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SOIL QUALITY INDICATORS OF CHEMICALLY DEGRADED

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Abstract

Nowadays, due to the influence of industrialization, the increase in the effect of chemical degradation has led to the loss of specific physical, chemical, and biological quality indicators of the soil as a result of the influence of anthropogenic processes, which has led to a decrease in important ecosystem functions or an increase in environmental stress. [1] The main causes of chemical degradation of the soil and therefore the main threat to its ecological functions are reduction of organic matter, reduction of biological diversity, compaction, acidification, increase of local source and diffuse pollution, affecting soil health, quality, and fertility indicators. (Montanarella), 2007). These indicator factors provide useful information about soil fertility status and ensure that plant growth development can help to effectively identify constraints or promising challenges that may limit agricultural productivity [Bünemann EK, Mäder P, et al. 2018]. [2] This includes studying the qualities of the physical, chemical, and biological indicators of the soil and assessing its health and fertility. Soil indicators are often divided into categories of physical, chemical, and biological indicators [Moebius-Klun, B.N., Thies, J.E., and Abawi, G.S. 2009]. Additional information about these soil indicators is available. http://soilhealth.cals.cornell.edu Soil quality and performance indicators are based on soil functions (Loveland and Thompson, 2002; Ritz et al., 2009; Rosa, 2005). It is shown that these functions are related to the health and fertility of the soil and the crop yield.[3] It has become increasingly important in the delivery of ecologically clean food. Soils also interact with other components of the environment (air, water, and soil). [4] These physico-chemical and biological parameters include regulation of climate and hydrology in soil-environment ecosystem relations, control of pollutants, and biocontrol of plant pathogens and parasites. (Sylvain and Wall, 2011) chemical pollutant in soil water filtration control and flow reduction, filtration is required. (Breure et al., 2012). [6] It helps determine the effect of chemically degrading substances on soil fertility. It increases soil formation, soil fertility, biochemical dynamic balance (C sequestration and nutrient cycling), decomposition of organic compounds, and the transfer of plant nutrients to the soil solution (Robinson et al., 2013). Includes water and climate change regulation through carbon sequestration from soil. Soil quality indicators are usually used to study soil quality and function. Soil quality indicators are also relevant in environmental monitoring (Pulleman et al., 2012). Indicators help assess human and natural impacts on soil, including chemical degradation processes, and help determine the effectiveness of sustainable soil health (Doran and Parkin, 1994; Karlen and Stott, 1994; Schipper and Sparling, 2000). In order to assess the quality of chemically degraded soil, a combined approach is required in which the biological, chemical, and physical properties of the soil are evaluated (Bone et al., 2010; Seybold et al., 1998). In the research area, these indicators have been studied by scientists in our country and the world community for years as a way to determine the source of chemical degradation, the quality of soil health, and fertility. [5].

Introduction

Materials and Methods

There are various programs that monitor soil conditions [Bunemann et al. 2018]. Statistical methods, such as principal component analysis, are used to measure the extent of sampling [Lilburne et al. 2004]. Streams and sampling methods were used in [Hill & Sparling, 2009]. Land Monitoring Forum Manual: Land and Soil Monitoring: Guide for SOE and Regional Council Reports. The data collected from the soil quality monitoring program is not only the basis for regional and national interstate reporting [Drewry et al., 2021; MFE & Stats NZ, 2021, 2018] [Stevenson and Parfitt et al., 2015]. Determining the best distinguishing indicators of land use, It includes environmental pH, bacteriological content, total carbon, total N, P (phosphorus), soil density, and structure. [4]

3. Results and Discussion

Soil functions include:

- Conservation of biological diversity, activity, and productivity;
- Regulating the flow of water and dissolved substances;
- Filtration, buffering, and preservation of organic and inorganic substances from degradation
- Ensuring the storage and circulation of nutrients and carbon;

When determining soil fertility and quality, a soil function indicator matrix is used. In this case, it is necessary to select the appropriate indicators for the evaluation of a specific soil, and if the indicators are selected, it is necessary to reveal the relation of the matrix indicator. In order to determine indicators of soil fertility, health, and ecological condition, the following should be carried out: [8]

- identification and description of indicators;
- connecting indicators with soil function;
- analysis of specific and dynamic factors affecting it;
- propose management methods to improve soil function;

By providing information for evaluation, the following quality indicators are analyzed:.

Soil quality indicators

(www.nrcs.usda.gov)

Table 1.

Aggregate stability
Amount of water available
Volume is weight
Earthworms

Infiltration
Particles of organic matter
Potentially mineralizable nitrogen
Reactive carbon
Disintegration
Soil aggregates
Electrical conductivity of the soil
Soil enzymes
Soil nitrates
Soil pH
Soil respiration
Soil structure and micropores
Total organic carbon

Measures to determine soil health indicators by analyzing soil indicators for chemical degradation are studied.

Activities to study soil health indicators

[Moebius-Kluhn, B.N., Thies, J.E. and Abawi, G.S. 2009]

Table 2

2. Sufficient normative depth
3. Sufficient or insufficient supply of nutrients
4. A small population of plant pathogens
5. Good soil drainage
6. A large number of groups of beneficial microorganisms
7. Weed control measure
8. Limitation of damage to this crop without chemicals and toxins possible
9. Increasing soil resistance to degradation

4. Feasibility of the application of the novel soil quality indicators

The advantages and disadvantages of each new soil quality indicators are presented in Table 3.

Biological properties as novel soil quality indicators
[Giulia Bongiorno 2020]
Table 3.

Novel indicator	Advantages	Disadvantages
Labile carbon fractions	Sensitive Multifunctional indicators Unified protocols are available	Individual laboratory protocols vary, hampering general standardization and comparability. Pre-treatment conditions (sieving and storing) affect all the fractions, as well as the quantity of soil and soil organic carbon. affects POXC determination It is not clear which part of the total carbon is quantified. complicating the interpretation of the results (POXC might not quantify only the labile part of TOC).
Soil suppressiveness	Highly reproducible, fast, and easy assay Close to in situ conditions Sensitive	Other factors, not quantified in our study, affect soil suppressiveness. Assessment of potential, which does not take into account the specificity of a particular host-pathogen interaction in the field Bioassays with different pathogens can give different results. Bioassay should be combined with in situ characterization. Of disease severity and/or with a bioassay using the crop and the pathogens that are present in the area and cause disease.
Free-living soil nematode communities	Sensitive Molecular techniques gave results in accordance with more established microscopic techniques. Data obtained with molecular methods can be interpreted using knowledge of nematode community composition (i.e., trophic and life strategy groups). Molecular characterization will become faster, cheaper, and more efficient than morphological identification. Information on taxonomic as well as functional and ecological aspects based on food preferences and life history is available.	Variable efficiency of the extraction of nematodes and DNA from soil, and high variability in the methodology between laboratories Optimization and standardization of the method are needed. primer selection, database completeness,and bioinformatic analysis workflow. The number of copies of targeted genes varies with species and life stage, complicating the assessment of relative abundances and standardizing the sequencing results.
Microbial catabolic profile (MicroResp^{TM})	Easy and practical functional characterization of the soil microbial community, which combines functional diversity and degradation rates	The method selects only species adapted to rapid growth on simple substrates.The choice of the substrates is critical, and the current set of substrates has a low discriminating capacity. The same amount of carbon source is added to the soil, not the same amount of carbon.Final values are highly dependent on a laboratory-specific calibration line, making comparisons between laboratory results problematic.

In addition, it was considered why the use of new indicators in soil can make it difficult to assess the quality. These considerations apply not only to new indicators but also to biological, physical, and chemical indicators of soil traditionally used. [10] First, there is a need to standardize methods, including timing of sampling (i.e., timing of crop development versus season and soil management), to facilitate comparisons across space and time and to achieve consensus among different laboratories. However, it should be recognized that standardization is not always possible and that sometimes methods adapted to specific conditions are more effective. Second, data interpretation depends on data collection and availability. [12] These are necessary to obtain more accurate information about soil conditions and changes in the development of boundaries, curves, references, and benchmarks. Because the analysis of the obtained results is variable, it may be difficult to analyze some results due to seasonality.

5. General considerations and suggestions for future research.

The approach used to identify and measure new indicators of soil quality requires facilitating the management process in a wide range of ten LTEs (tillage and organic matter addition) [Bongiorno et al.]. This type of generalization can be important for the development of soil conservation measures [11]. A thorough time and cost analysis is needed to assess whether these aspects make them appropriate elements of soil quality assessment schemes. At present, the inclusion of POXC as a soil quality indicator is the most feasible option if the above-mentioned problems are taken into account, in particular those related to standardization and interpretation. In this regard, the following research opportunities should be explored: (1) studies aimed at determining what fraction of TOC is measured as labile carbon (POXC can measure not only the labile fraction of TOC); (2) the development of a rapid and easy method to assess organic carbon quality; and (3) labile carbon. The relationship between different organic carbon compounds and functions should be explained. Spectroscopic methods seem very promising in this regard, such as mid-infrared photoacoustic spectroscopy [7] and diffuse reflection Fourier-transformed mid-infrared spectroscopy; they can also be used to estimate the microbial properties of the soil community, such as microbial biomass carbon [12]. It is necessary to clarify which methodologies can help in the evaluation of indicators of the effectiveness of soil disease control. In this context, sequencing, transcriptomics, quantitative PCR, metabolomics, and proteomics methods are promising [7]. At the same time, it is necessary to determine the relationship between the potential antagonistic activity of microorganisms assessed by molecular methods (for example, the presence of genes encoding antagonistic properties) and the actual suppressiveness of the soil measured by bioassays, as well as the predictive value for field conditions. . Validation of the results of food web indices of free-living nematode communities estimated with sequence results, optimization of databases, method pipelines (primer selection, bioinformatics analysis), and sequence standardization are needed. results to obtain a corrected relative abundance. [1]. Better interpretation and validation of Micro Resp TM results is needed to ensure that results are understandable and easily translated into management recommendations. It is necessary to strengthen the relationship between taxonomic and functional diversity and soil processes to use soil biota data more effectively in soil quality assessment. Additional research is needed for other management practices, such as crop rotation, intercropping, cover crops, and more specific organic matter input practices (such as farmyard manure, slurry, and biochar).[2] Additionally, the effects of soil texture should be further considered to provide more specific management recommendations. It is necessary to explore when and to what extent the participation of different stakeholders (e.g., farmers and other land managers) in the development, validation, and application of new soil quality indicators can support soil quality indicator research. [14,15]

6. Conclusion

Assessment of soil indicator quality indicators is necessary to monitor the state and change of chemical degradation and soil processes under anthropogenic influence. This article discusses the potential of various soil properties, namely, labile organic carbon, soil reclamation, and nutrient activity enhancement, as new indicators of chemically degraded soil quality. It is possible to estimate the changes in the quality of the soil, the methods of disposal of chemical industrial products that cause significant damage to the soil, the reproductive activities of soil cultivation, and the dynamic addition of organic substances. It is characterized by a better understanding of their physical, chemical, and biological relations with soil functions, determining the amount of organic matter with labile carbon fractions, and evaluating the change in new indicators of productivity. [13] Combined with our previous research, the study may contribute to the further development of soil quality assessment by providing information on the suitability of new indicators for soil health productivity and quality assessment. Future work will require confirmation of the studied indicators, recommendations for production, and analysis of optimal approaches for their use in combination with existing soil quality indicators or instead of them. supply and regulation functions), emphasizing the current main soil functions related to the development of priority TQI (Soil Quality Indicators) to describe soil processes, soil functions, and consequently ecosystem services can be managed. These can be used to develop soil and environmental policy in Uzbekistan, as well as soil monitoring programs aimed at assessing the physical, chemical, and biological quality of soil.

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