

**Sri Dev Suman Uttarakhand University,
Badshahithaul, Tehri, Garhwal (UK)**

M.Sc. Ag. (Agronomy)

**Syllabus to be implemented from Academic Session 2023-
2024**

Course Curriculum

Course Codes	Course Title	Total Marks	Sessional Marks (I+II)	External Marks	Credit
SEMESTER-I					
SOA/AGRON/C-501	Advances in Soil fertility and Nutrient Management	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	Statistical Methods and Experimental Designs	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	3
SOA/AGRON/C-514	Agronomy of Commercial Crops	100	40	60	3
SOA/AGRON/C-515	Dry land Farming	100	40	60	3
In addition to SOA/ AGRON/ C&E520, students can choose any Two elective papers out of the following four electives.					
SOA/AGRON/E-516	Management of Problematic 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/E-519	Seed and Crop Physiology	100	40	60	2
*SOA/AGRON/ C & E-520	Lab course- III	100	40	60	5
Total		700	280	420	18

**SOA/AGRON/SS-01	Self-Study courses to be decided by concern department/college and to be Evaluated by them. It is only a qualifying course.	100	40	60	3
SEMESTER-IV					
SOA/AGRON/C-521	Thesis	100	40	60	8
SOA/AGRON/C-522	OR Project based on Farmers field Survey				
SOA/AGRON/C-522	Seminar	100	40	60	1
In addition to SOA/AGRON/E/527, students can choose 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		2500	1000	1300	72

Summary of Credit:

Semester	Core Credits	Elective Credits	Total Credits
1 st	18	--	18
2 nd	18	--	18
3 rd	9	09	18
4 th	9	09	18
	54	18	72

SOA/GPB/C&E-520*- This is a practical course combining both core and elective courses only in the third semester.

****SOA/AGRON/SS-01-** This is a Self-Study course and will be provided to the students by the concerned 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

M.Sc. Ag. (Agronomy)

DESCRIPTION OF COURSES

I SEMESTER

SOA/AGRON/C-501 ADVANCES IN SOIL FERTILITY AND NUTRIENT MANAGEMENT

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. Common practices of organic farming in Uttarakhand.

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

Suggested Readings

Brady, N.C. and Weil, R.R. 2002. *The Nature and Properties of Soils*. 13th Ed. Pearson Edu.

Epestein, E. and Bloom, A. 2005. *Mineral Nutrition of Plants: Principles and Perspectives*. Second edition. Sinauer Associates.

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.

Khasawneh, F.E., Sample, E.C. and Kamprath, E.J. (Eds.)

1980. *The Role of Phosphorus in Agriculture*. Soil Science Society of America, Madison, Wisconsin, USA.

Marschner, H. 1995. *Mineral Nutrition of Higher Plants*. Second Edition. Academic Press

Ltd. Pierzynski, G.W., Sims, J.T. and Vance, G.F. 2002. *Soils and Environmental Quality*. Second

Edn. Tandon, H.L.S. (Ed.) 1995. *Management of Nutrient Interactions in Agriculture*. FDCO,

New Delhi. Yawalkar, K.S., Agrawal, J.P. and Bokde, S. 2000. *Manures and Fertilizers*. Agri-Horti Publ.

SOA/AGRON/C-502 PRINCIPLES OF CROP PRODUCTION

Theory

UNIT I : Historical aspects of crop production, genesis of scientific principles and modern concepts of crop production. Characteristic features of Agroclimatic zone of Uttakhand and crop suitability.

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

- Balasubramaniyan, P. and Palaniappan, SP. 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 WEEDMANAGEMENT

Theory

UNIT I: Weeds and their importance-harmful and beneficial aspects, weed characteristics and classification. Important weed flora of cultivable crops in hilly areas with special reference to Uttarakhand.

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

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: Control of weeds, disease and insect pest management, biological and pheromones bio pesticides

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

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 of Uttarakhnad state.

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

UNIT I

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 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 LD_{50}/GR_{50} 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: Phonological 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.

II SEMESTER

SOA/AGRON/C-507 CROP ECOLOGY AND AGROMETEOROLOGY

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.

Suggested Readings

- Chadha, K.L. and Swaminathan, M.S. 2006. *Environment and Agriculture*. Malhotra Publ. House. Critchfield, H.J. 1995. *General Climatology*. Prentice Hall of India.
Hemantaraman, A. 2007. *Environmental Physiology*. Scientific Publ.
Kumar, H.D. 1992. *Modern Concepts of Ecology*. 7th Ed. Vikas. Publ.
Lal, D.S. 1998. *Climatology*. Sharda Pustak Bhawan.
Lenka, D. 1998. *Climate, Weather and Crops in India*. Kalyani Publ.
Menon, P.A. 1991. *Our Weather*. National Book Trust Publ.
Sahu, D.D. *Agro meteorology and Remote Sensing: Principles and Practices*.
Sharma, P.D. 1998. *Ecology and Environment*. Rastogi Publ.
Varshneya, M.C. and Balakrishana Pillai, P. 2003. *Textbook of Agricultural Meteorology*. ICAR Publ.

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

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.

Suggested Readings

- Palaniappan SP & Sivaraman K. 1996. *Cropping Systems in the Tropics; Principles and Management*. New Age.
Panda SC. 2003. *Cropping and Farming Systems*. Agrobios.
Reddy SR. 2000. *Principles of Crop Production*. Kalyani.
Sankaran S & Mudaliar TVS. 1997. *Principles of Agronomy*. The Bangalore Printing & Publ. Co.
Singh SS. 2006. *Principles and Practices of Agronomy*. Kalyani.
Tisdale SL, Nelson WL, Beaton JD & Havlin JL. 1997. *Soil Fertility and Fertilizers*. Prentice Hall.

SOA/AGRON/C-509 STATISTICAL METHODS AND EXPERIMENTAL DESIGNS

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.

Kemphorne, O. (1957). An Introduction to Genetic Statistics, John Willey, 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, 71e. Iowa State Univ. Press Ames, Iowa.

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

York Gomez, AG and Gomez, AA (1994). Statistical Procedures for Agricultural Research, 2/e. John Wile & Sons, New York.

SOA/AGRON/C-510 AGRONOMY OF PULSES AND OILSEED CROPS

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 *rabbi* 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.

Suggested Readings

Ali, M., Singh, B.B., Shiv Kumar and Dhar, V. 2004. *Pulses in New Perspective*. Indian Society of Pulses Research and Development, Kanpur, India.

Asthana, A.N. and Ali, M. 1997. *Recent Advances in Pulses Research*. Indian Society of Pulses Research and Development, Kanpur, India.

Jeswani, L.M. and Baldev, B. 1997. *Advances in Pulse Production Technology*. ICAR, New Delhi. Prasad, R. 2002. *Text Book of Field Crops Production*. ICAR, New Delhi.

Sengupta, K. and Das, P.K. 2003. *Cultivated Annual Oilseed Crops in India*. Calcutta. Singh, G., Sekhon, H.S. and Kolar, J.S. 2005. *Pulses*. Agrotech Publishing Academy, Udaipur, India. Weiss, E.A. 2000. *Oilseed Crops*. Blackwell Science Ltd., Oxford, UK

SOA/AGRON/C-511 AGRONOMY OF MEDICINAL AND AROMATIC CROPS

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. Role of medicinal plants in rural economy of Uttarakhand.

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,

Suggested Readings

Chadha KL & Gupta R. 1995. *Advances in Horticulture*. Vol. II. Medicinal and Aromatic Plants. Malhotra Publ.

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

Handa SS. 1984. *Cultivation and Utilization of Medicinal Plants*. RRL, CSIR,

Jammu. Hussain A. 1984. *Essential Oil Plants and their Cultivation*. CIMAP, Lucknow.

Hussain A. 1993. *Medicinal Plants and their Cultivation*. CIMAP, Lucknow.

ICAR 2006. *Hand Book of Agriculture*. ICAR, New Delhi.

Kumar N, Khader Md. Abdul, Rangaswami JBM & Irulappan 1997. *Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants*. Oxford & IBH.

Prajapati ND, Purohit SS, Sharma AK & Kumar T. 2003. *A Hand Book of Medicinal Plants: A Complete Source Book*. Agrobios.

Sharma R. 2004. *Agro-Techniques of Medicinal Plants*. Daya Publ. House.

SOA/AGRON/C-512 LABORATORY COURSE

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

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, poison & normal distributions, test of significance, correlation & regression coefficients and their significance, analysis of variance for RBD and LSD.

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 phosphate solubilizing 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

III SEMESTER

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

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

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, tith, 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. Katyal JC & Farrington J. 1995. *Research for Rainfed Farming*. CRIDA.

Rao SC & Ryan J. 2007. *Challenges and Strategies of Dryland Agriculture*. *Scientific Publishers*. Singh P & Maliwal PL. 2005. *Technologies for Food Security and Sustainable Agriculture*. Agrotech Publishing Company.

Singh RP. 1988. *Improved Agronomic Practices for Dryland Crops*. CRIDA.

Singh RP. 2005. *Sustainable Development of Dryland Agriculture in India*. Scientific Publ.

Singh SD. 1998. *Arid Land Irrigation and Ecological Management*. *Scientific Publishers*.

Venkateshwarlu J. 2004. *Rainfed Agriculture in India. Research and Development Scenario*. ICAR.

SOA/AGRON/E- 516 Management of Problem Soils

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 dry land 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.

SOA/AGRON/E-517 Farming Systems

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-storeyed 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 agro forestry; 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.

SOA/AGRON/E-518- Post-Harvest Technology of Agricultural Crops

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/E-519 – Seed & Crop Physiology

THEORY

UNIT I: PLANT WATER RELATIONS: Introduction – review on plant anatomy - Importance of crop physiology in agriculture, Role and significance of water - diffusion, imbibitions, osmosis and its significance, plasmolysis, Definitions - field capacity, water holding capacity of soil and permanent wilting point, Absorption of water - mode of water absorption – active and passive absorption and factors affecting absorption, Translocation of solutes - phloem and xylem transport, Transpiration - types - Steward's theory of mechanism - significance, factors affecting transpiration and guttation - antitranspirants.

UNIT II: NUTRIO PHYSIOLOGY: Mineral nutrition - introduction - criteria of essentiality of elements - macro, secondary and micronutrients - sand and soil less culture- hydroponics, Mechanism of uptake - physiological role of nutrients, Foliar diagnosis - nutritional and physiological disorders - foliar nutrition and fertigation .

UNIT III : PHOTOSYNTHESIS& RESPIRATION: Photosynthesis - requirements of photosynthesis - light, CO₂, pigments and water, Mechanism of photosynthesis - light reaction - cyclic and non cyclic photophosphorilation - Red drop - Emerson Enhancement Effect, Photosynthetic pathways - C₃, C₄ and CAM, Differences between C₃, C₄ and CAM pathways - Factors affecting photosynthesis, Photorespiration - photorespiration process and significance of photorespiration, Respiration - Glycolysis, TCA and Pentose Phosphate Pathway, Oxidative phosphorylation - differences between oxidative phosphorylation and photophosphorylation. Respiratory quotient and energy budgeting in respiration.

UNIT IV : GROWTH PHYSIOLOGY Growth - growth curve, phases of growth and factors influencing growth, Growth analysis - LAI, LAD, SLW, SLA, LAR, NAR, RGR and CGR in relation to crop productivity,- Source sink relationship - Photoperiodism - Role of phytochrome in flowering and regulation of flowering. Transmission of stimulus - theories of flowering-Vernalisation – devernalisation Protein and fat synthesis- Plant growth regulators - growth hormones - definition and classification - physiological role of auxins and GA, Physiological role of Cytokinin, Ethylene and ABA - synthetic growth regulators and their uses in crop productivity, Practical application of Plant Growth Regulators in crop productivity

UNIT V : STRESS PHYSIOLOGY Environmental stresses - water stress - physiological changes - adaptation to drought and amelioration, Temperature stress - Physiological changes - low and high temperature -chilling injury - tolerance – alleviation, Low light and UV radiation stresses - salt stress - physiological changes and alleviation, Global warming – Carbon Sequestration physiological effects on crop productivity, Seed germination - physiological changes during seed germination,. Abscission – senescence- ripening - types, causes, physiological and biochemical changes and regulation.

***SOA/AGRON/ C&E-520 LABORATORY COURSE**

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 agroforesters system visit to IGRI/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.

UNIT VII

Seed and Crop Physiology: Plant Water Relations; Preparation of solutions – Anatomical textures of plant body - Measurement of plant water status - Relative Water Content - Measurement of transpiration - studying the structure of stomata - Stomatal Index. Nutrient Physiology; Identification of Physiological disorders - Nutritional disorders in crop plants - Rapid tissue testing methods - Field visit for foliar diagnosis. Photosynthesis & Respiration; Estimation of plant pigments in crop plants - determination of photosynthetic efficiency - differences in C₃ and C₄ plants - estimation of soluble protein. Growth Physiology; Measurement of leaf area by different methods - Growth analysis. Practical application of plant growth regulators. . – Stress Physiology; Estimation of Chlorophyll Stability Index and proline content - Elevated CO₂ and crop productivity.

Suggested Books:

- Agrawal, P.K. & M. Dadlani, 1995. Techniques In Seed Science And Technology (2nd Ed.) South Asian Publ. New Delhi.
- Agrawal, R.L. 1997. Seed Technology (IInd Ed.) Oxford & IBH Publ. Co. Daryaganj, New Delhi.
- Bench ALR & Sanchez RA. 2004. Handbook of Seed Physiology. Food Product Press.
- Bewley JD & Black M. 1982. Physiology and Biochemistry of Seeds in Relation to Germination. Vols. I, II. Springer Verlag.
- Bewley, J. D. and Black, M. 1994. Seeds: (2Vols.) Physiology of Development and Germination. Plenum Press, New York.
- Carol, C. Baskin and Jerry, M. Baskin, (2005) Seed, Biogeography, and Evolution of dormancy and germination, (Elsevier), Academic Press.
- Jain, J.K. 2007. Fundamentals of plant physiology, S.Chand & Company Ltd., New Delhi. Pandey, S. N. and B. K.Sinha, 2006. Plant Physiology. Vikas Publishing House Private Limited, New Delhi.
- Purohit, S.S, 2005. Plant physiology, Student edition, Jodhpur.
- Ray Noggle, G. and Fritz, G. J., 1991. Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd., New Delhi.
- Taiz. L. and Zeiger. E., 2006. Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.
- Copeland, R.A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis. VCH Publishers, New York.
- Devlin, R.M. & F.H. Witham 1983. Plant Physiology. CBS Publ. New Delhi. Hartman, H. T. & Kester, Dale E. 2000. Plant Propagation: Principles and Practices. (6th Ed.) Prentice-Hall of India. New Delhi.
- Khan AA. 1977. Physiology and Biochemistry of Seed Dormancy and Germination. North Holland Co.
- Kigel, J. and Galili, G. 1995. Seed development and germination. (eds).Marcel Dekker, New York
- McDonald, M.B. Nelson (eds). Physiology of seed deterioration. Crop Sci. Society of America, Madison
- Murray DR. 1984. Seed Physiology. Vols. I, II. Academic Press.
- Ninfa, A.J. and Ballou, D.P. 1998. Fundamental Laboratory approaches for Biochemistry and Biotechnology. Fitzgerald Science Press, Inc., Maryland, USA.
- Roberts, E.H. 1972. Viability of seeds. Chapman and Hall, New York

IV SEMESTER

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

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

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 –

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 grass lands 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. IGRI.

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

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 overwater, 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. Shammil 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

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.