Syllabus

List of courses for Under graduate B. Sc. (Hons.) Agri. degree programme in Agronomy discipline

Sr. No.	Semester	Course No.	Credits	Course Title
1	I	AGRO 111	2(1+1)	Fundamentals of Agronomy-I
2	I	AGRO 112	2(1+1)	Introductory Agro-meteorology and Climate change
3	II	AGRO 123	2(1+1)	Fundamentals of Agronomy-II
4	III	AGRO 234	2(1+1)	Crop Production Technology-I (Kharif crops)
5	III	AGRO 235	2(1+1)	Rainfed Agriculture and Watershed Management
6	IV	AGRO 246	2(1+1)	Crop Production Technology-II (Rabi crops)
7	IV	AGRO 247	1(1+0)	Farming System and Sustainable Agriculture
8	IV	AGRO 248	2(1+1)	Principles of Organic Farming
9	V	AGRO 359	1(0+1)	Practical Crop Production-I (Kharif crops)
10	V	ELE AGRO 3510	3(2+1)	Weed Management
11	VI	AGRO 3611	1(0+1)	Practical Crop Production-II (Rabi crops)
12	VI	AGRO 3612	2(1+1)	Geo-informatics and Nanotechnology and Precision Farming
13	VII	ELM AGRO 4813	10(0+10)	Organic Farming Production Technology
14	VII	ELM AGRO 4814	10(0+10)	Commercial production of organic inputs (Proposed)

Course: AGRO 111 Credit: 2(1+1) Semester-I

Course title: Fundamentals of Agronomy-I

Syllabus

Theory: Agronomy, its scope and relationship with other sciences, Tillage and tilth, Seeds and sowing. Crop density and geometry, Crop nutrition, Manures and fertilizers. Nutrient use efficiency. Growth and development of crops, Plant ideotypes, Crop rotation and its principles. Study of crop adaptation and its distribution. Harvesting, threshing and Storage of field crops. Weeds - characteristics and classification. Crop - weed competition. Concept of weed management. Herbicides – Classification, selectivity and resistance of herbicide, Allelopathic effect of weed.

Practical: Identification of seeds and crop plants at different growth stages. Study of different tillage implements, Identification of fertilizers and pesticides. Identification of weed flora in different field crops. Agro climatic zones of Maharashtra and India, Operational tillage viz., primary, secondary, inter-tillage. Sowing, harvesting, harvesting implements and working with them. Calculation of Plant Population, Seed rate, fertilizer and herbicide dose for different field crops. Methods of seed germination and viability test. Practice of seed treatments in

different field crops. Computation of weed indices Application of manures and fertilizer in important field crops. Application of herbicides in different field crops. Yield contributing characters and yield estimation in different field crops.

Suggested Readings: 1) Chhidda Singh, Modern techniques of raising field corps. Oxford and IBH Publishing Co. Ltd., Bangalore. 2) Gopal Chandra De. 1980., Fundamentals of Agronomy. Oxford and IBH Publishing Co. Ltd., Bangalore. 3) Hand book of Agriculture, ICAR Publication. 4) Palaniappan, S.P., Cropping Systems in the tropics – Principles and Practices.Willey Eastern Ltd., New Delhi. 5) Panda, S.C., 2006.Agronomy Agribios Publication, New Delhi. 6) Reddy, S.R. Principles of Agronomy Kalyani Publishers, Ludhiana, India. 7) Sankaran, S and SubbiahMudliyar, V.T., 1991. Principles of Agronomy. The Bangalore Printing and Publishing Co. Ltd., Bangalore. 8) Vaidya, V.G., Sahasrabuddhe, K.R. andKhuspe, V.S. Crop production and field experimentation. Continental Prakashan, Vijaynagar, Pune. 9) Rao V.S. (2006), Principles of Weed Science. Oxford and IBH Publishing Co., New Delhi, India. 10) Gupta, O.P. (2008), Modern Weed Management Agribios India Publication.

Course: AGRO 112 Credit: 2(1+1) Semester-I

Course title: Introductory Agro-meteorology and Climate change

Syllabus Theory: Meaning and scope of agricultural meteorology; Earth atmosphere- its composition, extent and structure; Atmospheric weather variables; Atmospheric pressure, its variation with height; Wind, types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone, land breeze and sea breeze; Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, Energy balance of earth; Atmospheric humidity, concept of saturation, vapor pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rainmaking. Monsoon- mechanism and importance in Indian agriculture, Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave. Agriculture and weather relations; Modifications of crop microclimate, climatic normal for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national Agriculture.

Practical: Visit of Agro-meteorological Observatory, site selection of observatory, exposure of instruments and weather data recording. Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS .Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapor pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of wind rose .Measurement, tabulation and analysis of rain. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

Course: AGRO 123 Credit: 2(1+1) Semester-II

Course title: Fundamentals of Agronomy –II

Syllabus Theory: Water Resources of India and Maharashtra and Development Water Management - Role of water in plants. Irrigation scheduling criteria and methods. Quality of irrigation water. Crop water requirement. Water use efficiency, Soil - water–plant relationship. Classification of Soil Water, Soil Moisture Constants, Soil Moisture characteristic curve. Volume Mass Relationship, retention of soil water .Water absorption. Rooting characteristics of plants and moisture extraction patterns and SPAC. Water requirement of different Agronomic crops. Evaporation, Transpiration, Evapo-transpiration, Potential evapotranspiration, effective rainfall and consumptive use of water. Water Use efficiency, Irrigation Efficiencies. Water logging and Management of water logged soils. Crop water management techniques in problematic areas.

Practical: Estimation of soil moisture. Determination of Bulk and Particle Density, Determination of Field Capacity. Determination of PWP. Study of Soil moisture Measuring Devices and its installation, Determination of Infiltration. Estimation of Gross water requirement, Net water requirement, Irrigation Interval, Available Soil Moisture, Scheduling of Irrigation. Methods of surface irrigation, Irrigation Layouts, Study of Drip and Subsurface irrigation Systems and their components, Installation of drip Irrigation system in field, Fertigation , Care and Maintenance of Drip system, Sprinkler, Rain gun, Installation of various measuring devices and Measurement of Irrigation water, Visit to Atomized Irrigation Unit, Visit to ill-drained fields. Study of Drainage systems.

Suggested Readings: 1) Principles of Agronomy by S. R. Reddy 2) Crop production and Management by Y. B. Morachand 3) Principles of Agronomy by Sankaran S and V. T. SubbiahMudliyar 4) Principles of Agronomy by T. Yellamanda Reddy and G. H. Sankara Reddy 5) Irrigation Water Managemnt by Dilip Kumar Muzumdar 6) Principles and Practices of Water Management by A. M. Michel 7) Irrigation and Drainage by Lenka D. . 8) Soil Management and organic farming By S.C. Panda Agrobios

Course: AGRO 234 Credit: 2(1+1) Semester-III

Course title: Crop Production Technology-I (Kharif crops)

Syllabus Theory: Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices Intercropping, pest and disease management and yield of Kharif crops. Cereals – rice, maize, sorghum, pearl millet and finger millet, Small millets* pulses- pigeon pea, mung bean, urdbean, Cowpea, kidney bean and horse gram*; oilseeds- groundnut, soybean, Sesame and Niger*; fibre crops- cotton & Jute; forage crops sorghum, cowpea, cluster bean, Napier, pearl millet and maize*, Grasses - marvel*.

Practical: Rice nursery preparation, transplanting of Rice, sowing of soybean, pigeon pea and mung bean. maize, groundnut and cotton, effect of seed size on germination and seedling vigour of kharif season crops, effect of sowing depth on germination of kharif crops,

identification of weeds in kharif season crops, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of kharif season crops, study of crop varieties and important agronomic experiments at experimental farm. Study of forage experiments, morphological description of kharif season crops, visit to research centers of related crops. Mechanization in crop cultivation of kharifcrops.*

Suggested Readings: 1. Modern technique of raising field crops by Chidda singh 2. Agronomy of field crop by S.R. Reddy 3. Hand book of Agriculture, ICAR New Delh.

Course: AGRO 235 Credit: 2(1+1) Semester-III

Course title: Rainfed Agriculture and Watershed Management

Syllabus Theory: Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India, Problems and prospects of rainfed agriculture in India; Soil and climatic conditions prevalent in rainfed areas; Soil and water conservation techniques, Drought: types, effect of water deficit on physio- morphological characteristics of the plants, Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices, Management of crops in rainfed areas, Contingent crop planning for aberrant weather conditions, Concept, objective, principles and components of watershed management, Factors affecting watershed management.

Practical: Studies on climate classification, studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of Evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation. Studies on cultural practices for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil & moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Suggested Readings: 1) Sustainable Development of Dryland Agriculture in India – R. P Singh 2) Dry Farming Technology in India – P. Rangaswamy 3) Dryland resources and Technology – Vol. 8 L.L Somani, K.W. Kaushal 4) Physiological Aspect of Dryland Farming – U.S Gupta 5) Principles of Agronomy S.R. Reddy 6) Dryland Technology – M.L. Jat, S.R. Bhakar, S.K. Shrma , A. K. Kothri 7) Climate, Weather and Crops in India – D. Lenka.

Course: AGRO 246 Credit: 2(1+1) Semester-IV

Course title: Crop Production Technology-II (Rabi crops)

Syllabus Theory : Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield of Rabi crops; cereals –wheat and barley, Rabi Sorghum and maize, pulses-chickpea, lentil, peas, French bean oilseeds-rapeseed, mustard and sunflower; Safflower, linseed sugar crops- sugarcane; Sugar beet, medicinal and

aromatic crops- mentha, lemon grass and citronella, Forage crops-berseem, Lucerne, oat., maize and sorghum and other crops –Tobacco* and sweet potato.

Practical: Sowing methods of wheat and sugarcane, identification of weeds in rabi season crops, study of morphological characteristics of *Rabi* crops, study of yield contributing characters of rabi season crops, yield and juice quality analysis of sugarcane, study of important agronomic experiments of rabi crops at experimental farms. Study of *rabi* forage experiments, oil extraction of medicinal crops, visit to research stations of related crops. Mechanization in crop cultivation of kharif crops.

Suggested Readings: 1. Modern technique of raising field crops by Chidda singh 2. Agronomy of field crop by S.R. Reddy 3. Hand book of Agriculture, ICAR New Delhi

Course: AGRO 247 Credit: 1(1+0) Semester-IV
Course title: Farming System and Sustainable Agriculture

Syllabus Theory: Farming System-scope, importance, and concept, Types and systems of farming system and factors affecting types of farming, Farming system components and their maintenance, Cropping system and pattern, multiple cropping system, Efficient cropping system and their evaluation, Allied enterprises and their importance, Tools for determining production and efficiencies in cropping and farming system; Sustainable agriculture-problems and its impact on agriculture, indicators of sustainability, adaptation and mitigation, conservation agriculture strategies in agriculture, HEIA, LEIA and LEISA and its techniques for sustainability, Integrated farming system-historical background, objectives and characteristics, components of IFS and its advantages, Site specific development of IFS model for different agro-climatic zones, resource use efficiency and optimization techniques, Resource cycling and flow of energy in different farming system, farming system and environment, Visit of IFS model in different agro-climatic zones of nearby states University/ institutes and farmers field.

Suggested Readings: 1) Cropping systems Theory and Practice -Chatterjee B.N. and Maiti S. 2) Cropping Systems in Tropics – Principles and practices. -Palanniappan S.P.

Course: AGRO 248 Credit: 2(1+1) Semester-IV
Course title: Principles of Organic Farming

Syllabus Theory: Organic farming, principles and its scope in India; Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture; Organic ecosystem and their concepts; Organic nutrient resources and its fortification; Restrictions to nutrient use in organic farming; Choice of crops and varieties in organic farming; Fundamentals of insect, pest, disease and weed management under organic mode of production; Operational structure of NPOP; Certification process and standards of organic farming; Processing, leveling, economic considerations and viability, marketing and export potential of organic products.

Practical :Visit to organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost, bio-fertilizers/bio-inoculants and their quality

analysis; Indigenous technology knowledge (ITK) for nutrient, insect, pest disease and weed management; Cost of organic production system; Post harvest management; Quality aspect, grading, packaging and handling.

Suggested Readings: 1) Organic Farming for Sustainable Agriculture by Dahama A. K. Agrobios Publication. 2) Organic Farming: Theory and Practices by Palanippan, S.P. and Anaadurai, K. 3) Organic Farming in India, Problems and Prospects byThapa, U. and Tripathi, P. 4) Trends in Organic Farming in India by Agrobios Publication 5) Handbook of Organic Farming. 6) Recent Developments in Organic farming by Gulati and Barik

Course: AGRO 359 Credit: 1(0+1) Semester-V
Course title: Practical Crop Production-I (Kharif crops)

Syllabus Practical : Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students. Study of farm inventories and records.

(To get practical oriented knowledge to the student, 2 R area per student will be allotted for raising kharif crop of the region. The student has to raise the crop from sowing to harvesting threshing, drying, winnowing, storage and preparation of produce for marketing. Also he has to study the cost of cultivation, net return per student as well as per team of a group of students.)

Suggested Readings: 1. Modern technique of raising field crops by Chidda Singh 2. Agronomy of field crop by S.R. Reddy 3. Hand book of Agriculture, ICAR New Delhi

Course: ELE AGRO 3510 Credit: 3(2+1) Semester-V
Course title: Weed Management (Elective)

Syllabus Theory: Introduction to weeds, characteristics of weeds their harmful and beneficial effects on ecosystem. Classification, reproduction and dissemination of weeds. Herbicide classification, concept of adjuvant, surfactant, herbicide formulation and their use. Introduction to mode of action of herbicides and selectivity. Allelopathy and its application for weed management. Bio-herbicides and their application in agriculture. Concept of herbicide mixture and utility in agriculture. Herbicide compatibility with agro-chemicals and their application. Integration of herbicides with non-chemical methods of weed management. Herbicide Resistance and its management.

Practical: Techniques of weed preservation. Weed identification and their losses study. Biology of important weeds. Study of herbicide formulations and mixture of herbicide. Herbicide and agro-chemicals study. Shift of weed flora study in long term experiments. Study of methods of herbicide application, spraying equipment's. Calculations of herbicide doses and weed control efficiency and weed index.

Suggested Readings: 1) Aldrich, R.J. and Kramer R.J. (1997), Principles in Weed Management. 2) Gupta O.P. (2007), Weed management Principles and Practices. 3) Gupta,

O.P. (2008), Modern Weed Management 4) Gupta, O.P. 1984. Scientific Weed Management Today and Tomorrows. 5) Jayakumar, R. and Jagannathan, R. (2007). Weed Science Principles. 6) Mandal R.C. (1999), Weed, Weedicides and Weed control Principles and Practices. 7) Rao V.S. (2006), Principles of Weed Science.

Course: AGRO 3611 Credit: 1(0+1) Semester-VI

Course title: Practical Crop Production-II (Rabi crops)

Syllabus Practical: Crop planning, raising field crops in multiple cropping systems: Field preparation, seed, treatment, nursery raising, sowing, nutrient, water and weed management and management of insect-pests diseases of crops, harvesting, threshing, drying winnowing, storage and marketing of produce. The emphasis will be given to seed production, mechanization, resource conservation and integrated nutrient, insect-pest and disease management technologies. Preparation of balance sheet including cost of cultivation, net returns per student as well as per team of 8-10 students. (To get practical oriented knowledge to the student, 0.02 ha. area per student will be allotted for raising rabi crops of the region. The student has to raise the crop from sowing to harvesting threshing, drying, winnowing, storage and preparation of produce for marketing. Also he has to study the cost of cultivation, net return per student as well as per team of a group of students.)
Note: To get practical oriented knowledge to the students, 40 R area per batch will be allotted for raising rabi crop of the region, viz., land preparation, sowing to harvesting, threshing, drying, winnowing, storage and preparation of produce for marketing. Study of cost of cultivation, net return and B: C ratio.

Suggested Readings: 1. Modern technique of raising field crops by Chidda singh 2. Agronomy of field crop by S.R. Reddy 3. Hand book of Agriculture, ICAR New Delhi

Course: AGRO 3612 Credit: 2(1+1) Semester-VI

Course title: Geo-informatics and Nano-technology and Precision Farming

Syllabus Theory: Precision agriculture: concepts and techniques; their issues and concerns for Indian agriculture; Geo-informatics- definition, concepts, tool and techniques; their use in Precision Agriculture. Crop discrimination and Yield monitoring, soil mapping; fertilizer recommendation using geospatial technologies; Spatial data and their management in GIS; Remote sensing concepts and application in agriculture; Image processing and interpretation; Global positioning system (GPS), components and its functions; Introduction to crop Simulation Models and their uses for optimization of Agricultural Inputs; STCR approach for precision agriculture; Nanotechnology, definition, concepts and techniques, brief introduction about nanoscale effects, nano-particles, nano-pesticides, nano-fertilizers, nano-sensors, Use of nanotechnology in seed, water, fertilizer, plant protection for scaling-up farm productivity.

Practical: Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping. Creation of thematic layers of soil fertility based on GIS. Creation of productivity and management zones. Fertilizers recommendations based of VRT and STCR techniques. Crop stress (biotic/abiotic) monitoring using geospatial technology. Use of GPS for agricultural survey. Formulation, characterization

and applications of nanoparticles in agriculture. Projects formulation and execution related to precision farming.

Suggested Readings: 1) GIS: Fundamentals, Applications & Implementations – Dr. K Elangovan
New India publishing Agency, New Delhi. 2) Remote sensing, GIS and wet land management – Er Tasneem Abbasi& Prof. S.A. Abbasi

M.Sc. (Agri) Agronomy
Course Structure

Post Graduate courses M.Sc. (Agri.)

Sr. No.	Sem. No.	Course No	Credits	Title of the course
1.	I	AGRON-501	3+0=3	Modern Concept in Crop Production
2.	I	AGRON-503	2+1=3	Principles and Practices of Weed Management
3.	I	AGRON-505	2+1=3	Agro Meteorology and Crop Weather Forecasting
4.	II	AGRON-502	2+1=3	Soil fertility and Nutrient Management
5.	II	AGRON-504	2+1=3	Principles and Practices of Water Management
6.	II	AGRON-513	2+1=3	Principles and Practices of Organic Farming
7.	III	AGRON-512	2+1=3	Dryland Farming and Watershed Management
8	III	AGRON-505	1+1=2	Conservation Agriculture

***Compulsory Courses**

Semester wise core Courses offered based on credit requirement

Course Code	Semester	Course Title	Credit Hrs.
AGRON 501*	I	Modern Concepts in Crop Production	3+0 = **3**
AGRON 503*	I	Principles and Practices of Weed Management	2+1 = **3**
AGRON 513	I	Principles and practices of organic farming	2+1 = **3**
AGRON 502*	II	Principles and practices of soil fertility and nutrient management	2+1 = **3**
AGRON 504*	II	Principles and Practices of Water Management	2+1 = **3**
AGRON 505	II	Conservation Agriculture	1+1 = **2**
AGRON 511	III	Cropping System and Sustainable Agriculture	2+0 = **2**
AGRON 512	III	Dryland Farming and Watershed Management	2+1 = **3**
AGRON 513	III	Principles and practices of organic farming	2+1 = **3**
AGRON 550	IV	Master's Seminar	1+0 = **1**

		Total	**19+7=26**
		Master's Research	0+30 = **30**

***Compulsory Courses**

Common Courses: (Non-Credit)

Course code	Semester	Course Title	Credits
PGS 501	I	Library and Information Services	0+1=1
PGS 504	I	Basic Concepts in Laboratory Techniques	0+1=1
PGS 502	I	Technical Writing and Communications Skills	0+1=1
PGS 503	II	Intellectual Property and its management in Agriculture	1+0=1
PGS 505	III	Agricultural Research, Research Ethics and Rural Development Programmes	1+0=1

Optional Courses:

Course Code	Semester	Course Title	Credit Hrs.
STAT 502,	I	Statistical Methods for Applied Sciences	**3+1=4**
STAT 511	II	Experimental Designs	**2+1=3**
COM 501	II	Information Technology in Agriculture	**2+1=3**

Minor Disciplines:

1. Natural Resource Management
2. Seed Science and Technology
3. Plant Physiology
4. Soil Science
5. Agricultural Meteorology
6. Plant Protection
7. Microbiology

Course Contents

1. M.Sc. (Agriculture) Agronomy

Course No: AGRON 501

Credit Hour: 3+0

Course title: MODERN CONCEPTS IN CROP PRODUCTION

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 modelling for desired crop yield, Define; causes; factors and remedies of lodging.

UNIT-IV:
Scientific principles of crop production; crop response production functions; concept of soil plant relations; yield and environmental stress, use of growth hormones and regulators for better adaptation in stressed condition; Remedies to mitigate 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. Modern crop production concepts: soil less cultivation, Aeroponics, Hydroponics, Robotics and terrace farming. Use of GIS, GPS and remote sensing in modern agriculture and protected agriculture, use of Drone technology in modern agriculture; Vertical farming.

Teaching methods/activities: Classroom teaching with AV aids, group discussion, assignment and class discussion

Learning outcome: Basic knowledge on soil management and crop production

Reading materials:
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 &Muda liar TVS. 1997. Principles of Agronomy. The Bangalore Printing & Publ.
Singh SS. 2006. Principles and Practices of Agronomy. Kalyani.
Alvin, P.T. and Kozlowski, T.T. (ed.) 1976. Eco physiology of Tropical Crops. Academia Pul., New York.
Gardner, P.P., Pearce, G.R. and Mitchell, R. L. 1985. Physiology of Crop Plants. Scientific Pub. Jodhpur.
Lal, R. 1989. Conservation tillage for sustainable agriculture: Tropics versus Temperate Environments. Advances in Agronomy 42: 85-197.
Wilsie, C.P. 1961. Crop Adaptation and Distribution. Euresia Pub., New Delhi.
Rana D.S., P.K. Ghosh, Y.S. Shivay, Gurbachan Singh (2016 Ed) Modern Concepts of Agronomy ISA, New Delhi Publ.
K.R. Krishna (2021 Ed) Precision Farming Soil Fertility and Productivity Aspects, CRC Press Publ.
All about Drone 2015 by Ronald Sanford

2. AGRON 502

Credit hour: 2+1

Course Title: PRINCIPLES AND PRACTICES OF SOIL FERTILITY AND NUTRIENT MANAGEMENT

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

Theory

UNIT I

Soil fertility and productivity - factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; Integrated Nutrient Management.

UNIT II

Criteria of essentiality of nutrients; Essential plant nutrients – their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients, Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; Nutrient sources.

UNIT III

Preparation and use of farmyard manure, compost, green manures, vermicompost, biofertlizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management. Soil less cultivation, Enrichment of FYM and compost, recycling of urban waste and garbage

UNIT IV

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency; agronomic, chemical and physiological, fertilizer mixtures and grades; nano-fertilizer materials and application; methods of increasing fertilizer use efficiency; nutrient interactions; precision nutrient management; Forms of fertilizers (Conventional and Water soluble fertilizers), Nano fertilizers, Customized slow fertilizers.

UNIT V

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic nutrients; economics of fertilizer use; integrated nutrient management; use of vermin-compost and vermi-wash and residue wastes in crops, STCR technique.

Practical

1. Determination of soil pH and soil EC,
2. Determination of soil organic C,
3. Determination of available N, P, K and S of soil and DTPA extractable micronutrients in soil.
4. Determination of total N, P, K and S of soil,
5. Determination of total N, P, K, S in plant,
6. Computation of optimum and economic yield

7. Nutrient requirement as per soil test,
8. Use of sensors and Apps in soil fertility estimation

Teaching methods/activities: Classroom teaching with AV aids, group discussion, assignment and class discussion

Learning outcome: Basic knowledge on soil fertility and management

Suggested Reading:

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.
Jackson, M. L. (1973) Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd. New Delhi.
Lindsay, W.L. and Norvell, W.A. (1978). Development of DTPA soil testing for Zn, Fe, Mn and Cu. Soil Sci. Amer. J. 42(10): 421-428.
Tandon, H.L.S. (1995). Methods of Soil, Plants, Water and Fertilizer Analysis, FDCO, New Delhi, 190-205.
L.L. Somani, (2016 Ed) Soil Fertility and Crop Productivity at a Glance (Vol. I), Scientific Publishers, India
Introduction to Nano Technology by Charles P Pool and Frank J Owens

Practical

SN	Topic	No. of Practical (s)
1.	Determination of soil pH and soil EC,	01
	Determination of soil Electrical Conductivity,	01
2.	Determination of soil organic carbon	01
3.	Determination of available N from soil	01
4.	Determination of available P from soil	01
5.	Determination of available K from soil	01
6.	Determination of available S from soil	01
7.	Determination of DTPA extractable micronutrients from soil	01
8.	Determination of total N from soil	01
9.	Determination of total P from soil	01
10.	Determination of total K from soil	01
11.	Determination of total S from soil	01
12.	Determination of total N from plant,	01
13.	Determination of total P from plant	01
14.	Determination of total K from plant	01
15.	Determination of total S from plant	01
16.	Computation of optimum and economic yield	01
17.	Nutrient requirement as per soil test,	01
18.	Use of sensors and Apps in soil fertility estimation	01

	Total	18

3. AGRON 503

Credit hour: 2+1

Course Title: PRINCIPLES AND PRACTICES OF WEED MANAGEMENT

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

Theory:

UNIT I

Weed biology, and ecology and classification, crop-weed competition including allelopathy; principles and methods of weed control and management; weed indices, weed shift in different eco-systems, weed dispersal; weed uses.

UNIT II

Herbicide's 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, sequential application of herbicides, rotation; weed control through use of nano-herbicides and bio-herbicides, myco-herbicides bio- agents, and allelochemicals; movement / fate of herbicides in soil and plant, Degradation of herbicides in soil and plants; herbicide resistance, residue, persistence and management; development of herbicide resistance in weeds and crops and their management, herbicide combination and rotation**.**

UNIT IV

Weed management in major crops and cropping systems; alien, invasive and parasitic weeds and their management; weed shifts in cropping systems; aquatic and perennial weed control; weed control in non-crop area.

UNIT V

Integrated weed management; recent development in weed management- robotics, use of drones and aero planes, etc., 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,

1. Crop-weed competition studies,
2. Weed indices calculation and interpretation with data,
3. Preparation of spray solutions of herbicides for high and low-volume sprayers,
4. Use of various types of spray pumps and nozzles and calculation of swath width,
5. Economics of weed control,
6. Herbicide resistance analysis in plant and soil,
7. Bioassay of herbicide resistance residues,

8. Calculation of herbicide requirement,
9. Effect of herbicides on soil micro flora,
10. Use of drone for herbicide application.

Teaching methods/activities: Classroom teaching with AV aids, group discussion, field visit to identify weeds.

Learning outcome: Basic knowledge on weed identification and control for crop production

Reading materials:

Zimdahl R. L., (ed). 2018. Integrated Weed Management for Sustainable Agriculture, B. D. Sci. Pub.
Jugulan, Mithila, (ed). 2017. Biology, Physiology and Molecular Biology of Weeds. CRC Press
Das T K. 2015. Weed Science: Basics and Applications, Jain Brothers (New Delhi).
Chauhan Bhagirath and Mahajan Gulshan. 2014. Recent Advances in Weed Management. Springer.
Fennimore, Steven A and Bell, Carl. 2014. Principles of Weed Control, 4th Ed, California Weed Sci. Soc.
Monaco, T. J. Weller, S. C. & Ashton, F. M. 2014. Weed Science Principles and Practices, Wiley
Gupta, O. P. 2007. Weed Management: Principles and Practices, 2nd Ed.
Walia US. 2014. Weed Management, 4th Edition Reprinted, 2016, Kalyani publisher.
Böger, Peter, Wakabayashi, Ko, Hirai, Kenji (Eds.). 2002. Herbicide Classes in Development. Mode of Action, Targets, Genetic Engineering, Chemistry. Springer.
Powles, S. B. and Shaner, D. L. 2001. Herbicide Resistance and World Grains, CRC Press.

Practical

Sr. No.	Topic	No. of Practical (s)
1.	Identification of important weeds of different crops	02
2.	Preparation of a weed herbarium	01
3.	Weed survey in crops and cropping systems	02
4.	Crop-weed competition studies	01
5.	Weed indices calculation and interpretation with data	01
6.	Preparation of spray solutions of herbicides for high and low - volume sprayers	01
7.	Use of various types of spray pumps and nozzles and calculation of swath width	02
8.	Economicsofweedcontrol	01
9.	Herbicide resistance analysis in plant and soil	01
10.	Bioassay of herbicide resistance residues	01
11.	Calculationof herbicide requirement	01
12.	Effect of herbicides on soil micro flora	01
13.	Use of drone for herbicide application	01
	Total	**16**

4. AGRON 504

Credit. hr.: 2+1

Course Title: PRINCIPLES AND PRACTICES OF WATER MANAGEMENT

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

UNIT I

Water and its role in plants; Irrigation: Definition and objectives, water resources and irrigation development in India and concerned state, major irrigation projects, extent of area and crops irrigated in India and in different states.

UNIT II

Field water cycle, 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. Water availability and its relationship with nutrient availability and losses, Soil water potentials; Kinds of water**.**

UNIT III

Soil, plant and meteorological factors determining water needs of crops, consumptive use of water; scheduling, depth and methods of irrigation; micro irrigation systems; automated irrigation system; deficit irrigation; fertigation; management of water in controlled environments, polyhouses and Hydroponics.

UNIT IV

Water management of crop and cropping system; crop water requirement; estimation of ET and effective rainfall; irrigation efficiency and water use efficiency', Water management of the major crops under climate change scenario, Virtual Water.

UNIT V

Excess of soil water and plant growth;, drainage requirement of crops and methods of field drainage, their layout and spacing;

UNIT VI

Quality of irrigation water and management of saline water for irrigation, water management in problem soils

UNIT VII

Soil moisture conservation, conjunctive water uses; water harvesting; roof-water harvesting; rain water management and its utilization for crop production.

Practical

1. Determination of Field capacity by field method
2. Determination of Permanent Wilting Point by sunflower pot culture technique
3. Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus
4. Determination of Hygroscopic Coefficient

5. Determination of maximum water holding capacity of soil
6. Measurement of matric potential using gauge and mercury type tensiometer
7. Determination of soil-moisture characteristics curves
8. Determination of saturated hydraulic conductivity by constant and falling head method
9. Determination of hydraulic conductivity of saturated soil below the water table by auger hole method
10. Measurement of soil water diffusivity
11. Estimation of unsaturated hydraulic conductivity
12. Estimation of upward flux of water using tensiometer and from depth ground water table
13. Determination of irrigation requirement of crops (calculations)
14. Determination of effective rainfall (calculations)
15. Determination of ET of crops by soil moisture depletion method
16. Determination of water requirements of crops
17. Measurement of irrigation water by volume and velocity-area method
18. Measurement of irrigation water by measuring devices and calculation of irrigation efficiency
19. Determination of infiltration rate by double ring infiltrometer
20. Use of different apps for irrigation and fertigation scheduling
21. Estimation of Potential ET by Thornthwaite method
22. Estimation of uniformity coefficient of pressurized irrigation system.
23. Artificial intelligence and machine learning in irrigation management
24. Estimation of Reference ET by Penman Monteith Method

Teaching methods/activities: Classroom teaching with AV aids, group discussion, assignment and field visit

Learning outcome: Basic knowledge on water management for optimization of crop yield

Reading materials:

Majumdar D.K. 2014. Irrigation Water Management: Principles and Practice.PHL Learning private publishers
Mukund Joshi. 2013.A Text Book of Irrigation and Water Management Hardcover, Kalyani publishers
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.

Practical

SN	Topic	No. of Practical (s)

1	Determination of Field capacity by field method Determination of Permanent Wilting Point by sunflower pot culture technique	01
2	Determination of Field capacity and Permanent Wilting Point by Pressure Plate Apparatus	01
3	Determination of Hygroscopic Coefficient Determination of maximum water holding capacity of soil	01
4	Measurement of matric potential using gauge and mercury Type tensiometer	01
5	Determination of soil-moisture characteristics curves	01
6	Determination of saturated hydraulic conductivity by constant and falling head method	01
7	Determination of hydraulic conductivity of saturated soil below the water table by auger hole method	01
8	Measurement of soil water diffusivity Estimation of unsaturated hydraulic conductivity	01
9	Estimationofupwardfluxofwaterusingtensiometerandfromdepthgroundwater table	01
10	Determination of irrigation requirement of crops (calculations) Determination of effective rainfall (calculations)	01
11	Determination of ET of crops by soil moisture depletion method Determination of water requirements of crops	01
12	Measurement of irrigation water by volume and velocity area method Measurement of irrigation water by measuring devices and calculation of irrigation efficiency	01
13	Determination of infiltration rate by double ring infiltrometer	01
14	Use of different apps for irrigation and fertigation scheduling	01
15	Estimation of Potential ET by Thornthwaite method Estimation of Reference ET by Penman Monteith Method	01
16	Estimation of uniformity coefficient of pressurized irrigation system Artificial intelligence and machine learning in irrigation management	01
	Total	**16**

5. AGRON 505

Credit Hour: 1+1

Course Title: Conservation Agriculture

Objective: To impart knowledge of conservation of agriculture for economic development.

Theory:

UNIT I

Conservation agriculture (CA), definition, scope, principles, prospects and importance, advantages and disadvantages; conventional and conservation agriculture systems, sustainability concerns; conservation agriculture – concept, historical background, global experiences, present status in India; similarity/dissimilarity between resource conservation

technology (RCT) and CA; similarity/dissimilarity between conservation tillage and CA; modern concept of tillage and its management through conservation agriculture.

UNIT II

Crop establishment and varietal response; nutrient management; water management; weed dynamics and management; energy use, resource-and input-use efficiency; insect-pest and disease dynamics and management; farm machinery, crop residue management; constraints in crop residue management; cover crop management in CA; cropping pattern in CA, role of farm mechanization in CA

UNIT III

Climate change adaptation and mitigation potential of CA and potential benefits; C-sequestration; soil health management: physical, chemical and biological properties of soil under CA.

UNIT IV

CA in agroforestry systems, rainfed / dryland regions

UNIT V

Economic considerations in adoption of CA, constraints and future of agriculture under CA, Policy issues**.**

Practical:

1. Study of long-term experiments on CA,
2. Evaluation of soil health parameters,
3. Estimation of C-sequestration,
4. Machinery calibration for sowing different crops,
5. Weed seedbank estimation under CA,
6. Energy requirements in CA,
7. Economic analysis of CA.

Teaching methods/activities: Classroom teaching with AV aids, group discussion, oral presentation by students.

Learning outcome: Experience on the knowledge of various types of conservation of agriculture.

Suggested Reading:

Muhammad, F. and Kamdambot, H.M.S. (2014). Conservation Agriculture. Publisher: Springer Cham Heidelberg, New Yaork Dordrecht London. Doi: 10.1007/978-3-319-11620-4.

Bisht, J.K., Meena, V.S., Mishra, P.K. and Pattanayak, A. (2016). Conservation Agriculture- An approach to combat climate change in Indian Himalaya. Publisher: Springer Nature. Doi: 10/1007/978-981-10-2558-7.

Gracia-Torres, L., Benites, J., Martinez-Vilela, A. and Holgado-Cabera, A. (2003). Conservation Agriculture- Environment Farmers experiences, innovations Socio- economic policy.

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

Dhruvanarayana VV. 1993. Soil and Water Conservation Research in India. ICAR.
FAO. 2004. Soil and Water Conservation in Semi-Arid Areas. Soils Bull., Paper 57.
Yellamanda Reddy T & Sankara Reddy GH. 1992. Principles of Agronomy. Kalyani.
Conservation Agriculture by M. C. Hugh 2010
V.K. Singh & B. Gangwar. 2018, System based conservation Agriculture

AGRON 512

Cr Hr: 2+1

Course Title: DRYLAND FARMING AND WATERSHED MANAGEMENT

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.

UNIT-III:

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; management and breeding strategies to improve crop productivity under different patterns of drought situation under limited water supplies preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions; abiotic stress management in dry land agriculture

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); anti-transpirants; soil and crop management techniques, seeding and efficient fertilizer use; good agricultural practices in dry land; farm pond technology; tools and implements in dry land agriculture.

UNIT-V:

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

Practical

1. Method of Seed Priming
2. Determination of moisture content of germination of important dryland crops
3. Determination of Relative Water Content and Saturation Deficit of Leaf
4. Moisture stress effects and recovery behaviour of important crops
5. Estimation of Potential ET by Thornthwaite method
6. Estimation of Reference ET ny Penman Monteith Method
7. Classification of climate by Thornthwaite method (based on moisture index, humidity

index and aridity index)
8. Classification of climate by Koppen Method
9. Estimation of water balance by Thornthwaite method
10. Estimation of water balance by FAO method
11. Assessment of drought
12. Estimation of length of growing period
13. Estimation of probability of rain and crop planning for different drought condition
14. Spray of anti-transpirants and their effect on crops
15. Estimation of water use efficiency
16. Visit to dryland research stations and watershed projects
17. Drought indices in dryland Crops and Cropping pattern in dry land to mitigate drought condition
18. Study of green seeker and leaf colour chart techniques in precision nutrient management

Teaching methods/activities: Classroom teaching with AV aids, group discussion, assignment.

Learning outcome: Basic knowledge on dry land farming and soil moisture conservation.

Suggested Reading:

Reddy T.Y.2018.Dryland Agriculture Principles &Practices, Kalyani publishers
Das NR. 2007. Tillage and Crop Production. Scientific Publ.
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 forDrylands. Oxford & IBH.
Katyal JC & Farrington J. 1995. Research for Rainfed Farming. CRIDA.
Rao SC & Ryan J. 2007. Challenges and Strategies of Dryland Agriculture. Scientific Publ.
Singh P &Maliwal PL. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publ. 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 Publ.
Venkateshwarlu J. 2004. Rainfed Agriculture in India. Research and Development Scenario. ICAR.

Practical

Sr. No.	Topic	No. of Practical (s)
1.	Method of Seed Priming	1
2.	Determination of moisture content of germination of important dryland crops	1
3.	Determination of Relative Water Content and Saturation Deficit of Leaf	1
4.	Moisture stress effects and recovery behavior of important crops	1
5.	Estimation of Potential ET by Thornthwaite method	1
6.	Estimation of Reference ET by Penman Monteith Method	1

7	Classification of climate by Thornthwaite method (based on moisture index, humidity index and aridity index)	1
8	Classification of climate by Koppen Method	1
9	Estimation of water balance by Thornthwaite method	1
10	Estimation of water balance by FAO method	1
11	Assessment of drought	1
12	Estimation of length of growing period	1
13	Estimation of probability of rain and crop planning for different drought condition	1
14	Spray of anti-transpirants and their effect on crops	1
15	Estimation of water use efficiency	1
16	Visit to dryland research stations and watershed projects	1
17	Drought indices in dryland Crops and Cropping pattern in dry land to mitigate drought condition	1
18	Study of green seeker and leaf colour chart techniques in precision nutrient management	1
	Total	**18**

13. AGRON 513

Credit hr.: 2+1

Course Title: PRINCIPLES AND PRACTICES OF ORGANIC FARMING

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; principles of organic agriculture; organic farming and sustainable agriculture; selection and conversion of land, soil and water management - land use, conservation tillage; shelter zones, hedges, pasture management, agro-forestry.

UNIT II:

Organic farming and water use efficiency; soil fertility, nutrient recycling; organic manures, composting; soil biota and decomposition of organic residues; earthworms and vermicompost; green manures, bio-fertilizers and biogas technology; biodynamic compost, enrichment of organic manures; organic formulations and bio fertigation

UNIT III

Farming systems, selection of crops and crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity; maintenance of soil fertility, concept of IOFS; mixed cropping; cover crops; smoother crops.

UNIT IV

Pest management through biological agents and pheromones; bio-pesticides, Management of weeds; pests and diseases; Botanicals; Trap crops; Insect traps; ITKs, Bio herbicides; use of plant extract in weed management; Allelopathic effect.

UNIT V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy; types of certifications; certification agencies; branding and packaging; Farmer Participatory Organization in organic farming.

Practical

1. Compost preparation by method by aerobic and anaerobic methods
2. Methods of vermicomposting
3. Identification and nursery raising of important agro-forestry tress and tress for Shelter belts
4. Efficient use of Biofertilizers, technique of treating legume seeds with Rhizobium Cultures, use of Azotobacter, Azospirillum, and PSB cultures in field
5. Visit to a biogas plant
6. Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms
7. Preparation of different organic formulations
8. Preparation of seed album of local/deshi germplasm
9. Visit to an organic farming research and training Centre
10. Visit to NCOF

Teaching methods/activities: Classroom teaching with AV aids, group discussion, assignment, exposure visit

Learning outcome: Basic knowledge on organic farming for sustainable agriculture and development of entrepreneurship on organic inputs.

Suggested Reading:

Joshi, Mukund 2016. New Vistas of Organic Farming. Scientific Publishers

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 B V, 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.