

## DEPARTMENT OF AGRONOMY

### PROGRAMMES

1. M.Sc.
2. Ph.D.

### COURSE REQUIREMENTS

#### M.Sc.

Field of specialization	Crop production, Nutrient management, Weed management, Water management, Crop physiology, Organic farming
Core courses	AGRON 511, AGRON 512, AGRON 513, AGRON 531
Optional courses	AGRON 521, AGRON 522, AGRON 523, AGRON 524, AGRON 525, AGRON 526, AGRON 532, AGRON 533, AGRON 534, AGRON 535, AGRON 536
Minor & supporting courses	STAT 511, STAT 521, PPHYS 521 or as per decision of advisory committee in view of research problem
Non credit compulsory courses	PGS 502, PGS 503
Deficiency courses	Nil or as deemed suitable by advisory committee

#### Ph.D.

Field of specialization	Crop production, Nutrient management, Weed management, Water management, Crop physiology, organic farming, Cropping systems
Core courses	Agron 611, Agron 612
Optional courses	Agron 613, Agron 614, Agron 621, Agron 622, Agron 623, Agron 624
Minor & supporting courses	Stat 612, Stat 622, Pphys 522 or as per decision of advisory committee in view of research problem
Non credit compulsory courses	PGS 502, PGS 503 (Exempted if done in M.Sc.)
Deficiency courses	Nil or as deemed suitable by advisory committee

## **DESCRIPTION OF COURSES**

### **Post graduate courses**

#### **AGRON 511 PRINCIPLES AND PRACTICES OF WEED MANAGEMENT**

**2+1**

#### **Objective**

To familiarize the students about the weeds, herbicides and methods of weed control.

#### **Theory**

##### **UNIT I**

Weed biology and ecology, crop-weed competition including allelopathy; principles and methods of weed control and classification; weed indices.

##### **UNIT II**

Herbicides introduction and history of their development; classification based on chemical, physiological application and selectivity; mode and mechanism of action of herbicides.

##### **UNIT III**

Herbicide structure - activity relationship; factors affecting the efficiency of herbicides; herbicide formulations, herbicide mixtures; herbicide resistance and management; weed control through bio-herbicides, myco-herbicides and allelochemicals; Degradation of herbicides in soil and plants; herbicide resistance in weeds and crops; herbicide rotation.

##### **UNIT IV**

Weed management in major crops and cropping systems; parasitic weeds; weed shifts in cropping systems; aquatic and perennial weed control.

##### **UNIT V**

Integrated weed management; cost : benefit analysis of weed management.

#### **Practical**

- Identification of important weeds of different crops
- Preparation of a weed herbarium
- Weed survey in crops and cropping systems
- Crop-weed competition studies
- Preparation of spray solutions of herbicides for high and low-volume sprayers
- Use of various types of spray pumps and nozzles and calculation of swath width
- Economics of weed control

- Herbicide resistance analysis in plant and soil
- Bioassay of herbicide resistance
- Calculation of herbicide requirement

### **Suggested Readings**

1. Aldrich RJ & Kramer RJ. 1997. *Principles in Weed Management*. Panima Publ.
2. Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2nd Ed. Wiley Inter-Science.
3. Gupta OP. 2008. *Modern Weed Management*. Agrobios.
4. Naylor REL. 2002. *Weed Management Hand Book*. Blackwell Publishing.
5. Rao VS. 2000. *Principles of Weed Science*. Oxford & IBH.
6. Sarswat VN, Bhan VM & Yaduraju NT. 2003. *Weed Management*. ICAR
7. Singh HP, Batish DR & Kohli RK. 2006. *Sustainable Weed Management*. Food Products Press – An imprint of The Haworth Press Inc.
8. Streibig JC & Kudsk P. 1993. *Herbicide Bioassay*. CRC Press Inc.
9. Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic Press.

## **AGRON 512 PRINCIPLES AND PRACTICES OF WATER MANAGEMENT 2+1**

### **Objective**

To teach the principles of water management and practices to enhance the water productivity.

### **Theory**

#### **UNIT I**

Water and its role in plants; water resources of India, major irrigation projects, extent of area and crops irrigated in India and different states.

#### **UNIT II**

Soil water movement in soil and plants; transpiration; Soil moisture constants; soil-water-plant relationships; water absorption by plants; plant response to water stress, crop plant adaptation to moisture stress condition.

#### **UNIT III**

Soil, plant and meteorological factors determining water needs of crops; scheduling, depth and methods of irrigation; microirrigation system; fertigation; management of water in controlled environments and polyhouses.

#### UNIT IV

Water management of the crops and cropping systems; quality of irrigation water and management of saline water for irrigation; water use efficiency.

#### UNIT V

Excess of soil water and plant growth; water management in problem soils; drainage requirement of crops and methods of field drainage, their layout and spacing.

#### **Practical**

- Measurement of soil moisture by using tensiometer, and pressure plate and membrane apparatus
- Soil-moisture characteristics curves
- Water flow measurements using different devices
- Determination of irrigation requirements
- Calculation of irrigation efficiency
- Determination of infiltration rate
- Determination of saturated/unsaturated hydraulic conductivity

#### **Suggested Readings**

1. Lenka D. 1999. *Irrigation and Drainage*. Kalyani
2. Mishra RD & Ahmed M. 1990. *Manual on Irrigation Agronomy*. Oxford & IBH Publishing Co. Pvt. Ltd.
3. Michael AM. 1978. *Irrigation: Theory and Practice*. Vikas Publ.
4. Paliwal KV. 1972. *Irrigation with Saline Water*. IARI Monograph, New Delhi.
5. Panda SC. 2003. *Principles and Practices of Water Management*. Agrobios.
6. Prihar SS & Sandhu BS. 1987. *Irrigation of Food Crops - Principles and Practices*. ICAR.
7. Reddy SR. 2000. *Principles of Crop Production*. Kalyani.

## **AGRON 513 PRINCIPLES AND PRACTICES OF SOIL FERTILITY AND 2+1 NUTRIENT MANAGEMENT**

### **Objective**

To impart knowledge of fertilizers and manures as sources of plant nutrients and apprise about the integrated approach of plant nutrition and sustainability of soil fertility.

### **Theory**

#### **UNIT I**

Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

#### **UNIT II**

Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients.

#### **UNIT III**

Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.

#### **UNIT IV**

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

#### **UNIT V**

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of vermicompost and residue wastes in crops.

### **Practical**

- Determination of soil pH, E<sub>Ce</sub>, organic C, total N, available N, P, K and S in soils
- Determination of total N, P, K and S in plants
- Interpretation of interaction effects and computation of economic and yield optima

### **Suggested Readings**

1. Brady NC & Weil R.R 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.
2. Fageria NK, Baligar VC & Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops*. Marcel Dekker.
3. Gupta PK. 2007. *A Hand Book of Soil, Fertilizer and Manures*. Agribios
4. Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
5. Prasad R & Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
6. Somani LL. 1996. *Efficient Use of Fertilizers*. Agrotech Publishing Academy.
7. Yawalkar KS, Agrawal JP & Bokde S. 2000. *Manures and Fertilizers*. Agri-Horti Publ.

## **AGRON 521    AGROMETEOROLOGY AND CROP WEATHER FORECASTING    2+1**

### **Objective**

To impart knowledge about agro-meteorology and crop weather forecasting to meet the challenges of aberrant weather conditions.

### **Theory**

#### UNIT I

Agro meteorology - aim, scope and development in relation to crop environment; composition of atmosphere, distribution of atmospheric pressure and wind.

#### UNIT II

Characteristics of solar radiation; energy balance of atmosphere system; radiation distribution in plant canopies, radiation utilization by field crops; photosynthesis and efficiency of radiation utilization by field crops; energy budget of plant canopies; environmental temperature: soil, air and canopy temperature.

#### UNIT III

Temperature profile in air, soil, crop canopies; soil and air temperature effects on plant processes; environmental moisture and evaporation: measures of atmospheric temperature and relative humidity vapor pressure and their relationships; evapo-transpiration and meteorological factors determining evapotranspiration.

#### UNIT IV

Modification of plant environment: artificial rain making, heat transfer, controlling heat load, heat trapping and shading; protection from cold, sensible and latent heat flux, controlling soil moisture; monsoon and their origin, characteristics of monsoon; onset, progress and withdrawal of monsoon; weather hazards, drought monitoring and planning for mitigation.

#### UNIT V

Weather forecasting in India – short, medium and long range; aerospace science and weather forecasting; benefits of weather services to agriculture, remote sensing; application in agriculture and its present status in India; atmospheric pollution and its effect on climate and crop production; climate change and its impact on agriculture.

#### **Practical**

- Visit to agro-meteorological observatory and to record sun-shine hours, wind velocity, wind direction, relative humidity, soil and air temperature, evaporation, precipitation and atmospheric pressure
- Measurement of solar radiation outside and within plant canopy
- Measurement/estimation of evapo-transpiration by various methods
- Measurement/estimation of soil water balance
- Rainfall variability analysis
- Determination of heat-unit requirement for different crops
- Measurement of crop canopy temperature
- Measurement of soil temperatures at different depths
- Remote sensing and familiarization with agro-advisory service bulletins
- Study of synoptic charts and weather reports, working principle of automatic weather station
- Visit to solar observatory

#### **Suggested Readings**

1. Chang Jan Hu 1968. *Climate and Agriculture on Ecological Survey*. Aldine Publ.
2. Critchfield HJ.1995. *General Climatology*. Prentice Hall of India.
3. Das PK.1968. *The Monsoons*. National Book Trust Publ.
4. Lal DS.2005. *Climatology*. Sharda Pustak Bhawan.
5. Lenka D.1998. *Climate, Weather and Crops in India*. Kalyani.
6. Mavi H.S.1994. *Introduction to Agro-meteorology*. Oxford & IBH.

7. Mavi HS & Tupper GJ. 2004. *Agrometeorology: Principles and Application of Climate Studies in Agriculture*. Haworth Press.
8. Menon PA.1991. *Our Weather*. National Book Trust Publ.
9. Sahu DD. *Agrometeorology and Remote Sensing: Principles and Practices*. Agrobios.
10. Variraju R & Krishnamurty 1995. *Practical Manual on Agricultural Meteorology*. Kalyani.
11. Varshneya MC & Balakrishana Pillai P. 2003. *Textbook of Agricultural Meteorology*. ICAR.

**AGRON -522      PRINCIPLES OF SOIL MANAGEMENT      3+0**  
**AND CROP PRODUCTION**

**Objective**

To study various aspects of soil and crop management practices, water deficit and excess stress situation and management thereof.

**Theory**

**UNIT I**

Tillage: definition, objectives, types and its effect on physical properties on soil; Concept of zero tillage; Concept of minimum tillage.

**UNIT II**

Soil fertility management in crop production: Plant nutrients – criteria of essentiality and forms of uptake, Role and deficiency symptoms of plant nutrients; Concept of balanced fertilization and integrated nutrient management; Nutrient management in cereal/ pulse based cropping systems; Concepts regarding

**UNIT III**

Precision farming and Site specific nutrient management; Organic matter : Importance, benefits, composition and decomposition; Factors affecting decomposition and detrimental effects; Crop residue management ; Classification and reclamation of saline and sodic soils; Management of saline and sodic soils.

**UNIT IV**

Constraints/Problems of crop production in different agro-climatic zones of Rajasthan; Seeds and their role in crop production; Concepts of optimum plant population, planting geometry and ideal plant type; Concepts regarding cropping systems-monoculture, crop rotation, multiple , Cropping, relay cropping, mixed cropping and intercropping;



## UNIT V

Water stress in relation to crop growth; Soil fertility and moisture interaction; Agronomic manipulation for higher yield in dryland agriculture; Excess soil water and crop growth; Agronomic practices for poorly drained soils; Weed management in crop production.

### **Suggested Readings**

1. Singh SS.1988. *Crop Management under Irrigated and Rainfed conditions*, Kalyani Publishers
2. Morachan YB. 1986. *Crop Production and Management*, Oxford & IBH Publishing Co
3. Singh KN, Bhattacharya HC, Mishra BN and Ahlawat IPS.1988. *Major Crop Production Constraints and Their Remedial Measures for Different Agro Climatic Zones of India*, ICAR
4. Reddy T, Yellamandu & Reddi, G.H. Sankara. 1992. *Principles of Agronomy*, Oxford & IBH Publishing Co
5. Tisdale SL, Nelson WL, Beaton JD & Halvin JL. 1995.*Soil Fertility and Fertilizers*, Prantice Hall of India Pvt. Ltd
6. Reddy SR.1999. *Principles of Agronomy*, Kalyani PublishersReddy, S.R.2000. Principles of Crop Production, Kalyani Publishers, New Delhi.
7. Halvin JL Beaton JD Tisdale SL & Nelson WL.2005.*Soil Fertility and Fertilizers: An Introduction to Nutrient Management*, Prentice Hall of India Pvt. Ltd
8. Panda SC. 2004. *Cropping and Farming Systems*, Agrobios (India)
9. Singh Gurriqbal Kotar JS & Sekhon HS. 2002. *Recent Advances in Agronomy*, Indian Society of Agronomy
10. Balasubramaniyan P & Pilanippan SP. 2004. *Principles and Practices of Agronomy*, Agrobios (India)
11. Nilsen ET & Orcutt DM. 1996. *The Physiology of Plants under Stress: Abiotic Factors*, John Wiley & Sons Inc.

## **AGRON 523 SOIL CONSERVATION AND WATERSHED MANAGEMENT 2+1**

### **Objective**

To teach about different soil moisture conservation technologies for enhancing the agricultural productivity through holistic approach watershed management.

### **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

### **Suggested Readings**

1. Arakeri HR & Roy D. 1984. *Principles of Soil Conservation and Water Management*. Oxford & IBH.

2. Dhruvanarayana VV. 1993. *Soil and Water Conservation Research in India*. ICAR.
3. FAO. 2004. *Soil and Water Conservation in Semi-Arid Areas*. *Soils Bull.*, Paper 57.
4. Frederick RT, Hobbs J, Arthur D & Roy L. 1999. *Soil and Water Conservation: Productivity and Environment Protection*. 3rd Ed. Prentice Hall.
5. Konkhe KH & Bertrand AR. 1969. *Soil Conservation*. McGraw Hill Book Int. Co.
6. Michael AM & Ojha TP. 1981. *Principles of Agricultural Engineering Vol. II*, Jain Brothers.
7. Murthy VVN. 1995. *Land and Water Management Engineering*. Kalyani.
8. Tripathi RP & Singh HP. 1993. *Soil Erosion and Conservation*. Wiley Eastern.
9. Yellamanda Reddy T & Sankara Reddy GH. 1992. *Principles of Agronomy*. Kalyani.

## **AGRON 524 DRYLAND FARMING**

**2+1**

### **Objective**

To teach the basic concepts and practices of dry land farming and soil moisture conservation.

### **Theory**

#### **UNIT I**

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture.

#### **UNIT II**

Soil and climatic parameters with special emphasis on rainfall characteristics; constraints limiting crop production in dry land areas; types of drought, characterization of environment for water availability; crop planning for erratic and aberrant weather conditions.

#### **UNIT III**

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

#### **UNIT IV**

Tillage, tith, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants; soil and crop management techniques, seeding and efficient fertilizer use.

## UNIT V

Concept of watershed resource management, problems, approach and components.

### **Practical**

- Seed treatment, seed germination and crop establishment in relation to soil moisture contents
- Moisture stress effects and recovery behaviour of important crops
- Estimation of moisture index and aridity index
- Spray of anti-transpirants and their effect on crops
- Collection and interpretation of data for water balance equations
- Water use efficiency
- Preparation of crop plans for different drought conditions
- Study of field experiments relevant to dryland farming
- Visit to dryland research stations and watershed projects

### **Suggested Readings**

1. Das NR. 2007. *Tillage and Crop Production*. Scientific Publishers.
2. Dhopte AM. 2002. *Agrotechnology for Dryland Farming*. Scientific Publ.
3. Gupta US. (Ed.). 1995. *Production and Improvements of Crops for Drylands*. Oxford & IBH.
4. Katyal JC & Farrington J. 1995. *Research for Rainfed Farming*. CRIDA.
5. Rao SC & Ryan J. 2007. *Challenges and Strategies of Dryland Agriculture*. Scientific Publishers.
6. Singh RP. 1988. *Improved Agronomic Practices for Dryland Crops*. CRIDA.
7. Singh RP. 2005. *Sustainable Development of Dryland Agriculture in India*. Scientific Publ.
8. Singh SD. 1998. *Arid Land Irrigation and Ecological Management*. Scientific Publishers.
9. Venkateshwarlu J. 2004. *Rainfed Agriculture in India. Research and Development Scenario*. ICAR.

**Objective**

To acquaint the students about prevailing cropping systems in the country and practices to improve their productivity.

**Theory**

## UNIT I

Cropping systems: definition, indices and its importance; physical resources, soil and water management in cropping systems; assessment of land use.

## UNIT II

Concept of sustainability in cropping systems and farming systems, scope and objectives; production potential under monoculture cropping, multiple cropping, alley cropping, sequential cropping and intercropping, mechanism of yield advantage in intercropping systems.

## UNIT III

Above and below ground interactions and allelopathic effects; competition relations; multi-storied cropping and yield stability in intercropping, role of non-monetary inputs and low cost technologies; research need on sustainable agriculture.

## UNIT IV

Crop diversification for sustainability; role of organic matter in maintenance of soil fertility; crop residue management; fertilizer use efficiency and concept of fertilizer use in intensive cropping system.

## UNIT V

Plant ideotypes for drylands; plant growth regulators and their role in sustainability.

**Suggested Readings**

1. Palaniappan SP & Sivaraman K. 1996. *Cropping Systems in the Tropics; Principles and Management*. New Age.
2. Panda SC. 2003. *Cropping and Farming Systems*. Agrobios.
3. Reddy SR. 2000. *Principles of Crop Production*. Kalyani.
4. Sankaran S & Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ. Co.
5. Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

**Objective**

To teach the crop husbandry of cereals and pulse crops.

**Theory**

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition, quality components, handling and processing of the produce for maximum production of

UNIT I

*Rabi* cereals: Wheat & barley

UNIT II

*Kharif* cereals: Paddy, maize, sorghum & pearl millet

UNIT III

*Rabi* pulses: Chick pea

UNIT IV

*Kharif* pulses: Pigeon pea

**Practical**

- Phenological studies at different growth stages of crop
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Working out growth indices (CER, CGR, RGR, NAR, LAD), aggressiveness, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems of different crops
- Estimation of protein content in pulses
- Planning and layout of field experiments
- Judging of physiological maturity in different crops
- Intercultural operations in different crops
- Determination of cost of cultivation of different crops
- Working out harvest index of various crops

- Study of seed production techniques in various crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

### **Suggested Readings**

1. Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
2. Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.
3. Jeswani LM & Baldev B. 1997. *Advances in Pulse Production Technology*. ICAR.
4. Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.
5. Kumar Ranjeet & Singh NP. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
6. Pal M, Deka J & Rai RK. 1996. *Fundamentals of Cereal Crop Production*. Tata McGraw Hill.
7. Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
8. Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
9. Singh, SS. 1998. *Crop Management*. Kalyani.
10. Yadav DS. 1992. *Pulse Crops*. Kalyani.

## **AGRON 531 MODERN CONCEPTS IN CROP PRODUCTION**

**3+0**

### **Objective**

To teach the basic concepts of soil management and crop production.

### **Theory**

#### **UNIT I**

Crop growth analysis in relation to environment; agro-ecological zones of India.

#### **UNIT II**

Quantitative agro-biological principles and inverse yield nitrogen law; Mitscherlich yield equation, its interpretation and applicability; Baule unit.

#### **UNIT III**

Effect of lodging in cereals; physiology of grain yield in cereals; optimization of plant population and planting geometry in relation to different resources, concept of ideal plant type and crop modeling for desired crop yield.

#### UNIT IV

Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress.

#### UNIT V

Integrated farming systems, organic farming, and resource conservation technology including modern concept of tillage; dry farming; determining the nutrient needs for yield potentiality of crop plants, concept of balance nutrition and integrated nutrient management; precision agriculture.

#### **Suggested Readings**

1. Balasubramaniyan P & Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.
2. Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.
3. Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.
4. Paroda R.S. 2003. *Sustaining our Food Security*. Konark Publ.
5. Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.
6. Sankaran S & Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.
7. Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

### **AGRON 532 AGRONOMY OF OILSEED, FIBRE AND SUGAR CROPS**

**2+1**

#### **Objective**

To teach the crop husbandry of oilseed, fiber and sugar crops.

#### **Theory**

Origin and history, area and production, classification, improved varieties, adaptability, climate, soil, water and cultural requirements, nutrition quality component, handling and processing of the produce for maximum production of :



## UNIT I

*Rabi* oilseeds – Rapeseed & mustard, linseed.

## UNIT II

*Kharif* oilseeds - Groundnut, sesame, soybean etc.

## UNIT III

Fiber crops - Cotton, sunhemp.

## UNIT IV

Sugar crops –Sugarcane.

### **Practical**

- Planning and layout of field experiments
- Cutting of sugarcane setts, its treatment and methods of sowing, tying and propping of sugarcane
- Determination of cane maturity and calculation on purity percentage, recovery percentage and sucrose content in cane juice phenological studies at different growth stages of crop
- Intercultural operations in different crops
- Cotton seed treatment
- Working out growth indices (LER, CGR, RGR, NAR, LAD) aggressivity, relative crowding coefficient, monetary yield advantage and ATER of prominent intercropping systems
- Judging of physiological maturity in different crops and working out harvest index
- Working out cost of cultivation of different crops
- Estimation of crop yield on the basis of yield attributes
- Formulation of cropping schemes for various farm sizes and calculation of cropping and rotational intensities
- Determination of oil content in oilseeds and computation of oil yield
- Estimation of quality of fibre of different fibre crops
- Study of seed production techniques in various crops
- Visit of field experiments on cultural, fertilizer, weed control and water management aspects
- Visit to nearby villages for identification of constraints in crop production

### **Suggested Readings**

1. Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
2. Das PC. 1997. *Oilseed Crops of India*. Kalyani.

3. Lakshmikantam N. 1983. *Technology in Sugarcane Growing*. 2nd Ed. Oxford & IBH.
4. Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
5. Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
6. Singh SS. 1998. *Crop Management*. Kalyani.

## **AGRON 533 AGRONOMY OF FODDER AND FORAGE CROPS**

**2+1**

### **Objective**

To teach the crop husbandry of different forage and fodder crops along with their processing.

### **Theory**

#### **UNIT I**

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important fodder crops like maize, *bajra*, *guar*, cowpea, oats, barley, berseem, *senji*, lucerne etc.

#### **UNIT II**

Adaptation, distribution, varietal improvement, agro-techniques and quality aspects including anti-quality factors of important forage crops/grasses lime, napier grass, *Panicum*, *Lasiurus*, *Cenchrus* etc.

#### **UNIT III**

Year-round fodder production and management, preservation and utilization of forage and pasture crops.

#### **UNIT IV**

Principles and methods of hay and silage making; chemical and biochemical changes, nutrient losses and factors affecting quality of hay and silage; use of physical and chemical enrichments and biological methods for improving nutrition; value addition of poor quality fodder.

#### **UNIT V**

Economics of forage cultivation uses and seed production techniques.

### **Practical**

- Practical raining of farm operations in raising fodder crops;
- Canopy measurement, yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops

- Anti-quality components like HCN in sorghum and such factors in other crops
- Hay and silage making and economics of their preparation

### **Suggested Readings**

1. Chatterjee BN. 1989. *Forage Crop Production - Principles and Practices*. Oxford & IBH.
2. Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
3. Narayanan TR & Dabadghao PM. 1972. *Forage Crops of India*. ICAR.
4. Singh P & Srivastava AK. 1990. *Forage Production Technology*. IGFRI, Jhansi.
5. Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
6. Tejwani KG. 1994. *Agroforestry in India*. Oxford & IBH.
7. Tyagi ID. 2002. *Modern Agriculture: New Paradigm*. Jain Brothers.

## **AGRON 534 AGRONOMY OF MEDICINAL, AROMATIC AND UNDER-UTILIZED CROPS 2+1**

### **Objective**

To acquaint students about different medicinal, aromatic and underutilized field crops, their package of practices and processing.

### **Theory**

#### **UNIT I**

Importance of medicinal and aromatic plants in human health, national economy and related industries, classification of medicinal and aromatic plants according to botanical characteristics and uses.

#### **UNIT II**

Climate and soil requirements; cultural practices; yield and important constituents of medicinal plants (Isabgol, Rauwolfia, Poppy, *Aloe vera*, Satavar, Stevia, Safed Musli, Kalmegh, Asaphoetida, *Nux vomica*, Rosadle etc).

#### **UNIT III**

Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants (Citronella, Palmarosa, Mentha, Basil, Lemon grass, Rose, Patchouli, Geranium etc.).

#### **UNIT IV**

Climate and soil requirements; cultural practices; yield of under-utilized crops (Rice bean, Lathyrus, Sesbania, Clusterbean, French bean, Fenugreek, Grain Amaranth, Coffee, Tea and Tobacco).

### **Practical**

- Identification of crops based on morphological and seed characteristics
- Raising of herbarium of medicinal, aromatic and under-utilized plants
- Quality characters in medicinal and aromatic plants
- Methods of analysis of essential oil and other chemicals of importance in medicinal and aromatic plants

### **Suggested Readings**

1. Chadha KL & Gupta R. 1995. *Advances in Horticulture*. Vol. II. *Medicinal and Aromatic Plants*. Malhotra Publ.
2. Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
3. Handa SS. 1984. *Cultivation and Utilization of Medicinal Plants*. RRL, CSIR, Jammu.
4. Hussain A. 1984. *Essential Oil Plants and their Cultivation*. CIMAP, Lucknow.
5. Hussain A. 1993. *Medicinal Plants and their Cultivation*. CIMAP, Lucknow.
6. ICAR 2006. *Hand Book of Agriculture*. ICAR, New Delhi.
7. Kumar N, Khader Md. Abdul, Rangaswami JBM & Irulappan 1997. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants*. Oxford & IBH.
8. Prajapati ND, Purohit SS, Sharma AK & Kumar T. 2003. *A Hand Book of Medicinal Plants: A Complete Source Book*. Agrobios.
9. Sharma R. 2004. *Agro-Techniques of Medicinal Plants*. Daya Publ. House.

**AGRON 535 AGROSTOLOGY AND AGRO-FORESTRY**

**2+1**

### **Objective**

To teach crop husbandry of different forage, fodder and agroforestry crops/trees along with their processing.

### **Theory**

## UNIT I

Agrostology: definition and importance; principles of grassland ecology: grassland ecology – community, climax, dominant species, succession, biotype, ecological status of grasslands in India, grass cover of India; problems and management of grasslands.

## UNIT II

Importance, classification (various criteria), scope, status and research needs of pastures; pasture establishment, their improvement and renovation-natural pastures, cultivated pastures; common pasture grasses.

## UNIT III

Agroforestry: definition and importance; agroforestry systems, agrisilviculture, silvipasture, agrisilvipasture, agrihorticulture, aquasilviculture, alley cropping and energy plantation.

## UNIT IV

Crop production technology in agro-forestry and agrostology system; silvipastoral system: meaning and importance for wasteland development; selection of species, planting methods and problems of seed germination in agro-forestry systems; irrigation and manuring in agro-forestry systems, associative influence in relation to above ground and underground interferences; lopping and coppicing in agro-forestry systems; social acceptability and economic viability, nutritive value of trees; tender operation; desirable tree characteristics.

### **Practical**

- Preparation of charts and maps of India showing different types of pastures and agro-forestry systems
- Identification of seeds and plants of common grasses, legumes and trees of economic importance  
with reference to agro-forestry
- Seed treatment for better germination of farm vegetation
- Methods of propagation/planting of grasses and trees in silvipastoral system
- Fertilizer application in strip and silvipastoral systems
- After-care of plantation
- Estimation of protein content in loppings of important fodder trees
- Estimation of calorie value of wood of important fuel trees
- Estimation of total biomass and fuel wood

- Economics of agro-forestry
- Visit to important agro-forestry research stations

### **Suggested Readings**

1. Chatterjee BN & Das PK. 1989. *Forage Crop Production. Principles and Practices*. Oxford & IBH.
2. Dabadhao PM & Shankaranarayan KA. 1973. *The Grass Cover in India*. ICAR.
3. Dwivedi AP. 1992. *Agroforestry- Principles and Practices*. Oxford & IBH.
4. Indian Society of Agronomy. 1989. *Agroforestry System in India. Research and Development*, New Delhi.
5. Narayan TR & Dabadhao PM. 1972. *Forage Crop of India*. ICAR, New Delhi.
6. Pathak PS & Roy MM. 1994. *Agroforestry System for Degraded Lands*. Oxford & IBH.
7. Sen NL, Dadheech RC, Dashora LK & Rawat TS. 2004. *Manual of Agroforestry and Social Forestry*. Agrotech Publ.
8. Shah SA. 1988. *Forestry for People*. ICAR.
9. Singh Panjab, Pathak PS & Roy MM. 1994. *Agroforestry System for Sustainable Use*. Oxford & IBH.
10. Singh SP. 1994. *Handbook of Agroforestry*. Agrotech Publ.
11. Solanki KR. 2000. *Multipurpose Tree Species: Research, Retrospect and Prospects*. Agrobios.
12. Tejwani KG. 1994. *Agroforestry in India*. Oxford & IBH.
13. Tyagi ID. 2002. *Modern Agriculture: New Paradigm*. Jain Brothers.

## **AGRON 536 PRINCIPLES AND PRACTICES OF ORGANIC FARMING**

**2+1**

### **Objective**

To study the principles and practices of organic farming for sustainable crop production.

### **Theory**

#### **UNIT I**

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use, minimum tillage; shelter zones, hedges, pasture management, agro-forestry.

## UNIT II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

## UNIT III

Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

## UNIT IV

Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

## UNIT V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

### **Practical**

- Aerobic and anaerobic methods of making compost
- Making of vermicompost
- Identification and nursery raising of important agro-forestry trees and trees 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

### **Suggested Readings**

1. Ananthakrishnan TN. (Ed.). 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.
2. Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.
3. Lampin N. 1990. *Organic Farming*. Press Books, Ipswich, UK.
4. Palaniappan SP & Anandurai K. 1999. *Organic Farming – Theory and Practice*. Scientific Publ.

5. Rao BV Venkata. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective*: Publ.3, Parisaraprajna Parishtana, Bangalore.
6. Reddy MV. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
7. Sharma A. 2002. *Hand Book of Organic Farming*. Agrobios.
8. Singh SP. (Ed.) 1994. *Technology for Production of Natural Enemies*. PDBC, Bangalore.
9. Subba Rao NS. 2002. *Soil Microbiology*. Oxford & IBH.
10. Trivedi RN.1993. *A Text Book of Environmental Sciences*, Anmol Publ.
11. Veeresh GK, Shivashankar K & Suiglachar MA. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.
12. WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*. WHO.
13. Woolmer PL & Swift MJ. 1994. *The Biological Management of Tropical Soil Fertility*. TSBF & Wiley.



## **Ph.D. courses**

### **AGRON 611 ADVANCES IN CROP GROWTH AND PRODUCTIVITY**

**2+1**

#### **Objective**

To study the physiology of vegetative and reproductive growth in relation to productivity of different crops in various environments.

#### **Theory**

##### **UNIT I**

Plant density and crop productivity; plant and environmental factors, yield, plant 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; principles 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 III**

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 IV**

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 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 in intercropping
- Senescence and abscission indices
- Analysis of productivity trend in un-irrigated areas
- Analysis of productivity trend in irrigated areas

### **Suggested Readings**

1. Chatterjee BN, S. Maiti & Mandal BK. 1989. *Cropping System: Theory & Practice*. Oxford & IBH Publishing Co. Pvt. Ltd.
2. Chopra VL & Paroda RS. 1984. *Approaches for Incorporation of Drought and Salinity Resistance in Crop Plants*. Oxford and IBH.
3. Franklin P, Gardner, R.Brent Pearce & Roger L. Mitchell. 1985. *Physiology of Crop Plants*. Scientific Publishers.
4. Lincoln Taiz & Eduardo Zeiger. 2002. *Plant Physiology* 3<sup>rd</sup> Ed. Panima Publishing Corporation.
5. Evans LT. 1975. *Crop Physiology*. Cambridge Univ. Press.
6. Evans LT. 1996. *Crop Evolution, Adaptation and Yield*. Cambridge Univ. Press.
7. Gupta US. (Ed.). 1995. *Production and Improvement of Crops for Drylands*. Oxford & IBH.
8. Gupta US. 1988. *Progress in Crop Physiology*. Oxford and IBH.
9. Kramer PJ & Boyer JS. 1995. *Water Relations of Plant and Soils*. Academic Press.
10. Mukherjee S & Ghosh AK. 1996. *Plant Physiology*. Tata McGraw Hill.
11. Narwal SS, Politycka B & Goswami CL. 2007. *Plant Physiology: Research Methods*. Scientific Publishers.
12. Palaniappan, SP & Shivaraman K. 1996. *Cropping System in The Tropics*. Principles and Management. New Age International (P) Ltd. Publisher.
13. Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publishers.

14. Salisbury FB & Ross CW. 1986. *Plant Physiology*. CBS Publishers & Distributors.
15. Verma SC & Singh MP. 1987. *Agronomy of New Plant Types*. Tara Book Co.
16. Hilmann M. 1990. *Synthetic Plant Growth Regulators*. *Advance Agronomy*. 43: 48-105.

**Objective**

To teach about the changing weed flora, new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems.

**Theory**

**UNIT I**

Crop-weed competition in different cropping situations; changes in weed flora, various causes and affects.

**UNIT II**

Important herbicide families & molecules; herbicide absorption, translocation, metabolism and mode of action; selectivity of herbicides and factors affecting them.

**UNIT III**

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

**UNIT IV**

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**

Development of transgenic herbicide resistant crops; herbicide development, registration procedures.

**UNIT VI**

Relationship of herbicides with tillage, fertilizer and irrigation; bioherbicides, allelochemical herbicide bioassays.

**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. Gupta OP. 2008. *Modern Weed Management*. Agrobios.
4. Naylor REL. 2002. *Weed Management Hand Book*. Blackwell Publishing.
5. Prados RDe, Jarrin J & Torres L. 1997. *Weed and Crop Resistance to Herbicides*. Kluwer Academic Publisher.

6. Rao VS. 2007. *Principles of Weed Science*. Oxford & IBH.
7. Ross MA & Carola Lembi A. 1999. *Applied Weed Science*. 2nd Ed. Prentice Hall.
8. Subramanian SAM & Kumar R.J. 1997. *All About Weed Control*. Kalyani.
9. Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic Press.

## **AGRON 613 IRRIGATION MANAGEMENT**

**2+1**

### **Objective**

To teach students about optimization of irrigation in different crops under variable agroclimatic conditions.

### **Theory**

#### UNIT I

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

#### UNIT II

Soil-plant-water relationships, transpiration and evapotranspiration, significance of transpiration, energy utilization in transpiration, scheduling of irrigation in field crops..

#### UNIT III

Measurement of irrigation water; Infiltration; water movement under saturated and unsaturated conditions; management practices for improving water use efficiency of crops.

#### UNIT IV

Methods and Application of irrigation water, conveyance and distribution system, irrigation efficiency; agronomic considerations in the design and operation of irrigation projects; characteristics of irrigation and farming systems affecting irrigation management.

#### UNIT V

Strategies of using limited water supply; 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 VI

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.

### **Practical**

- Determination of water infiltration characteristics and water holding capacity of soil profiles
- Moisture extraction pattern of crops
- Consumptive use, water requirement of a given cropping pattern for optimum/variable productivity
- Crop planning at the farm and project level
- Agronomic evaluation of irrigation projects, case studies

### **Suggested Readings**

1. FAO. 1984. *Irrigation Practice and Water Management*. Oxford & IBH.
2. Michael AM. 1978. *Irrigation: Theory and Practice*. Vikas Publ.
3. Mishra RD & Ahmad M. 1987. *Manual on Irrigation and Agronomy*. Oxford & IBH.
4. Panda SC. 2003. *Principles and Practices of Water Management*. Agrobios.
5. Reddy SR. 2000. *Principles of Crop Production*. Kalyani.
6. Sankara Reddy GH & Yellamananda Reddy 1995. Efficient Use of Irrigation Water. In: Gupta US. (Ed.). *Production and Improvement of Crops for Drylands*. Oxford & IBH.
7. Singh SS. 2006. Principles and Practices of Agronomy. In: Gupta US. (Ed.). *Production and Improvement of Crops for Drylands*. Oxford & IBH.

## **AGRON 614 CROP ECOLOGY**

**3+0**

### **Objective**

To acquaint the students about the agricultural systems, agro-ecological regions, and adaptation of crops to different agro-climatic conditions.

### **Theory**

#### **UNIT I**

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

## UNIT II

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

## UNIT III

Physiological response of crop plants to light, temperature, CO<sub>2</sub>, moisture and solar radiation; influence of climate on photosynthesis and productivity of crops; effect of global climate change on crop production.

## UNIT IV

Exploitation of solar energy in crops; vertical distribution of temperature; efficiency in crop production.

## UNIT V

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.

### **Suggested Readings**

1. Ambasht RS. 1986. *A Text Book of Plant Ecology*. 9th Ed. Students' Friends & Co.
2. Chadha KL & Swaminathan MS. 2006. *Environment and Agriculture*. Malhotra Publ. House.
3. Dhaliwal GS & Kler DS. 1995. *Principles of Agricultural Ecology*. Himalaya Publishing House.
4. Dwivedi P, Dwivedi SK & Kalita MC. 2007. *Biodiversity and Environmental Biotechnology*. Scientific Publ.
5. Hemantarajan A. 2007. *Environmental Physiology*. Scientific Publ.
6. Kumar HD. 1992. *Modern Concepts of Ecology*. 7th Ed. Vikas.Publ.
7. Lenka D. 1998. *Climate, Weather and Crops in India*. Kalyani.
8. Misra KC. 1989. *Manual of Plant Ecology*. 3rd Ed. Oxford & IBH.
9. Pandey SN & Sinha BK. 1995. *Plant Physiology*. Vikas Publ.
10. Sharma PD. 1998. *Ecology and Environment*. Rastogi Publ.
11. Singh J & Dhillon SS. 1984. *Agricultural Geography*. Tata McGraw Hill.
12. Taiz L & Zeiger E. 1992. *Plant Physiology*. Benjamin/Cummings Publ.

**Objective**

To acquaint the students about recent advances in agricultural production.

**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, global warming, GM crops, seed production technology; seed certification, seed multiplication, hybrid seed production etc.

**UNIT V**

Concepts of system agriculture; holistic approach of farming systems, dryland farming, sustainable agriculture and research methodology in Agronomy.

**Suggested Readings**

1. Agarwal RL. 1995. *Seed Technology*. Oxford & IBH.
2. Dahiya BS & Rai KN. 1997. *Seed Technology*. Kalyani.
3. Govardhan V. 2000. *Remote Sensing and Water Management in Command Areas: Agroecological Prospectives*. IBDC.
4. ICAR. 2006. *Hand Book of Agriculture*. ICAR.
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. Sheaffer CC & Moncada KM. 2009. *Introduction to Agronomy: Food, Crops and Environments*. Delmar Cengage Learning.
9. Tarafdar JC, Tripathi KP & Mahesh Kumar 2007. *Organic Agriculture* Scientific Publ.

## **AGRON 622 STRESS CROP PRODUCTION**

**2+1**

### **Objective**

To study various types of stresses in crop production and strategies to overcome them.

### **Theory**

#### **UNIT I**

Stress and strain terminology; nature and stress injury and resistance; causes of stress.

#### **UNIT II**

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 stress through, soil and crop manipulations.

#### **UNIT III**

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 IV**

Water deficit stress: meaning of 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.

#### **UNIT V**

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 VI**

Salt stress: meaning of salt stress and its effect on crop growth, salt stress injury and resistance in plants, practical ways to overcome the effect of salt stress through soil and crop manipulations.

#### **UNIT VII**

Mechanical impedance of soil and its impact on plant growth; measures to overcome soil mechanical impedance.

## UNIT VIII

Environmental pollution: air, soil and water pollution, and their effect on crop growth and quality of produce; ways and means to prevent environmental pollution.

### **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

### **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. Mavi HS.1978. *Introduction to Agro-meteorology*. Oxford & IBH.
6. Michael AM & Ojha TP.1981. *Principles of Agricultural Engineering*. Vol II. Jain Bros.
7. Nilsen ET & Orcut DM. 1996. *Physiology of Plants under Stress – Abiotic Factors*. John Wiley & Sons.
8. Salisbery FB & Ross CW. 1988. *Plant Physiology*. CBS Publishers and Distributors.
9. Singh K. 2000. *Plant Productivity under Environmental Stress*. Agribios.
10. Somani LL & Totawat KL. 1992. *Management of Salt-affected Soils and Waters*. Agrotech Publ.
11. Somani LL. 1996. *Efficient Use of Fertilizers*. Agrotech Publishing Academy.
12. Virmani SM, Katyal JC, Eswaran H & Abrol IP.1994. *Stressed Ecosystem and Sustainable Agriculture*. Oxford & IBH.

## **AGRON 623 INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE 3+0 AGRICULTURE**

### **Objective**

To apprise about different enterprises suitable for different agroclimatic conditions for sustainable agriculture.

### **Theory**

#### UNIT I

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

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

#### UNIT III

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

Simulation models for intercropping; soil nutrient in intercropping; preparation of different farming system models; evaluation of different farming systems.

#### UNIT V

New concepts and approaches of farming systems and cropping systems and organic farming; case studies on different farming systems.

### **Suggested Readings**

1. Ananthkrishnan TN. (Ed.) 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.
2. Balasubramanian P & Palaniappan SP 2006. *Principles and Practices of Agronomy*. Agrobios.
3. Joshi M & Parbhakarasetty TK. 2005. *Sustainability through Organic Farming*. Kalyani.
4. Lampin N. 1990. *Organic Farming*. Farming Press Books.
5. Palaniappan SP & Anandurai K. 1999. *Organic Farming - Theory and Practice*. Scientific Publ.

6. Panda SC. 2004. *Cropping systems and Farming Systems*. Agribios.
7. Reddy MV. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
8. Sharma AK. 2001. *A Hand Book of Organic Farming*. Agrobios.
9. Singh KN & Singh RP. 1990. *Agronomic Research towards Sustainable Agriculture*. Indian Society of Agronomy, IARI.
10. Singh SP. (Ed) 1994. *Technology for Production of Natural Enemies*. PDBC, Bangalore.
11. Trivedi RN. 1993. *A Text Book of Environmental Sciences*. Anmol Publ.
12. Veeresh GK, Shivashankar K & Suiglachar MA. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.
13. Venkata Rao BV. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective*. Publ. 3. Parisaraprajna Parishtana, Bangalore.

## **AGRON 624 CROP PRODUCTION AND SYSTEM MODELING**

**2+1**

### **Objective**

To familiarize the students about systems approach and to simulate yields and growth of several crops under varied soil and weather conditions with different management practices and their optimization.

### **Theory**

#### UNIT I

Systems classification; flow charts, modeling techniques and methods of integration - state, rates and driving variables, feedbacks and relational diagrams.

#### UNIT II

Elementary models for crop growth based on basic methods of classical growth analysis.

#### UNIT III

Crop modeling methods for crop-weather interaction, climate change and variability components.

#### UNIT IV

Potential production: leaf and canopy CO<sub>2</sub> assimilation, respiration, dry matter accumulation, crop phenology and dry matter distribution and development in different crops.

#### UNIT V

Production by moisture availability, potential evapotranspiration, water balance of the soil, and production with nutrient and moisture limitations.

### **Practical**

- Simulation of elementary models for crop growth
- Simulation of potential production
- Simulation with limitations of water and nutrient management options
- Sensitivity analysis using different climatic years and crop management practices

### **Suggested Readings**

1. Gordan G. 1992. *System Simulation*. 2nd Ed. Prentice Hall.
2. Kropff MJ & Vann Laar HH. (Ed.). 1993. *Modelling Crop Weed Interactions*. ISBN.
3. Mathews RB, Kropff MJ, Bachelet D & Vaan Laar HH. (Eds.). 1993. *Modelling the Impact of Climate Change on Rice Production in Asia*. CABI.
4. Penning de Vries FWT & Van Laar HH. (Eds.). 1982. *Simulation of Plant Growth and Crop Production*. Wageningen Centre for Agricultural Publications and Documentation, Netherlands.
5. Ritchie JT & Hanks J. 1991. *Modelling Plant and Soil Systems*. American Society of Agronomy, Madison.
6. Zeigler BP. 1976. *Theory of Modeling and Simulation*. John Wiley & Sons.