



From Field Sampling to Laboratory Characterization: A Practical Training Experience at Mewar University

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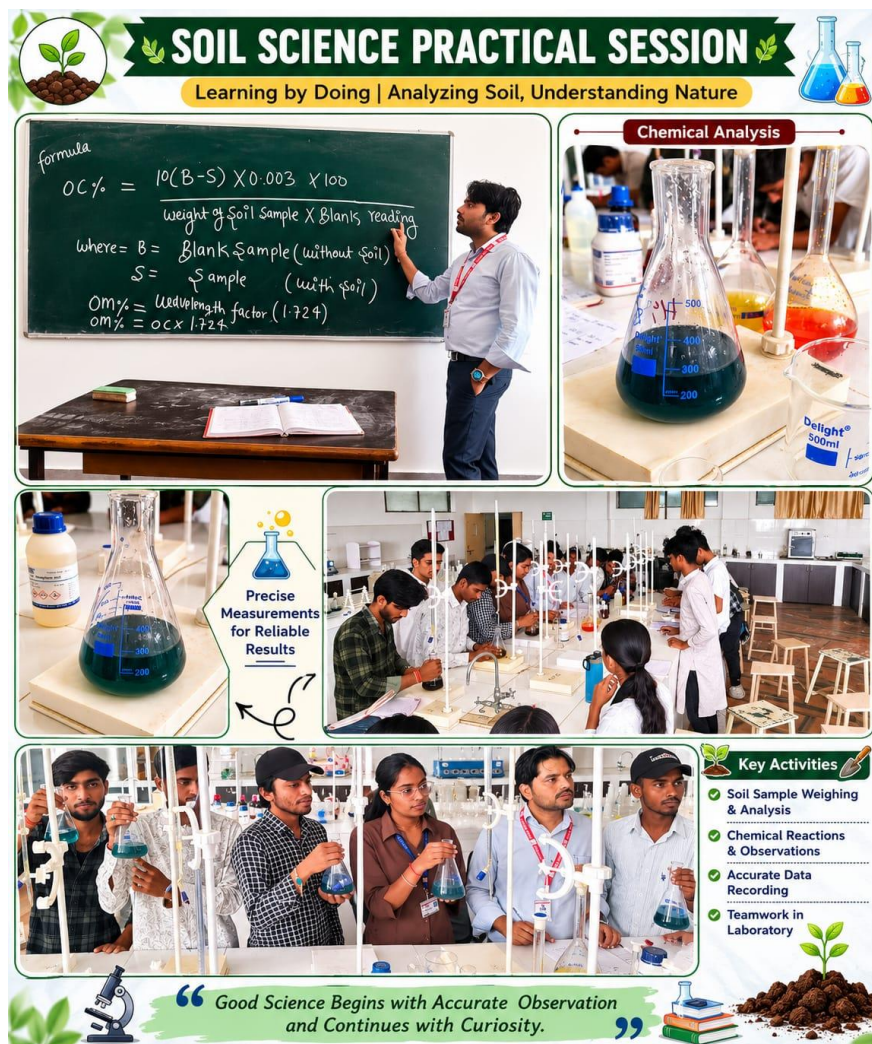
INTRODUCTION

This article converts the 2026 consolidated practical activity record into a teaching-focused magazine narrative. It documents five core practicals field soil sampling, soil pH and EC, soil organic carbon, calcium carbonate, and sieve-based particle-size analysis while retaining the photographic evidence from the original practical report.

Why Practical Soil Science Matters

Soil Science becomes meaningful when students move between the field, instruments, reagents, calculations and interpretation. The 2026 practical programme of the Department of Soil Science at Mewar University was designed to connect theoretical concepts with supervised field and laboratory observations. Students were guided through representative soil sampling, routine instrumental analysis, wet-chemical titration, carbonate determination and physical fractionation of soil. The emphasis throughout was not merely on completing an exercise, but on building transferable competence in observation, sample handling, measurement, calculation, data recording, safety and scientific interpretation.

The sessions covered B.Sc. (Hons.) Agriculture students from Semesters II and IV, B.Sc. Forestry Semester IV and B.Sc. Horticulture. Instruction combined live demonstration, supervised hands-on practice, observation, calculation and discussion. Photographs, class and laboratory records, student notebooks and attendance registers formed the documentary basis of the programme.



Opening visual: Soil Science practical sessions combining explanation observation, laboratory analysis and student participation.

Five Practical Objectives at a Glance

Practical		Core objective
1.	Field soil sampling using an auger	To train students to collect representative field samples while maintaining correct sampling strategy, sample integrity, labelling and contamination-free handling.
2.	Soil pH and electrical conductivity	To demonstrate and practice measurement of soil reaction and soluble salt status using calibrated instruments and a properly prepared soil-water suspension or extract.
3.	Soil organic carbon by Walkley-Black method	To develop practical understanding of dichromate oxidation and back-titration, including reagent handling, endpoint observation, blank correction and calculation of organic carbon percentage.
4.	Calcium carbonate in soil	To determine CaCO_3 content and develop student competence in acid neutralization, back-titration, endpoint recognition and quantitative calculation.
5.	Soil texture by sieve method	To determine the distribution of soil particle-size fractions by sieving a prepared dry soil sample, weighing retained material and calculating the proportion of each fraction.

1. Representative Soil Sampling: Quality Begins Before the Laboratory

Representative sampling is the first quality-control step in soil testing. No laboratory method can compensate for a sample that does not represent the field or management unit from which it was taken. During the field session, students learned to use a soil auger, identify relatively uniform sampling areas, avoid obvious abnormal spots unless specifically required for diagnosis, remove surface litter, and collect soil from multiple representative locations using a distributed or zig-zag approach.

Objective and practical sequence

The practical objective was to train students to collect representative soil samples while maintaining sample integrity, correct labelling and contamination-free handling. Individual cores were combined to prepare a composite sample. The material was mixed thoroughly, reduced to a manageable representative quantity and transferred to a clean labelled bag for laboratory analysis. Students also discussed the difference between an individual core and a composite sample, common sources of sampling error, the value of field notes and the importance of traceable labelling.



Figure 1: Field demonstration of representative soil sampling using a soil auger.



Figure 2: Practical field sampling session; original photograph retains geotag/date evidence (04 August 2026).

KEY LEARNING

Students gained confidence in auger handling, composite sampling, sample reduction, labelling and contamination control skills that directly influence the reliability of every later soil test.

2. Soil pH and Electrical Conductivity: Reading Soil Reaction and Soluble Salts

The pH and electrical conductivity practical introduced students to two routine indicators that are central to soil diagnosis. Soil pH expresses the hydrogen-ion activity of the soil suspension and provides an indication of soil reaction, while electrical conductivity reflects the ability of the soil solution or extract to conduct electrical current and serves as an index of soluble salt concentration.

Objective, instruments and procedure

The objective was to demonstrate and practice measurement of pH and EC using calibrated laboratory instruments and a properly prepared soil-water suspension or extract. Students worked with processed soil, clean beakers and measuring glassware, distilled or deionized water, a calibrated pH meter and EC meter, and clean electrode-handling materials. The pH meter was calibrated with suitable buffer solution(s), the electrode was rinsed and immersed in the sample, and the stabilized reading was recorded. The EC measuring system was similarly checked, rinsed and used to obtain a stable value with the correct unit.

The exercise emphasized that sample preparation, calibration, clean electrodes and stable readings are part of the measurement not optional steps around it. Students linked pH and EC to nutrient availability, soluble salts and potential salt stress in the soil environment.



Figure 3: Faculty demonstration and supervised student observation during soil pH and EC practical work in the Soil Science Laboratory.

3. Soil Organic Carbon: Learning Wet Chemistry through the Walkley-Black Method

The soil organic carbon practical moved students from instrumental readings to wet-chemical analysis. The practical

objective was to develop understanding of organic carbon estimation through dichromate oxidation and back-titration, with attention to correct reagent handling, endpoint observation, blank correction and calculation.

Principle and supervised analysis

In the Walkley-Black wet oxidation method, soil organic carbon is oxidized by potassium dichromate in a strongly acidic medium. The unreacted dichromate is then determined by titration with a ferrous salt solution. The difference between the blank and sample titration values provides the basis for estimating oxidizable organic carbon. Under supervision, a known weight of processed soil was treated with the prescribed dichromate solution, concentrated sulphuric acid was added carefully, the reaction was allowed to

proceed for the specified oxidation period, and the remaining dichromate was back-titrated after dilution and addition of the prescribed indicator.

A reagent blank was carried out under identical conditions without soil. Students compared blank and sample titres, recognized the analytical endpoint, recorded burette readings and calculated organic carbon percentage. Where required by the reporting protocol, organic matter may be estimated from organic carbon using the conventional factor 1.724.



Figure 4: B.Sc. Forestry students participating in titrimetric soil analysis under supervised laboratory conditions.



Figure 5: Student practical work during titrimetric analysis; original photograph retains geotag/date evidence (14 August 2026).

QUALITY CONTROL IN ACTION

Clean glassware, safe handling of concentrated acid and oxidizing reagents, use of a reagent blank, careful endpoint recognition and immediate recording of observations were repeatedly emphasized. These habits reduce error and strengthen confidence in wet-chemical results.

4. Calcium Carbonate in Soil: Understanding Acid Neutralization and Back-Titration

Calcium carbonate determination provided another opportunity to connect chemical reaction with quantitative calculation. The objective was to determine the CaCO_3 content of soil and strengthen student competence in acid neutralization, back-titration, endpoint recognition and calculation.

Principle and calculation

A known excess of standard hydrochloric acid reacts with soil carbonates. After the reaction is complete, the acid remaining unreacted is measured by back-titration with standard sodium hydroxide. The difference between blank and sample titration represents the acid consumed by the soil carbonates. Students used processed soil, analytical balance, conical flasks, burette, pipette or measuring glassware, standard HCl, standard NaOH and the prescribed indicator. Phenolphthalein is commonly used for the back-titration endpoint in this type of exercise.

For equivalent normalities, a general expression used in the practical is: $\text{CaCO}_3 (\%) = [(V_b - V_s) \times N \times 50 \times 100] / (W \times 1000)$, where V_b is blank titre (mL), V_s is sample titre (mL), N is the normality of the standard solution and W is the weight of soil (g). The session reinforced careful use of burettes and pipettes, comparable blank and sample conditions, accurate endpoint recognition and safe handling of acid and alkali solutions.



Figure 6: Students performing the calcium carbonate determination practical using titration apparatus in the Soil Science Laboratory.



Figure 7: Faculty-supervised CaCO_3 practical session;
original photograph retains geotag/date evidence (08 September 2026).

1. Acid base titration- Based on reaction that neutralization is between a base or acid and analyte.

Generally two basic type- Indicator (a chemical that change colour at pH equal to the equivalence point. example- phenolphthalein) and Potentiometric titration (based on stoichiometric property).

Indicator	Colour on acidic side	Range of colour change	Colour on basic side
Methyl violet	yellow	0.0-1.6	Violet
Bromophenol blue	yellow	3.0-4.6	Blue
Methyl orange	Red	3.1-4.4	Yellow
Methyl red	Red	4.4-6.3	Yellow
Litmus	Red	5.0-8.0	Blue
Bromothymol blue	Yellow	6.0-7.6	Blue
Phenolphthalein	Colourless	8.3-10.0	Pink
Alizarin yellow	Yellow	10.1-12.0	Red

Figure 8: Indicator colour-change reference retained from the original practical report as supporting teaching material for acid-base titration concepts.

5. Soil Texture by Sieve Method: From Particle Separation to Physical Interpretation

The final practical focused on physical fractionation. The objective was to determine the distribution of soil particle-size fractions by passing a prepared dry soil sample through a standard series of sieves, weighing the retained material and calculating the proportion of each fraction.

Principle, apparatus and procedure

A known mass of air-dried soil was separated mechanically through sieves arranged from larger to smaller openings. During controlled shaking, larger particles were retained on upper sieves while finer particles passed downward. Students prepared the sample by air-drying and removing visible plant residues, stones or other foreign material as required by the practical protocol, gently loosened clods

without grinding primary mineral particles, weighed a known sample mass, arranged the sieve stack correctly, shook it uniformly and weighed the material retained on each sieve. The percentage of each retained fraction was calculated as: % of fraction = (Weight of fraction / Total weight of soil sample) × 100. Students also checked recovery or mass balance against the initial sample weight. The exercise was used to relate particle-size

distribution to aeration, water movement, water retention and ease of tillage. The practical report also notes an important limitation: the sieve method is especially suitable for coarse fragments and sand-size separation; complete silt and clay quantification requires the prescribed sedimentation method, such as hydrometer or pipette analysis, in conjunction with the laboratory protocol.

KNOW
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Determination of Soil Texture by Sieve Method

SOIL SCIENCE PRACTICAL

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Today
for a Better
Tomorrow

Objective

To determine the distribution of different soil particle-size fractions using a standard set of sieves.

Principle

Dried soil is passed through a series of sieves arranged from coarse to fine, and each retained fraction is weighed to estimate the relative proportion of particle sizes.

Apparatus Required

- Soil sample
- Sieve set of different mesh sizes
- Lid and receiver pan
- Weighing balance
- Brush
- Tray or paper sheet
- Notebook

Procedure

- 1 Collect and air-dry the soil sample.
- 2 Remove debris and break clods gently.
- 3 Weigh a known quantity of soil.
- 4 Arrange sieves from coarse to fine with pan at the bottom.
- 5 Place soil in the top sieve and shake thoroughly.
- 6 Collect soil retained on each sieve separately.
- 7 Weigh each fraction.
- 8 Calculate percentage of each fraction.

Formula

$$\% \text{ of fraction} = \frac{\text{Weight of fraction}}{\text{Total weight of soil sample}} \times 100$$

Observation Table

Fraction	Weight (g)	Percentage (%)
Coarse gravel	81.5	12.92
Fine gravel	139.5	22.11
Coarse sand	25.8	4.08
Fine sand	158.5	25.11
Silt	177.5	28.12
Clay	51.0	8.08
Total	631.0	100.00

Practical Images



Fig. 1: Instructor demonstrating the sieve method to students in soil science practical.



Fig. 2: Calculation of soil particle-size fractions on the board during the practical class.

Result

The soil sample showed a mixed distribution of gravel, sand, silt and clay fractions, which helps in understanding texture and physical behavior of the soil.

Precautions

- Use a dry sample.
- Arrange sieves correctly.
- Avoid sample loss during transfer.
- Clean sieves after use.
- Record weights carefully.

Department of Soil Science – Practical Demonstration

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Figure 9: Teaching poster summarizing the objective, principle, apparatus, procedure, calculation and precautions for sieve-based soil particle-size analysis.



Figure 10: Faculty demonstration of the assembled sieve stack with students observing the soil texture practical.



Figure 11: Supervised class participation and observation during sieve-based fractionation.



Figure 12: Close-view demonstration of soil placement and handling of the sieve stack during the practical session.

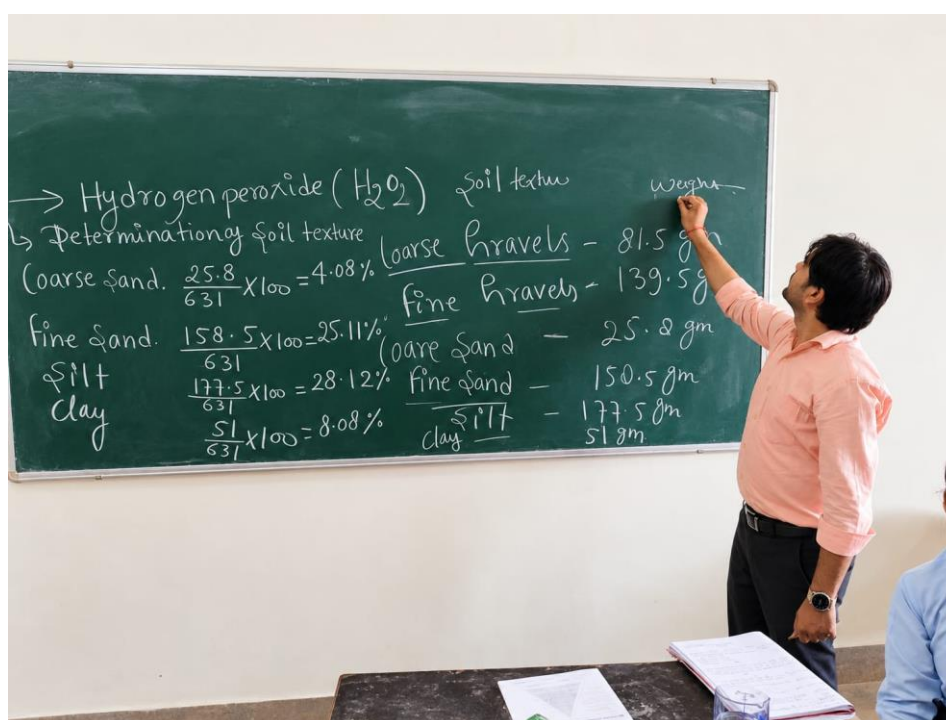


Figure 13: Board-based calculation and discussion of particle-size fractions following the sieve exercise.

SAFETY AND METHOD DISCIPLINE

Students were instructed to use a properly air-dried sample, avoid forcing particles through sieve openings, prevent sample loss during transfer, record weights immediately, use

consistent units, clean and dry sieves after use, and apply any chemical pretreatment—such as hydrogen peroxide for organic-matter removal only under the approved procedure and supervision.

From Individual Practicals to Transferable Competence

Across the five practicals, the teaching objective extended beyond individual methods. Field sampling developed representative-sample thinking; pH and EC work built instrument discipline; organic-carbon and carbonate determinations strengthened titration and blank-correction skills; and sieve analysis linked measured fractions with soil physical behaviour. These activities were reinforced through practical notebooks, immediate observation recording, unit checking, calculation and discussion.

Competencies emphasized across the programme

- Representative field sampling, composite sample preparation and reduction of sampling error.
- Calibration, rinsing and careful operation of routine soil-analysis instruments.
- Wet-chemical titration, endpoint recognition and comparison of blank and sample observations.
- Traceable data recording, correct units, calculation and interpretation.
- Clean glassware, safe reagent handling, contamination control and teamwork.
- Linking pH, EC, organic carbon, carbonate status and particle-size distribution with soil condition and agronomic meaning.

Teaching-Learning Approach: Demonstrate, Practice, Observe, Calculate, Interpret

Each practical followed a consistent teaching sequence: the purpose, scientific principle and precautions were explained before the exercise; the faculty member demonstrated the technique; students then carried out supervised hands-on work with real-time correction; observations and calculations were recorded in practical notebooks; and a short discussion connected the analytical result with soil fertility, nutrient availability, salinity, soil health or physical behaviour. This structure

helped students understand not only how a procedure is performed, but why each step matters for result quality.

For future academic verification, the practical programme recommends maintaining dated attendance records, representative photographs with original metadata or geotags where available, approved practical schedules and laboratory manuals, sample observation sheets, and instrument calibration or reagent-standardization records where applicable.

Conclusion: Practical Evidence of Learning by Doing

The 2026 Soil Science practical programme at Mewar University illustrates how undergraduate teaching can move from explanation to demonstrable skill. Students sampled soils in the field, calibrated and used routine instruments, performed titrimetric analyses, calculated carbon and carbonate-related results, separated particle-size fractions and interpreted observations in relation to soil behaviour. Equally important, they practiced the habits that make analytical work defensible: representative sampling, clean handling, blanks and calibration, careful measurement, immediate data recording, safety and verification.

In Soil Science, practical competence is built step by step from the first auger core in the field to the final calculation in the laboratory notebook. The photographs retained in this article document that progression and provide a visual record of supervised, outcome-oriented learning across the participating undergraduate programmes.

ACADEMIC CONTEXT

Prepared from the Department of Soil Science practical activity documentation for Academic Session 2026, Faculty of Agriculture and Veterinary Sciences, Mewar University, Chittorgarh, Rajasthan. The article retains all 14 images embedded in the original report, including field photographs, laboratory photographs, a practical-session montage, indicator reference material and the soil-texture teaching poster.