AGRONOMY

Course Structure - at a Glance

CODE	COURSE TITLE	CREDITS
AGRON 501*	MODERN CONCEPTS IN CROP PRODUCTION	3+0
AGRON 502*	PRINCIPLES AND PRACTICES OF SOIL FERTILITY AND NUTRIENT MANAGEMENT	2+1
AGRON 503*	PRINCIPLES AND PRACTICES OF WEED MANAGEMENT	2+1
AGRON 504*	PRINCIPLES AND PRACTICES OF WATER MANAGEMENT	2+1
AGRON 505	AGROMETEOROLOGY AND CROP WEATHER FORECASTING	2+1
AGRON 506	AGRONOMY OF CEREAL CROP-I (RICE)	2+1
AGRON 507	AGRONOMY OF CEREAL CROPS-II (MAIZE AND MILLETS)	2+1
AGRON 508	AGRONOMY OF CEREAL CROPS II (WHEAT AND BARLEY)	2+1
AGRON 509	AGRONOMY OF PULSE CROPS (KHARIF AND RABI)	2+1
AGRON 510	AGRONOMY OF OIL SEED CROPS (KHARIF AND RABI)	2+1
AGRON 511	AGRONOMY OF FIBRE CROPS	2+1
AGRON 512	AGRONOMY OF SUGAR CROPS	2+1
AGRON 513	AGRONOMY OF TUBER CROPS	2+1
AGRON 514	AGRONOMY OF FODDER AND FORAGE CROPS	2+1
AGRON 515	CROPPING SYSTEMS AND SUSTAINABLE AGRICULTURE	2+0
AGRON 516	DRYLAND FARMING AND WATERSHED MANAGEMENT	2+1
AGRON 517	PRINCIPLES AND PRACTICES OF ORGANIC FARMING	2+1
AGRON 518	DIAGNOSIS OF NUTRITIONAL DEFICIENCY IN FIELD CROPS AND THEIR REMEDIAL MEASURE	2+1
AGRON 591	MASTER’S SEMINAR	1+0
AGRON 599	MASTER'S RESEARCH	20
AGRON 601	CURRENT TRENDS IN AGRONOMY	3+0
AGRON 602	CROP ECOLOGY	2+0
AGRON 603	ADVANCES IN CROP GROWTH AND PRODUCTIVITY	2+1
AGRON 604	ADVANCES IN WATER MANAGEMENT	2+1
AGRON 605	ADVANCES IN WEED MANAGEMENT	2+0
AGRON 606	INTEGRATED FARMING SYSTEMS AND SUSTAINABLE AGRICULTURE	2+0
AGRON 607	SOIL CONSERVATION AND WATERSHED MANAGEMENT	2+1
AGRON 608	STRESS CROP PRODUCTION	2+1
AGRON 609	CROP PRODUCTION AND SYSTEM MODELING	2+1
AGRON 610	ADVANCE TECHNOLOGY IN CEREALS PRODUCTION	2+1
AGRON 691	DOCTORAL SEMINAR I	1+0
AGRON 692	DOCTORAL SEMINAR II	1+0
AGRON 699	DOCTORAL RESEARCH	45

* Compulsory for Master's programme

Course Contents

AGRON 501 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; gro-ecological zones ofIndia.

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

Balasubramaniyan P & Palaniappan SP. 2001. *Principles and Practices of Agronomy*. Agrobios.

Fageria NK. 1992. *Maximizing Crop Yields*. Marcel Dekker.

Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.

Paroda R.S. 2003. *Sustaining our Food Security*. Konark Publ.

Reddy SR. 2000. *Principles of Crop Production*. Kalyani Publ.

Sankaran S & Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.

Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

AGRON 502 SOIL FERTILITY AND NUTRIENT MANAGEMENT 2+1

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 vermincompost and residue wastes in crops.

Practical

- Determination of soil pH, ECe, 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

Brady NC & Weil R.R 2002. *The Nature and Properties of Soils.* 13th Ed. Pearson Edu.
Fageria NK, Baligar VC & Jones CA. 1991. *Growth and Mineral Nutrition of Field Crops.* Marcel Dekker.
Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. *Soil Fertility and Fertilizers.* 7th Ed. Prentice Hall.
Prasad R & Power JF. 1997. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
Yawalkar KS, Agrawal JP & Bokde S. 2000. *Manures and Fertilizers*. Agri-Horti Publ.

AGRON 503 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.
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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 herbicidal requirement

Suggested Readings

Aldrich RJ & Kramer RJ. 1997. *Principles in Weed Management*. Panima Publ.
Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2nd Ed. Wiley Inter-Science.
Gupta OP. 2007. *Weed Management – Principles and Practices.* Agrobios.
Mandal RC. 1990. *Weed, Weedicides and Weed Control - Principles and Practices*. Agro-Botanical Publ.
Rao VS. 2000. *Principles of Weed Science*. Oxford & IBH.
Subramanian S, Ali AM & Kumar RJ. 1997. *All About Weed Control*. Kalyani.
Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic Press.

AGRON 504 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-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 water potential 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

Lenka D. 1999. *Irrigation and Drainage*. Kalyani
Michael AM. 1978. *Irrigation: Theory and Practice*. Vikas Publ.
Paliwal KV. 1972. *Irrigation with Saline Water*. IARI Monograph, New Delhi.
Panda SC. 2003. *Principles and Practices of Water Management*. Agrobios.
Prihar SS & Sandhu BS. 1987. *Irrigation of Food Crops - Principles and Practices*. ICAR.
Reddy SR. 2000. *Principles of Crop Production*. Kalyani.
Singh Pratap & Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publ.

AGRON 505 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.

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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

Chang Jan Hu 1968. *Climate and Agriculture on Ecological Survey*. Aldine Publ.

Critchfield HJ.1995. *General Climatology.* Prentice Hall of India.

Das PK.1968. *The Monsoons*. National Book Trust Publ.

Lal DS.1998. *Climatology*. Sharda Pustak Bhawan.

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

Mavi H.S.1994. *Introduction to Agro-meteorology*. Oxford & IBH.

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

AGRON. 506 (CORE): Agronomy of Cereal Crop-I (Rice) 2+1

Objective:

To teach the crop husbandry of rice crop

Theory:

Origin, antiquity of rice, area and production, distribution, classification, description and varietal improvement. Adouptibility, Agro-climatic different zones of rice in India, growth of rice, effect of temperature on growth, nutrition and yield of rice, fertilizer-soil interaction in relation to nutrition and yield of rice, cultural practices including integrated weed management for rice. Water & fertilizer management practices for rice. Rice culture in problematic soil conditions. Rice-based cropping systems Yield gap analysis concept and package of practices of hybrid rice. Post harvest Technology and crop quality. Handling and processing of the produce for maximum production of rice.

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
• 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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.

Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.

Pal M, Deka J & Rai RK. 1996. *Fundamentals of Cereal Crop Production*.Tata McGraw Hill.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.

Singh, SS. 1998. *Crop Management*. Kalyani.

AGRON 507: Agronomy of Cereal Crops-II (Maize and Millets) 2+1

Objective:

To teach the crop husbandry of Maize and Millets crop

Theory:

Origin & history, area & production, distribution, botany, classification, description and varietal improvement, adaptability, climate, soil water and cultural requirement, development and nutrition of the crop plant based on agronomic investigation. Crop protection, Cost of cultivation, Crop quality, Industrial uses of byproducts. Handling and processing of the produce for maximum production of Maize and Millets.

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
- 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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.
Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.
Kumar Ranjeet & Singh NP. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
Pal M, Deka J & Rai RK. 1996. *Fundamentals of Cereal Crop Production*.Tata McGraw Hill.
Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.
Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
Singh, SS. 1998. *Crop Management*. Kalyani.

AGRON 508: Agronomy of Cereal Crops II (Wheat and Barley) 2+1

Objective:

To teach the crop husbandry of Wheat and Barley crop

Theory:

Origin & history, area & production, distribution, place of wheat and barley cops position in India, description, Varieties and their improvements, adaptability, climatic requirements and soil management, tillage and other special cultural practices in respect of rice-wheat cropping sequence. Growth phases of wheat and barley and its relation with temperature. Agronomic appraisal of varieties, crop quality, handling and processing of the produce, crop protection-weed control, cultivation cost, wheat and barley cultivation with special references to West Bengal conditions. Industrial uses of byproducts. Handling and processing of the produce for maximum production of Wheat and Barley.

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
- 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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.

Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.

Pal M, Deka J & Rai RK. 1996. *Fundamentals of Cereal Crop Production*.Tata McGraw Hill.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.

Singh, SS. 1998. *Crop Management*. Kalyani.

AGRON 509: Agronomy of Pulse Crops (Kharif and Rabi) 2+1

Objective:

To teach the crop husbandry of Pulse crops

Theory:

Origin & history, area & production, distribution, botany, classification, description and agronomic appraisal of the varietal improvement. Role of green legumes in building of soil fertility and moisture conservation. Adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Kharif and Rabi legumes based crop rotations and cropping systems. Crop protection. Cost of cultivation, industrial uses of bye-products, Crop quality, handling and processing of the produce for maximum production of Kharif and Rabi Pulses.

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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Hunsigi G & Krishna KR. 1998. *Science of Field Crop Production*. Oxford & IBH.

Jeswani LM & Baldev B. 1997. *Advances in Pulse Production Technology*. ICAR.

Khare D & Bhale MS. 2000. *Seed Technology*. Scientific Publ.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.

Singh, SS. 1998. *Crop Management*. Kalyani.

Yadav DS. 1992. *Pulse Crops*. Kalyani.

AGRON 510: Agronomy of Oil Seed Crops (Kharif and Rabi) 2+1

Objective:

To teach the crop husbandry of Oil Seed crops

Theory:

Origin & history, area & production, distribution, botany, classification, description and varietal improvement of the crop. Adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of byproducts. Crop quality, handling and processing of the produce for maximum production of Kharif (Ground nut, Soybean, Sesame, Castor etc) and Rabi (Rapeseed and Mustard, Linseed, Sunflower, Safflower, Niger and Taramira) Oil Seeds.

Practical

- Planning and layout of field experiments
- Intercultural operations in different crops
- 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
- 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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Das PC. 1997. *Oilseed Crops of India*. Kalyani.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops.* Oxford & IBH.

Singh SS. 1998. *Crop Management*. Kalyani.

AGRON 511: Agronomy of Fibre Crops 2+1

Objective:

To teach the crop husbandry of Fibre crops

Theory:

Origin & history, area & production, distribution, botany, classification, description and agronomic appraisal of the varietal improvement of the crops (Jute, Sunhemp, Cotton). Adaptability, climate, soil, water and agricultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop quality, handling and processing of the produce for maximum production of Jute, Sunhemp, Cotton .

Practical

- Planning and layout of field experiments
- 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
- 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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Fiel dCrops.* Oxford & IBH.

Singh SS. 1998. *Crop Management*. Kalyani.

AGRON 512: Agronomy of Sugar Crops 2+1

Objective:

To teach the crop husbandry of Sugar crops

Theory:

Origin & history, area & production, distribution, botany, classification, description and varietal improvement. Adaptability, climate, soil, water and cultural requirements. Development and nutrition of the crop plant based on agronomic investigations. Crop protection. Cost of cultivation. Industrial uses of byproducts. Crop quality, handling and processing of the produce for maximum production of sugar crops (sugar cane, sugar beet).

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
- 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
- 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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Lakshmikantam N. 1983. *Technology in Sugarcane Growing*. 2nd Ed. Oxford & IBH.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops.* Oxford & IBH.

Singh SS. 1998. *Crop Management*. Kalyani.

AGRON 513: Agronomy of Tuber Crops 2+1

Objective:

To teach the crop husbandry of Tuber crops

Theory:

Origin & history, area & production, distribution, botany, classification, description and agronomic appraisal of the varietal improvement of the crop, adaptability, climate, soil, water and cultural requirements, development and nutrition of the crop plant based on agronomic investigation. Crop protection, cost of cultivation, industrial uses of by products, individual crop-based cropping system. Crop quality, handling and processing of the produce for maximum production of Tuber crops: potato and other tuber crops [sweeppotato, cassava, yams (*Dioscorea*), aroids (*Colocasia, Amorphophallus, Alocasia, Zanthosoma*), yam bean (*Pachyrrhisus*)].

Practical

- Planning and layout of field experiments
- Intercultural operations in different crops
- 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
- Estimation of quality for different tuber 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

Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.

Prasad, Rajendra. 2002. *Text Book of Field Crop Production*. ICAR.

Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops.* Oxford & IBH.

Singh SS. 1998. *Crop Management*. Kalyani.

AGRON 514 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/grasseslime, napier grass, *Panicum, Lasiuras, 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

Chatterjee BN. 1989. *Forage Crop Production - Principles and Practices*. Oxford & IBH.
Das NR. 2007. *Introduction to Crops of India*. Scientific Publ.
Narayanan TR & Dabadghao PM. 1972. *Forage Crops of India*. ICAR.
Singh P & Srivastava AK. 1990. *Forage Production Technology*. IGFRI, Jhansi.
Singh C, Singh P & Singh R. 2003. *Modern Techniques of Raising Field Crops*. Oxford & IBH.
Tejwani KG. 1994. *Agroforestry in India*. Oxford & IBH.

AGRON 515 CROPPING SYSTEMS AND SUSTAINABLE AGRICULTURE 2+0

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

Palaniappan SP & Sivaraman K. 1996. *Cropping Systems in the Tropics; Principles and Management.* New Age.

Panda SC. 2003. *Cropping and Farming Systems*. Agrobios.

Reddy SR. 2000. *Principles of Crop Production*. Kalyani.

Sankaran S & Mudaliar TVS. 1997. *Principles of Agronomy.* The Bangalore Printing & Publ. Co.

Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.

Tisdale SL, Nelson WL, Beaton JD & Havlin JL. 1997. *Soil Fertility and Fertilizers*. Prentice Hall.

AGRON 516 DRYLAND FARMING AND WATERSHED MANAGEMENT 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, tilth, 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

Das NR. 2007. *Tillage and Crop Production*. Scientific Publishers.
Dhopte AM. 2002. *Agrotechnology for Dryland Farming*. Scientific Publ.
Dhruv Narayan VV. 2002. *Soil and Water Conservation Research in India*. ICAR.
Gupta US. (Ed.). 1995. *Production and Improvements of Crops for Drylands*. Oxford & IBH.
Katyal JC & Farrington J. 1995. *Research for Rainfed Farming*. CRIDA.
Rao SC & Ryan J. 2007. *Challenges and Strategies of Dryland Agriculture*. Scientific Publishers.
Singh P & Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture.* Agrotech Publishing Company.
Singh RP. 1988. *Improved Agronomic Practices for Dryland Crops*. CRIDA.
Singh RP. 2005. *Sustainable Development of Dryland Agriculture in India*. Scientific Publ.
Singh SD. 1998. *Arid Land Irrigation and Ecological Management*. Scientific Publishers.
Venkateshwarlu J. 2004. *Rainfed Agriculture in India. Research and Development Scenario*. ICAR.

AGRON 517 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 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

Suggested Readings

Ananthakrishnan TN. (Ed.). 1992. *Emerging Trends in Biological Control of Phytophagous Insects*. Oxford & IBH.
Gaur AC. 1982. *A Manual of Rural Composting*, FAO/UNDP Regional Project Document, FAO.

Lampin N. 1990. *Organic Farming*. Press Books, lpswitch, UK.
Palaniappan SP & Anandurai K. 1999. *Organic Farming – Theory and Practice.* Scientific Publ.
Rao BV Venkata. 1995. *Small Farmer Focused Integrated Rural Development: Socio-economic Environment and Legal Perspective*: Publ.3, Parisaraprajna Parishtana, Bangalore.
Reddy MV. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
Sharma A. 2002. *Hand Book of Organic Farming*. Agrobios.
Singh SP. (Ed.) 1994. *Technology for Production of Natural Enemies.* PDBC, Bangalore.
Subba Rao NS. 2002. *Soil Microbiology*. Oxford & IBH.
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.
WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*. WHO.
Woolmer PL & Swift MJ. 1994. *The Biological Management of Tropical Soil Fertility*. TSBF & Wiley.

AGRON 518: Diagnosis of Nutritional Deficiency in Field Crops and their Remedial Measure 2+1

Objective

To teach the basic concepts of nutritional deficiency in field crops and their remedial measures.

Theory

Deficiency symptoms of individual elements- macro, micro exhibited by cereals, oilseeds, pulses, fibre crops, forage crops, sugar crops, tuber crops, causes of deficiency, physiological changes brought about in plants due to deficiency. Plants parts showing the symptoms critical level of nutrient elements of deficiency, indicator plants for different elements. Toxicity limits of different elements. Toxicity systems. Prevention alleviation of deficiency toxicity, similarly of deficiency symptoms with disease symptoms.

Practical

- Principles of colorimetry
- Flame-photometry and atomic absorption spectroscopy
- Chemical analysis of soil for total and available nutrients
- Analysis of plants for essential elements

Suggested Readings

Brady NC & Weil RR. 2002. *The Nature and Properties of Soils.* Pearson Edu.
Kabata-Pendias A & Pendias H. 1992. *Trace Elements in Soils and Plants*. CRC Press.
Kanwar JS. (Ed.). 1976. *Soil Fertility: Theory and Practice*. ICAR.
Mengel K & Kirkby EA. 1982. *Principles of Plant Nutrition*. International Potash Institute, Switzerland.
Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. *Micronutrients in Agriculture*. 2nd Ed. SSSA, Madison.
Prasad R & Power JF. *Soil Fertility Management for Sustainable Agriculture*. CRC Press.
Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999. *Soil Fertility and Fertilizers.* 5th Ed. Prentice Hall of India.
Troeh FR & Thompson LM. 2005. *Soils and Soil Fertility*. Blackwell.
Vogel AI. 1979. *Textbook of Quantitative Inorganic Analysis*. ELBS.

AGRON 601 CURRENT TRENDS IN AGRONOMY 3+0

Objective

To acquaint the students about recent advances in agricultural production.

Theory

UNIT I

Agro-physiological basis of variation in yield, recent advances in soilplant-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.

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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.

AGRON 602 CROP ECOLOGY 2+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_2, 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*. 9th 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*. 7th Ed. Vikas.Publ.
Lenka D. 1998. *Climate, Weather and Crops in India*. Kalyani.
Misra KC. 1989. *Manual of Plant Ecology*. 3rd 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 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

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 604 ADVANCES IN WATER 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, 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 605 ADVANCES IN WEED MANAGEMENT 2+0

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

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.

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Suggested Readings

Aldrich RJ & Kramer R.J. 1997. *Principles in Weed Management*. Panama Publ.
Ashton FM & Crafts AS. 1981. *Mode of Action of Herbicides*. 2nd 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.* 2nd Ed. Prentice Hall.
Subramanian SAM & Kumar R.J. 1997. *All About Weed Control*. Kalyani.
Zimdahl RL. 1999. *Fundamentals of Weed Science*. 2nd Ed. Academic Press.

AGRON 606 INTEGRATED FARMING SYSTEMS AND SUSTAINABLE AGRICULTURE 2+0

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

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 607 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

Arakeri HR & Roy D. 1984. *Principles of Soil Conservation and WaterManagement*. 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.* 3rd 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 608 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 tress 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.

AGRON 609 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_2 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*. 2nd 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 610: Advance Technology in Cereals Production 2+1

Significance of cereal in present farming systems, causes of low yields and strategies for improving the production and productivity of cereals. Resource conservation technologies in cereals production, Organic farming- its role and importance/significance, Biofertilizer- its role and importance/significance, Sustainable use of ground water for enhanced cereals productivity, cereals production in coastal, hill and mountain eco-systems climate change and cereals productivity. Allelopathy and cereals productivity.

AGRONOMY
List of Journals

• Advances in Agronomy • Agriculture, Ecosystems and Environment • Agricultural Systems • Agricultural Water Management • Agronomy Journal • Annual Review of Plant Physiology • Applied Ecology and Environment Research • Australian Journal of Agricultural Research • Australian Journal of Experimental Agriculture • Crop Protection • Environment and Ecology • European Journal of Agronomy • Fertilizer Research • Field Crops Research • Indian Journal of Agricultural Sciences • Indian Journal of Agronomy • Indian Journal of Ecology • Indian Journal of Weed Science	• Irrigation Science • Japanese Journal of Crop Science • Journal of Agronomy • Journal of Applied Ecology • Journal of Experimental Botany • Journal of Farming Systems Research • Journal of Range Management • Journal of Agricultural Science Cambridge • Journal of Sustainable Agriculture • Netherlands Journal of Agricultural Sciences • Nutrient Cycling in Agroecosystems • Pesticide Biochemistry and Physiology • Plant and Soil • Plant Production Science • Soil and Tillage Research • Swedish Journal of Agricultural Research • Tropical Agriculture • Weed Research

Suggested Broad Topics for Master's and Doctoral Research

• Crop diversification under different agricultural situations
• Development of farming systems for marginal, small and other farmers
• Agricultural information at door step/click of mouse
• Farm-specific nutrient management
• Weed management in different cropping/farming systems
• Nutrient studies in different cropping/farming systems
• Biodiversity of farming systems for conservation
• Organic farming systems for different regions
• Modeling for different crop situations
• Conservation agriculture for yield sustainability
• Role of edaphic factors on weeds proliferation and management
• Implications of global warming on weed growth and herbicide behaviour
• Ecological implications of using thresholds for weed management
• Effect of cultivation practices and herbicides on weed flora shift
• GM crops and weed management strategies
• Weed management under reduced moisture regime in major summer/*kharif* crops
• Avoidance of herbicide resistance using IWM