



**Nagaland University**  
(A central University Established by the Act of Parliament No. 35 of 1989)

**School of Agricultural Sciences**  
**Medziphema Campus- 797 106 (Nagaland)**  
**Department of Agronomy**

**Course Structure for Ph.D in Agronomy**

<b>COURSE CODE</b>	<b>COURSE TITLE</b>	<b>CREDITS</b>
AGRON 601*	CURRENT TRENDS IN AGRONOMY <sup>[L]</sup> <sub>[SEP]</sub>	<b>3+0</b>
AGRON 602	RECENT TRENDS IN CROP GROWTH AND PRODUCTIVITY	<b>2+1</b>
AGRON 603	IRRIGATION MANAGEMENT	<b>2+1</b>
AGRON 604	RECENT TRENDS IN WEED MANAGEMENT	<b>2+0</b>
AGRON 605	INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE	<b>2+0</b>
AGRON 606	SOIL CONSERVATION AND WATERSHED MANAGEMENT <sup>[L]</sup> <sub>[SEP]</sub>	<b>2+1</b>
AGRON 607	STRESS CROP PRODUCTION <sup>[L]</sup> <sub>[SEP]</sub>	<b>2+1</b>
AGRON 608*	RESEARCH AND PUBLICATION ETHICS <sup>[L]</sup> <sub>[SEP]</sub>	<b>2+0</b>
AGRON 691	DOCTORAL SEMINAR <sup>[L]</sup> <sub>[SEP]</sub>	<b>1+0</b>
AGRON 692	DOCTORAL SEMINAR <sup>[L]</sup> <sub>[SEP]</sub>	<b>1+0</b>
AGRON 699	DOCTORAL RESEARCH	<b>75</b>

\* Indicates core courses for Ph.D

**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**

- Agarwal RL. 1995. *Seed Technology*. Oxford & IBH.  
Dahiya BS & Rai KN. 1997. *Seed Technology*. Kalyani.  
Govardhan V. 2000. *Remote Sensing and Water Management in Command Areas: Agroecological Prospectives*. IBDC.  
ICAR. 2006. *Hand Book of Agriculture*. ICAR.  
Narasaiah ML. 2004. *World Trade Organization and Agriculture*. Sonali Publ.  
Palaniappan SP & Annadurai K. 2006. *Organic Farming - Theory and Practice*. Scientific Publ.  
Sen S & Ghosh N. 1999. *Seed Science and Technology*. Kalyani.  
Tarafdar JC, Tripathi KP & Mahesh Kumar 2007. *Organic Agriculture*. Scientific Publ.

**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

Ambasht RS. 1986. *A Text Book of Plant Ecology*. 9<sup>th</sup> Ed. Students' Friends & Co.

Chadha KL & Swaminathan MS. 2006. *Environment and Agriculture*.

Malhotra Publ. House.

Dwivedi P, Dwivedi SK & Kalita MC. 2007. *Biodiversity and*

*Environmental Biotechnology*. Scientific Publ.

Hemantarajan A. 2007. *Environmental Physiology*. Scientific Publ.

Kumar HD. 1992. *Modern Concepts of Ecology*. 7<sup>th</sup> Ed. Vikas.Publ.

Lenka D. 1998. *Climate, Weather and Crops in India*. Kalyani.

Misra KC. 1989. *Manual of Plant Ecology*. 3<sup>rd</sup> Ed. Oxford & IBH.

Pandey SN & Sinha BK. 1995. *Plant Physiology*. Vikas Publ.

Sharma PD. 1998. *Ecology and Environment*. Rastogi Publ.

Singh J & Dhillon SS. 1984. *Agricultural Geography*. Tata McGraw Hill.

Taiz L & Zeiger E. 1992. *Plant Physiology*. Benjamin/Cummings Publ.

## AGRON 603 CROP PRODUCTION AND SYSTEM MODELING

2+1

### 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

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

## AGRON 604 ADVANCES IN CROP GROWTH AND PRODUCTIVITY

2+1

### 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**

- Chopra VL & Paroda RS. 1984. *Approaches for Incorporation of Drought and Salinity Resistance in Crop Plants*. Oxford and IBH.
- Delvin RM & Vitham FH. 1986. *Plant Physiology*. CBS Publ.
- Evans LT. 1975. *Crop Physiology*. Cambridge Univ. Press.
- Evans LT. 1996. *Crop Evolution, Adaptation and Yield*. Cambridge Univ. Press.
- Gupta US. (Ed.). 1995. *Production and Improvement of Crops for Drylands*. Oxford & IBH.
- Gupta US. 1988. *Progress in Crop Physiology*. Oxford and IBH.
- Kramer PJ & Boyer JS. 1995. *Water Relations of Plant and Soils*. Academic Press.
- Mukherjee S & Ghosh AK. 1996. *Plant Physiology*. Tata McGraw Hill.
- Narwal SS, Politycka B & Goswami CL. 2007. *Plant Physiology: Research Methods*. Scientific Publishers.

## **AGRON 605 IRRIGATION MANAGEMENT**

**2+1**

### **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, physiological processes and crop productivity.

#### **UNIT III**

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

#### **UNIT IV**

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

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

## AGRON 606 ADVANCES IN WEED MANAGEMENT

2+0

### Theory

#### UNIT I

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

#### UNIT II

Physiological and biological aspects of herbicides, their 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

- Aldrich RJ & Kramer R.J. 1997. *Principles in Weed Management*. Panama Publ.
- Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2<sup>nd</sup> Ed. Wiley-Inter Science.
- Gupta OP. 2000. *Weed Management – Principles and Practices*. Agrobios.
- Mandal RC. 1990. *Weed, Weedicides and Weed Control - Principles and Practices*. Agro-Botanical Publ.
- Rao VS. 2007. *Principles of Weed Science*. Oxford & IBH.
- Ross MA & Carola Lembi A. 1999. *Applied Weed Science*. 2<sup>nd</sup> Ed. Prentice Hall.
- Subramanian SAM & Kumar R.J. 1997. *All About Weed Control*. Kalyani.
- Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2<sup>nd</sup> Ed. Academic Press.

## AGRON 607 INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE

2+0

### 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

- Ananthakrishnan TN. (Ed.) 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.
- Balasubramanian P & Palaniappan SP 2006. *Principles and Practices of Agronomy*. Agrobios.
- Joshi M & Parbhakarasetty TK. 2005. *Sustainability through Organic Farming*. Kalyani.
- Lampin N. 1990. *Organic Farming*. Farming Press Books.
- Palaniappan SP & Anandurai K. 1999. *Organic Farming - Theory and Practice*. Scientific Publ.
- Panda SC. 2004. *Cropping systems and Farming Systems*. Agribios.

- Reddy MV. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
- Sharma AK. 2001. *A Hand Book of Organic Farming*. Agrobios.
- Singh SP. (Ed) 1994. *Technology for Production of Natural Enemies*. PDBC, Bangalore.
- Trivedi RN. 1993. *A Text Book of Environmental Sciences*. Anmol Publ.
- Veeresh GK, Shivashankar K & Suiglachar MA. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.
- Venkata Rao BV. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective*. Publ. 3. Parisaraprajna Parishtana, Bangalore.

**AGRON 608 SOIL CONSERVATION AND WATERSHED  
MANAGEMENT**

**2+1**

**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**

- Arakeri HR & Roy D. 1984. *Principles of Soil Conservation and Water Management*. Oxford & IBH.
- Dhruvanarayana VV. 1993. *Soil and Water Conservation Research in India*. ICAR.
- FAO. 2004. *Soil and Water Conservation in Semi-Arid Areas*. *Soils Bull.*, Paper 57.
- Frederick RT, Hobbs J, Arthur D & Roy L. 1999. *Soil and Water Conservation: Productivity and Environment Protection*. 3<sup>rd</sup> Ed. Prentice Hall.
- Gurmel Singh, Venkataraman CG, Sastry B & Joshi P. 1990. *Manual of*



*Soil and Water Conservation Practices*. Oxford & IBH.  
Murthy VVN. 1995. *Land and Water Management Engineering*. Kalyani.  
Tripathi RP & Singh HP. 1993. *Soil Erosion and Conservation*. Wiley Eastern.  
Yellamanda Reddy T & Sankara Reddy GH. 1992. *Principles of Agronomy*. Kalyani.

## **AGRON 609 STRESS CROP PRODUCTION**

**2+1**

### **Theory**

#### **UNIT I**

Stress and strain terminology; 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 stress through soil and crop manipulations.

#### **UNIT II**

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: 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 IV**

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 V**

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 VI**

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

#### **UNIT VII**

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**

- Baker FWG.1989. *Drought Resistance in Cereals*. Oxon, UK.
- Gupta U.S. (Ed.). 1988. *Physiological Aspects of Dryland Farming*. Oxford & IBH.
- Kramer PJ.1983. *Water Relations of Plants*. Academic Press.
- Levitt J. 1980. *Response of Plants to Environmental Stresses*. Vols. I, II. Academic Press.
- Mavi HS.1978. *Introduction to Agro-meteorology*. Oxford & IBH.
- Michael AM & Ojha TP.1981. *Principles of Agricultural Engineering*. Vol II. Jain Bros.
- Nilsen ET & Orcut DM. 1996. *Physiology of Plants under Stress - Abiotic Factors*. John Wiley & Sons.
- Singh K. 2000. *Plant Productivity under Environmental Stress*. Agribios.
- Singh KN & Singh RP. 1990. *Agronomic Research Towards Sustainable Agriculture*. Indian Society of Agronomy, New Delhi.
- Somani LL & Totawat KL. 1992. *Management of Salt-affected Soils and Waters*. Agrotech Publ.
- Virmani SM, Katyal JC, Eswaran H & Abrol IP.1994. *Stressed Ecosystem and Sustainable Agriculture*. Oxford & IBH.

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