

pH in Soil Samples

Reflectometric determination after reaction with a chemically bound pH indicator

Introduction

Soil pH is one of the most important indicators of soil health, as it directly controls the availability of nutrients to plants.¹ In acidic soils (pH below 5.5), elements such as manganese and aluminum can accumulate to levels toxic to plant roots. In alkaline soils (pH above 7.5), essential micronutrients including iron, zinc, and copper become increasingly insoluble and unavailable for uptake.¹ For most crops, a slightly acidic to neutral pH between 6.0 and 7.0 provides the most favorable conditions for nutrient availability and plant growth.¹ Regular soil pH testing is therefore a fundamental part of nutrient management in agricultural systems.¹

Soil pH is measured in a suspension prepared with calcium chloride (CaCl_2), which stabilizes ionic conditions and improves reproducibility across samples of varying composition, in accordance with ISO 10390² and DIN EN 15933:2012-11.³ The resulting suspension can be analyzed using a range of methods, including electrode-based, colorimetric, or reflectometric techniques, depending on the available instrumentation and required throughput.

Experimental

The procedure detailed in this application note encompasses sample preparation and analysis using the Reflectoquant® pH Test strips in conjunction with the portable RQflex® 20 reflectometer. This method offers a rapid, cost-effective, and reliable approach to assessing pH value while also allowing comparisons with pH electrode (LUFA method) to ensure the accuracy and validity of results.

Method

Special indicator dyes are covalently bound to the reagent papers, which changes the color depending on the pH value of the sample. The resultant color is evaluated reflectometrically.

Measuring Range

pH 4.0–9.0

Applicable Sample

Soil samples

Reagents, Instruments and Materials

Test/Reagent Kit(s)

- Reflectoquant® pH Test 4.0–9.0 (**1.16996**)

Instrument(s) & Devices

- Reflectometer RQflex® 20, Reflectoquant® (**1.17246**)

Other Reagents and Accessories

- Calcium chloride dihydrate for analysis EMSURE® ACS, Reag. Ph Eur (**1.02382**)
- Distilled water (e.g., from a suitable Milli-Q® system) or water for analysis (**1.16754**)
- Balance
- Volumetric flask

Products for AQA

- RQcheck set for RQflex® 20 Reflectometer (**1.17247**)
- Recalibration Set for RQflex® 20 Reflectometer (**1.16954**)
- Buffer solution pH 7.00 Certipur® (**1.09439**)

Analytical Procedure

Sample Preparation

- Preparation of the extraction solution (0.0125 mol/L CaCl_2 -solution): Dissolve 0.919 g calcium chloride dihydrate in water for analysis and make up to 500 mL with water for analysis in a volumetric flask to prepare a 0.0125 mol/L CaCl_2 -solution.
- Preparation of the soil suspension: Homogenize 10 g (exactly weighed) of soil sample with 25 mL of 0.0125 mol/L CaCl_2 solution by shaking for 15 minutes.

Measurement

- Place the test strip in the soil suspension for 10 minutes, ensuring that both reaction zones are immersed.
- Remove the strip from the suspension and quickly rinse the reaction zones with distilled water to remove particles.

- Carefully allow excess liquid to run off via the long edge of the strip onto an absorbent paper towel for 1 second.
- Press the START button of the reflectometer and insert test strip into the strip adapter, then press START key anew.
- After 10 seconds, read off the pH from the display. The result is automatically stored.

Notes on the measurement

For detailed operating procedures, consult the operating instructions for RQflex® instrument and the package insert of the Reflectoquant® pH Test.

Analytical Quality Assurance

Analytical quality assurance (AQA) is recommended before each measurement series. Check the instrument using the RQcheck. If RQcheck failed, perform a recalibration using the recalibration set and repeat the RQcheck. For more details see RQflex® 20 manual.

To check test strips, measurement device, and handling (recommended before each measurement series): Analyze the buffer solution pH 7.00 (approx. 20 °C) as described in the section measurement.

Results and Conclusion

Here in this study, ten different soil samples were used as test samples for measurement and comparison. The results were verified using pH electrode (LUFA method) as orthogonal method to the Reflectoquant® test kit.

In conclusion, the Reflectoquant® pH Test, used in conjunction with the RQflex® 20 reflectometer, offers farmers a rapid, cost-effective, and reliable analytical approach for routine pH monitoring.

Table 1. Comparison of Reflectoquant® pH Test and pH electrode (LUFA method)

Sample	Reflectoquant® pH Test	pH electrode
1	6.9	7.0
2	5.9	6.1
3	6.7	6.7
4	5.4	5.7
5	6.1	6.1
6	5.5	5.7
7	6.2	6.1
8	6.4	6.5
9	5.5	5.6
10	6.5	6.5

References

1. Khaled, F.; Sayed, A. Soil pH and Its Influence on Nutrient Availability and Plant Health. *Int. J. Adv. Chem. Res.* **2023**, 5 (2), 61–63. DOI: 10.33545/26646781.2023.v5.i2a.204.
2. ISO 10390:2021. Soil, Treated Biowaste and Sludge — Determination of pH; International Organization for Standardization: Geneva, Switzerland, **2021**. <https://www.iso.org/standard/75243.html>.
3. DIN EN 15933:2012-11. Sludge, Treated Biowaste and Soil — Determination of pH; Deutsches Institut für Normung: Berlin, Germany, **2012**. <https://www.din.de/en/getting-involved/standards-committees/naw/din-standards/wdc-beuth:din21:175880818>.

Featured Products

Description	Cat. No.
Reflectoquant® instruments and strips	
Reflectometer RQflex® 20, Reflectoquant®	1.17246
Reflectoquant® pH Test pH 4.0-9.0	1.16996
Products for sample preparation	
Calcium chloride dihydrate for analysis EMSURE® ACS, Reag. Ph Eur	1.02382
Distilled water (e.g., from a suitable Milli-Q® system) or water for analysis	1.16754
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Buffer solution pH 7.00 Certipur®	1.09439

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