

New and Restructured Curriculum & Syllabus
Implemented from Academic Session 2020-2021



M.Sc. Ag. (Agronomy)

Approved by:
Board of Studies –Agriculture
School of Agriculture & Allied Science

Hemvati Nandan Bahuguna Garhwal University
(A Central University)
Srinagar Garhwal, Uttarakhand (India)-246 174

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Course Curriculum

Course Codes	COURSE TITLE	Total Marks	Sessional Marks	External Marks	Credits
Semester I			(I + II)		
SOA/AGRON/C-501	Statistical Methods and Experimental Designs	100	40	60	3
SOA/AGRON/C-502	Principles of Crop Production	100	40	60	3
SOA/AGRON/C-503	Principles and Practices of Weed Management	100	40	60	3
SOA/AGRON/C-504	Principles and Practices of Organic Farming	100	40	60	2
SOA/AGRON/C-505	Agronomy of Cereals Crops	100	40	60	2
SOA/AGRON/C-506	Lab course - I	100	40	60	5
Total		600	240	360	18
Semester II					
SOA/AGRON/C-507	Crop Ecology and Agro meteorology	100	40	60	2
SOA/AGRON/C-508	Cropping System and Sustainable Agriculture	100	40	60	2
SOA/AGRON/C-509	Advances in Soil fertility and Nutrient Management	100	40	60	3
SOA/AGRON/C-510	Agronomy of Pulses and oil Seed Crops	100	40	60	3
SOA/AGRON/C-511	Agronomy of Medicinal and Aromatic Crops	100	40	60	3
SOA/AGRON/C-512	Lab course - II	100	40	60	5
Total		600	240	360	18
Semester III					
SOA/AGRON/C-513	Principles and Practices of Water Management	100	40	60	4
SOA/AGRON/C-514	Agronomy of Commercial Crops	100	40	60	3
In addition to SOA/ AGRON/ C&E520, students can choose any Three elective papers out of the following four electives.					
SOA/AGRON/C-515	Dry land Farming	100	40	60	2
SOA/AGRON/E-516	Management of Problem soils	100	40	60	2
SOA/AGRON/E-517	Farming Systems	100	40	60	2
SOA/AGRON/E-518	Post-Harvest Technology of Agricultural Crops	100	40	60	2
*SOA/AGRON/ C & E-519	Lab course- III	100	40	60	5
Total		700	240	360	18
**SOA/AGRON/SS-01	Self Study courses to be decided by concern	100	40	60	3

	department/college and to be Evaluated by them. It is only a qualifying course.				
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Semester - IV

SOA/AGRON /C-520 OR SOA/AGRON /C-521	Thesis (Thesis must be signed by the Supervisor and having plagiarism certified by the student. Thesis must be checked by the external examiner and viva voce/presentation conducted)	100	40	60	8
	Project Based on seed production of Crops / farmer Field Survey (Projects must be evaluated and viva voce conducted by the external examiners appointed by the University)	100	40	60	8
SOA/AGRON /C-522	Seminar (Open presentation will be made by the students in presence of external examiner appointed by the University)	100	40	60	1

In addition to SOA/AGRON/E/527, students can choose any three elective papers out of the following four electives

SOA/AGRON/E -523	Seed Production Technology of Field Crops	100	40	60	2
SOA/AGRON/E -524	Soil Conservation and watershed Management	100	40	60	2
SOA/AGRON/E -525	Agronomy of Fodder and Pasture crops	100	40	60	2
SOA/AGRON/E -526	Environmental Studies and Disaster Management	100	40	60	2
SOA/AGRON/E -527	Lab course - IV	100	40	60	3
Total		600	240	360	18
Grand Total		2400	960	1440	72

SUMMARY OF CREDITS

Semester	Core Credits	Elective Credits	Total Credits
1 st	18	--	18
2 nd	18	--	18
3 rd	09	09	18
4 th	09	09	18
	54	18	72

SOA/GPB/ C&E-520*- Is a practical course combining of both core and elective courses in third semester.

****SOA/AGRON/SS-01-** Is a Self Study course and will be provided to the students by the concern Department/College and after evaluation at the Department, theory and Sessional marks shall have to be submitted to the University.

The distribution of marks for the Thesis or Project based on Farmer field Survey will is as below:

Thesis or Project based on Farmer field Survey (External Evaluation)	60 Marks
Periodical presentation	20 Marks
Viva-Voce	20 Marks

Total - - - - - 100 Marks

MASTER OF SCIENCE (AGRICULTURE) AGRONOMY

DESCRIPTION OF COURSES

I SEMESTER

SOA/AGRON/C-501 STATISTICAL METHODS AND EXPERIMENTAL DESIGNS

3

Theory

UNIT I

Processing of data: - Classification & Tabulation of data, Graphical and Diagrammatic presentation of data by histogram, frequency polygon, frequency curve & cumulative frequency curve.

UNIT II

Measures of Central Tendencies And Dispersion: - Mean, Median, Mode, Partition values, Range, Quartile deviation, Mean deviation, Standard deviation, Coefficient of variation.

UNIT III

Probability and Distribution:- Definition of Probability, Random distribution, Binomial distribution, Poisson distribution and Normal distribution, simple properties of the above distribution (without derivation).

UNIT IV

Correlation & Regression:- Bivariate data, Bivariate frequency distribution, Simple correlation coefficients, Regression line, Regression coefficients & their relation with correlation coefficient, Multiple regression multiple & Partial correlation coefficients.

UNIT V

Sampling: Concept of population and sample; random samples; methods of taking a simple random sample.

UNIT VI

Tests of significance: Sampling distribution of mean and standard error; z and t-test (equality of means: paired and unpaired t-test); t-test for comparison of means when variances of two populations differ: Chi-square test for goodness of fit: independence of attributes, and homogeneity of samples, interrelation between t-test and F-Test

UNIT VII

Experimental Designs: Principles of experimental designs; completely randomized, randomized complete block design (missing plot value in RBD); latin square designs; augmented block design, simple factorial experiments (mathematical derivations not required): analysis of variance (ANOVA) and its use including estimation of LSD (CD)

Suggested Readings

- Goulden, C.H. (1952). Methods of Statistical Analysis. 2/e, John Wiley, New York
lioshmand A. Reza 1988. Statistical Methods for Agricultural Sciences, Timber Press, Portland, Oregon, USA.
Kempthorne, O. (1957). An Introduction to Genetic Statistics, John Wiley, New York.
Kempton RA and Fox PN (1997). Statistical Methods for Plant Variety Evaluation. Chapman and Hall
Panse, V.C. and Sukhatme, P.V. (1967). Statistical Methods for Agricultural Workers, I.C.A.R., New

Delhi.

Snedecor, G.W. and Cochran, W.G. (1980). *Statistical Methods*, 7th ed. Iowa State Univ. Press. Ames, Iowa.

Steel, R.G.D. and Torrie, H.H. (1960). *Principles and Procedures of Statistics*. McGrawHill, New York

Gomez, A.G. and Gomez, A.A. (1994). *Statistical Procedures for Agricultural Research*, 2nd ed. John Wiley & Sons, New York.

SOA/AGRON/C-502 PRINCIPLES OF CROPPRODUCTION

3

Theory

UNIT I

Historical aspects of crop production, genesis of scientific principles and modern concepts of crop production.

UNIT II

Quantitative agro-biological principles and their validity; Mitscherlich yield equation, its interpretation and validity; concept of inverse yield nitrogen law and Boule unit.

UNIT III

Conceptual development in tillage practices, resources conservation technologies, conservation agriculture, integrated farming systems, organic farming and precision agriculture.

UNIT IV

Concepts of soil-plant relationships yield potential of crops and cropping systems and their relationship to fertility status of soil; maximization of crop yields and the apparent limitations.

UNIT V

Crop plants in relation to environment, competition between component crop plants in mixed crop and between crops and weeds; solar radiation, available moisture regime and crop production.

UNIT VI

Economics of crop production, law of diminishing returns in crop production, and crop response production functions.

Suggested Readings

Balasubramanian, P. and Palaniappan, S.P. 2001. *Principles and Practices of Agronomy*. Agrobios.

Fageria, N.K. 1992. *Maximizing Crop Yields*. Marcel Dekker.

Havlin, J.L., Beaton, J.D., Tisdale, S.L. and Nelson, W.L. 2006. *Soil Fertility and Fertilizers*. 7th Ed. Prentice Hall.

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

S.R. 2000. *Principles of Crop Production*. Kalyani Publ.

Sankaran, S. and Mudaliar, T.V.S. 1997. *Principles of Agronomy*. Bangalore Printing & Publ.

Singh, S.S. 2006. *Principles and Practices of Agronomy*. Kalyani Publ.

SOA/AGRON/C-503 PRINCIPLES AND PRACTICES OF WEED MANAGEMENT

3

Theory

UNIT I

Weeds and their importance-harmful and beneficial aspects, weed characteristics and classification.

UNIT II

Weed multiplication/propagation – seed dormancy, viability, germination and dissemination of weeds; crop-weed competition/ interference, Allelopathy.

UNIT III

Weed management principles and methods/options – preventive, physical, cultural, biological, chemical and integrated weed management approaches.

UNIT IV

History and properties of herbicides, differences with other pesticides, classification of herbicides based on miscellany, chemistry (organic and inorganic) and physiology, structure - activity and selectivity.

UNIT V

Herbicide injury symptoms, physiology/biochemistry of mode/mechanisms of action, herbicide transformations in plants and soil, herbicide formulations and applications; herbicide mixtures; herbicide resistance and management, herbicide residues in environment.

UNIT VI

Weed management in major crops and cropping systems, and non-cropped situations; perennial, aquatic, parasitic and invasive weeds management.

UNIT VII

Biotechnological applications in weed management; herbicide tolerant crops - risks and opportunities.

Suggested Readings

- Aldrich, R.J. and Kramer, R.J. 1997. *Principles in Weed Management*. Panima Publ. Das, T.K. 2008. *Weed Science – Basics and Applications*. Jain Brothers, New Delhi, 901p.
- Devine, M.D., Duke, S.O. and Fedtke, C. 1993. *Physiology of Herbicide Action*. PTR Prentice Hall, Englewood Cliffs, New Jersey, 441 p.
- Gupta, O.P. 1998. *Modern Weed Management*. AgroBotanica, Bikaner, 488 p.
- Gupta, O.P. 2007. *Weed Management – Principles and Practices*. Agrobios.
- Jayakumar, R. and Jagannathan, R. 2003. *Weed Science Principles*, Kalyani Publishers, Ludhiana.
- Mandal, R.C. 1990. *Weed, Weedicides and Weed Control - Principles and Practices*. Agro-Botanical Publ.
- Rao, V.S. 2000. *Principles of Weed Science*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 555 p.
- Subramanian, S., Ali, A.M. and Kumar, R.J. 1997. *All About Weed Control*. Kalyani Publ.
- Walia, U.S. 2003. *Weed Management*. Kalyani Publishers, Ludhiana.

SOA/AGRON/C-504 PRINCIPLES AND PRACTICES OF ORGANIC FARMING

2

Theory

UNIT I

Definition, concepts, history and importance of organic farming; organic production scenario organic farming minimum tillage, shelter zone, hedges, pasture.

UNIT II

Use of organic inputs, viz. Vermicompost, biofertilizers, compost, green manures for crop nutrition, water and weed management, crop protection, harvesting and post-harvesting processing / care.

UNIT III

Production technology and availability of different organic inputs, viz. vermicompost, biofertilizers, improved compost, green manure, bio-pesticides and plant products, crop-specific package of practices for organic production of different food, vegetable and flower crops.

UNIT IV

Farming system, crop rotations multiply and relay cropping systems intercropping in relation to soil productivity.

UNIT V

Suggested Readings

- Cooper, J., Niggli, U. and Leifert, C. 2007. *Handbook of Organic Food Safety and Quality*. Woodhead Publishing Limited, Cambridge.
- FAO. 2002. *Organic Agriculture, Environment and Food Security*. FAO Publ.
- Lampkin, N. 1990. *Organic Farming*. Press Books, Ipswich, UK.
- Palaniappan, SP. and Annadurai, 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, M.V. (Ed.). 1995. *Soil Organisms and Litter Decomposition in the Tropics*. Oxford & IBH.
- Sharma, A. 2002. *Hand Book of Organic Farming*. Agrobios.
- Singh, S.P. (Ed.) 1994. *Technology for Production of Natural Enemies*. PDBC, Bangalore.
- Veeresh, G.K., Shivashankar, K. and Suiglachar, M.A. 1997. *Organic Farming and Sustainable Agriculture*. Association for Promotion of Organic Farming, Bangalore.
- WHO. 1990. *Public Health Impact of Pesticides Used in Agriculture*. WHO Publ.

SOA/AGRON/C-505 AGRONOMY OF CEREAL CROPS

2

Theory

UNIT I

Origin, history, production trends, adaptability, classification, varietal improvement, climate and soil requirements, cultural, nutritional, weed and water management, quality components for maximum production of *kharif* cereals - rice, maize, sorghum and pearl millet & smaller millets.

UNIT II

Origin, history, production trends, adaptability, classification, varietal improvement, climate and soil requirements, cultural, nutritional, weed and water management, quality components for maximum production of *rabi* cereals - wheat and barley.

UNIT III

Integrated nutrient, water and weed management in cereal-based cropping systems. Agronomic management in problematic soils.

Suggested Readings

- Das, N.R. 2007. *Introduction to Crops of India*. Scientific Publ.
- Hunsigi, G. and Krishna, K.R. 1998. *Science of Field Crop Production*. Oxford & IBH.
- Khare, D. and Bhale, M.S. 2000. *Seed Technology*. Scientific Publ.
- Kumar, Ranjeet and Singh, N.P. 2003. *Maize Production in India: Golden Grain in Transition*. IARI, New Delhi.
- Pal, M., Deka, J. and Rai, R.K. 1996. *Fundamentals of Cereal Crop Production*. Tata McGraw Hill.
- Prasad, Mahendra. 2002. *Text Book of Field Crop Production*. ICAR Publ.

SOA/AGRON/C-506

LABORATORY COURSE

5

UNIT I

Statistical Methods and Experimental Designs

Presentation of data- tabulation, Histograms and frequency polygons, calculations of mean, median, mode, standard deviation, calculations of expected frequencies in binomial, poisson & normal distributions, test of significance, correlation & regression coefficients and their significance, analysis of variance for RBD and LSD.

UNIT II

Principles of crop production

Plant sampling at different crop growth stages for dry matter and leaf area measurement. Calculation of growth indices using dry matter and leaf area, and interpretation of results in relation to treatments. Computation of harvest index of different crops based on biomass and energy equivalent. Working out sustainability index of different cropping systems. Calculation of indices for reassessment of cropping systems and input-use efficiency. Studying the effect of planting geometry on competition between crop plants, crop plants and weeds and input-use efficiency. Assessment of crop yield on the basis of yield attributing characters. Statistical analysis of fertilizer experiments to work out response equation, and optimum/economic dose of nutrients.

UNIT III

Principles and Practices of weed Management

Weeds and weed seeds identification. Determination of IVI (importance value index). Methodologies in studying crop-weed interference. Calibration of sprayer, and volume, rate and swath width calculations. Herbicide application equipment and accessories, and application techniques. Herbicide formulations demonstration. Bioassay technique for the analysis of herbicide residues in soil. Determination of LD₅₀/GR₅₀ value of herbicides. Calculations of herbicide requirements for different crops, and non-crop terrestrial and aquatic situations. Weed control experiments–types, planning, conduct and recording of data. Data transformation and calculations of weed indices. Weed herbarium preparation.

UNIT IV

Principles and Practices of organic farming

Technique of biofertilizers application and their response in crops. Technique of biopesticide and pheromones application and their response in crops. Techniques of growing green manure crops. Visit to National Centre for Organic Farming (NCOF). Visit to blue- green algae centre, Vermicompost and biofertilizers production unit. Vermi compost and compost making methods, Visit to biopesticide production units, Centre for Protected Crop Production, organic crop production farm.

UNIT V

Agronomy of cereal crops

Phenological studies at growth stages of crops. Growth indices analysis: CGR, RGR, NAR, LAD, LAI, and root growth. Calculation of cropping and rotational intensity. Estimation of crop yield on the basis of yield attributes. Nutrient, water and weed management practices. Determination of harvest index and economics of different crops. Nutrient-use efficiency and nutrient balance studies in cereal-based systems.

M.SC. (AG.) AGRONOMY, II SEMESTER

SOA/AGRON/C-507 Crop Ecology and Agrometeorology

2

Theory

UNIT I

Concept of crop ecology, ecosystem characteristics, energy flow in ecosystem, succession and climax concept, adaptation of crops, agro-ecological regions.

UNIT II

Agrometeorology—aims, scope and development in relation to environment. Historical aspects of meteorology /climatology.

UNIT III

Physiological response of crop plants to weather variables (light, temperature, CO₂, moisture and solar radiation). Atmospheric pollution and its effect on climate. Global climate change and its impact on agriculture.

UNIT IV

Monsoons – their origin and characteristics. Weather hazards and their mitigation. Artificial rain making. Weather forecasting in India—short, medium and long range. Remote sensing— aerospace science and weather forecasting. Benefits of weather services to agriculture.

SOA/AGRON/C-508 CROPPING SYSTEMS AND SUSTAINABLE AGRICULTURE

2

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 dry lands; plant growth regulators and their role in sustainability.

Theory

UNIT I

Soil fertility and productivity, essential plant nutrients - criteria of essentiality, classification, functions, deficiency and toxicity symptoms, beneficial elements.

UNIT II

Factor effecting of soil fertility, methods of fertilizer application and classification of fertilizer

UNIT III

Commercial fertilizers, new fertilizer materials and principles, fertilizer application and use efficiency, economics of fertilizer use, nutrient requirements of crops.

UNIT IV

Preparation and use of FYM, compost, Green manures, Vermi compost, Bio fertilizer and other organic manure, Recycling of organic wastes .

UNIT V

Nutrient function deficiency symptoms fertilizer mixture and grades, integrated nutrient management, Use of Vermi compost, Residual Management.

Theory

UNIT I

Role of pulse and oilseed crops in Indian agriculture. Causes of low yields of pulse and oilseed crops, and strategies for improving productivity.

UNIT II

Origin, history, production trends, adaptability, classification, varietal improvement, climate and soil requirements, cultural, nutritional, weed and water management, quality components for maximum production of *kharif* pulses - pigeon pea, green gram, black gram, cowpea, moth bean, field bean.

UNIT III

Origin, history, production trends, adaptability, classification, varietal improvement, climate and soil requirements, cultural, nutritional, weed and water management, quality components for maximum production of *rabi* pulses – chickpea, lentil, peas, French bean.

UNIT IV

Origin, history, production trends, adaptability, classification, varietal improvement, climate and soil requirements, cultural, nutritional, weed and water management, quality components for maximum production of *kharif* oil seeds - soybean, groundnut, sesamum and castor.

UNIT V

Origin, history, production trends, adaptability, classification, varietal improvement, climate and soil requirements, cultural, nutritional, weed and water management, quality components for maximum production of *rabi* oil seeds – rape seed and mustard, sunflower, safflower, and linseed.

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 Sarpagandha, Poppy, Sadabahardioscorea, Solanum, Brahmi, Isabgol, Senna Aloe, Neem and Cinchona winter cherry, Safed musali.

UNIT III

Climate and soil requirements; cultural practices; yield and important constituents of aromatic plants. Lemon grass, Palma rosa, Citronella, Vetiver, Ocimum geranium, dill (Sowa), Jasmine, Rose, Lavender, Mentha,

UNIT I**Crop Ecology and Agrometeorology**

Study of the climatic logical data of the state and their relationship with the growth and yield of the crops. Effect of solar light on photosynthesis rate of plants. Nitrogen cycle and Nitrogen fixation. Food Chain. Determination of areas in India with the help of data of crop yield. Study the micro- climate in crops. Visit to agro-meteorological observatory 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, soil and canopy temperature. Measurement/estimation of evapo-transpiration by various methods.

UNIT II**Cropping Systems And Sustainable Agriculture**

Preparation of cropping schemes for dry and irrigated areas. Evaluation of cropping system: Simple values indices, crop equivalent yield (CEY), Land equivalent ratio (LER), Relative crowding co-efficient. Evaluation of constraints and optimization of farming system. Intercropping trap and decoy crops, constructed traps, repellents, biological control and strategic use of pesticides in crops and natural medicines in animals, contour farming, and integrated crop- livestock – fish farming. Integrated forage production and forms – centered techniques and practices thereof.

UNIT III**Advances in Soil Fertility and Nutrient Management**

Soil and plant sampling, and processing for chemical analysis. Determination of soil pH, total and organic carbon in soil. Chemical analysis of soil for total and available nutrients (major).

UNIT IV**Agronomy of Pulses and oil seed crops**

Sowing methods vis-à-vis germination pattern in pulses and oilseeds. Seed inoculation with *Rhizobium* and phosphatesolubilizing bacteria. Cultural operations for higher productivity of pulses and oilseeds. Yield attributes of pulses and oilseeds, and estimation of yield. Estimation of biological nitrogen fixation by legume crops. Determination of oil content in oilseeds, and computation of oil yield. Estimation of quality parameters in pulses and oilseeds. Identification of major weeds, insect-pests and diseases of pulses and oilseed crops. Visit to oilseed and pulse processing industry, research and development institution.

UNIT V**Agronomy of Medicinal and Aromatic Crops**

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

M.SC. (AG.) AGRONOMY, III SEMESTER

SOA/AGRON/C-513 Principles and Practices of Water Management

- 4

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-plant-atmosphere continuum, soil water movement in soil and plants, transpiration, soil-water-plant relationships, water absorption by plants, plant response to water stress.

UNIT III

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

UNIT IV

Water management of crops soil moisture stress and plant growth, strategies of using limited water supply, 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 soil, soils drainage, requirement of crop and methods of drainage, Systems of drainage.

Suggested Readings

- Lenka, D. 1999. *Irrigation and Drainage*. Kalyani Publ. Michael, A.M. 1978. *Irrigation: Theory and Practice*. Vikas Publ.
- Panda, S.C. 2003. *Principles and Practices of Water Management*. Agrobios.
- Prihar, S.S. and Sandhu, B.S. 1987. *Irrigation of Food Crops - Principles and Practices*. ICAR.
- Reddy, S.R. 2000. *Principles of Crop Production*. Kalyani Publ.
- Singh, Pratap and Maliwal, P.L. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publ.

SOA/AGRON/C-514 Agronomy of Commercial Crops

3

Theory

UNIT I

Importance, origin, history, adaptability, production, distribution, constraints, growth and development, varietal improvement, water and nutrient requirements, weed management, cropping systems, produce quality and value addition in respect of cotton, jute, sugar beet and sugarcane, crops.

UNIT II

Importance, origin, history, adaptability, production, distribution, constraints, growth and development, varietal improvement, water and nutrient requirements, weed management, cropping systems, produce quality and value addition in respect of potato, chili and tobacco crops.

UNIT III

Importance, origin, history, adaptability, production trend, distribution, plant growth and development, varietal improvement, soil, water and nutrient requirements, weed management and crop protection, factors affecting produce quality, processing and value addition in respect of tea and coffee.

Suggested Readings

- Das, N.R. 2007. *Introduction to Crops of India*. Scientific Publ.
- ICAR. 2006. *Hand Book of Agriculture*. ICAR, New Delhi.
- Prasad, R. 2002. *Text Book of Field Crops Production*. ICAR Publ.

SOA/AGRON/E-515 Dryland Farming

2

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

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, tillage, 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-transparent; soil and crop management techniques, seeding and efficient fertilizer use.

UNIT V

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

Suggested Readings

- Das NR. 2007. *Tillage and Crop Production*. Scientific Publishers.
Dhopte AM. 2002. *Agro technology for Dry land 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.
Katyaj 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.

SOA/AGRON/E- 516 Management of Problem Soils - 2

Theory

UNIT I

Problem soil classification, Area and distribution of problem soils – acidic, saline, sodic.

UNIT II

Saline, sodic and saline-sodic soils; characterization of salt-affected soils- soluble salts.

UNIT III

Management of saline and sodic soils; salt tolerance of crops-mechanism and ratings; monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dryland soils.

UNIT IV

Agronomic practices in relation to problematic soils Quality of irrigation water, Effect of Excess water in plant.

Suggested Readings

- Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. 1982. *Saline and Alkali Soils of India*. ICAR, New Delhi.
Bolt, G.H. and Bruggenwert, M.G.M. 1978. *Soil Chemistry*. Elsevier, Amsterdam, The Netherlands.
Goswami, N.N., Rattan, R.K., Dev, G., Narayanasamy, G., Das, D.K., Sanyal, S.K., Pal, D.K. and Rao, D.L.N. 2009. *Fundamentals of Soil Science*. Second Edition. Indian Society of Soil Science, New Delhi.
Havlin, J. L., Beaton, J. D., Tisdale, S. L. and Nelson W. L. 2006. *Soil Fertility and Fertilizers* (7th Edn.) Prentice Hall, New Delhi. .
Jurinak, J.J. 1978. *Salt-affected Soils*. Department of Soil Science and Biometeorology, Utah State Univ, Ames, USA.
Mahapatra, I.C., Mandal, S.C., Mishra, C., Mitra, G.N. and Panda, N. (Eds). *Acid Soils of India*. ICAR, New Delhi.

Theory

UNIT I

Cropping systems – definition, indices, production potential, resource management in cropping systems, production potential under monoculture, multiple cropping, alley cropping, intercropping, and multi-storied cropping. Yield advantages in intercropping systems.

UNIT II

Farming systems - definition and importance; classification of farming systems, characteristics, objectives and principles. Concept of sustainability in farming systems; efficient farming systems; natural resources - identification and management.

UNIT III

Production potential of different components of farming systems. Cropping systems as an important component of farming systems, remunerative cropping systems, crop diversification.

UNIT IV

Integrated farming systems for different agro-ecosystems, interactions and resource recycling among different enterprises.

UNIT V

Farming system research methodologies: on-farm research, on-station research and system modeling. Preparation of different farming system models; evaluation of different farming systems. Case studies on different farming systems.

UNIT VI

Multi-criteria decision making and optimization methodologies for designing integrated farming systems.

UNIT VII

Agroforestry systems—definition, classification and importance. Crop production technology in agroforestry; silvipastoral system. Wasteland development-selection of species, planting methods and problems of seed germination in agro-forestry systems. Lopping and coppicing in agroforestry systems.

Suggested Readings

- Behera, U.K., Das, T.K. and Sharma A.R. 2009. *Manual on Multicriteria Decision Making and Optimization Methodology for Sustainable Farming*. Division of Agronomy, IARI, New Delhi. Co.
- FAO and World Bank, Rome and Washington, D.C.
- Mahapatra, I.C., Mahapatra, P.K. and Batra, P.K. 2002. *Field Manual for On-farm Adaptive Research. Agroecosystem Directorate (Rainfed Farming)*. National Agricultural Technology Project. Central Research Institute for Dryland Agriculture, Hyderabad.
- Malcolm, Hall. 2001. *Farming Systems and Poverty: Improving Farmers Livelihood in Changing World*. New Age Publ.
- Palaniappan, S.P. and Sivaraman, K. 1996. *Cropping Systems in the Tropics: Principles and Management*.
- Panda, S.C. 2004. *Cropping Systems and Farming Systems*. Agribios.
- Raman, K.V. and Balguru, T. 1992. *Farming Systems Research in India: Strategies for Implementation*. Proceedings of the National Workshop, November 25-28, 1991, NAARM, Hyderabad, India
- Rangaswamy, A., Annadurai, K., Subbain, P. and Jayanti, C. 2002. *Farming Systems in the Tropics*, Kalyani Publishers.
- Sankaran, S. and Mudaliar, T.V.S. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ.
- Singh, A.K., Sharma, S.K., Batra, P.K. and Sharma, N.K. 2003. *Instruction Manual for On-farm Research (Cropping Systems)*. Project Directorate for Cropping Systems Research, Modipuram, Meerut.

UNIT-I

Importance of Post-harvest technology. Problems occurring in harvesting, threshing, transport drying, milling and marketing.

UNIT-II

Moisture content and its measurement. Drying and its importance: Methods of drying grains. Grain dryers. Food grain storage structures. Bulk storage structures.

UNIT-III

Thin layer and deep bed drying, Unit operations in seed processing. Equipment for cleaning, sorting, grading and separation. Milling,

UNIT-IV

Principles of size reduction, size reduction machinery, Technology of parboiling of paddy, advantages, disadvantages of parboiling, methods of parboiling.

Suggested readings:

K. M. Sahay and K. K. Singh Unit Operations of Agricultural Processing. Vikas Publishing House Pvt. Ltd., New Delhi.

A. M. Michael & T. P. Ojha. Principles of Agricultural Engineering Vol. I, Farm Power & Machinery, Farm Buildings and Post harvest technology. Jain Brothers. Jodhpur.

A. Chakravarty Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH, Publishing Com. Pvt. Ltd., New Delhi.

G.A. Henderson and R.C. Perry Agricultural Processing Engineering. AVI Publishing Co. West-Port, Connecticut, USA.

C.W. Hall. Mohan Makhijani Drying Farm Crops. Rekha Printers, New Delhi.

Sawant B.P., Potekar J. M. and H. W. Awari. A text book of Greenhouse and Post Harvest Technology. Nikita Publication, Latur

SOA/AGRON/ C&E-519 LABORATORY COURSE*5****UNIT****Principles and Practices of water management**

Measurement of soil water potential by using tensiometer, and pressure plate and membrane apparatus. Preparation of soil-moisture characteristic curves. Water flow measurements using different devices. Determination of irrigation requirement and irrigation efficiency. Determination of infiltration rate. Soil moisture constant sand measurement. Measurement of evapo-transpiration and water requirement of crops.

UNIT II**Agronomy of Commercial Crops**

Seed/seedling treatment in different crops. Delinting in cotton and visit to cotton growing area. Estimation of seed rate in cotton and jute based on different parameters. Estimation of crop yield on the basis of yield attributes. Working out cost of cultivation of different crops.

Preparation of project report for commercial cultivation of crops. Field visits to acquaint the students about the plant growth and important cultural practices in the crops under study.

UNIT III

Dryland Farming

Seed treatment, seed germination and crop establishment in relation to soil moisture contents
Moisture stress effects and recovery behavior of important crops
Estimation of moisture index and aridity index
Spray of anti-transpirant 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

UNIT IV

Management of Problem Soils

Characterization of acid, acid-sulfate, salt-affected and calcareous soils. Determination of cations (Na^+ , K^+ , Ca^{++} and Mg^{++}) in ground water and soil samples. Determination of electrical conductivity and gypsum requirement of salt-affected soils. Determination of soil pH and lime requirements of acid soils. Visit to salt-affected / acid soil areas (CSSRI /CPRI).

UNIT V

Farming systems

Indices for assessing cropping system efficiency. Measurement of competition effects in intercropping systems. Farming system analysis: Participatory Rural Appraisal, Rapid Rural Appraisal, diagnostic survey. Farming system analysis: Interaction with farmers, problem identification, prioritization and development projects/interventions for solutions to the identified problems. Use of optimization software for developing models, formation of matrix and drawing of different scenarios. Handling single objective LP model, Handling multi-objective LP model and analysis of data for risk analysis, resource allocation and enterprise selection decisions. Visit to apiary, vermicomposting, mushroom production and biogas production unit, integrated farming systems. Trees of economic importance with reference to agro-forestry with reference to agroforestry methods of propagation, trees in Silvopastoral system, Fertilizer application in silvi-pastoral system. Economics of agro foresters system visit to IGFRI/NRCAF, Jhansi.

UNIT VI

Post-Harvest Technology of Agricultural Crops

Study of different moisture measuring methods, Determination of grain moisture content and numerical, Expected yield, Multifactor Productivity, Study of various types of grain dryers, Study of cleaning equipment, Study of different types of separators., Study of material handling equipments, Study of vapour compression system of refrigeration, Study of cold storage, & Visit to seed processing plant / cold storage unit / oil mill / dal mill / rice mill.

M.SC. (Ag.) AGRONOMY, IV SEMESTER

SOA/AGRON/E-523 Seed Production Technology of Field Crops

2

UNIT I

Objectives of seed production technology: Role in increasing agriculture production seeds its

importance, in green revolution difference between grain and seed. Concept of seed quality, steps involve in seed production. Principles of seed production, concept and factors that affect the seed quality in the growing; processing and distribution of seed, seed replacement rate, multiplication rate, seed industry in India and role of various agencies, important terminology used in seed industry, breeders, foundation, and certified seed, maintenance of genetic purity.

UNIT II

Seed certification: Its concept, role & goal, necessity of seed certification, minimum seed certification standard for self and cross pollinated crops, Field and seed inspections, objectives, general principles and methods. Preparation of field reports, seed certification terms; seed certification agencies, certified and truthfully labeled seeds.

UNIT III

Nucleus and breeders seed production of self pollinated crops: Viz. Rice, Wheat, Arhar, Gram, Soybean, Rapeseed and Mustard.

UNIT IV

Maintenance of nucleus and breeders seed in cross pollinated crop varieties: in breeds and no-inbreeds, maintenance of seed of established varieties, foundation, and certified seed production of Maize inbreeds, single and double cross hybrids.

UNIT V

Hybrid seed production: of Rice, Maize, Sorghum, and Bajra, and Sunflower using male sterility systems.

UNIT VI

Latest released hybrids L of Rice, Maize, Sorghum, and Bajra, their characteristic features.

UNIT VII.

Seed testing: Importance of seed testing in production of high quality seed. Techniques of seed testing; Sampling, Sample preparation for seed testing, purity testing, germination test, physiology of seed in relation to viability, vigour & dormancy of seeds, Varietal identification, through electrophoresis. Growth out test for cultivar, purity. Seed legislation and seed law enforcement including IPR, PBR in India. Recent development in seed industry. Genetic aspect of varietal deterioration.

UNIT VIII

Seed processing storage and marketing principle & practices of seed drying and seed separation selecting of sources air and screen seed cleanness physical characteristics utilized in seed cleaning & grading; seed treatment, type of seed treatment, materials & methods of seed packing, factors affecting seed in storage, problems of stored grains pest & methods to avoid the loss. Distribution & marketing of seed.

Suggested Readings

1. U.S.D.A. Year Book Seeds, 1961.
2. International rules for seed testing I.S.T.A. proceedings 959. Vol. 2 & 3.
3. Seed certification, processing & storage, I.C.A.R. Miscellaneous Bulletin No. 84.

4. Seed certification Manual, produced by N.S.C. & the Rockefeller Foundation.
5. Seed processing storage & distribution Manual, produced by N.S.C. and the Rockefeller Foundation.
6. Seed Production Manual, Produced by N.S.C. and the Rockefeller Foundation.
7. Seed Technology-Agrawal, R.L.
8. Technique seed Science & Technology-Agrawal, P.K.
9. Seed Technology-Dahia, B.S. and Rai, K.N.
10. Seed Science and Technology-Sen, S. and Ghosh, N.

SOA/AGRON/E-524 Soil Conservation and Watershed Management

- 2

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 - bonding, 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; lay 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.

Suggested Readings

- Arakeri HR & Roy D. 1984. Principles of Soil Conservation and Water Management. Oxford & IBH.
- Dhruvanarayana VV. 1993. Soil and Water Conservation Research in India. CAR.
- 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.

SOA/AGRON/E-525 Agronomy of Fodder and Pasture Crops

- 2

Theory

UNIT I

Introduction, origin, history, distribution, adaptation, classification, climate, soil, varieties, water,

weed management and nutrient requirement of important cultivated fodder crops like maize, pearl millet, teosinte, cluster bean, cowpea, oats, barley, berseem, senji, Lucerne etc.

UNIT II

Introduction, origin, history, distribution, adaptation, classification, climate, soil, varieties, water, weed management and nutrient requirement of important forage crops/grasses/ legumes, like, Napier grass, guinea grass, Phulwa grass, Deenanath grass.

UNIT III

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 IV

Natural grasslands of India. Establishment of pastures and their management with special reference to weed control.

Suggested Readings

Das, N.R. 2007. *Introduction to Crops of India*. Scientific Publ.

George, Thomas, C. 2003. *Forage Crop Production in the Tropics*. Kalyani Publishers.

IGFRI. 1999. *Forage Production Technology - A Bulletin* by P.S. Tomar, N.P. Shukla and S.N. Tripathi

SOA/AGRON/E-526 Environmental Studies and Disaster Management

2

Unit I

Multidisciplinary nature of environmental studies Definition, scope and importance

Unit II

Natural Resources: Renewable and non-renewable resources Natural resources and associated problems. (a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. (e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Unit III

Ecosystems Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: - a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit IV

Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social,

ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit V

Environmental Pollution: definition, cause, effects and control measures of :- a. Air pollution, b. Water pollution, c. Soil pollution, d. Marine pollution, e. Noise pollution, f. Thermal pollution, g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

Unit VI

Social Issues and the Environment: From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Dyes. Wasteland reclamation. Consumerism and waste products. Environment Protection Act- Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. Public awareness.

Unit VII

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.

Unit VIII

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Suggested readings:

Erach Barouche Text book of Environmental Studies for undergraduate courses, University Grants Commission, New Delhi.
P.D. Sharma -Ecology and Environment, Rastogi Publication. Meerut.
S.S. Purohit, Q.J. Shammi and A.K. Agrawal -Environmental Sciences, Student Edition, Jodhpur.
M. Peasant rajan and P.P. Mahendran., A text book on Ecology and Environmental Science Agrotech Publishing Academy, Udaipur-313002.
The biodiversity of India, Maplin Publishing Pvt. Ltd., Ahmadabad.
Sarthak Singh -Disaster Management. Oxford Book Company.
Dr. B.K. Khanna and Nina Khanna- Disaster - Strengthening community Mitigation and Preparedness. New India Publication Agency.
Amrit Kaur Laboratory Manual of Ecology and Environmental Studies, Paragon International Publisher, New Delhi.

SOA/AGRON/E-527 Laboratory Course

3

UNIT I

Seed Production Technology

Testing of seeds for their purity, viability & germination. Seed treatment for diseases & pests. Handling of crop protection equipment. Seed sampling & preparation of samples for seed testing. Evaluation of seed tests & writing of seed testing report. Visit to a seed processing plant. To see equipment & machinery used in seed processing. To see cleaning grading, treating & packing of seed. Field trip to see production in field of maize. Visit to seed production plots of vegetable crop. Acquaintance of insecticide, fungicide

& pesticide. Identification of important varieties of Maize, Jowar, Bajara, Paddy & Wheat.

UNIT II

Soil Conservation and Watershed Management

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.

UNIT III

Agronomy of Fodder and Pasture crops

Practical training of farm operations in raising fodder crops and canopy measurement. Yield and quality estimation, viz. crude protein, NDF, ADF, lignin, silica, cellulose etc. of various fodder and forage crops. Hay and silage making, and economics of their preparation. Methods of propagation/planting of grasses.

UNIT IV

Environmental Studies and Disaster Management

Sampling of sewage waters, sewage sludge, solid/liquid industrial wastes, polluted soils and plants. Estimation of dissolved and suspended solids, chemical oxygen demand (COD), biological demand (BOD), nitrate and ammoniac nitrogen and phosphorus, heavy metal content in effluents. Heavy metals in contaminated soils and plants. Management of contaminants in soil and plants to safeguard food safety. Air sampling and determination of particulate matter and oxides of sulphur. Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, visit to a local polluted site-Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.