# AGRONOMY

## Course Structure – at a Glance

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*Compulsory for Master’s programme
Minor Departments
Soil Science
Plant Physiology

Supporting Departments
Soil Science
Plant Physiology
Statistics and Mathematics

Non credit compulsory courses

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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

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 vermin compost and residue wastes in crops.

Practical

Determination of soil pH, Determination of EC, Determination of organic Carbon, Determination of total N and available N in soils, Determination of P in soils, Determination of K in soils, Determination of S in soils, Determination of total N in plants, Determination of total P in plants, Determination of total K in plants, Determination of total S in plants, Interpretation of interaction effects, Computation of economic and yield optima

Suggested Readingss


Suggested assay of herbicide residues

Analysis of weed management practices in different crops and cropping systems, experiments, identification, practical

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 weed herbarium, Weed survey in crops and cropping systems, Study of crop weed competition in on-going research experiments, 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, Economic analysis of weed management practices in different crops and cropping systems, Calculation of herbicide dose requirement, Study of herbicide residue analysis in plants and soils, Bio-assay of herbicide residues

Suggested Readings
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 Tensiometer, Measurement of soil water potential by pressure plate & pressure membrane apparatus, Construction of soil moisture characteristic curves for soils representative to the region, Determination of infiltration rate by double ring infiltrometer method, Determination of saturated and unsaturated hydraulic conductivity, Determination of reference crop evapotranspiration by Modified Penman, Penman Monteith & Pen evaporation method, Construction of crop coefficient curves for important crops of the region, Determination of crop evapotranspiration, effective rainfall, leaching requirements and irrigation requirements, Measurement of irrigation water by 90 V-notch, Parshall flume and water meter, Calculation of irrigation efficiency parameters, Study of sprinkler & drip irrigation system components, Determination of design emission uniformity in drip irrigation, Study of ongoing irrigation experiments

Suggested Readings
Lenka D. 1999. Irrigation and Drainage. Kalyani
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.
• 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

AGRON 506 AGRONOMY OF MAJOR CEREALS AND PULSES 2+1

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.
UNIT II
*Kharif* cereals.

UNIT III
*Rabi* pulses.

UNIT IV
*Kharif* pulses

Practical

Suggested Readings

**AGRON 507 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 and mustard, linseed, etc.

UNIT II

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

UNIT III

Fiber crops - Cotton, jute, sunhemp etc.

UNIT IV

Sugar crops – Sugar-beet and 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


Oxford & IBH.


AGRON 508 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

AGRONOMY OF FODDER AND FORAGE CROPS

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
Narayanan TR & Dabadghao PM. 1972. Forage Crops of India. ICAR.

AGRON 510
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

Dabadghao PM & Shankaranarayan KA. 1973. The Grass Cover in India. ICAR.


Shah SA.1988. Forestry for People. 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


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 Study of moisture stress effects and recovery behaviour of important crops, Estimation of moisture index and aridity index, Spraying of antitranspirants and their effect on crops, Collection and interpretation of data for water balance equations, Study of water use efficiency in different crops, 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
Dhruv Narayan VV. 2002. Soil and Water Conservation Research in India. ICAR.
Katyal JC & Farrington J. 1995. Research for Rainfed Farming. CRIDA.
AGRON 513 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
AAGR 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 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
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, CO2, 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
Malhotra Publ. House.
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 CO2 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
Mathews RB, Kropff MJ, Bachelet D & Vaan Laar HH. (Eds.). 1993. Modelling the Impact of Climate Change on Rice Production in Asia. CABI.
AGRON 604 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

**AGRON 605 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, 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

AGRON 606 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.

Suggested Readings

AGRON 607 INTEGRATED FARMING SYSTEMS FOR 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


AGRON 608  
**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
Dhruvanarayana VV. 1993. Soil and Water Conservation Research in India. ICAR.

AGRON 609 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
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
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