Swami Vivekanand University, Sagar (M.P.)

SYLLABUS

Master of Science in Agriculture

(As per, 5th Dean Committee of ICAR)

Faculty of Agriculture Science & Technology

Department of Agriculture Science

Study and Evaluation Scheme

of

M. Sc. (Ag.) Soil Science and Agricultural Chemistry

(Applicable w.e.f. Academic Session 2018 to till revised)

Duration of Course: 02 year
Mode of Examination: Semester

SWAMI VIVEKANAND UNIVERSITY, SIRONJA, SAGAR, (M.P.)

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M. Sc. (Ag) Soil Science and Agricultural Chemistry
(Two Year Master Degree Programme)

REQUIREMENT OF CREDIT HOURS FOR AWARD OF THE DEGREE

S. No.	Nature of Courses	Credit
1	**Major Courses**	21
2	**Minor Courses**	11
3	**Supporting Courses**	07
4	**Masters Seminar**	01
5	**Masters Research**	20
	Total Credits	**60**

Major Subject: The subject (Department/Discipline) in which a student takes admission.

Minor Subject: The subject closely related to a student's major subject.

Supporting Subject: The subject not related to the major subject. It could be any subject considered relevant for student's research work or necessary for building his overall competence.

Non-Credit Compulsory Courses: Six courses are of general nature and are compulsory for Master's programme.

M.Sc. (Ag.) Soil Science and Agricultural Chemistry

SEMESTER-WISE DISTRIBUTIONS OF COURSE

First Semester

S.No.	Paper Code	Course Title	Credits
A. Major Courses			
1.	**SS-501**	Soil Chemistry	**3(2+1)**
2.	**SS-502**	Soil Mineralogy, Genesis, Classification and Soil Survey	**3(2+1)**
3.	**SS-503**	Soil Biology and Biochemistry	**3(2+1)**
4.	**SS-504**	Analytical Techniques and Instrumental Methods in Soil and Plant Analysis	**3(1+2)**
B. Minor Courses			
5.	**AGRON - 502**	Principles and Practices of Water Management	**3(2+1)**
6.	**AGRON - 505**	Dry Land Farming & Watershed Management	**3(2+1)**
C. Supporting			
7.	**STAT-501**	Statistical Methods for Applied Sciences	**4(3+1)**
D. Non-credit Courses			
8.	**PGS-501**	Basic concept in Laboratory Techniques	**N.C.**
9.	**PGS-502**	Agricultural Research, Research Ethics and Rural Development Programmes	**N.C.**
		Grand Total Credits	**22(14+8)**

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Second Semester

S.No.	Paper Code	Course Title	Credits
A. Major Courses			
1.	**SS-511**	Soil Physics	**3(2+1)**
2.	**SS-512**	Soil Fertility and Fertilizer use	**3(2+1)**
3.	**SS-513**	Soil Water and Air Pollution	**3(2+1)**
B. Minor Courses			
4.	**AGRON-512**	Principles and Practices of Soil Fertility and Nutrient Management	**3(2+1)**
5.	**AGRON-514**	Principles and practices of Organic Farming	**3(2+1)**
C. Supporting			
6.	**STAT-511**	Design of Experiments	**3(2+1)**
D. Non-credit Courses			
7.	**PGS-511**	Library and Information Services	**N.C.**
8.	**PGS-512**	Intellectual Property and its Management in Agriculture	**N.C.**
		Grand Total Credits	**18(12+6)**

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Third Semester

S.No.	Paper Code	Course Title	Credits
A. Major Courses			
1.	**SS-591**	Masters Seminar	**1(0+1)**
2.	**SS-599**	Masters Research (Under Process)	**10(0+10)**
B. Non-credit Courses			
3.	**PGS-521**	Technical Writing and Communication Skill	**N.C.**
4.	**PGS-522**	Disaster Management	**N.C.**
5.	**SVN-500**	Charitra Nirman Evam Samgra Vyaktitva Vikas	**N.C.**
		Grand Total Credits	**11(0+11)**

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Fourth Semester

S.No.	Paper Code	Course Title	Credits
A. Major Course			
1.	**SS-599**	Masters Research (Accepted)	**10(0+10)**

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Course Contents

(FIRST SEMESTER)

Paper Code	Course Title	Credits
SS-501	SOIL CHEMISTRY	3(2+1)

OBJECTIVE

To introduce the classical concepts of soil chemistry and to familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plant growth.

THEORY

UNIT I

Chemical (elemental) composition of the earth's crust and soils. Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics. Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter- fractionation of soil organic matter and different fractions, clay-organic interactions.

UNIT II

Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement,; anion and ligand exchange – innersphere and outer-sphere surface complex formation, fixation of oxyanions,hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition.

UNIT III

Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management aspects.

UNIT IV

Chemistry of acid soils; active and potential acidity; lime potential,; sub-soil acidity. Chemistry of salt-affected soils and amendments, Chemistry and electrochemistry of submerged soils.

PRACTICAL

Determination of CEC and AEC of soils, Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH, meter and conductivity meter, Adsorption-desorption of phosphate/sulphate by soil using simple, adsorption isotherm, Determination of titratable acidity of an acid soil by BaCl2-TEA method.

SUGGESTED READINGS

- *Bear RE. 1964. Chemistry of the Soil. Oxford and IBH.*
- *Bolt GH & Bruggenwert MGM. 1978. Soil Chemistry. Elsevier.*
- *Greenland DJ & Hayes MHB. 1981. Chemistry of Soil Processes. John Wiley & Sons. Greenland DJ & Hayes MHB. Chemistry of Soil Constituents. John Wiley & Sons.*
- *McBride MB. 1994. Environmental Chemistry of Soils. Oxford Univ. Press.*
- *Sposito G. 1981. The Thermodynamics of Soil Solutions. Oxford Univ. Press. Sposito G. 1984. The Surface Chemistry of Soils. Oxford Univ. Press.*
- *Sposito G. 1989. The Chemistry of Soils. Oxford Univ. Press. Stevenson FJ. 1994. Humus Chemistry. 2nd Ed. John Wiley & Sons.*
- *Van Olphan H. 1977. Introduction to Clay Colloid Chemistry. John Wiley & Sons.*

Paper Code	Course Title	Credits
SS-502	SOIL MINERALOGY, GENESIS, CLASSIFICATION AND SOIL SURVEY	3(2+1)

OBJECTIVE

To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals; soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning.

THEORY

UNIT I

Fundamentals of crystallography, isomorphism and polymorphism, Structural chemistry. Classification of minerals, chemical composition and properties of clay minerals; genesis and transformation of crystalline and non-crystalline clay minerals; amorphous soil constituents and other non-crystalline silicate minerals; clay minerals in Indian soils,Soil morphology and micromorphology.

UNIT II

Factors of soil formation, soil forming processes, weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils. Concept of soil individual; soil classification systems – historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness.

UNIT III

Soil survey and its types; soil survey techniques - conventional and modern; soil series – characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretations; soil mapping, thematic soil maps, cartography, mapping units, techniques for generation of soil maps.

UNIT IV

Landform – soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT) – concept and application; approaches for managing soils and landscapes in the framework of agro-ecosystem.

PRACTICAL

Identification of rocks and minerals, Morphological properties of soil profile in different landforms, Classification of soils using soil taxonomy, Grouping soils using available data base in terms of soil quality, Aerial photo and satellite data interpretation for soil and land use, Cartographic techniques for preparation of base maps and thematic maps, processing of field sheets, compilation and obstruction of maps in different scales, Land use planning exercises using conventional and RS tools

SUGGESTED READINGS

- *Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.*
- *Buol EW, Hole ED, MacCracken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publ.*
- *Dixon JB & Weed SB. 1989. Minerals in Soil Environments. 2nd Ed. Soil Science Society of America, Madison.*
- *Grim RE. 1968. Clay Mineralogy. McGraw Hill.*
- *Indian Society of Soil Science 2002. Fundamentals of Soil Science. ISSS, New Delhi.*
- *Sehgal J. 2002. Introductory Pedology: Concepts and Applications. New Delhi*
- *Sehgal J. 2002. Pedology - Concepts and Applications. Kalyani.*
- *USDA. 1999. Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.*
- *Wade FA & Mattox RB. 1960. Elements of Crystallography and Mineralogy. Oxford & IBH.*
- *Wilding LP & Smeck NE. 1983. Pedogenesis and Soil Taxonomy: II. The Soil Orders. Elsevier.*
- *Wilding NE & Holl GF. (Eds.). 1983. Pedogenesis and Soil Taxonomy. I. Concept and Interaction. Elsevier.*

Paper Code	Course Title	Credits
SS-503	SOIL BIOLOGY AND BIOCHEMISTRY	3(2+1)

OBJECTIVE

To teach students the basics of soil biology and biochemistry, including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities.

THEORY

UNIT I

Soil biota, soil microbial ecology, types of organisms in different soils; soil microbial biomass; microbial interactions; un-culturable soil biota. Microbiology and biochemistry of root-soil interface; phyllosphere; rhizoshpere, soil, enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora.

UNIT II

Microbial transformations of nitrogen, phosphorus, sulphur, iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, humus formation; cycles of important organic nutrients.

UNIT III

Biodegradation of organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil. Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost.

UNIT IV

Biofertilizers – definition, classification, specifications, method of production and role in crop production, BIS standards for biofertilizer for quality control.

PRACTICAL

Determination of soil microbial population, soil microbial biomass (C N P), fractionation of organic matter (HA, FA, Humin, Lignin and humus) and functional groups, soil enzymes, measurement of important soil microbial processes such as nitrification, N2 fixation, S oxidation, P solubilization.

SUGGESTED READINGS

- *Alexander M. 1977. Introduction to Soil Microbiology. John Wiley & Sons.*
- *Burges A & Raw F. 1967. Soil Biology. Academic Press.*
- *McLaren AD & Peterson GH. 1967. Soil Biochemistry. Vol. XI. Marcel Dekker.*
- *Metting FB. 1993. Soil Microbial Ecology – Applications in Agricultural and Environmental Management. Marcel Dekker.*
- *Paul EA & Ladd JN. 1981. Soil Biochemistry. Marcel Dekker.*
- *Reddy MV. (Ed.). Soil Organisms and Litter in the Tropics. Oxford & IBH.*
- *Russel RS. 1977. Plant Root System: Their Functions and Interaction with the Soil. ELBS & McGraw Hill.*
- *Stotzky G & Bollag JM. 1993. Soil Biochemistry. Vol. VIII. Marcel Dekker.*
- *Sylvia DN. 2005. Principles and Applications of Soil Microbiology. Pearson Edu.*

Paper Code	Course Title	Credits
SS-504	ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS	3(1+2)

OBJECTIVE

To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples.

THEORY

Principles of visible, ultraviolet and infrared spectrophotometery. Atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques. Mass spectrometry and X-ray defractrometery; identification of minerals by X-ray by different methods.

PRACTICAL

- Preparation of solutions for standard curves, analytical reagents, qualitative reagents, indicators and standard solutions for acid-base, oxidation reduction and complexometric titration; soil, water and plant sampling techniques, their processing and handling.
- Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.
- Electrochemical titration of clays; determination of cation and anion exchange capacities of soils; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity, analysis of soil and plant samples for N, P, K, Ca, Mg, S, Zn, Cu, Fe, Mn, B and Mo; analysis of plant materials by digesting plant materials by wet and dry ashing and soil by wet digestion methods, drawing normalized exchange isotherms; measurement of redox potential.

SUGGESTED READINGS

- *Hesse P. 971. Textbook of Soil Chemical Analysis. William Clowes & Sons.*
- *Jackson ML. 1967. Soil Chemical Analysis. Prentice Hall of India.*
- *Keith A Smith 1991. Soil Analysis; Modern Instrumental Techniques. Marcel Dekker.*
- *Kenneth Helrich 1990. Official Methods of Analysis Association of Official Analytical Chemists. Page AL,*
- *Miller RH & Keeney DR. 1982. Methods of Soil Analysis. Part II. SSSA, Madison. Piper CE. Soil and Plant Analysis. Hans Publ.*
- *Singh D, Chhonkar PK & Pandey RN. 1999. Soil Plant Water Analysis – A Methods Manual. IARI, New Delhi.*
- *Tan KH. 2003. Soil Sampling, Preparation and Analysis. CRC Press/Taylor & Francis.*
- *Tandon HLS. 1993. Methods of Analysis of Soils, Fertilizers and Waters. FDCO, New Delhi. Vogel AL. 1979. A Textbook of Quantitative Inorganic Analysis. ELBS Longman.*

Paper Code	Course Title	Credits
AGRON - 502	PRINCIPLES AND PRACTICES OF WATER MANAGEMENT	3(2+1)

OBJECTIVE

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

THEORY

UNIT- I

Water, its properties and role in plants; Water resources of India, Major irrigation projects and extent of area and crops irrigated in India.Water potential – concept, components and relationship between different components; Water movement in plant and soils; Absorption and transpiration of water in plants; Scheduling and methods of irrigation including micro irrigation system; Fertigation, Water use efficiency: Water management of crops and cropping systems.

UNIT- II

Soil, plant and meteorological factors deter mining water needs of crops; Water deficit stress in plants and its effect on growth. Quality of irrigation water – effect of saline water and soil salinity on plants and its management, Excess soil water and plant growth.

UNIT- III

Water management in problem soils; Drainage requirement of crops and methods of drainage, their layout and spacing.

PRACTICAL

Determination of soluble salts, Ca + Mg, CO_3 = and HCO_3- and Na in irrigation water; Determination of FC and PWP; Soil moisture measurement by tensiometer and pressure plate apparatus; Water flow measurement using different devices. Determining soil profile moisture deficit and irrigation requirement. Calculations on irrigation efficiencies; Computation of water requirement of crops using modified Penman formula. Determination of infiltration rates and hydraulic conductivity.

SUGGESTED READINGS

- *A.M. Michael, 1987. Irrigation – Theory and Practice, Vikas Publishing House Pvt. Ltd., New Delhi*
- *S.S. Parihar and B.S. Sandhu, 1978. Irrigation of field crops – Principles and Practices, ICAR, New Delhi*
- *Lenka, 1999. Irrigation and Drainage. Kalyani Publishers, New Delhi.*
- *R.D. Mishra and M. Ahmed. 1987. Manual on Irrigation Agronomy, Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi*
- *G.H. Sankara Reddy and T. Yellamanda Reddy. 1995. Efficient use of irrigation water. Kalyani Publishers, New Delhi*
- *K.V. Paliwal. 1972 Irrigation with saline water WTC, IARI, New Delhi.*
- *I.C. Gupta 1990. Use of saline water in Agriculture. Oxford & IBH Pub. Co. Ltd., New Delhi*
- *P.J. Kramer and J.S. Boyer 1995. Water relations of Plants & Soils, Academic Press, California, USA.*
- *S.R. Reddy 2000. Principles of Crop Production, Kalyani Publication, New Delhi.*
- *D.K. Majumar 2004. Irrigation water management – principles and practice, Prentice Hall of India, New Delhi.*
- *S.C.Panda 2003. Principles and practices of water management. Agrobios, Jodhpur*
- *Singh Pratap and Maliwal P.L. 2005. Technologies for Food Security and Sustainable Agriculture. Agrotech Publc.*

Paper Code	Course Title	Credits
AGRON - 505	DRY LAND FARMING & WATERSHED MANAGEMENT	3(2+1)

OBJECTIVE

To teach the basic concepts and practices of dry land farming and soil moisture conservation.

THEORY

UNIT I

Definition, concept and characteristics of dry land farming; dry land versus rainfed farming; significance and dimensions of dry land farming in Indian agriculture. 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 II

Stress physiology and resistance to drought, adaptation of crop plants to drought, drought management strategies; preparation of appropriate crop plans for dry land areas; mid contingent plan for aberrant weather conditions.

UNIT III

Tillage, tilth, frequency and depth of cultivation, compaction in soil tillage; concept of conservation tillage; tillage in relation to weed control and moisture conservation; techniques and practices of soil moisture conservation (use of mulches, kinds, effectiveness and economics); antitranspirants; soil and crop management techniques, seeding and efficient fertilizer use. Concept of watershed resource management, problems, approach and components.

PRACTICAL

- Seed treatment, seed germination and crop establishment in relation to soil moisture contents.
- Moisture stress effects and recovery behaviour of important crop Estimation of moisture index and aridity index Spray of anti-transpirants and their effect on crops.
- Collection and interpretation of data for water balance equations Water use efficiency.
- Preparation of crop plans for different drought conditions Study of field experiments relevant to dryland farming Visit to dryland research stations and watershed projects.

SUGGESTED READINGS

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

Paper Code	Course Title	Credits
STAT-501	STATISTICAL METHODS FOR APPLIED SCIENCES	4(3+1)

OBJECTIVE

It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, tests of significance, regression and multivariate analytical techniques.

THEORY

UNIT I

Classification, tabulation and graphical, representation of data. Box-plot, Descriptive statistics. Exploratory data analysis;

UNIT II

Measures of central tendancy- Mean, Median, Mode, Geometric mean, Harmonic mean. Measures of Dispersion- Range, Quartile deviation, Mean deviation, Standard deviation.

UNIT III

Theory of probability. Random variable and mathematical expectation. Discrete and continuous probability distributions. Correlation and regression

UNIT IV

Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions and their applications. Concept of sampling distribution: chi-square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions.

PRACTICAL

- Exploratory data analysis, Box-Cox plots; Fitting of distributions~Binomial, Poisson, Negative Binomial.
- Normal; Large sample tests, testing of hypothesis based on exact sampling distributions-chi square, t and F.
- Confidence interval estimation and point estimation of parameters of binomial, Poisson and Normal distribution.
- Correlation and regression analysis, fitting of orthogonal polynomial regression; applications of dimensionality reduction and discriminant function analysis.
- Nonparametric tests.

SUGGESTED READINGS

- *Anderson TW. 1958. An Introduction to Multivariate Statistical Analysis. John Wiley.*
- *Goon AM, Gupta MK & Dasgupta B. 1977. An Outline of Statistical Theory. Vol. I*
- *Goon AM, Gupta MK & Dasgupta B. 1983. Fundamentals of Statistics. Vol. I.*
- *Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley.*

Paper Code	Course Title	Credits
PGS-501	BASIC CONCEPT IN LABORATORY TECHNIQUE	N.C.

OBJECTIVE

To acquaint the students about the basics of commonly used techniques in laboratory.

PRACTICAL

- Safety measures while in Lab; Handling of chemical substances;
- Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccupets; Washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution;
- Handling techniques of solutions; Preparation of different agrochemical doses in field and pot applications; Preparation of solutions of acids; Neutralization of acid and bases; Preparation of buffers of different strengths and pH values.
- Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath; Electric wiring and earthing.
- Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability.
- Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

SUGGESTED READINGS

- *Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press.*
- *Gabb MH & Latchem WE.1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.8. FMPE 503: Testing and Evaluation of Tractors and Farm Equipment.*
- *Aneja, K.R. fourth edition Experiments in Microbiology, Plant pathology and Biotechnology.*

Paper Code	Course Title	Credits
PGS-502	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	N.C.

OBJECTIVE

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

THEORY

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NA RS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR):

UNIT II

International Agricultural Research Centers (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility. Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group Area Specific Programme, Integrated Rural' Development Programme (lROP) Panchayati Raj Institutions, Co-operatives. Voluntary Agencies/Non-Governmental Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

SUGGESTED READINGS

- *Bhalla G. S. & Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publ.*
- *Punia M. S. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.*
- *Rao B. S. V. 2007. Rural Development Strategies and Role of Institutions Issues, In/lovations and Initiatives. Mittal Pub.*
- *Singh K. 199H. Rural Development - Principles. Policies and Management. Sage Pub.*

M.Sc. (Ag.) Soil Science and Agricultural Chemistry

Course Contents

(SECOND SEMESTER)

Paper Code	Course Title	Credits
SS-511	SOIL PHYSICS	3(2+1)

OBJECTIVE

To impart basic knowledge about soil physical properties and processes in relation to plant growth.

THEORY

UNIT I

Scope of soil physics and its relation with other branches of soil science; soil as a three phase system. Soil texture, textural classes, mechanical analysis, specific surface. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage - basic concepts.

UNIT II

Soil structure - genesis, types, characterization and management soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation.

UNIT III

Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential. Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils.

UNIT IV

Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum. Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management.

UNIT V

Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

PRACTICAL

Mechanical analysis by pipette and international methods, determination of bulk density of soil by core sampler method, measurement of Atterberg limits, aggregate analysis - dry and wet, measurement of soil-water content by different methods, measurement of soil-water potential by using tensiometer and gypsum blocks, determination of soil-moisture characteristics curve and computation of pore-size distribution, determination of hydraulic conductivity under saturated and unsaturated conditions, determination of infiltration rate of soil, determination of aeration porosity and oxygen diffusion rate, soil temperature measurements , estimation of water balance components in bare and cropped fields.

SUGGESTED READINGS

- *Baver LD, Gardner WH & Gardner WR. 1972. Soil Physics. John Wiley & Sons.*
- *Ghildyal BP & Tripathi RP. 2001. Soil Physics. New Age International.*
- *Hanks JR & Ashcroft GL. 1980. Applied Soil Physics. Springer Verlag.*
- *Hillel D. 1972. Optimizing the Soil Physical Environment toward Greater Crop Yields. Academic Press.*
- *Hillel D. 1980. Applications of Soil Physics. Academic Press.*
- *Hillel D. 1980. Fundamentals of Soil Physics. Academic Press. Hillel D. 1998. Environmental Soil Physics. Academic Press.*
- *Hillel D. 2003. Introduction to Environmental Soil Physics. Academic Press.*
- *Indian Society of Soil Science. 2002. Fundamentals of Soil Science. ISSS,New Delhi. Kirkham D & Powers WL. 1972. Advanced Soil Physics. Wiley-Interscience.*
- *Kohnke H. 1968. Soil Physics. McGraw Hill.*
- *Lal R & Shukla MK. 2004. Principles of Soil Physics. Marcel Dekker. Oswal MC. 1994. Soil Physics. Oxford & IBH.*
- *Saha AK. 2004. Text Book of Soil Physics. Kalyani.*

Paper Code	Course Title	Credits
SS-512	SOIL FERTILITY AND FERTILIZER USE	3(2+1)

OBJECTIVE

To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency.

THEORY

UNIT I

Soil fertility and soil productivity; nutrient sources – fertilizers and manures; essential plant nutrients - functions and deficiency symptoms. Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation -types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

UNIT II

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behavior in soils and management under field conditions, potassium - forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions, sulphur - source, forms, fertilizers and their behavior in soils; calcium and magnesium– factors affecting their availability in soils; management of sulphur.

UNIT III

Calcium and magnesium fertilizers, micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants. Role of chelates in nutrient availability, common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions.

UNIT IV

Fertilizer use efficiency; blanket fertilizer recommendations – usefulness and limitations; site- specific nutrient management; plant need based nutrient management; integrated nutrient management, soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture.

PRACTICAL

Chemical analysis of soil for total N,P&K and available nutrients (N, P, K, S, Cu, Fe, Mn, Zn, Mo. B), analysis of plants for essential elements (N, P, K, S, Cu, Fe, Mn, Zn, Mo, B).

SUGGESTED READINGS

- *Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.*
- *Kabata-Pendias A & Pendias H. 1992. Trace Elements in Soils and Plants. CRC Press.*
- *Kannaiyan S, Kumar K & Govindarajan K. 2004. BiofertilizersTechnology. Scientific Publ. Leigh JG. 2002. Nitrogen Fixation at the Millennium. Elsevier.*
- *Mengel K & Kirkby EA. 1982. Principles of Plant Nutrition. International Potash Institute, Switzerland.*
- *Mortvedt JJ, Shuman LM, Cox FR & Welch RM. 1991. Micronutrients in Agriculture. 2nd Ed. SSSA, Madison. Pierzinsky GM, Sims TJ & Vance JF. 2002. Soils and Environmental Quality. 2nd Ed. CRC Press.*
- *Stevenson FJ & Cole MA. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.*
- *Tisdale SL, Nelson SL, Beaton JD & Havlin JL. 1999. Soil Fertility and Fertilizers. 5th Ed. Prentice Hall of India.*
- *Troeh FR & Thompson LM. 2005. Soils and Soil Fertility. Blackwell.*

Paper Code	Course Title	Credits
SS-513	SOIL WATER AND AIR POLLUTION	3(2+1)

OBJECTIVE

To make the students aware of the problems of soil, water and air pollution associated with use of soils for crop production.

THEORY

UNIT I

Soil, water and air pollution problems associated with agriculture, nature and extent. Nature and sources of pollutants– agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants - their CPC standards and effect on plants, animals and human beings.

UNIT II

Sewage and industrial effluents – their composition and effect on soil properties/health, and plant growth and human beings; soil as sink for waste disposal. Pesticides – their classification, behavior in soil and effect on soil microorganisms.

UNIT III

Toxic elements – their sources, behavior in soils, effect on nutrients availability, effect on plant and human health. Pollution of water resources due to leaching of nutrients and pesticides from soil; emission of greenhouse gases – carbon dioxide, methane and nitrous oxide.

UNIT IV

Remediation/amelioration of contaminated soil and water; soil as a sink for waste disposal, soil and water quality standards.

PRACTICAL

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 ammonical nitrogen and phosphorus, heavy metal content in effluents, heavy metals in contaminated soils and plants, analysis of soil and plant samples for pesticides residues, visit to various industrial sites to study the impact of pollutants on soil and plants.

SUGGESTED READINGS

- *Lal R, Kimble J, Levine E & Stewart BA. 1995. Soil Management and Greenhouse Effect. CRC Press.*
- *Middlebrooks EJ. 1979. Industrial Pollution Control. Vol. I. Agro-Industries. John Wiley Interscience.*
- *Ross SM. Toxic Metals in Soil Plant Systems. John Wiley & Sons.*
- *Vesilund PA & Pierce 1983. Environmental Pollution and Control. Ann Arbor Science Publ.*

Paper Code	Course Title	Credits
AGRON-512	PRINCIPLES AND PRACTICES OF SOIL FERTILITY AND NUTRIENT MANAGEMENT	3(2+1)

OBJECTIVE

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

THEORY

UNIT I

Soil fertility and productivity-factors affecting; features of good soil management; problems of supply and availability of nutrients; relation between nutrient supply and crop growth; organic farming - basic concepts and definitions.

UNIT II

Criteria of essentiality of nutrients; Essential plant nutrients–their functions, nutrient deficiency symptoms; transformation and dynamics of major plant nutrients. Preparation and use of farmyard manure, compost, green manures, vermin compost, bio-fertilizers and other organic concentrates their composition, availability and crop responses; recycling of organic wastes and residue management.

UNIT III

Commercial fertilizers; composition, relative fertilizer value and cost; crop response to different nutrients, residual effects and fertilizer use efficiency, fertilizer mixtures and grades; agronomic, chemical and physiological methods of increasing fertilizer use efficiency; nutrient interactions.

UNIT IV

Time and methods of manures and fertilizers application; foliar application and its concept; relative performance of organic and inorganic manures; economics of fertilizer use; integrated nutrient management; use of Vermin compost and residue wastes in crops.

PRACTICAL

- Determination of soil pH, EC, organic C, total N, available N, P, K and S in soils.
- Determination of total N, P, K and S in plants.
- Interpretation of interaction effects and computation of economic and yield optima.

SUGGESTED READINGS

- Brady NC & Weil R.R 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.
- Havlin JL, Beaton JD, Tisdale SL & Nelson WL. 2006. Soil Fertility and Fertilizers. 7th Ed. Prentice Hall.
- Prasad R & Power JF. 1997. Soil Fertility Management for Sustainable Agriculture. CRC Press.
- Yawalkar KS, Agrawal JP & Bokde S. 2000. Manures and Fertilizers. Agri-Horti Publ

Paper Code	Course Title	Credits
AGRON-514	PRINCIPLES AND PRACTICES OF ORGANIC FARMING	3(2+1)

OBJECTIVE

To study the principles and practices of organic farming for sustainable crop production.

THEORY

UNIT- I

Organic farming - concept and definition, its relevance to India and global agriculture and future prospects; land and water management - land use,minimum tillage; shelter zones, hedges, pasture management, agro-forestry.

UNIT- II

Organic farming and water use efficiency; soil fertility, nutrient recycling, organic residues, organic manures, composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

UNIT- III

Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity. Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

UNIT- V

Socio-economic impacts; marketing and export potential: inspection, certification, labeling and accreditation procedures; organic farming and national economy.

PRACTICAL

- Aerobic and anaerobic methods of making compost.
- Making of vermicompost.
- Identification and nursery raising of important agro-forestry trees and tress for shelter belts.
- Efficient use of biofertilizers, technique of treating legume seeds with Rhizobium cultures, use of Azotobacter, Azospirillum, and PSB cultures infield.
- Visit to an organic farm.
- Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms.

SUGGESTED READINGS

- *Lampin N. 1990. Organic Farming. Press Books, lpswitch, UK.*
- *Palaniappan SP & Anandurai K. 1999. Organic Farming–Theory and Practice.*
- *Sharma A. 2002. Hand Book of Organic Farming. Agrobios.*
- *Subba Rao NS. 2002. Soil Microbiology. Oxford & IBH.*
- *Trivedi RN.1993. A Text Book of Environmental Sciences, Anmol Publ.*
- *Veeresh GK, Shivashankar K & Suiglachar MA. 1997. Organic Farming and Sustainable Agriculture.*

Paper Code	Course Title	Credits
STAT-511	DESIGN OF EXPERIMENTS	3(2+1)

OBJECTIVE

This course is meant for students of agricultural and animal sciences other than Statistics. Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

THEORY

UNIT I

Need for designing of experiments, characteristics of a good design. Basic principles of designs-randomization, replication and local control. Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.

UNIT II

Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.

UNIT III

Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomisation procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.

UNIT IV

Bioassays- direct and indirect, indirect assays based on quantal dose response, parallel line and slope ratio assays potency estimation.

PRACTICAL

- Uniformity trial data analysis, formation of plots and blocks,
- Fairfield Smith Law; Analysis of data obtained from CRD, RBD, LSD
- Analysis of factorial experiments without and with confounding; Analysis with
- missing data; Split plot and strip plot designs
- Transformation of data; Analysis of resolvable designs
- Fitting of response surfaces.

SUGGESTED READINGS

- Cochran WG & Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
- Dean AM & Voss D. 1999. Design and Analysis of Experiments. Springer.
- Federer WT. 1985. Experimental Designs. MacMillan. Fisher RA. 1953.
- Design and Analysis of Experiments. Oliver & Boyd.
- Nigam AK & Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ. Pearce SC. 1983.
- The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley. Design Resources Server: www.iasri.res.in/design.

Paper Code	Course Title	Credits
PGS-511	LIBRARY AND INFORMATION SERVICES	N.C.

OBJECTIVE

To equip the library users with skills to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

PRACTICAL

- Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.).
- Tracing information from reference sources.
- Literature survey; Citation techniques / Preparation of bibliography.
- Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services.
- Use of Internet including search engines and its resources; ere sources access methods.

Paper Code	Course Title	Credits
PGS-512	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	N.C.

OBJECTIVE

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

THEORY

UNIT I

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs. Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, Trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection

UNIT II

Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives, Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

SUGGESTED READINGS

- *Erbisch FH & Maredia K. 1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.*
- *Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill.*
- *Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC & Aesthetic Technologies. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V.*
- *Technology Generation and IPR Issues. Academic Foundation. Rothschild M & Scott N. (Ed.). 2003.*
- *Intellectual Property Rights in Animal Breeding and Genetics. CABI.*
- *Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.*
- *The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.*

M.Sc. (Ag.) Soil Science and Agricultural Chemistry

Course Contents

(THIRD SEMESTER)

Paper Code	Course Title	Credits
PGS-521	TECHNICAL WRITING AND COMMUNICATION SKILL	N.C.

OBJECTIVE

To equip the students/scholars with skills to write dissertations, research papers, etc. To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

PRACTICAL

Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

SUGGESTED READINGS

- *Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India.*
- *Collins' Cobuild English Dictionary. 1995. Harper Collins.*
- *Gordon HM & Walter JA. 1970. Technical Writing. 3rd Ed. Holt, Rinehart*
- *& Winston.*
- *Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of*
- *Current English. 6th Ed. Oxford University Press.*
- *James HS. 1994. Handbook for Technical Writing. NTC Business Books.*
- *Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed.*
- *Affiliated East-West Press.*
- *Mohan K. 2005. Speaking English Effectively. MacMillan India.*
- *Richard WS. 1969. Technical Writing. Barnes & Noble.*
- *Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.*
- *Sethi J & Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd*
- *Ed. Prentice Hall of India.*
- *Wren PC & Martin H. 2006. High School English Grammar and*
- *Composition. S. Chand & Co.*

Paper Code	Course Title	Credits
PGS-522	DISASTER MANAGEMENT	N.C.

OBJECTIVES

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

THEORY

UNIT I

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 II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

SUGGESTED READINGS

- *Gupta H. K. 2003. Disaster Management. Indian National Science*
- *Academy. Orient Blackswan.*
- *Hodgkinson P. E. & Stewart M. 1991. Coping with Catastrophe: A*
- *Handbook of Disaster Management. Routledge.*
- *Sharma V. K. 2001. Disaster Management. National Centre for Disaster*
- *Management, India.*

Paper Code	Course Title	Credits
SVN-500	**CHARITRA NIRMAN EVAM SAMGRA VYAKTITVA VIKAS**	**N.C.**

(As per Swami Vivekanand University Syllabus)

M.Sc. (Ag.) Soil Science and Agricultural Chemistry

Course Contents

(FOURTH SEMESTER)

Paper Code	Course Title	Credits
SS-599	MASTERS RESEARCH (ACCEPTED)	10(0+10)

Note:

To complete master research from the same campus as well from any ICAR, CSIR laboratory/ institute to fulfillment of his/her Master of Science in Agriculture.

LIST OF SOME JOURNALS

- Australian Journal of Agricultural Research
- Australian Journal of Soil Research
- Biology and Fertility of Soils
- Communications in Soil Science and Plant Analysis
- Clays and Clay minerals
- European Journal of Soil Science
- Geoderma
- Indian Journal of Agricultural Sciences
- Journal of Plant Nutrition and Soil Science
- Journal of the Indian Society of Soil Science
- Nutrient Cycling in Agroecosystems
- Plant and Soil
- Soil and Tillage Research
- Soil Biology and Biochemistry
- Soil Science
- Soil Science Society of America Journal
- Soil Use and Management
- Water, Air and Soil Pollution