

INTRODUCTION TO SOIL SCIENCE

Theory

Definition of soil, soil components-mineral matter, organic matter, water and air rocks and minerals, classification and characteristics.

Types of weathering-factors of soil formation - Soil forming processes, soil profile. Soil organic matter-role of micro and macro flora and fauna on organic matter decomposition in soil, decomposition of organic materials, C: N, C: P and C:S ratios and their significance, soil organic matter in relation to soil fertility. Soil colloids - definition, classification, properties and importance of soil colloids - structure and properties of clay minerals.

Development of negative charge on organic and inorganic soil colloids, cation and anion exchange phenomena. Soil reaction-pH, definition and its importance, influence of pH on nutrient availability, buffering capacity of soils. Soil erosion in relation to plant nutrient loss and its control. Soil science in relation to environment- Soil degradation-soil, water and air pollution

Soil texture-particle size analysis, textural classes, significance of soil texture, soil consistency, Soil structure - classification, evaluation, significance. Soil compaction, soil crusting and soil strength.

Soil water-forces of soil water retention, soil water potentials, soil moisture constants, soil water movement, saturated, unsaturated and vapour flow, infiltration and redistribution of soil water, soil drainage.

Soil air - composition and exchange of gases, influence of soil aeration on plant growth, measurement and methods to improve aeration. Soil colour - components and significance. Soil temperature - importance of soil temperature, factors influencing soil temperature, modification of soil thermal regimes. Soil physical properties in relation to availability of nutrients and soil erosion. Management of physically problematic soils.

Practicals

1. Methods of chemical analysis, principles, techniques and calculations
2. Preparation of standard solutions, percentage solutions and ppm

SSAC 221

Credits 3(2 + 1)

Soil Chemistry and Soil Fertility

Theory

Soil as a source of plant nutrients. Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants. Measures to overcome deficiencies and toxicities.

Problem soils - acid, salt affected and calcareous soils, characteristics, nutrient availabilities. Reclamation - mechanical, chemical and organic amendments, their characteristics and availabilities, problems associated with excess applications.

Irrigation water - quality of Irrigation water and its appraisal. Indian standards for water quality, use of saline water for agriculture.

Soil fertility - methods of soil fertility evaluation. Soil testing - chemical methods, - levels of different nutrients in soil, determination of critical level, use of critical level for scheduling fertilizer P doses to crops. Plant analysis - DRIS methods, critical level in plants. Rapid tissue tests. Indicator plants. Biological methods of soil fertility evaluation. Soil based fertilizer recommendations to crops.

Use of tracer techniques in soil fertility and plant nutrition investigations.

Practicals

1. Preparation of soil extracts for available nutrients.
2. Estimation of available N in soils
3. Estimation of available P in soils
4. Estimation of available K in soils
5. Estimation of available S in soils
6. Estimation of available Zn in soils (Optional)
7. Assessment of quality of irrigation water (a) pH (b) EC
8. Estimation of carbonates, bicarbonates and chlorides in irrigation water
9. Determination of calcium and magnesium in irrigation water by EDTA method

10. Estimation of K and Na in irrigation water
11. Quick tests and interpretation of soil tests and irrigation water analysis data
12. Determination of lime requirement of soils
13. Determination of gypsum requirement of soils
14. Estimation of N in plant samples
15. Estimation of P in plant samples
16. Estimation of K in plant samples

References

1. Chemistry of the Soil Bear F E 1964, Oxford & IBH Publishing Company, New Delhi
2. Diagnosis and Improvement of Saline and Alkali Soils Richard LA 1968, Oxford & IBH Publishing Company, New Delhi
3. Soil fertility - Theory and Practice Kanwar J S (ed.) 1976. ICAR, New Delhi.
4. Principles of Soil Chemistry Tan K H 1993. Marshall Dekker Incorporated, New Delhi
5. Soil Fertility and Fertilizers Tisdale S L Nelson W L and Beaton J D 1993. Macmillan Publishing Company, New York

SSAC 324

Credits 3(2 + 1)

Manures, Fertilizers and Agricultural Chemicals

Theory

Introduction - Definitions, differences between manures and fertilizers, Manures - Classification, Collection, storage and handling of farm wastes - Preparation of composts - Various techniques involved in composting - Composting of urban solid wastes-Rural composting - Vermi composting. Biogas plants. Green manuring and green leaf manuring. Recycling of organic wastes and their impact on environment. Importance of organic manures in organic farming - Opportunities and constraints.

Fertilizers _ **Commercial fertilizers - Straight. compound and complex fertilizers**
 Properties and reactions occurring due to use of important fertilizers

containing N, P and K. Inorganic materials containing Ca, Mg, and S and micronutrients. Amendments - fertilizer mixtures. Fertilizer use efficiency (FUE) - Factors influencing FUE. Balanced fertilization Direct and residual effects of fertilizers. Packaging, transport and storage of fertilizers. Quality control and FCO.

Bio-fertilizers - Types, methods of preparation and use in agriculture, horticulture and silviculture. Integrated Nutrient Management for agricultural and horticultural crops. Problems and prospects.

Classification of agricultural chemicals. Naturally occurring insecticides - Pyrethrum, nicotine and rotenone. Synthetic pyrethroids-Structure, properties and uses of cyclodiene insecticides (Endosulfan), OP insecticides (DDVP, Phosphomidon etc.) and carbamates (carbaryl and carbofuran) insecticides. Fungicides - Classification based on chemical nature, structure, properties and uses of CDC, zineb etc. - Herbicides - Classification based on chemical nature: example for each class, mode of action and selectivity. Structure, properties and uses of 2, 4 -D, butachlor etc. Pesticide residues and their influence on soil, water, air, animal and human beings. Compatibility - combined application of fertilizers and agricultural chemicals; precautions.

Growth regulators and hormones, properties, functions and importance in commercial agriculture and horticulture.

Practicals

1. Sampling of organic manures and fertilizers for chemical analysis
2. Quick tests for identification of important fertilizers
3. Detection of adulteration in fertilizers
4. Determination of total N in urea
5. Determination of total N in FYM
6. Determination of water soluble P_2O_5 in SSP
7. Determination of K in MOP/SOP
8. Determination of Zn in $ZnSO_4$ and working out quantities and doses of fertilizers for application to the field
9. Collection of pesticide samples and pesticide control order
10. Study of the physical and chemical characteristics of different formulations
of pesticides

11. Determination of percent purity in metasystox by acid-base neutralization
12. Iodometric titrations - Determination of strength of iodine and standardization of
 $\text{Na}_2\text{S}_2\text{O}_3$
13. Determination of percent purity in endosulfan by iodometry
14. Determination of percent purity in sulfur by iodometry
15. Determination of copper content in copper fungicides
16. Determination of percent purity in isoproturn by spectrophotometer and visit to pesticide residue laboratory

References

- | | | |
|----|--|--|
| 1. | Manures and Fertilizers | Yawalkar K S Agarwal J P and Bokde G 1977. Agri. Horticultural Publishing House, Nagpur |
| 2. | Fertilizers Guide | Tandon H L S 1994. Fertilizer Development Consultation Organization, New Delhi |
| 3. | Hand Book on Fertilizer Usage | Seetharaman S Biswas B C Yadav D S and Maheshwari S 1996. The Fertilizer Association of India, New Delhi |
| 4. | Chemistry of Insecticides and Fungicides | Sreeramulu U S 1991. Oxford & IBH Publishing Company, New Delhi |
| 5. | Fungicides in Plant Disease Control | Nene Y L and Thapliyal P N 1991. Oxford & IBH Publishing Company, New Delhi |
| 6. | Principles of Weed Science | Rao V S 1992. Oxford & IBH Publishing Company, New Delhi |