Comments on "Beyond the laboratory: performance and agreement of rapid methodologies for soil health assessment" by Epelde et al., 2026

Soil health

This manuscript showed comparable results between four rapid approaches including aggregate stability (measured with SLAKES), soil respiration (measured with portable CO_2 analyzer), microbial biomass carbon (measured with microBIOMETER®) and enzyme activities (measured with Soil Enzymatic Activity Reader, SEAR), against standard laboratory measurements. Using 132 soil samples from long-term experimental multi-species pastures in Spain across 11 sampling campaigns, the author concludes that while these field tools show comparable overall trends, indicating them as complementary options in applications such as informing soil health assessments and management decisions, they exhibit weakness in capturing the relationship in soil respiration and the fungal-to-bacterial ratio. This study addresses a critical bottleneck (e.g., the time lag and cost of laboratory-based biological analyses) in practical soil health monitoring.

The manuscript is well-organized, relevant for practical management and within the scope of the journal. However, the reviews have comments below for authors' considerations before this manuscript can be accepted for publication.

1) In the introduction, the author explains the ecological relevance for each selected indicator. Could the author add the rationale for choosing these four as a representative set of soil health metrics?
2) In lines 41-42, the authors introduce in-situ respiration. Because field respiration varies based on immediate soil moisture and temperature on the day of testing, while lab methods standardize these variables through controlled incubation, please expand the Discussion to address this inherent decoupling. Do the authors recommend a specific environmental 'window' (e.g., specific moisture range or time of day) for land managers to use these rapid tools to ensure data is comparable?

3) Rapid tools are sensitive to environmental factors such as soil type, climate, land use, management history, PH and organic matter. The study demonstrates comparability within one long-term grassland experiment; however, the broader applicability of these rapid tools remains unclear. Could the author discuss the need for regional or soil-type-specific calibration datasets and reference ranges before these methods can be generalized across various climate and land use conditions?

4) In Lines 148–149, the authors state that higher aggregate stability was associated with deeper soil layers (20–50 cm). This finding is counterintuitive and seems to contradict the biological framework established in the Introduction (Lines 37–40), which notes that aggregates rely on biologically derived binding agents (which are concentrated in the 0–20 cm layer). Finding higher stability in the subsoil suggests that either: a) the SLAKES and wet-sieving methods are responding heavily to inherent subsoil mineralogy (e.g., high clay or calcium carbonate accumulation) rather than biological health, or b) there is an issue with data orientation. Could the authors expand the discussion to ecologically explain why aggregate stability increased with depth despite a significant decline in microbial biomass carbon and activity?

5) In Line 174 of the Conclusions, the authors state that rapid methods represent a complementary or alternative, to laboratory analyses. Given that two out of the four biological metrics tested (in-situ respiration and F:B ratio) showed weak or statistically non-significant relationships with

laboratory reference standards, using the word 'alternative' may be overstating their readiness. The review suggests softening this phrasing to emphasize that they are “valuable tools for dynamic trend tracking” rather than direct alternatives to standard laboratory quantifications.

6) In line 74, please add the unit for variables.

7) In figure 1, please put the x-label in inverse position.

8) Regarding the FAIR principles for open science, the review recommends that the raw data can be archived in a dedicated, public data repository (such as Zenodo, Figshare, or the European Soil Data Centre - ESDAC) to ensure a permanent DOI and easier machine-readability. Furthermore, since the multivariate statistics (RDA and Procrustes analysis using the vegan package) are core to the paper's conclusions, the authors could make their R script publicly available (e.g., via a GitHub repository linked to Zenodo). This would allow other researchers to replicate the exact statistical workflows for validating these rapid methods in their own local regions.

   In Supplement A, the authors should ensure that a comprehensive metadata codebook is included. Specifically, for the rapid tools (SLAKES, microBIOMETER®, and SEAR), please ensure the exact raw units, software version numbers (e.g., the specific version of the SLAKES mobile application used in 2024), and smartphone operating system or camera hardware details are explicitly noted. As rapid methodologies rely heavily on software algorithms that update over time, documenting these technical parameters is vital for the long-term reusability of the dataset by the global soil health community.