DEPARTMENT OF AGRONOMY
Ph.D. AGRONOMY (BY COURSE WORK)
(FULL TIME COURSE WORK)
(2019-2020)

Course No.	Course Title	Credit Hours
MAJOR COURSES (three and two from I and II sem. respectively)		
GAGR 811	Advances in crop growth and productivity	2+1
GAGR 812	Current trends in Agronomy	3+0
GAGR 813	Advances in weed management	2+1
GAGR 814	Advances in soil conservation and watershed management	2+1
GAGR 821	Farming Systems and Sustainable Agriculture	3+0
GAGR 822	Current trends in irrigation Agronomy	2+1
GAGR 823	Stress Crop Production	2+1
GAGR 824	Advances in crop ecology	2+1
	Total	10+ 5 = 15
MINOR COURSES		
GAGR 815	Environmental protection and pollution management	2+1
GAGR 825	Principles and practices of organic management	2+1
GAGR 826	MOOC COURSE	2+0
	Total	6 + 2 =8
SUPPORTING COURSES		
GCOM 811	Advances in Computing Application	0+1
GLIS 812	Advances in agricultural information retrieval	0+1
GSTA 821	Advances in Design of Experiments	2+1
	Total	2+3 =5
GAGR 081	Seminar	0 + 1
GAGR 082	Seminar	0 + 1
	Total	0 + 2=2
GAGR801-806	Research	0 + 45=45
	Total	18 + 57 =75

GAGR 811: ADVANCES IN CROP GROWTH AND PRODUCTIVITY (2+1)

Learning Objectives

- Students will understand the advances in crop growth and productivity.
- Students will undertake basic, applied and adaptive research to address current and future challenges of farming community and to provide management options relevant to the prevailing agro-climatic and socioeconomic situations.
- Students will generate appropriate technologies to support sustainable growth of agricultural crop production.
- Students will develop and analyze crop growth under different ecosystems for enhanced and sustainable agricultural production.

Theory

Unit I – Plant Density and Crop Productivity:

Environmental factors, affecting crop yield, distribution, strategies for maximizing solar energy utilization; leaf area; interception of solar radiation and crop growth. Photosynthesis: the photosynthetic apparatus, factors essential for photosynthesis; difference in photosynthetic rates among and within species; physiological limitations to crop yield; solar radiation concept and agro-techniques for harvesting solar radiation.

Unit II - Growth Analysis:

Concept, CGR, RGR, NAR, LAI, LAD, LAR; validity and Limitations in interpreting crop growth and development; growth curves: sigmoid, polynomial and asymptotic; root systems; root-shoot relationship.

Unit III – Cropping Systems:

Principals involved in inter and mixed cropping systems under rainfed and irrigated conditions; concept and differentiation of inter and mixed cropping; criteria in assessing the yield advantages.

Unit IV - Competitive Relationship and Competition Functions:

Biological and agronomic basis of yield advantage under intercropping; physiological principles of dry land crop production, constraints and remedial measures; heat unit concept of crop maturity: concept and types of heat units.

Unit V - Concept of plant ideotypes:

Crop physiological and new ideotypes; characteristics of ideotype for wheat, rice, maize, etc.; concept and types of growth hormones; their role in field crop production; efficient use of resources.

Practical

- Field measurement of root-shoot relationship in crops at different growth stages
- Estimation of growth evaluating parameters like CGR, RGR, NAR, LAI, ATER, CR, EMAI etc., at different stages of crop growth.
- Computation of harvest index of various crops
- Assessment of crop yield on the basis of yield attributing characters
- Construction of crop growth curves based on growth analysis data
- Computation of competition functions, viz. LER, IER, aggressivity, competition Index etc.
- Senescence and abscission indices

- Analysis of productivity trend in un-irrigated areas
- Analysis of productivity trend in irrigated areas

Lecture Schedule

1. Crop productivity – Soil fertility – plant density – definition – concepts
2. Agronomic significance of plant density and crop productivity
3. Factors and constraints involved in soil and crop productivity for sustainable Production.
4. Importance of radiation energy-solar constant-Dispassion of solar energy net radiation balance
5. Radiation laws such as Planck law, wavelength and frequency relationship, Wein's law etc.
6. Radiation distribution in a plant and in a plant community – Monteith's equations.
7. Photosynthesis a big business – interaction between radiant energy and matter action & absorption spectra – importance – quantum yield.
8. C_3, C_4 and CAM Plants and its importance in crop productivity
9. Crop management practices for higher photosynthesis
10. Growth analysis concepts CGR, RGR & NAR for higher productivity.
11. Growth analysis concepts – LAI, LAD and LAR for higher productivity
12. Growth expressions using growth curves – sigmoid, polynomial and asymptotic
13. Root - shoot relationships
14. Resource utilization in irrigated cropping
15. Resource utilization in rainfed cropping
16. Criteria for assessing yield advantages
17. Assessment of competition and yield advantages
18. **Mid semester examinations**
19. Interaction in mixed crop communities
20. Competition for solar radiation & carbon dioxide
21. Competition for soil & other factors
22. Role of plant population & geometry for maximum yield under inter cropping
23. Role of sowing time & genotype selection for maximum yield under inter cropping
24. Problems of crop production in dry farming
25. Moisture stress - Development of moisture stress & effects of moisture stress.
26. Crop adaptations & water harvesting in dry areas.
27. Soil & moisture conservation measurers
28. Definition and concept of plant ideotypes
29. Factors responsible for successful cultivation of new plant types.
30. Recent approaches towards reconstructing new plant types.
31. Ideotype for advance agronomy
32. Characters of ideotype for wheat & maize
33. Characters of ideotype for rice
34. Role of growth hormones and crop production

Practical Schedule

1. Beer's law – calculation resulting
2. Seed rate & yield from vegetative as well as from reproductive growth usage of experimental data & discussing.
3. Growth analysis – Determination of CGR & RGR – experimental data from cereals & millets interpretation.
4. Growth analysis estimation LAI, NAR experimental data from cereals & millets interpretation.
5. Working out & mapping rainfall types in dry farming tracts in Tamil Nadu, India & world.
6. Working out drought indices.
7. Rainfall prediction – rainfall analysis & formulation of cropping system
8. Working out rainfall use efficiency and solar use efficiency.
9. Working out yield sustainability indices
10. Working out yield stability indices.
11. Indices for evaluation of intercropping system.
12. Working out economics of inter cropping system in dry lands
13. Working out watershed models for alfisol and vertisols
14. Visit to dry farming research stations for studying improved dry land technology
15. Crop response to growth regulators.
16. Determination of photosynthetic efficiency in crop plants
17. Estimation of soluble protein in crops to assess the photosynthetic rate.

Course Outcomes

- To describe the role of physiological processes controlling plant growth and development.
- To understand the impact of latest crop management practices on crop productivity and resource use efficiency.
- To undertake sampling of plants and soils to interpret results of research on crop growth and development, radiation interception and radiation use efficiency, crop water use and water use efficiency.

Suggested readings

1. Chopra, V.L. and Paroda, R.S. 1984. *Approaches for Incorporation of Drought and*
2. *Salinity Resistance in Crop Plants.* Oxford & IBH
3. Evans, L.T. 1975. *Crop Physiology.* Cambridge Univ. Press
4. Evans, L. T. 1996. *Crop Evolution, Adaptation and yield.* Cambridge Univ. Press Gupta, U.S. (ed.).1995. *Production and Improvement of Crops for Drylands.* Oxford & IBH
5. Gupta, U.S. 1988. *Progress in Crop Physiology.* Oxford & IBH
6. Kramer P. J. and Boyer . J. S. 1995. *Water Relations of Plants and Soils.* Academic Press
7. Mukherjee, S. and Ghosh. 1996. *Plant Physiology.* Tata Mc Graw Hill
8. Narwal S.S , Politycka B. and Goswami, C.L. 2007. *Plant Physiology: Research Methods.* Scientific Publishers
9. Noggle, G. R. and Fritz, G. J. 1983. *Introductory Plant Physiology.* Prentice-Hall of India.

10. Nanda Kumar Fagria, Zhenli He and Virupax C. Baligar 2017. Phosphorus management in crop production CRC press.
11. Raltan Lal and B.A. Stewart, 2016. Soil water and agronomic productivity. CRC. Press.

e- Resource

1. www.el.doccentre.info/eldoc1/k33_/intercropping-principles.pdf
2. agriinfo.in/default.aspx?page=topic&superid=3&topicid=2122
3. eagri.org/eagri50/PPHY261/lec19.pdf
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2613695/
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5227689/
6. http://www.wamis.org/agm/pubs/agm8/Paper-13.pdf
7. http://www.fao.org/3/a-i7339e.pdf
8. https://academic.oup.com/jxb/article/63/1/13/553113

GAGR 812: CURRENT TRENDS IN AGRONOMY (3+0)

Learning Objectives

- Students will gain knowledge on recent advances in Agricultural production.
- Students will acquire knowledge on globalization Agriculture, Marketing and export potential of organic products.
- Students will gain knowledge on GIS based Crop management, precision agriculture.

Theory

Unit–I

Agro-physiological basis of variation in yield, recent advances in soil plant - water relationship.

Unit–II

Globalization of agriculture and WTO, precision agriculture, contract farming, organic farming, marketing and export potential of organic products, certification, labeling and accreditation procedures.

Unit–III

Crop residue management in multiple cropping systems; latest developments in plant management, weed management, cropping systems, grassland management, agro-forestry, allelopathy.

Unit–IV

GIS, GPS and remote sensing for crop management, Drone technology global warming, GM crops, climate resilient farming climate ready crops.

Unit–V

Concepts of system agriculture; holistic approach of farming systems, dryland farming, sustainable agriculture. Cost; effective agro techniques high tech production technologies in crop production, Nanotechnology Information technology in Agriculture research and Biotechnology.

Lecture Schedule

1. Physiological factors limiting crop yields
2. Microclimate and crop production
3. Potential yield – actual yield – reducing the gap between potential yield and actual yield
4. Growth analysis – tools, crop production in different eco-system
5. Recent advances in soil, water &plant relationship
6. Conventions adopted in soil and plant water relationship
7. Active and passive absorption – soil plant atmosphere continuum
8. Water resources in India and Tamilnadu
9. Water resources present status and future needs
10. Water and its role in plants
11. Globalization in agriculture
12. Impact of WTO in Agriculture sector
13. Crop modeling, information techniques and WTO issues in agriculture
14. Precision Agriculture – concept, approach and relevance to Indian agriculture
15. Precision agriculture and cropping system
16. Soil and land information for precision agriculture
17. Organic farming – definition, concepts, prospects, opportunities
18. Current status of organic farming in India and Tamilnadu
19. Marketing and export potential of organic product
20. Certification standards, procedure and regularity mechanism
21. Organic certification – standards and agencies – marketing and export avenues
22. Organic product – labeling and accreditation
23. Crop residues in crop association
24. Farm wastes utilization in agriculture - Organic manures and their dynamics
25. **Midsemester examination**
26. Crop residue management – its importance in soil and crop productivity
27. Organic manures in relation to soil fertility
28. Latest development in plant management
29. New developments in weed management
30. Latest developments in Cropping system
31. Latest development in grassland management and agroforestry
32. Allelopathy and interaction among crop communities
33. GIS, GPS – Introduction – History – basic concept
34. Techniques, procedure and terminology of geography information systems
35. Application of GPS in agricultural and natural resource management
36. GPS and Drone technology.
37. Scope of remote sensing in agriculture – sensors and platforms, data availability for agricultural remote sensing
38. Differentiation and identification of soils and soil resource mapping and remote sensing
39. Crop mapping – vegetation dynamics, crop stress evaluation and differentiation

40. Research prioritization and selection of research problem, designing research program for field experimentation
41. Definition and concept of climatic, crop stress evaluation and differentiation
42. Genetic engineering and crop improvement – steps and techniques involved and application
43. GM crops and traits – prospects of transgenic crops
44. Climate resilient farming and climate ready crops
45. Concept of system agriculture
46. Holistic approaches of farming system
47. Dry farming – dry land research – past and present scenario
48. Dry climates – dry farming regions in India and Tamil Nadu
49. Nanotechnology and its application in agriculture.
50. Cost effective techniques in crop production.
51. Information technology in Agriculture research.
52. Biotechnology in agriculture development.

Course Outcomes

- Students will be exposed to the latest knowledge on recent advances in soil-plant-water relationship.
- Knowledge enriching on principles and components of organic farming, resource conservation technologic, contact farming GIS and tender information on marketing.

Suggested readings

1. Govardhan V. 2000. *Remote Sensing and Water Management in Command Areas: Agroecological Prospectives*. IBDC.
2. ICAR. 2006. *Hand Book of Agriculture*. ICAR.
3. Jamie Hanks. 2015. Current progress in Agronomy volume 11. Elsevier.
4. Jitendra Kumar, Aditaya Pratap and Shir Kumar. 2015. Phenomics in crop plants: Trebds, options and Limitations. Springer.
5. Narasaiah ML. 2004. *World Trade Organization and Agriculture*. Sonali Publ.
6. Palaniappan SP & Annadurai K. 2006. *Organic Farming - Theory and Practice*.Scientific Publ.
7. Sen S & Ghosh N. 1999. *Seed Science and Technology*. Kalyani.
8. Tarafdar JC, Tripathi KP & Mahesh Kumar 2007. *Organic Agriculture*. Scientific Publ.

e-Resource

1. https://nptel.ac.in/courses/105105110/pdf/m3l02.pdf
2. https://pdfs.semanticscholar.org/d8a7/68c720c2dc01030a4ee654558d9240465d89.pdf
3. www.hillagric.ac.in/edu/coa/.../lect/.../Lecture-2-Concepts-of-Organic-Agriculture.pdf
4. https://en.wikipedia.org/wiki/Genetically_modified_crops

5. https://www.asti.cgiar.org/pdf/India-Note.pdf
6. https://bigdata.cgiar.org/blog-old/crop-modeling/
7. http://www.fao.org/3/a-i6583e.pdf
8. https://www.slideshare.net/FAOoftheUN/the-future-of-food-and-agriculture-trends and-challenges

GAGR 813: ADVANCES IN WEED MANAGEMENT (2+1)

Learning Objectives

- Students will learn about the changing weed flora under varied ecosystem
- Students will acquire knowledge on concepts and principles of weed management
- Students will know new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems
- Students will acquire skills on herbicide spraying techniques and bioassay

Theory

Unit I – Weed Biology and Ecology:

Ecological and physiological characteristics of weeds, crop-weed association and competition in different agro-eco systems, weed shift, weed migration, changes in weed flora, various causes and effects.

Unit II – Chemistry of Herbicides:

Physiological and biological aspects of herbicides, their absorption, translocation, metabolism and mode of action; selectivity of herbicides and factors affecting them.

Unit III – Herbicide Physiology:

Climatic factors and phytotoxicity of herbicides; fate of herbicides in soil and factors affecting them, residue management of herbicides, adjuvants.

Unit IV – Herbicide interaction with other Chemicals:

Advances in herbicide application techniques; herbicide resistance; antidotes and crop protection compatibility of herbicides of different groups; compatibility of herbicides with other pesticides.

Unit V – Herbicide Resistance:

Development of transgenic herbicide resistant crops; nano technological applications herbicide development, registration procedures. Relationship of herbicides with tillage, fertilizer and irrigation; bioherbicides and herbicide bioassays.

Practical

- Study on the biology of lowland, garden and dryland weeds.
- Phenological study of aquatic weeds.
- Weed indices.
- Classification of herbicides.
- Herbicide application techniques.
- Weed control experiments: lab and field.
- Herbicide phytotoxicity on crop and weed.

- Bioassay technique for analysis of herbicide residues

Lecture schedule

1. Definition – Characters of weed – Survival mechanism of weeds – Economic uses of weeds
2. Crop weed association and competition –Allelopathy- Allelochemicals
3. Impact of weeds on different crops
4. Behavior of weeds in different agro-eco system
5. Ecological role of weeds in agro-ecosystems of crop manipulations.
6. Weed migration – Dormancy and Germination
7. Herbicides – definition – classification and it's characteristics
8. Inorganic herbicides - un classified groups -descriptions
9. Absorption, translocation of herbicides - Mode of action of herbicides
10. Selectivity of herbicides in plants
11. Factors influencing the selectivity of herbicides
12. uptake and translocation of foliage & soil applied herbicides
13. Persistence of herbicides as influenced by climatic factors
14. Degradation of herbicides as influenced by climatic factors
15. Herbicide toxicity to crop & weeds – symptoms
16. Degradation mechanism of herbicides in plant
17. Fate of herbicides in soil – volatilization & leaching
18. **Midsemester examination**
19. Chemical decomposition – adsorption, photo decomposition & plant uptake
20. Herbicide persistence & residue & residue management
21. Advance techniques in herbicide application &equipments
22. Principles of herbicide resistance
23. Nature and characteristics of herbicide resistance in crops & associated weeds
24. Reasons for development of herbicide resistance & its significance
25. New herbicides – herbicide protectants & antidotes
26. Compatibility of herbicides with agrochemicals
27. Compatibility of herbicides with fertilizers
28. Bio-technological approaches – Development of herbicide resistance in crops
29. Development of herbicide resistance in crops – Genetic & other methods
30. Herbicide development
31. Herbicide relationship with – Tillage and irrigation
32. Herbicide registration & regulation – Decision support system
33. Bio-herbicides – development- Natural products & bio-technology in weed management- nano technological applications
34. Bio-Assays of herbicide residues

Practical schedule:

1. Identification, characterization and classification of terrestrial weeds

2. Identification, characterization and classification of aquatic weeds
3. Identification, characterization and classification of problem and parasitic weeds
4. Phytosociological survey of weeds
5. Assesment of weed seed bank and seed production potential of weeds
6. Working out herbicides and spray fluid requirements
7. Herbicide application techniques and equipments
8. Use of herbicides with different formulation
9. Working out weed control efficiencies of different weed management practices
10. Study on the influence of herbicides on soil micro flora
11. Study on complimentary weed control through cultural practices like mulching, and intercropping.
12. Identification and use of bio agents for weed control
13. Identification and use of natural products for weed control
14. Methodology for weed research- competition studies and control
15. Scoring for phyto-toxic injury of herbicides and bio –assay of herbicide residues
16. Economic analysis of different weed management methods
17. Weed management for different farming systems and crops.

Course outcomes

- To acquire knowledge on phytosociological weed survey and weed mapping under varied ecosystem
- To gain knowledge on interrelationship between crop and weed and management of weeds
- To understand the herbicide application techniques
- To gained information on methodology of weed research-competition, control, herbicide residue and bio-assay studies

Suggested readings

1. Aldrich RJ & Kramer R.J. 1997. *Principles in Weed Management*. Panama Publ.
2. Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2nd Ed. Wiley-Inter Science.
3. Chauhan, Bhagirath, S. Mahajan and Gulshan. 2014. Recent advances in weed management. Springer.
4. Gupta OP. 2000 *Weed Management – Principles and Practices*. Agrobios.
5. Kalyani. Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic Press.
6. Mandal RC. 1990. *Weed, Weedicides and Weed Control - Principles and Practices*. Agro-Botanical Publ.
7. Rao VS. 2007. *Principles of Weed Science*. Oxford & IBH.
8. Subramanian SAM & Kumar R.J. 1997. *All About Weed Control*.
9. Tomlin, C.D.S. 2006. *The Pesticide Manual*. 14th Edition, BCPC Publications, Hampshire, UK.

10. Xu, Zhenghao, Zhou and Guoning 2017. Identification and control and common weeds Vol, 2&3. Springer

e-Resources

1. http://erec.ifas.ufl.edu/weeds/powerpoints/Basic%20Principles%20of%20Weed%20Management.pdf
2. http://www.agrisk.umn.edu/cache/ARL02964.htm
3. hhttp://www.eolss.net/sample-chapters/c10/E1-05A-31-00.pdf
4. http://www.fao.org/docrep/006/y5031e/y5031e00.htm#Contents
5. http://www.fao.org/docrep//006/y5031e/y5031e0j.htm
6. http://www.omafra.gov.on.ca/english/crops/pub811/12crop.htm
7. https://icar.org.in/NRM-2016/7%20AICRP%20on%20Weed%20Management_4-2-2016.pdf
8. https://aicrp.icar.gov.in/wm/
9. http://dwr.org.in/PDF%20Document/Training-Brochure-final.pdf

GAGR 814: ADVANCES IN SOIL CONSERVATION AND WATERSHED MANAGEMET (2+1)

Learning Objectives:

- Students will gain knowledge on various aspects of soil conservation practices
- Students will be given larger exposure on areas affected by soil degradation in India and remedial measures to overcome those constraints
- Students will be put in the right track in understanding the common problems that act as a stumbling block in agriculture production
- Students will be imparted mastery on watershed management and its design & development for enhancing the overall livelihood.

Theory

Unit I - Soil erosion

definition, nature and extent of erosion; types of erosion, factors affecting erosion.

Unit II - Soil conservation

definition, methods of soil conservation; agronomic measures - contour cultivation, strip cropping, cover crops; vegetative barriers; improved dry farming practices; mechanical measures - bunding, gully control, bench terracing; role of grasses and pastures in soil conservation; wind breaks and shelter belts.

Unit III - Watershed management

definition, objectives, concepts, approach, components, steps in implementation of watershed; development of cropping systems for watershed areas.

Unit IV - Land use capability

classification, alternate land use systems; agro-forestry; ley farming; *jhum*management - basic

concepts, socio-ethnic aspects, its layout.

Unit V - Drainage

considerations and agronomic management; rehabilitation of abandoned *jhum*lands and measures to prevent soil erosion.

Practical

- Study of different types of erosion
- Field studies of different soil conservation measures
- Run-off and soil loss measurements
- Laying out run-off plot and deciding treatments
- Identification of different grasses and trees for soil conservation
- Visit to a soil conservation research centre, demonstration and training centre

Lecture Schedule

1. Soil erosion – Definition – Agents of erosion – Forms of erosion – soil and nutrient loss – land degradation.
2. Erosion – Extent of soil erosion – types – Geological – Accelerated erosion –
3. Water erosion – Process of water erosion – forms of water erosion – sheet erosion – rill erosion – Gully erosion – ravines – landslides – stream bank erosion.
4. Factors affecting water erosion – rainfall – soils – topography – soil surface cover – biotic interference.
5. Wind erosion – mechanism of wind erosion – saltation – suspension – surface crop.
6. Factors affecting wind erosion – soil cloudiness – surface crust – wind and soil moisture – vegetative cover – organic matter – Topography – soil.
7. Estimation of soil loss – losses due to water erosion – wind erosion – Erosion control factors – Agronomic measures forestry measures.
8. Soil conservation – Definition – soil conservation research in India – soil moisture constraints and their management.
9. Methods of soil and water conservation – Insitu conservation - Agronomic measures – contour cultivation - contour ploughing – summer ploughing - mulching – strip cropping – cover crops – Inter cropping.
10. Mechanical measures – Broad bed furrows – Dead furrow – contour bunding – compartmental bunding – Graded bunding –Terracing.
11. Biological measures – pastures – strip cropping with grasses – Ley farming – vegetative barriers.
12. Control of water losses – Evaporation control – shelter belts – wind breaks – Transpiration control – antitranspirants – Growth retardants – windbreaks – shelter belts.
13. Soil conservation programmes in rice valleys – national conservation strategy – Initiatives to control environmental pollution – new policy initiatives.
14. Degraded eco-system and conservation of biodiversity – India's efforts for biodiversity conservation – Insitu, Exsitu conservation – conventional methods of situ conservation by seeds.
15. Watershed management micro and macro watershed – definition – Principles of

watershed management – need and advantages.

16. Concepts – Aim and approaches of watershed management – components of watershed management – water resource improvement – soil and moisture conservation in cultivated lands.
17. Components – soil water conservation and water harvesting – Hardware treatments – water ways – bunds - graded bunds – Terracing.
18. **Mid semester examination**
19. Medium Software treatments – key line bunds – strip leveling – line buds - vegetative barriers – software treatments – contour farming – Tillage.
20. Water harvesting measures - minor irrigation tanks - Farm ponds – percolation tanks – stop dams.
21. Watershed development methods – crop management – selection of improved varieties – contingency plan – Integrated farming system.
22. Alternate land use system – action plan for watershed development - socio economic problems – cost benefit analysis of watersheds.
23. Classification of land – land use Pattern before independence – land use pattern in India – types of land use – land use planning.
24. Steps in land use planning – change in land use pattern – optimal land use pattern – cropping pattern - Area under food grains and non food grains.
25. Alternate land use systems for marginal and degraded lands – pastures and grasslands lands – silvi culture – multipurpose tree species.
26. Agroforesty – Definition - Importance – components.
27. Agro forestry systems – based on structure, dominance of components, Temporal arrangement of components and allied components.
28. Agroforesty systems in India – Agri – silviculutre – silvi pastoral – Agri-horticulture – Agri – Silvi pastoral – Agri-horti – silvi culture.
29. Agroforesty Systems –Homestead agroforestry – ley farming – alley cropping – classification of alley cropping.
30. Jhum/shifting cultivation – Jhum cultivation in India – basic concepts.
31. Harmful effects – ecological problems due to Jhum cultivation - Jhum cultivation in modernday – layout of Jhum cultivation.
32. Abolishing shifting cultivation – role of government – drainage considerations and agronomic management.
33. Waste land development – management classification – cultivable and uncultivable wastelands- raverine land – coastal sandy areas.
34. High altitude and steep sloppy areas – salt affected soils. Salt affected soils of India – alkali soils – water logged and marshy lands – Gullied and Ravinous land – sand dune management – afforestation

Practical Schedule

1. Types of erosion and methods to prevent erosion
2. Insitu soil moisture conservation techniques
3. Mulching and its effects

4. Antitranspirants
5. Estimation of run off and soil loss
6. Laying out run-off plot and deciding treatments
7. Working out land use pattern in the world, India and Tamilnadu
8. Preparation and methodology for implementation of water shed projects
9. Preparation of model watershed programme
10. Identification of common tree species
11. Identification of common pasture grasses and legumes
12. Nursery techniques and planting methodology for tree crops.
13. Study of litter fall and biomass deposits
14. Assessment of economic uses of trees
15. Assessment of biomass production under watershed area
16. Visit to an Institute related to Agroforestry / dryland agriculture
17. Visit to watersheds of NWDPRA / CWDP – Input analysis

Course Outcome:

- To understand the major areas of soil degradation in India and application of agro-techniques in conserving the soil
- To develop afforestation and other biological measures to conserve soil and water holding capacity toward improving crop productivity
- To design and develop watershed suitable for the region to save water for agricultural and non-agricultural uses.

Suggested readings

1. Arakeri HR & Roy D. 1984. Principles of Soil Conservation and Water Management. Oxford & IBH.
2. Bimal Chandra Mal. 2012. Introduction to soil and water conservation Engineering. Kalyani publishers.
3. Dhruvanarayana VV. 1993. Soil and Water Conservation Research in India. ICAR.
4. FAO. 2004. Soil and Water Conservation in Semi-Arid Areas. Soils Bull., Paper 57.
5. Frederick RT, Hobbs J, Arthur D & Roy L. 1999. Soil and Water Conservation: Productivity and Environment Protection. 3rd Ed. Prentice Hall.
6. Gurmel Singh, Venkataraman CG, Sastry B & Joshi P. 1990. Manual of Soil and Water Conservation Practices. Oxford & IBH.
7. Gabriela Vazquez. Rodriguez, Liliana and Lizarraga mendiola . 2016. Rainwater harvesting and soil water conservation technique . Intelliz press LLC.
8. Murthy VVN. 1995. Land and Water Management Engineering. Kalyani.
9. PawanJeet and Prem. 2016. Objectives in soil and water conservation engineering. New vishal publications.
10. Rattan and B.A. Stewart. 2012. Soil water and agronomic productivity. CRC press.
11. Tripathi RP & Singh HP. 1993. Soil Erosion and Conservation. Wiley Eastern.

12. Yellamanda Reddy T & Sankara Reddy GH. 1992. Principles of Agronomy.

e resources

1. https://www.nda.agric.za/docs/erosion/erosion.htm
2. www.shareyouressays.com/essays/8-different-methods-of-soil-conservation.../120602
3. www.themediaexpress.com/2016/07/16/factors-affecting-the-extent-of-wind-erosion/
4. www.yourarticlelibrary.com/watershed-management/watershed-management.../77309
5. www.envirothon.org/pdf/2012/.../KP4.3land_capability_classification%5B1%5D.pdf
6. www.crida.in/DRM1-Winter%20School/GSR.pdf
7. https://nptel.ac.in/courses/105101010/downloads/Lecture06.pdf
8. http://www.fao.org/docrep/t0321e/t0321e-14.htm

Second Semester

GAGR 821: FARMING SYSTEMS AND SUSTAINABLE AGRICULTURE (3+0)

Learning Objectives:

- Students will gain knowledge about different farming enterprises suitable for different agro-climatic condition for sustainable agriculture.
- Students will acquire knowledge on holistic approaches of farming system.
- Students will acquire knowledge on objective concepts of cropping system farming system, integrated farming system.

Theory

Unit I - Farming systems:

Farming systems: definition and importance; classification of farming systems according to type of rotation, intensity of rotation, degree of commercialization, water supply, enterprises.

Unit II – Natural resources and sustainable farming system:

Concept of sustainability in farming systems; efficient farming systems; natural resources - identification and management.

Unit III - Production potential of components in farming system:

Production potential of different components of farming systems; interaction and mechanism of different production factors; stability in different systems through research; eco- physiological approaches to intercropping.

Unit IV – Farming for environmental conservation:

Systems classification; flow charts, modeling techniques and methods of integration - state, rates and driving variables, feedbacks and relational diagrams. Crop diversification for Sustainability environmental pollutant and farming:

Unit V – Crop modeling:

Crop modeling methods for crop-weather interaction, climate change and variability components. Restoration of degraded and waste land.

Lecture Schedule

1. Concept – Principles of Farming Systems Management
2. Goals of farming systems
3. Farming system definition and importance
4. Farming systems research and development priorities and methodological issues
5. Classifications and approaches to farming systems research
6. Scope and futurology of farming systems.
7. Low input concepts for farming systems
8. Inter related objectives and steps of farming systems research
9. Nutrient and water management in farming systems
10. Weed management in farming systems
11. Factors influencing the choice of component elements
12. Integrated farming systems prospects of constraints
13. Types and intensity of rotations in farming systems
14. On farm nutrient budgeting in farming system
15. Commercialization of value addition in farming systems
16. Enterprises involved in wetland farming systems
17. Enterprises involved in dryland farming systems
18. Enterprises involved in gardenland farming systems
19. Sustainability of farming system and development
20. Resource management through farming systems
21. Crop planning and alternate land use systems
22. Natural resource recycling through farming systems
23. FSR methodology and problem identification
24. Environment conservation and farming
25. **Midsemester examination**
26. Socio economic constraints for farming systems adoption
27. Component technologies of systems approach farming
28. Multidisciplinary approach and prospects in farming systems
29. Components identification and management in farming systems
30. Production potentiality of different components of farming systems
31. Organic recycling and integrated farming systems
32. Interaction and Allocation of farming components
33. Mechanism of different production factors in farming systems
34. Stability and complimentary benefits through farming systems research
35. Allelopathy and plant Interactions in cropping systems
36. Evaluation and socio economic constraints in cropping systems
37. Systems classifications and methodology for institutional research
38. Flow chart for methods in on farm trials
39. Flow chart for problem identification and development of a base
40. Crop diversification for sustainability
41. Environmental conservation, GMO's and farming
42. Bio remediation and bio scavenging

43. Hierarchy and parameters quantifying the prototype evaluation
44. Modeling techniques in farming systems research
45. Driving variables, feed backs and relational modeling in farming systems
46. Tools to evaluate environmental impacts of farming systems
47. Predictions of crop production in relation to climate
48. Computerized farming system simulation model in land use optimization
49. Adaptation of different Agrl. systems to climate change.
50. Crop modeling a tool for Agrl. research
51. Variability and interaction involved in farming systems
52. Integrated approaches to climate crop modeling - Biotic interaction of farming components and crop modeling

Course Outcome:

- To understand the concepts, principles of cropping and advanced farming system management.
- To ascertain the production potentiality of different component of farming system.

Suggested readings

1. Balasubramanian P & Palaniappan SP 2006. *Principles and Practices of Agronomy*. Agrobios.
2. Joshi M & Parbhakarasetty TK. 2005. *Sustainability through Organic Farming*. Kalyani.
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4. Mathews RB, Kropff MJ, Bachelet D &VaanLaar HH. (Eds.). 1993. *Modelling the Impact of Climate Change on Rice Production in Asia.* CABI.
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6. http://www.agriinfo.in/?page=topiclist&superid=1&catid=42
7. http://agcollegejagtial.weebly.com/uploads/4/6/5/5/46554149/agro303.pdf
8. http://agritech.tnau.ac.in/sustainable_agri/susagri.html
9. http://www.uky.edu/~deberti/test/sust.pdf

GAGR 822: CURRENT TRENDS IN IRRIGATION AGRONOMY (2+1)

Learning Objectives:

- Students will understand the importance of water in agriculture
- Students will recognize the principles of water holding capacity of different soil and the suitable crops
- Students will know the soil moisture tension at various soil moisture regimes to understand the irrigation requirement of crops
- Students will gain knowledge on estimation of ET for different corps so that it they will advise the irrigation requirement for a larger farming community thereby saving water

Theory

Unit–I

Water resources and importance

Water resources of India, irrigation projects; irrigation needs, atmosphere, soil, agronomic, plant and water factors affecting irrigation need; water deficits and crop growth.

Unit–II

Soil-plant-atmosphere process

Soil-plant-water relationships, Reference evapotranspiration (ETo): (FAO-Penman Monteith approach), Soil physical properties and soil water content: Common expressions of soil water, pressure head, yield response to water under unlimited and limited water supply, Infiltration; water movement under saturated and unsaturated conditions; management practices for improving water use efficiency of crops.

Unit–III

Irrigation methods and scheduling

Surface irrigation, Sprinkler irrigation, Drip irrigation, Short introduction to water distribution for irrigation by surface and pressurized systems, Performance criteria for irrigation methods: efficiency, uniformity and adequacy, Irrigation scheduling-Deficit irrigation,

Unit–IV

Management of irrigation water quality

Strategies of using limited water supply, Leaching requirement to prevent soil salinity; Distribution, application and project efficiency in irrigation schemes, factors affecting ET, control of ET by mulching and use of anti-transpirants, fertilizer use in relation to irrigation; optimizing the use of given irrigation supplies.

Unit–V

Land suitability for irrigation

Land suitability for irrigation, land irrigability classification; integrated water management in command areas, institution of water management in commands, farmer's participation in command areas; irrigation legislation, Agronomic considerations in the design

and operation of irrigation projects; characteristics of irrigation and farming systems affecting irrigation management.

Practical

- Determination of water infiltration characteristics and water holding capacity of soil profiles
- Moisture extraction pattern of crops
- Computation of the crop evapotranspiration (crop water requirements), and the net and gross irrigation requirement, including the special case of paddy rice
- calculation of the leaching requirement to prevent soil salinity
- irrigation scheduling
- Estimation of wind drift for sprinkler, wetted area and wet bulb for drip and the time-distance graph for furrow irrigation
- Crop planning at the farm and project level
- Agronomic evaluation of irrigation projects, case studies

Lecture Schedule

1. Water resources of India, Tamil Nadu-present status and future needs
2. Irrigation projects in India – Tamil Nadu
3. Irrigation needs – Soil plant and meteorological factors determining irrigation need
4. Water deficits and its influence on crop growth
5. Soil-water-plant relationship: concepts
6. Mass water content, volumetric water content, equivalent depth, Water stored in the root zone; Root zone depletion, Water movement under – Saturated and unsaturated condition
7. Availability of water and absorption by roots- Soil water retention-field capacity, wilting point, total available water, readily available water
8. Study of climatic data such as air temperature, humidity, wind speed, solar radiation, sunshine and evaporation in relation to water needs
9. Significance of transpiration, factors determining the crop coefficient (Kc); Construction of the Kc-curve
10. Physiological process of transpiration and crop productivity
11. Computation of the net and gross irrigation,
12. Infiltration – Factors affecting infiltration rate – Measurement of infiltration rate.
13. Irrigation efficiency – Management practices for improving water use efficiency of crops.
14. Soil moisture conservation practices for improving water use efficiency of crops.
15. Operation of furrow and rice basins, estimation of advance time and needed infiltration time for furrow irrigation, Underground pipeline irrigation.
16. Different types and operation of sprinkler systems and estimation of wind drift losses, uniformity, impact of nozzle size and pressure on distribution of water
17. Operation, components of the drip system and estimation of the wetbulb.
18. Irrigation management for different agro ecosystem

19. **Mid-Semester exam**
20. Water requirement of major crops.
21. Strategies of using unlimited water supply.
22. Crop water requirements and gains of water by rainfall and capillary rise
23. Irrigation scheduling when water supply is not limiting and under conditions of water scarcity (e.g. deficit irrigation);
24. Crop plant adoption to moisture stress / excess and crop growth.
25. Factors affecting Evapotranspiration.
26. Control of ET by mulching and anti-transpirants
27. Fertilizer use in relation to irrigation – fertigation.
28. Optimizing the use of water / Effective utilizing of irrigation
29. Agronomic considerations in the design
30. Land suitability for irrigation land irrigability classification
31. Institutions of water management and IWM in command area
32. Farmers participation in command area
33. Characteristics of irrigation and farming systems affecting irrigation management.
34. Irrigation legislation in India

Practical Schedule

1. Estimation of soil moisture and constants by different methods
2. Measurement of evapotranspiration
3. Moisture extraction pattern of different crops
4. Computation of water requirement of crops using Penman-Montieth equation
5. Net and Gross irrigation requirement
6. Determination of infiltration rate and hydraulic conductivity
7. Designing and practical demonstration and measurement of sprinkler, drip and furrow irrigation
8. Time-distance graph for furrow irrigation
9. Estimation of wind drift for sprinkler, wetted area and wet bulb for drip
10. Developing fertigation scheduling for various crops, chemigation under micro -irrigation.
11. Working out irrigation efficiencies and crop water demand
12. Water requirement of a given cropping pattern/ variable productivity
13. Exercises on irrigation scheduling
14. Measurement of irrigation water by various devices.
15. Calculation of the leaching requirement to prevent soil salinity
16. Agronomic evaluation of irrigation projects
17. Excursion to a farmer and/or an experimental station where irrigation is used

Course Outcome:

- To understand the water resources of India and Tamil Nadu

- To understand the water requirement of various crops in various climatic and soil conditions
- To estimate the correct water requirement of crops.

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Suggested readings

1. Cecilia Tortajada , Asit K . Biswas and Avinash Tyagi 2016. Water
2. Davis Twomey . 2016. Irrigation and water management. Syrawood publishing, Hense.
3. FAO. 1984. Irrigation Practice and Water Management. Oxford & IBH.
4. Guy. J. Levy , Pinchas Fine and Asher Bar-Tal. 2010. Treated waste water in agriculture. John. Wiley and son Ltd.
5. Michael AM. 1978. Irrigation: Theory and Practice.Vikas Publ.
6. Mishra RR & Ahmad M. 1987. Manual on Irrigation and Agronomy. Oxford & IBH.
7. Megh R. Goyasl .2014. Sustainable micro irrigation management for trees and vines. CRC Press.
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7. http://projects.worldbank.org/P123112/irrigation-water-resources-management-project?lang=en
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GAGR 823: STRESS CROP PRODUCTION (2+1)

Learning Objectives

- Students will assess and analyze the symptoms, causes and effects of stress on crop production and implement appropriate stress management techniques.
- Students will monitor effectiveness of stress management techniques and revise to meet current needs.
- Students will gather information on current crop stress management techniques and to evaluate.
- Students will practice specific techniques, track effectiveness in different agro-ecosystem.

Theory

Unit I – Stress Concept in Agriculture:

Definition of stress – Distinction between stress and disturbances – limitation and stress – Crop Response to stress – Physiological and Ecological optimize – How crops cope up with stress – Ecological Dimension of stress science stress Biology.

Unit II - Stress and Strain Terminology:

Temperature stress Nature and stress injury and resistance; causes of stress. Low temperature stress: freezing injury and resistance in plants, measurement of freezing tolerance, chilling injury and resistance in plants, practical ways to overcome the effect of low temperature tress through, soil and crop manipulations. High temperature or heat stress: meaning of heat stress, heat injury and resistance in plants, practical ways to overcome the effect of heat stress through soil and crop manipulations.

Unit III - Water Deficit Stress:

Plant water deficient stress and its effect on growth and development, water deficit injury and resistance, practical ways to overcome effect of water deficit stress through soil and crop, manipulations. Stress at population level – density stress. Phenotypic and Genotypic variation – in population with stress. Excess water or flooding stress: meaning of excess water stress, its kinds and effects on crop plants, excess water stress injury and resistance, practical ways to overcome excess water stress through soil and crop manipulations

Unit IV - Salt stress:

Salt stress and Acid stress effect on crop growth, salt and acid soil stress injury and resistance in plants, practical ways to overcome the effect of salt and acid stress through soil and crop manipulations. Mechanical impedance of soil and its impact on plant growth; measures to overcome soil mechanical impedance.

Unit V – Stress response at cellular level:

Oxidative stress – definition - ROS - Types - ROS under stress and ROS Scavengers – Biological role of ROS Environmental pollution stress air, soil and water pollution, and their effect on crop growth

Practical

- Determination of electrical conductivity of plant cell sap
- Determination of osmotic potential and tissue water potential
- Measurement of transpiration rate
- Measurement of stomatal frequency
- Growing of plants in sand culture under salt stress for biochemical and physiological studies
- Studies on effect of osmotic and ionic stress on seed germination and seedling growth
- Measurement of low temperature injury under field conditions

Lecture Schedule

1. Stress and strain terminology
2. Nature and stress injury in crop plants.
3. Soil salinity and sodicity as particular plant / Crop stress factors.
4. Different causes of stress.

5. High temperature stress – Definition - heat injury
6. Effect of heat – Temperature stress on photosynthetic apparatus.
7. Soil and crop manipulations to overcome the effect of heat stress.
8. Excess water stress through soil and crop manipulations.
9. Water stress – Definition – Plant water deficit stress.
10. Constraints by water stress on plant growth
11. Effect of water deficit stress on growth and development.
12. Nutrient uptake by plants under stress condition.
13. Plant response to water – Deficit condition.
14. Soil and crop manipulation to overcome the effect of water deficit stress.
15. Excess water to crop plant water stress.
16. Water stress and its kinds and effect on crop plants.
17. **Mid-Semester examination**
18. Excess water stress injury and resistance.
19. Soil and crop manipulation to overcome the effect of excess water stress.
20. Salt stress – Definition – Its effect on crop growth.
21. Plants in saline environments.
22. Salt stress injury and resistance in plants.
23. Crop response & management of salt affected soils.
24. Soil manipulation to overcome the effect of salt stress.
25. Crop manipulation to overcome the effect of salt stress.
26. Mechanisms involved in salt tolerance in plants.
27. Mechanical impedance of soil & its impacts on plant growth.
28. Measures to overcome soil mechanical impedance.
29. Definition – Pollution – air pollution effect on crop growth and quality of produce.
30. Soil pollution – Effect on crop growth and quality of produce.
31. Water pollution – Effect on crop growth and quality of produce.
32. Effect of atmospheric pollution with special reference to ozone on plants under normal & saline conditions.
33. Plant response to air pollution & heavy metal stress.
34. Photosynthetic response of crop to environmental changes.

Practical schedule

1. Determination of electrical conductivity of plant cell sap.
2. Determination of osmotic potential.
3. Determination of tissue water potential.
4. Measurement of transipiration rate.
5. Measurement of stomatal frequency.
6. Growing of plants in sand culture under salt stress for biochemical studies.
7. Growing of plants in sand culture under salt stress for physiological studies.
8. Studies on effect of osmotic stress on seed germination.
9. Students on ironic stress on seed germination.

10. Studies on effect of osmotic stress on seedling growth.
11. Students on effect of ironic stress on seedling growth.
12. Measurement of low temperature injury under field condition.
13. Measurement of high temperature under controlled condition.
14. Studies on Air, water and soil pollution.
15. Studies on effect of different types of pollution on crop growth and quality of produce.
16. Studies on the effect of excess water or flooding stress on crop growth and development.
17. Measures to prevent different environmental pollution.

Course Outcomes

- To describe in detail the crop stress physiology.
- To discuss the concepts of assimilate translocation and partitioning in a crop plant under stress.
- To examine the physiology of crop adaptation to their environment;
- To develop critical thinking and problem-solving skills with respect to crop stress physiology

Suggested readings

1. Baker FWG.1989. Drought Resistance in Cereals. Oxon, UK.
2. Gupta U.S. (Ed.). 1988. Physiological Aspects of Dryland Farming. Oxford & IBH.
3. Kramer PJ.1983. Water Relations of Plants. Academic Press.
4. Levitt J. 1980. Response of Plants to Environmental Stresses. Vols. I, II. Academic Press.
5. Matthew P. Reynolds.2010. Climate change and crop production.CAB Publishing.
6. Mavi HS.1978. Introduction to Agro-meteorology. Oxford & IBH.
7. Mirza Hasanuzzman, Masayuki Fujita, Kamrun Nahar and Jiban Krishna Biswas.2018.Advances in rice research for abiotic stress tolerance. Wood head publishing.
8. Michael AM &Ojha TP.1981. Principles of Agrl. Engineering. Vol II. Jain Bros.
9. Nilsen ET &Orcut DM. 1996. Physiology of Plants under Stress – Abiotic Factors. John Wiley & Sons.
10. Parvaiz Ahmad.2015.Legume under environmental stress yield, improvement and adaptations.Wiley Blackwell.
11. Rakesh S. Sengar and Kalpana Senger.2014. Climate change effect on crop productivity.CRC press.
12. Singh K. 2000. Plant Productivity under Environmental Stress. Agribios.
13. Singh KN & Singh RP. 1990. Agronomic Research Towards Sustainable Agriculture. Indian Society of Agronomy, New Delhi.
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5. https://en.wikipedia.org/wiki/Air_pollution
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GAGR: 824 ADVANCES IN CROP ECOLOGY (2+1)

Learning Objectives:

- Students will study the various factors that influence the eco system
- Students will understand the adaptation of crops to different eco system

Theory

UNIT I - Concept of crop ecology:

Ecology of agricultural systems, ecology of cropping systems, principles of plant distribution and adaptation, crop and world food supply.

UNIT II – Ecosystems types and function:

Ecosystem characteristics, types and functions, terrestrial ecology, flow of energy in ecosystem, ecosystem productivity, biomass, succession and climax concept.

UNIT III – Physiological Response of crops in Ecosystems :

Physiological response of crop plants to light, temperature, CO2, moisture and solar radiation; influence of climate on photosynthesis and productivity of crops; effect of global climate change on crop production.

UNIT IV – Solar energy in ecosystems:

Exploitation of solar energy in crops; vertical distribution of temperature; efficiency in crop production. Solar corridor accepts in different latitude.

UNIT V – Competition of crop plants in ecosystem:

Competition in crop plants; environmental pollution, ecological basis of environmental management and environment manipulation through agronomic practices; improvement of unproductive lands through crop selection and management.

Practical

- Different growth stages of field crops
- Growth analysis
- Role of climatic factors on crop growth
- Impact of environmental pollution on crop yields
- Waste land development techniques
- Light measurement amidst crop canopy in cropping system

Lecture schedule

1. Introduction – bio diversity – biological and cultural diversity - plant genetic resources-

Bio sphere – Hot spots – Biotic wealth – its importance – distribution.

2. Genetic diversity – center of plant genetic diversity – in relation to Agriculture - origin of food crops.
3. Ecology definition, concepts and History.
4. Ecological crop geography – definition, concepts.
5. Crop ecology definition - concepts and history.
6. Agricultural systems – definition and hierarchy concepts – Natural social and artificial systems.
7. Agricultural systems – definition - classification and hierarchy – merits and demerits.
8. Cropping systems ecology – principles – diversification of crops and cropping systems.
9. Crop organization and rotation, crop choice.
10. Residue management – nutrient and water management.
11. Eco system – definition – components - characters.
12. Types of ecosystem – structure and its functions.
13. Terrestrial ecology – definition – components – characters.
14. Flow of energy in ecosystem – definition – importance.
15. Cycling energy and nutrients – tropic level – primary producers – role of organisms in energy flow.
16. Food chain – food web – energy pyramids.
17. Crop morphology and development in response to light and temperature.
18. Response of crops to moisture and solar radiation.
19. Crop plant in response to water stress – drought stress.
20. Influence of climate on crop distribution – temperature and photosynthesis.
21. Climatic factors on crop growth production and productivity.
22. Climate change and its effects on crop growth and development.
23. Impact of climate change on global crop production and productivity.
24. Agriculture and resource exploitation.
25. Renewable energy in agriculture – application of solar energy in agriculture.
26. Sustainable agriculture - renewable energy and its application.
27. Vertical temperature – definition – horizontal and vertical distribution of temperature on earth.
28. Horizontal and vertical distribution of temperature on ocean.
29. Effect of seasonal distribution of temperature.
30. Plant competition - definition – types – importance.
31. Crop - crop competition – crop weed competition.
32. Environmental pollution – its effects on crop growth and production.
33. Management of environmental pollution through agronomic practices.
34. Improvement of unproductive lands through crop selection and management.

Practical schedule

1. Basic problems in crop Ecology.
2. Methods of determining frequency.

3. Characters used in community structure.
4. &5. Practice in understanding various plant architecture.
6. &7. Growth analysis.
8. Nutrient use efficiency and studies on source and sink relationship.
9. Calculation of diversity index, dominance index and similarity index.
10. Different growth stages and yield components determination in rice.
11. Different growth stages and yield components determination in maize.
12. Different growth stages and yield components determination in sorghum.
13. Optimum soil temperatures for maximizing yield of important field crops.
14. Yield level, used to explain the conceptual basis for crop losses.
15. Survey about application of ecology in agriculture.
16. &17. Visit to different ecosystem – study the related experiments – data collection – interpretation.

Course Outcomes

- To understand the climatic factors and physiological response of crops to different eco systems
- To gain knowledge on competition of different crop plats in certain eco systems.

Suggested Readings

1. Alteri, M. A.1995. *Agroecology; the science of sustainable agriculture*(2nded.) Westview Press, Boulder, Colorado, USA
2. Ambasht RS. 1986. *A Text Book of Plant Ecology* (9th Ed). Students' Friends Chadha KL & Swaminathan MS. 2006. *Environment and Agriculture.* Malhotra Publ. House.
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4. David. J. Connor, Robert S. Loomis and Kenneth. G. Gassman. 2011. Crop ecology
5. productivity and management in Agricultural systems. Cambridge University press.
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9. Kumar HD. 1992. *Modern Concepts of Ecology* (7Ed). Vikas.Publ.
10. Lenka D. 1998. *Climate, Weather and Crops in India*. Kalyani.
11. Misra KC. 1989. *Manual of Plant Ecology* (3 Ed). Oxford & IBH.
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15. Singh J & Dhillon SS. 1984. *Agricultural Geography*. Tata McGraw Hill.
16. Taiz L & Zeiger E. 1992. *Plant Physiology*. Benjamin/Cummings Publ.

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7. https://ccafs.cgiar.org/blog/stakeholders-learn-new-features-yield-forecasting-toolkit
8. https://www.cimmyt.org/cimmyt-scientist-wins-award-from-crop-science-society-of-america/
9. https://www.eurekalert.org/pub_releases/2006-12/bc-ccc113006.php

MINOR COURSES

(First semester)

GAGR 815 Environmental protection and pollution management (2+1)

Learning Objective:

- Students will understand the impact of environmental agrochemicals in crop productivity
- Students will learn various technologies to mitigate environmental pollution
- Students will recognize various aspect that influence global warming and its impact in crop growth

Theory

UNIT I - Importance of environmental protection:

Environmental protection- importance- Sources of environmental pollution-Types and Impact of pollution-Agricultural pollution-

UNIT II - Agrochemicals and pollution:

Agro chemicals and pollution-pollution from herbicides – Fate of Herbicides in soil – Decomposition: microbial, chemical and photodecomposition, Herbicide persistence –Methods to minimize herbicide residues – placement, herbicide rotation, crop rotation, trap crops, use of bugs for herbicide degradation. PP chemicals and pollution- safe limits in food products and natural resources

UNIT III - Prevention of herbicide toxicity:

Herbicide toxicity problems to living organisms: Mammals, aquatic fauna, microorganisms, shifts in weed flora – herbicide resistance development in weeds – history, reasons and prevention of resistance development. Herbicides in warfare – undesirable effects and health hazards

UNIT IV - Nutrient sources and pollution:

Nutrient sources and pollution – unfavorable effects on soil fertility and soil microbes-Agronomic management of environmental pollution – Agroforestry practices. Use of aquatic weeds for water purification. Siltation and sedimentation of reservoirs and lakes – Eutrophication – reasons and control measures.

UNIT V - Global warming:

Climate change-Global warming- Greenhouse effect- Carbon sequestration- Ozone depletion.

Practical

- Assessment and analysis of ecological degradation and sources of degradation in
- agricultural lands
- Collection water samples and analysis of quality parameters
- Assessment of biodiversity of flora and fauna
- Visit to Pollution Control Board and collection of information related to pollution in Tamil Nadu.
- Visit to Environmental Science Laboratories of reputed Institutes and familiarization of activities.

Lecture schedule

1. Environmental protection and its impact on agriculture, Environmental pollution – sources.
2. Environmental pollution – global warming and impact of pollution on vegetation.
3. Natural depletion of vegetation.
4. Environmental planning and management - concept of environmental management.
5. Agrochemicals and pollution management.
6. Herbicide application and causes.
7. Action of herbicides in soil - Decomposition.
8. Herbicide persistence and residue management.
9. Methods of herbicide application and techniques used to reduce the herbicide residues.
10. Safe limits of herbicide application in crop production.
11. Herbicide toxicity, resistance and shifts in weed flora.
12. Herbicide registration and regulation – Decision support system.
13. Weed shift and invasive alien species and weed Risk assessment.
14. Bio – inoculants resource use in agriculture.
15. Bio scavenging of herbicide spills with GMO's.
16. Bio control of weeds using plant products.
17. Natural resources – definition - prospects.
18. **Mid semester examination**
19. Soil resources and crop productivity.
20. Agronomic measure for management of scarce and costly inputs.
21. Labour resource management – scarce and peak season demand.
22. Cost reduction in crop production.
23. Problem soil and their management.
24. Assessment of resource degradation under different land use system.
25. Resource management under constraint situations.
26. Environmental impact of poor water management.
27. Dealing climate change – causes.
28. Impact of climatic change on agriculture and food security.
29. Climate change mitigation strategies.
30. Climate resilient farming.
31. Bio security in the context of climate change - disaster mitigation.
32. Carbon sequestration strategies – Indigenous Agriculture practices.

33. Opportunity in changing climatic scenario.
34. Integrated approach in climate change adaptation.

Practical schedule

1. Study on environmental impact of poor water quality.
2. Quality assessment of irrigation water in Cuddalore - District.
3. Management of poor-quality water.
4. Study on problem soils.
5. Management of problem soils through reclamation.
6. Study about organic and industrial waste and availability.
7. Impact of organic and industrial wastes to the environment.
8. Awareness and education program modules for invasive alien species.
9. Management of invasive alien species.
10. Bio scavenging in aquatic systems and forestry.
11. Survey of natural resources, availability in Tamil Nadu.
12. Study about genetic resources and their use in modern agriculture.
13. Management of herbicide residues
14. Bio assay techniques for herbicide residues.
15. Scoring for phytotoxic injury of herbicides
16. Visit to pollution control board and data collection.
17. Visit to effluent treatment plant and familiarization of activities.

Course Outcome:

- To understand various agronomic management of environmental pollution
- To identify suitable crops and tree species for remediation of soil and environmental pollution.

Suggested Readings

1. Bhatia.S.C.2008. Hand book of Environmental Biotechnology. Atlantic Publisher.
2. Hodges, L. 1977. *Environmental Pollution.* Holt, Rinehart and Winston, New York
3. Khalid Rehman Hakeem.2015. Crop production and global environmental issues. Springer Nature.
4. Rana, S.V.S. 2005. *Essentials of Ecology and Environmental Science* (2nd ed.) Prentice-Hall of India, New Delhi.
5. Sharma, B.K. 2003. *Environmental Chemistry* (7th ed.). Goel Publishing House, Meerut
6. Tripathi A.K., Srivastava, A.K, and Pandey, S.N. 1993, *Advances in EnvironmentalSciences.*
7. Walker, C. 1975. *Environmental Pollution by Chemicals.* Anchor Press, Essex
8. Wright, R.T. 2007. *Environmental Science.* India Pvt Ltd. New Delhi.

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1. https://en.wikipedia.org/wiki/Environmental_protection
2. https://pdfs.semanticscholar.org/8e7b/a9595bab30d7ea87715533353c53f7452811.pdf

3. https://www.slideshare.net/pravirra/fate-of-herbicide-in-soil-by-pravir-pandey
4. cdn.intechopen.com/.../InTech-Herbicides_applications_problems_and_considerations...
5. https://www.researchgate.net/...used...weeds_in_control...borne.../21+Biocontrol+of+...
6. www.nicra-icar.in/.../NICRA%20Climate%20Resilient%20Agriculture%20Brochure.p...
7. http://www.fao.org/wairdocs/lead/x6114e/x6114e00.htm
8. https://phe.rockefeller.edu/mitigation/

(second semester)

GAGR 825 Principles and practices of organic management (2+1)

Learning Objectives

- Students will understand the importance organic farming in protecting the environment
- Students will learn the significance of indigenous practices and resource management in organic farming
- Student will know about the procedure for organic certification

Theory

Unit I – Importance of organic farming:

Organic farming for sustainable Agriculture –concept and Definition – Scope and principles – history of organic farming – global scenario-biodiversity-importance and measure to preserve biodiversity pre-requisites for Organic farming.

Unit II – Organic sources:

Organic sources of nutrients – manures and other inputs – on farm and off farm sources – organic waste recycling methods- methods of compost-compost making-*insitu* and *situ* manuring-soil and crop management-intercropping-crop rotation-green manures-cover crops-mulching.

Unit III – Indigenous practices of organic farming:

Indigenous Technical Knowledge (ITK) in organic agriculture. Bio – intensive nutrient management – Nutrient rich organic manures. Biofertilizers- Application of effective microorganism technology– phosphate rich organic manure-indigenous practices of organic farming- Organic Crop Production and Protection methods.

Unit IV – Organic certification:

Organic Certification and labeling – NPOP guidelines – Certification agencies in India – crop production standards – Quality considerations – labeling and accreditation process – marketing and export opportunities – Organic enterprises. Non chemical management methods for weeds, insects and diseases.

Unit V – Resource management :

Resource management LEIA and HEIA concepts And principles- Basic ecological principles of LEISA-Promising LEISA techniques-resource management under constraints situations-Cost

reduction strategies in crop production- Non-monetary inputs and low cost technologies- Labour management. Crop residue management. Conservation agriculture and its impact on agriculture.

Practical

- Aerobic and anaerobic methods of making compost
- Making of vermicompost
- Identification and nursery raising of important agro-forestry tress and tress for shelter belts
- Efficient use of biofertilizers, technique of treating legume seeds with Rhizobium cultures, use of Azotobacter, Azospirillum, and PSB cultures in field
- Visit to an organic farm
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms

Lecture Schedule

1. Definition-Organic farming-sustainable agriculture-prospects- concepts
2. Scope and principles-history and genesis of organic farming in world and India
3. Present status in world India and Tamilnadu.
4. Pre-requisites and basic steps for organic farming
5. Planning and processes of conservation of organic farming
6. Biodiversity-importance and measure to preserve biodiversity
7. Integration of animal components
8. Sources of organic manures – plant, animal and microbial origin-on-farm resources
9. FYM, green manures, crop residues, poultry manure, sheep and goat manures, biogas slurry.
10. Off-farm resources; coir pith, press mud, oilcakes, fly ash
11. Bio compost, minerals, bone meal, bio fertilizers, traditional preparations.
12. Organic waste recycling- methods and techniques
13. Composting, vermicomposting, in situ composting
14. Intensive cropping system
15. Intercropping-crop rotation
16. Green manuring-cover crops-mulching
17. Nutrient rich organic manures
18. **Mid-semester exam**
19. System approach in crop production
20. Indigenous technical knowledge (ITK) in organic agriculture – importance.
21. Bio intensive nutrient management
22. Organic certification – procedures
23. Certification agencies in India and labeling and accreditation processes.
24. Crop production standards – NPOP guidelines – principles, recommendations and standards and Organic farming
25. Promotional activities; role of government and NGO's – action plan – policy considerations.

26. Quality considerations – assessment methods – premium and export opportunities. Good crop husbandry practices for important field crops
27. Non – chemical weed management methods; preventive, physical, cultural, use of tools and implements and biological measures
28. Organic pests and diseases management practices – bio control agents, bio rational pesticides; minerals, botanicals, soaps, trap crops, bird perches, and traditional preparations – sanitation.
29. Resource management under constraint situation.
30. Cost reduction technologies and non monetary inputs in cropping and farming system.
31. LEIA and HEIA – principles and concepts – Basic ecological principles of LEISA and promising LEISA techniques
32. Labour management in cropping and farming system.
33. Crop residues management (CRM) for sustainable Agriculture
34. Conservation agriculture (CA), scope, advantages and CA technology for sustainable Agriculture.

Practical schedule

1. Resources Inventory of Organic farming.
2. Study on green manuring
3. Raising of green manures (Sunhemp/ Daincha/ Fodder cowpea)
4. Incorporation of green manure
5. Indigenous practices in seed treatment and raising of field crops (Rice, Maize, Cowpea, Cotton, Sugarcane)
6. Quantification of nutrients from organic sources
7. Hands on experience in recycling techniques – composting and vermicomposting
8. Production techniques – grading, packaging and post harvest management
9. Application methods of manures
10. Method of biofertilizer applications
11. Acquiring skills in quality aspects of inputs and products, grading, and packaging.
12. ITK based preparation (Panchakavya, Dasakavya, Amirthakaraisal, fish amino acids)
13. Exposure visit to organic farm market outlets and organic certification agencies.
14. Exposure visit to bio-control agent units
15. Exposure visit to bio fertilizer production units
16. Exposure visit to organic certification agencies/directorate of organic certification
17. Cost of production for organic cultivation of important field crops

Course Outcomes

- To know various input resources for organic farming
- To gain practical knowledge to develop a model organic farming that would help in enhancing their livelihood.

Suggested readings

1. Arun kumar Sharma, 2008. A Hand book of organic farming Agrobios polishers

2. Ann Larkin Hansen.2010. The organic farming method. Storey publishing.
3. Bibek Ghosh. 2007. Crops and livestock farming. Daya Publishing house.
4. Dahama, A.K.2009. Organic farming for sustainable agriculture, Agrobios publishers, Jodhpur
5. Diolip Nandvani. 2016. Organic farming for Sustainable Agriculture. Springer International publishing.
6. Gaur, A.C. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.
7. Rajpal Singh. 2008. Crop protection by botanical pesticide. Cbs Hb.
8. SP. Palaniappan and K Annadurai. 2008. Organic Farming: Theory and Practice. 2008. Scientific Publishers.
9. Sharma, A. 2002. *Hand Book of Organic Farming*. Agrobios.
10. Veeresh, G. K, Shivashankar, K. and Singlachar, M. A. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.

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1. http://www.fao.org/docrep/016/i2718e/i2718e.pdf
2. http://www.fao.org/fileadmin/templates/nr/sustainability_pathways/docs/
3. Compilation_techniques_organic_agriculture_rev.pdf
4. http://www.navdanya.org/attachments/Organic_Farming3.pdf
5. http://casfs.ucsc.edu/about/publications/Teaching – Organic – Farming/ PDF – downloads/TOFG – all.pdf
   https://www.iwapublishing.com/sites/default/files/ebooks/9781780402024.pdf
   df
7. https://www.nofany.org/files/USDA_What_is_Organic_Certification.pdf
8. http://agritech.tnau.ac.in/org_farm/orgfarm_principles.html
9. http://blog.agrivi.com/post/organic-farming-facts-and-principles

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