
4. Jasmine- importance and uses–origin and history- area and production – botany – species and varieties
5. Jasmine - soil climate propagation - season and planting-nutrition and irrigation –management practices - role of growth regulators-pruning methods- plant protection - harvest and yield.
6. Chrysanthemum - importance and uses–origin and history- area and production –botany soil climate – species and varieties–propagation - season and planting-nutrition and irrigation – management practices - role of growth regulators- pinching and disbudding – plant protection - harvest and yield.
7. Tuberose - importance and uses-origin and history-distribution-area and production-botany - species and varieties - propagation- season and planting-nutrition and irrigation soil climate – management practices – nematode management - role of growth regulators- plant protection - harvest and yield.

8. Crossandra - importance and uses-origin and history-distribution-area and production-botany - species and varieties - propagation- season and planting-nutrition and irrigation – management practices - role of growth regulators- nematode management - plant protection -harvest and yield.
9. Marigold - importance and uses–origin and history- area and production – botany – species and varieties–propagation - season and planting-nutrition and irrigation – management practices - role of growth regulators-pinching and disbudding- plant protection -harvest and yield.
10. Nerium and Gomphrena importance and uses–origin and history- area and production – botany – species and varieties–propagation - season and planting-nutrition and irrigation – management practices - role of growth regulators- plant protection - harvest and yield.
11. Celosia and China aster importance and uses–origin and history- area and production – botany – species and varieties–propagation - season and planting- nutrition and irrigation – management practices -role of growth regulators- plant protection -harvest and yield.
12. Field visit – Loose flower growing areas and exporters
13. Economics - loose flower production
14. Designing and erection of controlled structures for cut flower production
15. Flower forcing and factors affecting flower production under controlled atmospheric conditions.
16. Cut rose - importance and uses-origin and distribution-area and production- botany and varieties -propagation and planting—environmental factors- pruning – pinching - production constraints- inter culture- plant protection - harvesting and yield.
17. Mid semester examination
18. Carnation-importance and uses-origin and distribution-area and production- botany, species and varieties –propagation-media and planting-environmental factors- netting – inter culture - pinching-production constraints-plant protection-harvesting and yield.
19. Gerbera -importance and uses-origin and distribution-area and production- botany and varieties - propagation and planting-media – inter culture -production constraints-harvesting and yield.
20. Chrysanthemum-importance and uses-origin and distribution-area and production- botany and varieties -propagation and planting-media environmental factors– inter culture - pinching- production constraints-plant protection-harvesting and yield.
21. Gladiolus-importance and uses-origin and distribution-area and production- botany and varieties -propagation and planting-media – environmental factors-inter culture - production constraints- plant protection-harvesting and yield.
22. Orchids - importance and uses-origin and history-distribution-area and production- botany and varieties –environmental factors- methods of propagation media and methods of nutrient management - irrigation – plant protection-harvesting and yield.

23. Anthurium - importance and uses-origin and history-distribution-area and production- botany and varieties – environmental factors - methods of propagation – media and methods of nutrient management - irrigation – plant protection-harvesting and yield.
24. Bird of paradise and heliconia - importance and uses-origin and history-distribution-area and production- botany and varieties – media and climate - methods of propagation – nutrient management - irrigation – plant protection-harvesting and yield.
25. Guest lecture – Cut flower production
26. Asiatic lily, alstromeria, Foliage and flowering fillers limonium, asparagus ivy, gypsopals, baby eucalyptus - importance and uses – origin and distribution– botany and varieties – propagation – planting – inter culture – plant protection-harvesting and yield.
27. Post harvest - principles and methods of extension of shelf life
28. Prospects and constraints in green house production of cut flowers.
29. Methods of floral concrete extraction from rose, jasmine and tuberose
30. Natural dye extraction of flower crops.
31. Packaging, grading and export standards for important commercial flowers.
32. Industry visit – Dye extraction / Concrete extraction
33. Economics – cut flower production
34. Constraints in flower production and future thrust.

Practical schedule

1. Rose–identification and description of species/varieties – propagation and planting –pruning management.
2. Jasmine sp.-identification and description of species/varieties – propagation and planting – pruning management.
3. Tuberose and crossandra – identification, description of species/varieties, propagation and planting
4. Chrysanthemum and marigold- identification and description of species/varieties - propagation and planting
5. Nerium and gomphrena - identification, description of species/varieties, nursery raising and planting
6. Celosia and china aster - identification, description of species/varieties, nursery raising and planting
7. Visit – Flower market and flower growing areas – loose flowers.
8. Preparation of project – loose flower production – open condition
9. Cut rose - identification and description of species/varieties – media – planting

10. Carnation and gerbera - identification and description of species/varieties – media – planting
11. Cut chrysanthemum and gladiolus - identification and description of species/varieties – media – planting
12. Anthurium and orchids – identification and description of species/varieties – media preparation - planting
13. Bird of paradise and heliconia - identification and description of species/varieties – propagation - media preparation – planting
14. Asiatic lily, alstromeria, flowering and foliage fillers - identification and description of species/varieties – propagation - media preparation – planting
15. Visit to flower growing areas – Cut flowers
16. Rose, jasmine and tuberose-extraction of floral concrete – lecture / Field visit
17. Preparation of project – Cut flower production – controlled condition
18. Practical examination

Reference books

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2. Bhattacharjee, S.K., 2004 – Advanced commercial floriculture. Vol. I and II.
3. Bhattacharjee, S.K., 2004 – Landscape gardening and design with plants.
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12. Yadav, L., P. and Bose, T. K. 1986. Biology, conservation and culture of orchids. East-west press private Limited, New Delhi.
13. Bose, T. K. and S. K. Bhattacharjee. 1980. Orchids of India. Naya Prakash, Calcutta

Journals

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- J. South Indian Hort., South Indian Horticultural Society, TNAU, Coimbatore.
- J. ornamental Hort.

PSM 301 Production Technology of Medicinal and Aromatic Crops 2 + 1

Aim

- ❖ To impart knowledge on the current status and export potential of medicinal and aromatic plants.
- ❖ To sensitize the students on hi-tech production technology and extraction methods

Theory

Unit I Importance and scope of medicinal crops

Importance and scope - medicinal plant wealth of India and states - area and production - exports and imports - Demand of medicinal plants in phytochemicals and AYUSH - Conservation strategies, exsitu and insitu - Classification of medicinal plants based on family, habit, climate, soil and ecological factors- Organized production- GAP, GMP guidelines, contract farming- Institutions for promotion of medicinal plants- Constraints and challenges in production.

Unit II Production technologies of medicinal crops I

Soil and climate - varieties – propagation – nursery practices - planting methods - nutrient management- irrigation- intercropping - harvest Crops: senna, periwinkle, glory lily, ashwagandha, medicinal coleus, aloe, long pepper, *Phyllanthus amarus* and stevia.

Unit III Production technologies of medicinal crops II

Soil and climate - varieties – propagation - nursery practices - planting methods – nutrient management- irrigation- intercropping - harvest Crops: isabgol, opium poppy, medicinal solanum - medicinal dioscorea, rauwolfia, vasambu, vallarai and noni.

Unit IV Importance and scope of aromatic crops

Importance and scope- aromatic plant wealth of India- area and production - exports and imports of essential oil – Demand of aromatic crops in perfumery and cosmetic industries - International standards for perfumes – Classification of essential oils-Methods of distillation of essential oil – Fractional distillation-Aromatherapy.

Unit V Production technologies of aromatic crops

Soil and climate - varieties – propagation – nursery practices - planting methods - nutrient management- irrigation- intercropping - harvest Crops: ocimum, davana, mint, lemon grass, citronella, palmarosa, vetiver, geranium, patchouli and rosemary.

Lecture schedule

1. Importance and scope – current status – Medicinal plant wealth of India and states – Area and production- Exports and imports- Demand in AYUSH and phytochemicals – medicinal plant wealth of India and states – area and production.
2. Conservation of medicinal and aromatic plants-Strategies and methods

3. Classification system in medicinal plants based on family, habit, climate, soil and ecological conditions
4. Promotional organizations involved in medicinal plants production - Policies, guidelines
5. Organised production of medicinal crops- Contract farming- Need for GAP, GMP
6. Opportunities, challenges and constraints in medicinal plants
7. Soil and climate – varieties – propagation – nursery practices – planting methods – nutrient management- irrigation and intercropping – harvest and yield of senna and periwinkle
8. Soil and climate – varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of glory lily
9. Soil and climate – varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of aswagandha and Aloe
10. Soil and climate – varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of medicinal Coleus
11. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of long pepper and *Phyllanthus amarus*
12. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of Stevia and medicinal solanum
13. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of Isabgol and medicinal Dioscorea
14. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of rauwolfia and opium poppy
15. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of vasambu and vallarai
16. Soil and climate –varieties – propagation – planting methods – manuring, irrigation and intercropping – harvest and yield of noni
17. Mid semester examination
18. Importance and scope- current status on area and production of aromatic crops- Exports and imports of essential oil
19. Demand of aromatic crops in perfumery and cosmetic industries – Classification of essential oils
20. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of Ocimum and davana
21. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of lemon grass

22. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of citronella
23. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of palmarosa.
24. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of vetiver.
25. Soil and climate – varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of geranium
26. Soil and climate – varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of patchouli
27. Soil and climate – varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of Mentha
28. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest, coppicing and yield of Eucalyptus
29. Soil and climate –varieties – propagation – nursery practices – planting methods – manuring, irrigation and intercropping – harvest and yield of rosemary
30. Methods for extraction of secondary metabolites in medicinal plants
31. Methods of distillation of essential oil from aromatic plants
32. Fractional distillation of essential oil
33. Quality standards in medicinal and aromatic plants
34. Aromatherapy and use of essential oil in various ailments

Practical

1. Identification of major medicinal crops – parts used and their products
2. Identification of major aromatic crops- essential oil content
3. Study of varieties, propagation techniques of Senna and Periwinkle
4. Study of varieties, propagation techniques of ashwagandha
5. Study on propagation, pollination, standards in glory lily
6. Study of propagation techniques of medicinal coleus and aloe
7. Study of varieties, propagation techniques of vallarai and vasambu
8. Study of propagation techniques, use of media, growth regulators for rooting of long pepper.
9. Study of seed treatment techniques for enhancing germination of noni
10. Study of species, propagation techniques of Mint and Rosemary
11. Study of species, propagation techniques of ocimum and davana
12. Working out the benefit cost ratio for medicinal Coleus and Glory lily
13. Working out the benefit cost ratio for Ocimum and davana

14. Extraction of medicinal products using Soxhlet apparatus
15. Distillation of essential oil from aromatic crops using Clevenger apparatus
16. Visit to commercial medicinal and aromatic plantation
17. Practical examination

Text Books

1. Atal. C. K. and B. M. Kapur. 1992. Cultivation and utilisation of medicinal plants RRL. CSIR, Jammu Tawi.
2. Kumar, N. Md. Abdul Khader, JBM, Rangasamy, P. and I. Irulappan. 1998. Introduction to Spices, Plantation crops, Medicinal and Aromatic Plants. Oxford IBH Publishers, New Delhi.
3. Raychaudhuri, S. P. 1998. Recent advances in medicinal, aromatic and spice crops. Vol. I and Vol. II. Today and Tomorrow's printer and Publishers, New Delhi.
4. Farooqi, M. M. Khan and M. Vasundhara. 2004. Production technology of medicinal and aromatic crops. Publ. Natural Remedies Pvt. Ltd., Bangalore – 561229.
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- www.nmpb.nic.in
- www.agrobiosindia.com
- www.frlht.india.org
- www.traffic.org.
- <http://www.pubmed.com>

Journals

- Amruth
- Journal of medicinal and aromatic plants
- Journal of Indian Perfumer

VSC 301 Practical Crop Productions 0 + 1

Practical

Practical training - cum - cultivation in vegetable, flower and spice crop production in any two transplanted crop (tomato, brinjal, chilli, marigold, gomphrena) and any two direct sown crop (bhendi, amaranthus, radish, aggregatum onion, vegetable crops coriander) – seed treatment – raising nursery - sowing seeds- field preparation- transplanting, manuring, irrigation, weed control, inter culture - plant protection and harvesting – postharvest handling – seed extraction - maintenance of cultivation sheet - working out benefit/cost ratio.

Practical Schedule

1. Practice in raising nursery for transplanted vegetables.
2. Seed treatment, sowing and after care.
3. Practicing application of FYM and main field preparation.
4. Formation of beds, ridges and furrows.
5. Application of basal dressing of fertilizers.
6. Practising transplanting of vegetables.
7. Practising herbicide application.
8. Practising scheduling of irrigation.
9. Practising gap filling operation.
10. Practising top dressing and earthing up operation.
11. Practising PGR preparation and application.
12. Practising pesticide, fungicide application and other inter cultural operations.
13. Practising harvest and assessing maturity index
14. Practising seed extraction, processing, cleaning, grading, packaging and marketing.
15. Practising grading, packaging and marketing
16. Cost economics of production
17. Practical examination
18. Practising raising nursery for transplanted flower and spice crops
19. Seed treatment, sowing, after care and collection of stubbles
20. Practising application of FYM .
21. Formation of beds, ridges and furrows.
22. Application of basal dressing of fertilizers.
23. Practising transplanting and direct sowing of spice crops .
24. Practising herbicide application.

25. Practising scheduling of irrigation.
26. Practising gap filling operation.
27. Practising top dressing and earthing up operation.
28. Practising PGR preparation and application.
29. Practising pesticide, fungicide application and other inter cultural operations.
30. Practising harvest and assessing maturity index
31. Practising seed extraction, processing, cleaning, grading, packaging and marketing.
32. Practising grading, packaging and marketing.
33. Cost economics of production
34. Practical examination

Reference books

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- <http://www.attra.ncat.org/attra-pub//vegetables>
- <http://www.icar.org.in/dipa/events/ICAR.NEWS/volume-II>
- <http://www.hos.ufl.edu/protectedAg1>
- <http://ohioline.osu.edu/b672>

HOR 304 Study Tour – II 0 + 1

Visit to places of commercial cultivation of flower crops, spices and plantation crops (other than coffee and tea) in Tamil Nadu – study of cropping system – varieties – adoption of scientific crop production technology – constraints in production – marketing – economic analysis.

Practical schedule

1. Visit to Agricultural Research Station, Aliyarnagar – Coconut and coconut based intercrop systems.
2. Tamil Nadu Agricultural University, Coimbatore campus.
3. Visit to Thudiyalur- arecanut area-Forest Research Station, Mettupalayam – Eence Aromatics.
4. Visit to Ooty, Coonoor and Bhavanisagar.
5. Visit to mango orchards, Regional Research Station, Paiyur-processing unit.
6. Visit to Giant Orchards, Melchengam
7. Visit to Regional Research Station, Vridhachalam – Cashew.
8. Visit to Tamil Nadu Rice Research Institute, Aduthurai.- oilpalm
9. Visit to Sugarcane Research Station, Sirugamani – Betelvine

ABT 301 Applied Plant Biotechnology 1 + 1

Aim

- ❖ To impart knowledge on recent advances in the applications of plant molecular biology and biotechnology in crop improvement

Theory

Unit I Plant tissue culture and applications

Micropropagation and successful examples- meristem culture and production of virus free plants - protoplast isolation and fusion - somatic hybrids. Somaclonal variation, synthetic seeds - Doubled haploids - National certification system for TC plants- *in vitro* germplasm conservation

Unit II Molecular marker technology

DNA markers -different kinds -hybridization based RFLP -PCR based markers - AFLP, RAPD, SSR and SNPs - DNA fingerprinting of varieties -gene tagging - marker assisted selection and its application in crop improvement.

Unit III Transgenic technology

Transgenic plants for biotic and abiotic stress resistance and quality improvement-current status at national and international level- detection of GMOs - biosafety and bioethics

Unit IV Molecular pharming

Plants as biofactories – production of vaccines, therapeutic proteins, industrial enzymes and bioplastics

Unit V Bioprospecting

Discovery of novel compounds from plants - secondary metabolites – callus and cell suspension culture, bioreactors for plant cell culture.

Practical

Micropropagation of banana and rose. Meristem culture of cassava-virus indexing -DNA fingerprinting using RAPD and SSR markers- NTsys analysis - an example of marker assisted selection -transformation of tobacco, analysis of transgenic plants- PCR, strip assay of Bt cotton, ELISA for protein expression analysis -Callus and cell suspension culture-extraction and quantification of secondary metabolites- antimicrobial assay, visit to GC-MS, HPLC lab

Lecture schedule

1. Micropropagation of commercially viable crops – banana and ornamental plants
2. Meristem culture and production of virus free plants - disease detection and indexing- PCR, ELISA
3. Protoplast isolation and fusion- production of somatic hybrids
4. Synthetic seeds, Somaclonal variation and applications,
5. National certification system for TC plants
6. Herbicide tolerant, biotic stress resistant transgenic plants- pest and disease resistant
7. Abiotic stress resistant transgenic plants – Drought, salinity and temperature
8. Transgenic plants engineered for quality traits- enhancement of nutrition quality , shelf life
9. Mid semester examination
10. Detection of GMOs, Indian regulatory guidelines, biosafety and bioethics
11. Current status of transgenic crops at national and global level
12. DNA markers -hybridization and PCR based markers
13. DNA fingerprinting of varieties and gene tagging
14. Marker Assisted Selection and its application in crop improvement.
15. Plants as biofactories – Production of recombinant proteins- Vaccines, therapeutic proteins, industrial enzymes and bio plastics
16. Discovery of novel compounds from plants- importance of secondary metabolites.
17. Callus and Cell suspension culture, bioreactors for plant cell cultures.

Practical schedule

1. Micropropagation of banana
2. Micropropagation of rose
3. Meristem culture of tapioca
4. Virus indexing in banana and tapioca
5. Transformation of tobacco and analysis of transgenic plants - PCR
6. Visit to Bt cotton field and strip assay for detecting Cry protein
7. ELISA for Cry protein expression analysis
8. DNA isolation
9. DNA fingerprinting using RAPD primers
10. NTsys analysis
11. Hybrid identification using SSR marker
12. Callus culture
13. Cell suspension culture

14. Extraction of secondary metabolites
15. Antimicrobial assay using food poisoning technique
16. Visit to commercial tissue culture lab / biotech lab/GC-MS, HPLC lab
17. Practical Examination

Outcome

Students are exposed to current status of the applications of molecular manipulations in crop improvement.

Text Book

1. Bhojwani, S.S. and Razdan, M.K. 2006. Plant Tissue Culture Studies – Theory and Practice. Elsevier Publication.
2. Gupta, P.K. 2005. Molecular Biology and genetic engineering. Rastogi Publication, India.
3. Malacinski, M. and D. Friefelder. 2003. Essentials of molecular biology. IV Ed. Jones and Bartlett publishers, Boston
4. Singh, B.D. 2004. Frontier areas in Biotechnology. Kalyani Publications, New Delhi.

Further Reading

1. Chawla, H.S. 2005. Introduction to plant biotechnology, India.
2. Lehninger. 2004. Principles of Biochemistry. CBS Publications, New Delhi.
3. Brown, T.A. 2006. Gene cloning - An introduction. V Ed. Chapman Hill, U.K.
4. Slater A, 2008. Plant Biotechnology The Genetic Manipulation of Plants 2 edition Oxford University Press , London

References

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- <http://www.agbioworld.org>
- <http://www.cropgen.org>.
- <http://www.isaaa.org>.
- <http://www.agbiosafety.unl.edu/>.

AEC 301 Production Economics and Farm Management 1 + 1

Unit I Nature and scope

Production economics: Meaning - definition – nature and scope - Farm Management : Definition - objectives of farm management - production economics vs farm management - farm management decisions - decision making process - scope of farm management. Types and systems of farming: types - specialized and diversified-mixed systems of farming – peasant farming – state farming – capitalistic – collective- co-operative farming.

Unit II Factor product relationship

Factor - product relationship: Meaning Agricultural/horticultural production function: Meaning – definition- Laws of returns: increasing, constant and decreasing returns- Classical production function and three stages of production – Elasticity of production – Types/forms of production functions- Linear, Cobb-Douglas and Quadratic – Cost concepts and cost curves: total, average and marginal cost – Economics of scale - determination of optimum input and output - physical and economic optimum.

Unit III Factor factor relationship

Factor-factor relationship : Meaning- isoquant – definition and types - isoquant map - marginal rate of technical substitution - factor intensity - isocline- ridge line - returns to scale – elasticity of factor substitution- iso-cost line – principle of factor substitution and least cost combination of inputs – Expansion path - Effect of input price changes on the least cost combination.

Unit IV Product product relationship

Product-product relationship: Meaning – production possibility curve – marginal rate of product transformation - Enterprise relationship: joint products – complementary – supplementary – competitive products – iso-revenue line – optimum combination of products – principle of equi-marginal returns – Principle of opportunity cost.

Unit V Farm planning and budgeting

Farm planning: importance – characteristics of good farm plan – farm planning procedure – Budgeting: definition and types – complete budgeting – partial budgeting – enterprise budgeting – cash flow budgeting – limitations of budgeting – Linear programming: assumptions – linear programming model defined – graphical solution - advantages and limitations – Risk and uncertainty: definition – types of risk and uncertainty – safeguards against risk and uncertainty.

Practical

Problems on factor-product relationship- determination of least-cost combination-determination of optimum product combination-computation of cost concepts- cost of cultivation and cost of

production of agricultural/horticultural crops, horticultural and livestock products - depreciation- methods of calculation of depreciation- Farm records and accounts – analysis of farm records and accounts - Farm inventory analysis – Net worth statement – Profit and loss statement – Break-even analysis — preparation of complete and partial budgets - preparation of farm plan – graphical solution to linear programming problem.

Lecture schedule

1. Production Economics : Meaning- Definition – Nature and Scope - Farm Management : Definition - Objectives of Farm Management - Production Economics Vs Farm Management
2. Farm Management Decisions - Decision making process - Scope of farm management
3. Types and systems of farming: types - specialized and diversified-mixed – systems of farming – peasant farming – state farming – capitalistic – collective- co-operative farming.
4. Factor-Product relationship : Meaning - Agricultural/horticultural Production Function : Meaning – Definition- Laws of returns: increasing, constant and decreasing returns
5. Classical production function and three stages of production – Elasticity of production
6. Types of Production functions- Linear, Cobb-Douglas and Quadratic
7. Cost concepts and cost curves: total, average and marginal cost concepts and curves, economics of scale.
8. Determination of optimum input and output: input approach and output approach - physical and economic optimum.
9. Mid semester examination
10. Factor-factor relationship : meaning- isoquant – definition and types - isoquant map - marginal rate of technical substitution - factor intensity – isoclines – ridge line
11. Returns to scale – elasticity of factor substitution- iso-cost line – principle of factor substitution and least cost combination of inputs – Expansion path - Effect of input price changes on the least cost combination
12. Product-product relationship: Meaning – production possibility curve – marginal rate of product transformation - Enterprise relationship: joint products – complementary – supplementary – competitive products
13. Iso-revenue line – optimum combination of products – principle of equi-marginal returns – Principle of opportunity cost
14. Farm planning : importance – characteristics of good farm plan – farm planning procedure
15. Budgeting : definition and types – complete budgeting – partial budgeting – enterprise budgeting – cash flow budgeting – limitations of budgeting

16. Linear programming : Assumptions – Linear programming model defined – graphical solution - advantages and limitations
17. Risk and uncertainty : definition – types of risk and uncertainty – safeguards against risk and uncertainty

Practical schedule

1. Estimation of Optimum input – output combination.
2. Determination of least-cost combination
3. Determination of optimum product combination
4. Computation of cost concepts- cost of cultivation and cost of production of agricultural/horticultural crops
5. Cost of cultivation and production of perennial crops/ horticultural crops.
6. Cost of production of livestock products
7. Depreciation: methods of calculating depreciation
8. Visit to a farm (government/private/corporate) to study the layout and organization
9. Farm records and accounts : Usefulness, types of farm records–farm production records-farm financial records
10. Visit to a private agricultural/horticultural farm to collect information on farm business
11. Farm inventory analysis: Examination of assets – valuation of assets by different methods
12. Preparation and analysis of Net worth statement and Profit and loss statement
13. Estimation of Break-even analysis
14. Preparation of complete budget and partial budgets
15. Preparation of farm plan
16. Graphical solution to Linear programming problem
17. Final practical examination

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NST 301 Fundamentals and Applications of Nanotechnology 1 + 0

Theory

Unit I Principles of nanoscience

History, definition, terminologies in nanoscience - importance of Moore's law- introduction to nanomaterials – semiconductor – diode – Quantum Dots- Buckyball - CNT - Polymers- types – PLGA – coreshell nanoparticles - micelle - introduction to nanobiosensor- types- properties and applications

Unit II Synthesis of nanomaterials

Top-down and bottom-up approaches - physical, mechanical, chemical and biological synthesis of nanomaterials

Unit III Properties and characterization of nanomaterials

Physical, mechanical, optical, magnetic, thermal and electrical properties – characterization – SEM, TEM, AFM, FT-IR, XRD

Unit IV Application of nanotechnology

Agriculture, food industry, energy, environment, health – social, economic and ethical issues – nanotoxicology

Lecture schedule

1. History, definition, terminology in nanoscience and importance of Moore's law.
2. Nanomaterials – semiconductor – diode – quantum dots - Buckyball - CNT -characteristics – applications.
3. Nanomaterials: polymers - types – PLGA – Coreshell nanoparticles - Micelles - characteristics – applications.
4. Biosensors – principle, components, types, applications.
5. Top-down and bottom-up approaches - physical method, Physical Vapour Deposition (PVD), etching - molecular beam epitaxy – sputtering – lithography.
6. Mechanical synthesis - Ball milling – types - mechanical alloying.
7. Chemical synthesis – Sol-gel method – Chemical Vapour Deposition (CVD) – electro-deposition- thin film.
8. Biological synthesis using microorganisms and plants.

9. Mid semester examination.
10. Mechanical, magnetic and thermal properties of nanomaterials.
11. Optical and electrical properties of nanomaterials.
12. Principle, components and application of nanotechnology equipments: Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM).
13. Principle, components and application of nanotechnology equipments: X-ray diffraction (XRD) – Fourier Transform Infra Red Spectroscopy (FT-IR) – Atomic Force Microscope (AFM).
14. Agriculture – nano fertilizers – nano-herbicides – nano-pesticides – seed technology.
15. Energy, environment and health.
16. Nanotechnology in food systems – nano foods, nano-encapsulation of functional foods, nano-packaging, quality assessment.
17. Social, economic and ethical issues in nanotechnology and nano-toxicology.

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FSN 311 Principles of Processing and Value Addition of Horticultural Produces 2 + 1

Aim

- ❖ This course provides information on the principles and methods of processing and value addition of horticultural produces. This will also enhance the knowledge on value addition of horticultural produces.

Theory

Unit I Importance of processing and value addition

Introduction: Scenario of fruit and vegetable production and processing at national and international level - contribution of horticulture produces to human nutrition: nutritive value, nutraceutical properties – concept, principles and scope of processing and value addition of horticultural produces. Tools, equipments, lay out and other requirements of a small scale food processing unit.

Unit II Principles of processing and value addition using sugar and salt

Processing using sugar: principle – processing of jam, jelly, marmalade, squash, RTS, nectar, fruit bar, preserves and candies. Processing using salt: Principle – brining preservation of horticultural produces - preparation of pickles and sauces.

Unit III Principles of processing and value added dehydrated and canned products

Drying and dehydration: definition, principle, method, suitability – Types of driers: solar, cabinet, spray drier, drum drier, fluidized bed drier, freeze drying - methods of concentration : open kettle, flash evaporators – equipments used. Processing of dehydrated fruit, vegetable and spice products, fruit pulps. Canning: principles, methods – preparation of canned products - spoilage of canned foods and its prevention.

Unit IV Principles of preservation by low temperature, CA, MAP and irradiation

Preservation by low temperature: definition, principle, method, suitability – refrigeration, freezing - preparation of frozen foods – preservation by controlled atmosphere, modified atmosphere: definition, principle, method, suitability – processing by irradiation: definition, principle, method, suitability – application of irradiation in food industry.

Unit V Recent technologies in fruit and vegetable processing

Minimal processing of fruits and vegetables – techniques involved. Recent trends in processing – high pressure processing and processing using pulse electric field. Utilization of fruit and vegetable waste.

Practical

Survey on processed foods – shelf life studies of fruits and vegetables at different temperatures and atmospheric conditions. Preparation of jam, jelly, squash, marmalade, pickles, steeping preservation, dehydrated, canned and frozen products.

Lecture schedule

1. Scenario of food processing
2. Nutritive value and nutraceutical properties of horticulture produces
3. Concept, principle and scope of value addition
4. Tools and equipments for a food processing unit
5. Lay out and requirements of a food processing unit
6. Principle of processing using sugar for single and blended fruit products
7. Processing of jam, jelly, marmalade
8. Processing of squash and nectar
9. Processing of Ready To Serve beverage
10. Processing of fruit bars
11. Processing of preserves and fruit candies
12. Principle of processing using salt
13. Preservation by brining and processing of pickles and sauces
14. Need , principle, method and suitability of processing by dehydration
15. Types of driers : solar, cabinet, spray drier, drum drier, fluidized bed drier
16. Processing of dehydrated fruit products
17. Mid semester examination
18. Processing of osmo dried fruit products
19. Processing of dehydrated vegetable products
20. Processing of dehydrated spice products
21. Need , principle, method and suitability of processing by concentration
22. Methods of concentration and equipments used: open kettle, flash evaporators, dehydro freezing.
23. Processing of concentrated fruit pulps
24. Principle of preservation using low temperature
25. Canning of fruits
26. Canning of vegetables
27. Spoilage in canned foods and its prevention
28. Need , principle, method and suitability of processing by Controlled Atmosphere and Modified Atmospheric Packaging

29. Need , principle, method and suitability of processing by irradiation
30. Application of irradiation in food industry
31. Need , principle and methods of minimal processing of foods
32. Need , principle, method of high pressure processing
33. Need , principle, method of application of pulse electric field
34. Utilization of industrial fruit and vegetable wastes

Practical schedule

1. Market survey of processed foods
2. Packaging and evaluation of the shelf life of fruits at different temperatures
3. Packaging and evaluation of the shelf life of vegetables at different temperatures
4. Packaging and evaluation of the shelf life of fruits and vegetables under CAP and MAP
5. Processing of jam and jelly
6. Processing of squash and RTS
7. Processing of fruit bar and candies
8. Processing of pickles and sauces
9. Steeping preservation of fruits and vegetables
10. Processing of osmo dried fruit slices
11. Processing of dehydrated vegetables
12. Processing of dehydrated spices
13. Canning of fruits
14. Canning of vegetables
15. Processing of frozen fruits and vegetables
16. Visit to fruit and vegetable processing unit
17. Practical examination

Outcome

This course will enable the students to understand the concepts and principles of food processing and value addition and give an overview of the various value addition technologies.

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Journals

- Journal of Food Science and Technology
- Indian Food Industry
- Indian Food Packer
- Beverage and Food World