

# MICROORGANISMS AND MICROBIOTA: A BIBLIOMETRIC STUDY OF CURRENT LITERATURE

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**Abstract:** The actions of microorganisms in the soil are diverse and extremely important for the maintenance of their physical and chemical characteristics. The total or partial degradation of xenobiotic substances present in the soil through the processes of phytoremediation and bioremediation. The objective of this study is to present a bibliometric analysis of the biogeochemical cycle, microfauna and microbiota present in soils using the Rstudio software, an updated “radiography” of the literature. The methodological protocol followed for this research was the survey of the “Scopus” and “Web of Science” databases. The search expressions (“microbiological action”) OR (“fungi”) OR (“yeast”) OR (“bacteria”) OR (“enzymatic action”) AND (“soils”) OR (“agricultural soils”) OR (“soil physical characteristics”) OR (“chemical characteristics”) AND (“soil biogeochemical cycle”) were used, applying the following filters: scientific articles, from the last five years (2020-2025), in English, in soil science, with a minimum citation index of 3.5. A total of 1,981 articles were retrieved from

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Scopus and 1,041 from the Web of Science, totaling 3,022 papers. After the exclusion of 742 duplicate articles, 2,280 unique works were generated, which make up this bibliometric analysis on the subject. The relationship indicated by this bibliometric analysis between the soil and the microbiome is broad, complex, necessary and constant. Whether in the degradation of organic or inorganic compounds, xenobiotic compounds or in the maintenance of the physical characteristics of soil profiles. However, research faces a major challenge in terms of understanding the metabolic mechanisms of these individuals in terms of their reproduction and the metabolic products generated.

**Keywords:** Xenobiotics. Phytoremediation. Bioremediation. Metabolites. Mechanisms

### **Conflict of interest**

I hereby make a commitment that there is no conflict of interest between the author and co-authors that would prevent the analysis and subsequent publication of this article.

### **Introduction**

On the global stage, Brazil has stood out as a leader in vegetable protein production, not only because of its total arable area, but also with initiatives such as the low carbon agriculture program (ABC), the implementation of the no-till system, maintaining a vegetation cover under the soil, improving water retention, as well as biological nitrogen fixation (BNF). This success has been achieved not only by increasing production, but also by a set of phytosanitary measures that make exported commodities reliable (LIMA; SANTOS; DA ROCHA, 2024). For this leadership to occur, investments in research are substantial, the phytosanitary quality of the seeds (MATEUS ROCHA et al., 2024), combined with proper management and conservation of soil and water, are points that are increasingly being adopted by the producing class (VALERA et al., 2024).

In this equation, the role played by microorganisms is extremely important for production and provides the soil with the status of a vast laboratory for the development of cutting-edge research in agriculture (BRANDT et al., 2023). It has propelled researchers into the microbiological universe, with a diversity of studies on fertility (HARTMANN et al., 2022), enzymatic microbiological activity (RODRÍGUEZ-ALBARRACÍN et al., 2024), and anthropogenic contaminants that can alter microbiological action, physical characteristics and directly influence productivity, as well as researching strains with the affinity to contain contamination by xenobiotic substances (GHIMIRE et al., 2024); (KHAN et al., 2024); (MAITY et al., 2022).

The actions of microorganisms in the soil are diverse and extremely important for maintaining their physicochemical characteristics, which are essential for their agricultural exploitation. The total or partial degradation of xenobiotic substances present in the soil through the processes of phytoremediation, phytoremediation and bioremediation (WANG et al., 2022), are some examples of these actions. The biological process of root extension by arbuscular mycorrhizal fungi (DE MOURA et al., 2024) is yet another example of why soil is so important for research. Soil is a living, dynamic ecosystem made up of minerals, organic matter, air, water and organisms, containing more carbon than the atmosphere and vegetation combined. The relationship between the edaphic mesofauna present in the litter and the concentration of carbon in soils is much more complex than just an academic discussion, as it is a question of the balance between soil pedogenesis, correct management, ecosystem maintenance and a microclimate favourable to a diversity of biogeochemical reactions, all catalyzed by specific enzymes present in the soil.

In the meantime, scientific research has benefited from open software for statistical analyses of data, projecting the use of compounds in ideal mixtures, planning experiments, as well as the bibliometric analysis they provide. Through this type of analysis, it is possible to verify research trends, their global and regional impact, collaboration between authors and countries, offering scientific knowledge a more pragmatic and effective view of the issues addressed by the scientific community for a given area, reinforcing scientific and knowledge multidisciplinary. In view of the above, the

aim of this paper is to present a bibliometric analysis of the biogeochemical cycle, microfauna and microbiota present in soils using the Rstudio software, with the aid of the Bibliometrix package and the Biblioshiny function, an up to date “radiography” of literature.

## **Research methodology**

Statistical analysis was carried out through bibliometric analysis for the knowledge of reliable sources of literature, relevant authors who address the theme and its relations, the impacts based on Bradford’s law, the coupling relationships between authors and co-authors, in addition to the international cooperation of researchers regarding microbiological interactions and the biogeochemical cycle. To this end, it was necessary to develop a search protocol, including and excluding studies found in the databases listed below. The protocol followed for this research was formalized in a search in the “Scopus” and “Web of Science” databases, since the reliability of the indexing offered by the databases corroborates with the documents searched. Expressions that specifically encompass the scope of the object of this study in terms of the action of the microbiota present in soils, its relevance and activity in the soil biogeochemical cycle were sought.

The search expressions used were: (“microbiological action”) OR (“fungi”) OR (“yeast”) OR (“bacteria”) OR (“enzymatic action”) AND (“soils”) OR (“agricultural soils”) OR (“soil physical characteristics”) OR (“chemical characteristics”) AND (“soil biogeochemical cycle”), applying the following filters: scientific articles, published in the last five years (2020-2025), in English, with the search expressions in the title, abstract and keywords for the databases searched, with a minimum citation index of 3.5 according to the JCR factor, in the field of agronomy and soil science. Reviews, conference papers, books and book chapters were excluded. The data collected was entered into the Rstudio software version 4.4.1 and analysed with the Bibliometrix package, using the Biblioshiny tool, and reading to establish the inclusion and exclusion criteria was carried out using the open-source software Rayyan.

A total of 1,981 articles were retrieved from Scopus and 1,041 from Web of Science, totalling 3,022 papers. A script for reading, transforming data into a data frame object, unifying data and excluding duplicate papers was run in the Rstudio software. After excluding 742 duplicate articles, 2,280 unique papers were generated, which make up this bibliometric analysis of the subject as follows in the subsequent sections.

## **Results found**

### **Main Information**

Bibliometric Analysis has stood out as a scientific-statistical tool for surprising research (SWEET et al., 2025), Copyright Correlations (AMJAD et al., 2021), and the scientific relevance of mentors/guidance counselors (ALSHEBLI et al., 2020). Figure 1 below begins by providing general information on the total archive of 2,280 papers researched over the last five years, where 9,733 authors were identified, with an international co-authorship rate of 20.04 per cent, demonstrating that there is a good interest in the subject and an average of 7.53 co-authors per document. Although these figures are positive, the annual growth rate was negative at -64.38% for documents with an average age of 1.84 years.

Figure 1 - Main bibliometric survey information via Rstudio, with time interval, sources researched, documents surveyed, co-authorship per document.



Source: Information taken from biblioshiny report

The main data shows a path to follow in relation to the subject of this study, but a metatheoretical view of the observed source is necessary (HAN et al., 2022), as this information presents a general parameter on the subject through publications, authors, documents and sources. Analyzing small details of the research that helps to understand the total facts delimited by the observed data(WINSKEL, 2018), providing an analysis close to reality. A total of 419 sources were obtained, with 7.53% co-authorship by documents, 20.04% international co-authorship, showing a relevant collaboration between researchers, who build a very significant international collaboration network as can be seen in Figure 2 below.

Figure 2-Map of worldwide collaboration between researchers about this study



Figure 2 depicts the global collaboration network, illustrating the widespread and interconnected interest in the biogeochemical cycles of soil microbiota. The analysis of this network is crucial for understanding the dynamics of research and the flow of knowledge across borders. This transnational cooperation enhances the depth and breadth of research, leading to more comprehensive and diversified findings.

The subsequent sections delve into specific relationships and collaborative efforts among researchers, highlighting local and global interactions. The following analysis focuses on the connections between various research entities, examining how these relationships contribute to the advancement of understanding in the field.

The insights gained from this extensive bibliometric analysis reveal significant trends and patterns within the scientific community. Notably, the data underscores the importance of interdisciplinary collaboration and the interconnected nature of modern research. Furthermore, the findings highlight the pivotal role of international cooperation in advancing the understanding of complex scientific phenomena.

The intricate network of collaborations, visualized in Figure 2, demonstrates how researchers from diverse geographical regions contribute to a collective pool of knowledge, fostering innovation



keywords (DE), illuminating the intricate web of scholarly communication and thematic focus areas. This figure underscores the role of key contributors and recurring themes that drive the research discourse. By analyzing these elements, we gain a deeper understanding of the foundational concepts and influential works that shape the study of biogeochemical cycles in soil microbiota.

The exchange of information between researchers on the types of soils, strains of microorganisms and taxonomic units that exist in the types of soils on the planet helps researchers to construct logical and up-to-date reasoning on the characteristics of each type of soil, their physicochemical needs and the actions performed by these individuals in the soil profile, facilitating the integration of the soil microbiological chain into its food chain.

The exchange of information between researchers on the types of soils, strains of microorganisms and taxonomic units that exist in the types of soils on the planet (EREN; BANFIELD, 2024), helps researchers to construct logical and up-to-date reasoning on the characteristics of each type of soil, their physicochemical needs and the actions performed by these individuals in the soil profile, facilitating the integration of the soil microbiological chain into its food chain (WALL et al., 2019).

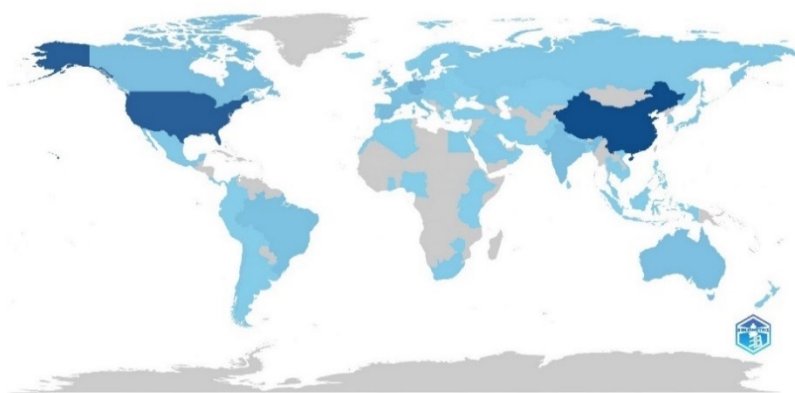
Thus, scientific research plays the role of linking the information and data obtained, but this requires the researcher to adhere to the basic precepts of research integrity. According to (HACKMAN et al., 2024), the integrity of the research and its transparency in the published material is totally based on the quality of the data obtained, and these are, in the words of the authors, the most precious assets of the research. (WILKINSON et al., 2016), on the other hand, emphasizes the urgent need to improve academic support for the use of research data, as well as the integration of interested parties, funding agencies, bookshops and industry, with a view to making the most of the data collected and treating it more appropriately, thus measuring its relevance.



## Relationships between researchers at local and global levels

In this way, the sources raised in the present work express reality, replicability and transparency of the panorama of current publications at the level of global production, ease of access through a global research network, as can be seen in Figure 4.

Figure 4- Global production for the theme addressed in this study



Source: Information extracted from the biblioshiny report

By fostering collaboration between global and local researchers, the scientific community can bridge gaps in knowledge and resource allocation. This collaboration not only enhances the quality and impact of research but also promotes inclusivity and diversity in scientific inquiry. The integration of diverse perspectives leads to innovative solutions to complex problems, particularly in the study of biogeochemical cycles in soil microbiota.

Table 1 below shows the top 30 countries, and their productions referenced in Figure 3. The relationship is clear between the publications shown in the table and the more pronounced colouring seen in Figure 3. In a recent study (BENITEZ HURTADO et al., 2024), the research demonstrations correlate with government and private investment, pointing out through a dynamic panel co-integration analysis the various bottlenecks that exist for researchers with lower publication factors at a global

level.

Table 1 - Production by the top 30 countries

REGION	FREQ
CHINA	2016
USA	1711
GERMANY	390
SPAIN	239
UK	237
CANADA	223
INDIA	215
AUSTRALIA	205
ITALY	184
BRAZIL	182
FRANCE	156
SWITZERLAND	120
NETHERLANDS	106
JAPAN	100
RUSSIA	93
CHILE	81
DENMARK	71
MEXICO	68
POLAND	66
SWEDEN	65
AUSTRIA	59
NORWAY	50
SOUTH KOREA	48
PORTUGAL	46
SOUTH AFRICA	43
CZECH REPUBLIC	42
SAUDI ARABIA	40
ISRAEL	38
NEW ZEALAND	37

Source: Information extracted from the Biblioshiny report



Table 2 below shows the first 30 sources of papers researched in this study. The main search index here focuses on the impact factor of the journal expected by the author to infer greater visualization of their study. Another point is the paper's suitability for the journal's scope.

The clarity of scientific writing, its innovative capacity to answer questions that constantly arise after various studies, means that editors and reviewers of high-impact journals are increasingly judgmental in their evaluations. So, co-operation between authors, as shown above in Figure 1, is an alternative in ongoing projects.

Table 2 - List of journal sources and their respective productions on the subject

SOURCES	ARTICLES
SCIENCE OF THE TOTAL ENVIRONMENT	348
FRONTIERS IN MICROBIOLOGY	97
JOURNAL OF HAZARDOUS MATERIALS	73
ISME JOURNAL	61
APPLIED AND ENVIRONMENTAL MICROBIOLOGY	53
ENVIRONMENTAL MICROBIOLOGY	51
CHEMOSPHERE	49
WATER RESEARCH	45
ENVIRONMENTAL RESEARCH	42
MICROBIOME	42
JOURNAL OF ENVIRONMENTAL MANAGEMENT	41
MSYSTEMS	38
MICROBIAL ECOLOGY	37
ENVIRONMENTAL SCIENCE AND TECHNOLOGY	35
SCIENTIFIC REPORTS	34
ENVIRONMENTAL POLLUTION	32
NATURE COMMUNICATIONS	32
MICROBIOLOGY SPECTRUM	29
BIORESOURCE TECHNOLOGY	28
ENVIRONMENTAL SCIENCE AND POLLUTION RESEARCH	28
GLOBAL CHANGE BIOLOGY	28
PLOS ONE	22
FEMS MICROBIOLOGY ECOLOGY	21

MICROORGANISMS	21
SOIL BIOLOGY \& BIOCHEMISTRY	20
FRONTIERS IN MARINE SCIENCE	19
PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA	19
MBIO	17
APPLIED SOIL ECOLOGY	16

Source: Information extracted from the biblioshiny report

An important point to raise is the large number of predatory journals that surround researchers, reducing the quality of scientific research (DARTUS et al., 2020) and (YAN et al., 2018), presenting themselves as a quick alternative to the time required by a good journal, even though they impose low visibility on studies.

The proliferation of these predatory journals has created a challenging environment for genuine researchers who strive for quality and impact in their work. Consequently, it becomes imperative for researchers to rigorously vet the journals they choose to publish in, ensuring that their studies gain the recognition and credibility they deserve.

### **Keywords as search cofactors and citations**

The objectivity and precision offered by the correct keyword search has been a strong driver and facilitator of academic research (WANG; YU, 2024), it is a search engine that facilitates and at the same time drives research and studies that have already been published. To this end, the literature is increasingly looking at ways and models of calculating specific algorithms and even ranking searches (MAROTTA et al., 2022). Figures 5 and 6 below show this graphically.



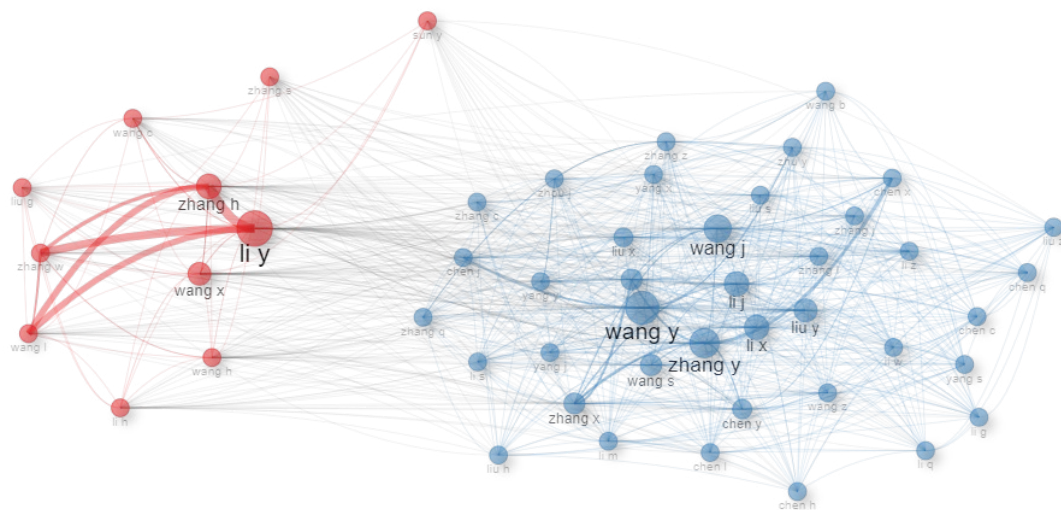


7 below and represent a trend obtained from the total data of the research carried out and which aimed to produce the expected products in the form of articles.

### Clusters formed by search expressions

In the construction of metadata, the importance of a collaborative network is essential (HASAN et al., 2024), the rationale offered by sharing, increases the relevance of the study, broadens the horizons of research and the researcher (MA et al., 2024), Figure 7 below points out in the form of Clusters these points presented above and brings a significant vision of the collaborative network between authors.

Figure 7-Collaboration network between authors, highlights for Wang Y, Zhang Y, Wang J, Li Y, Wang X , Zhang H

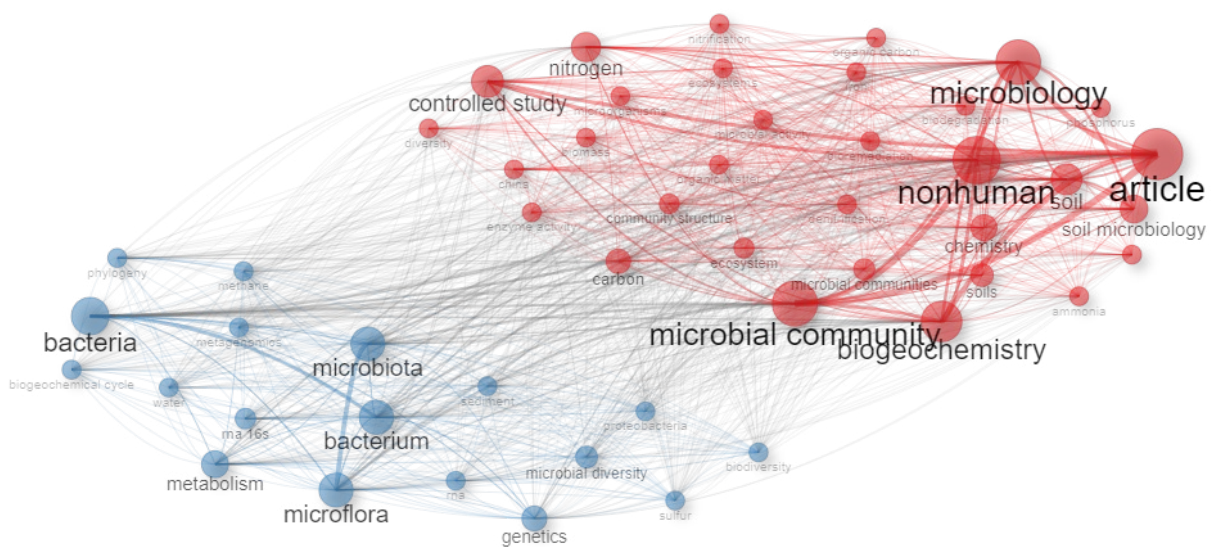


Source: Information taken from the report drawn up by the biblioshiny

The prospecting by similarity of data forming the clusters (AKHTER et al., 2025), provides the author with a filtering of the databases relevant to his research, which is truly an accelerator in the

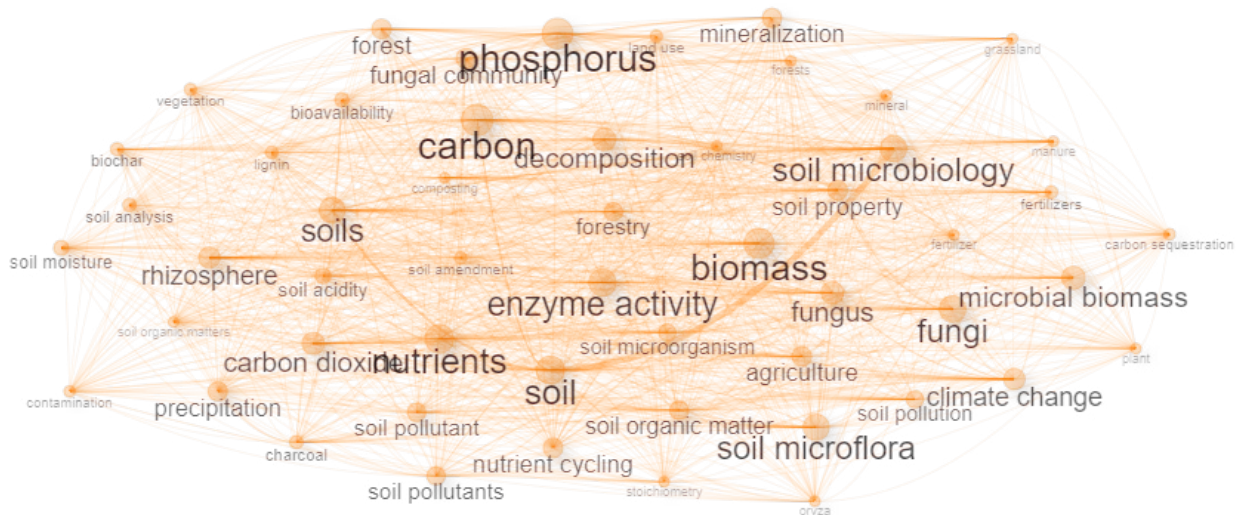
search process, although the points that are outside the clusters formed do not fail to demonstrate their scientific relevance, although this initial screening forming the most important clusters may also not address the discussion intended in the study completely (CHOUBISA et al., 2023) , generating only an acceleration of the search process. This direct relationship will be presented visually in Figures 8 and 9 below, substantially expanding the depth of the subject of this study by verifying the relationships between the microorganisms present in the soil and their functions and aptitudes.

Figure 8-Clusters formed from the similarity of search expressions, highlighting microbiology, soil microbiology, chemistry, biogeochemistry, microbiota, bacteria, microflora and metabolism.



Source: Information taken from the report drawn up by the biblioshiny

Figure 9-Clusters directly linked to actions carried out by the microbiological community in the soil, highlighting: Phosphorus, soils, soil microbiology, biomass, enzymatic activity, nutrients, carbon, fungi, climate change, agriculture



Source: Information extracted from the report prepared by biblioshiny

The key points of this study can be found in the clusters formed above based on the search expressions and their similarity and the algorithms that facilitate these searches. The mineralisation of compounds enhanced by microorganisms, their regulatory role in climate change (FENG et al., 2024), as well as their autotrophic growth and their capacity for anoxygenic photosynthesis (ALARCON et al., 2024), attest to some of the abilities of microorganisms in relation to the biogeochemical cycle.

The visual representation in Figures 8 and 9 provides a detailed understanding of how these clusters interact, revealing the intricate network and symbiotic relationships among soil microorganisms. By examining these clusters, researchers can gain valuable insights into the complex mechanisms that govern soil health and fertility. This analysis not only highlights the significant contributions of soil microorganisms to various biochemical cycles but also underscores the importance of preserving and enhancing microbial diversity to sustain soil ecosystems.

## Discussions

The intricate patterns revealed by these visualizations underscore the importance of microbial interactions in the soil ecosystem. For example, Figure 8 highlights the centrality of microbiology and metabolic processes, while Figure 9 emphasizes the critical role of phosphorus cycling and enzymatic activities. These clusters not only illustrate the complexity of soil microbiomes but also point to the dynamic nature of soil health, influenced by factors such as climate change and agricultural practices.

The data-driven approach adopted in this study, utilizing bibliometric tools, has enabled a precise mapping of the microbial landscape, shedding light on various biochemical cycles and the pivotal role of microorganisms. By drawing connections between different clusters, the research elucidates how microbial communities contribute to nutrient cycling, organic matter decomposition, and soil fertility. This comprehensive analysis provides a foundational understanding that can inform future studies and practical applications in agriculture, environmental management, and biotechnology.

The bibliometric analysis showed comprehensive results on the discussion raised in this study of the importance of microorganisms and their direct actions in the soil through biochemical and physicochemical reactions. A good depth of current research on strains of fungi, bacteria and yeasts was noted, although it also pointed out on a positive level that much remains to be studied about these individuals, their aptitudes, genomic mechanisms, nutritional needs, as well as the enzymatic activity of microbiota and those released into the soil. It is well known that soil is poor in microbiological activity suffers serious consequences when it comes to maintaining its physical characteristics and that these individuals are extremely important to the soil, the biogeochemical cycle, the maintenance of organic matter and the positive effects on the soil and its exploitation.

The driving force of microorganisms in regulating organic matter and helping to fertilise the soil is substantial (WANG et al., 2024c). However, the competition between microbiological taxa and the importance of the rhizosphere to the communities is essential, as this is where the greatest

concentration of nutrients needed by the individuals is located and this interaction is extremely relevant to the plant (CHENG et al., 2024). Thus, the identification of strains, the study of their aptitudes, their contribution as biomass or even necromass, are potentializes for the growth and nutrition of these communities (TRIVEDI et al., 2020).

The enzymatic action of prokaryotic and eukaryotic individuals is an important function for the soil and its exploitation in terms of food production. Enzymes such as  $\beta$ -1,4-N-acetylglucosaminidase, L-leucine amino peptidase and acid phosphatase are potentiators of products that are widely used in plant growth and in the nutrition of other microbiological communities present in the rhizoplane (SUN et al., 2024). Natural organic compounds such as: auxins, gibberellins, cytokinins, abscisic acids (DAI et al., 2024), are some of the growth promoters that are so essential and naturally produced by plants (BAJGUZ et al., 2023), delaying leaf senescence through cytokinins, favoring ripening through ethylene or preventing the formation of adventitious roots through auxins. The natural mechanism of seedling development is potentiated by the compounds, but the implication of these metabolites by biotic and abiotic stress directs research towards more pragmatic investigation, generating promising answers and initiatives (FERREIRA NERES et al., 2024); (KUMARI et al., 2024).

The diversification of the aptitudes of these individuals is impressive, whether in saline lakes (WANG et al., 2024a), or in other environments, what is known to date about the diversity of these individuals is still small (BAKER et al., 2020), another point that requires further discussion is the genomic metabolism of microorganisms (YAN et al., 2024), anaerobic strains and their biochemical interactions in carbon mineralisation, which are of extreme use in biotechnology and biogeochemistry, remain open to future discussion. Bioremediation of groundwater contamination with arsenic (JIANG et al., 2024), is yet another function performed by these individuals. Improving the production of volatile fatty acids for wastewater treatment by an oxidative process (DU et al., 2023), as well as in the oxidative process of atmospheric methane (ZENG et al., 2024), are some of the contributions of prokaryotic and eukaryotic microorganisms to the soil, with a view to maintaining its profile characteristics.

Thus, this bibliometric analysis has brought to discussion the diverse actions and aptitudes of these organisms when it comes to maintaining the physical-chemical characteristics of the soil, maintaining its profile, cycling compounds such as methane in forests (WIGLEY et al., 2024) , in other words, a broad universe for scientific research. Enzymatic releases of phosphorus, carbon and nitrogen in the soil (YU et al., 2024) , as well as the findings of carbon and nitrogen losses originating from soil respiration in cold climates caused by climate change (PI et al., 2024) , thus necessitating more pragmatic monitoring of these characteristics and presenting these results more comprehensively to the population, managers and investors so that mitigation actions can be more effective and direct. Because the microbiological relevance to the planet is immense and intense, ranging from the methylation of mercury treated by cyanobacteria (WANG et al., 2024b) , to improving the availability of exudates in the soil and consequently increasing organic matter (XU et al., 2024) , although anthropogenic actions such as the excessive discharge of effluents into receiving bodies, causing significant changes in microbiological taxonomy (HU et al., 2024) , or the inhibition of nitrogen fixation by the contamination of new phosphorus esters (GAO et al., 2024), microbiological communities, even with extensive action, are unable to respond satisfactorily to anthropogenic action.

## **Final considerations**

Population expansion, together with the demand to provide food for this constantly and exponentially growing population, has made soil and its direct relationship with microorganisms a highly relevant source of research and dissemination of knowledge.

The relationship between soil and microbiome is broad, complex, necessary and constant. Whether it's the degradation of organic or inorganic compounds, xenobiotic compounds or the maintenance of the physical characteristics of soil profiles. However, microbiological action in aquatic environments is also substantial and important to ecosystem balance, serving both in soil and aquatic environments as thermometers that indicate variations from anthropogenic contamination.

Phytoremediation and bioremediation are among the benefits extracted from this symbiotic relationship between microorganisms acting in the biogeochemical cycle of soils. This role of detoxifying compounds is highly developed by microorganisms and is crucial for better exploitation of the soil. Despite the advances, microbiology still has a vast field of research for identifying specific strains of microorganisms, better understanding the mechanisms of reaction and release of compounds, resistance and replicability of these strains.

Improving knowledge of the enzymatic reaction medium, its generated products and the relationship of these compounds to the development of food production areas, highlights the aptitudes of microorganism communities, and this bibliometric analysis shows that co-operation between researchers, governmental and private research institutions is essential. These co-operations also need to encompass areas of great strength in food production, broadening the scope of action so that the dissemination of technologies and knowledge has a greater impact at local, regional and international levels.

## **Bibliographic References**

AKHTER, M. M. et al. A fast sparse graph based clustering technique using dispersion of data points. *Neurocomputing*, v. 618, p. 129054, fev. 2025.

ALARCON, H. V. et al. Evidence for autotrophic growth of purple sulfur bacteria using pyrite as electron and sulfur source. *Applied and Environmental Microbiology*, v. 90, n. 7, 24 jul. 2024.

ALSHEBLI, B.; MAKOVI, K.; RAHWAN, T. RETRACTED ARTICLE: The association between early career informal mentorship in academic collaborations and junior author performance. *Nature Communications*, v. 11, n. 1, p. 5855, 17 nov. 2020.

AMJAD, T.; MUNIR, J. Investigating the impact of collaboration with authority authors: a case study of bibliographic data in field of philosophy. *Scientometrics*, v. 126, n. 5, p. 4333–4353, 12 maio 2021.

BAJGUZ, A.; PIOTROWSKA-NICZYPORUK, A. Biosynthetic Pathways of Hormones in Plants. *Metabolites*, v. 13, n. 8, p. 884, 25 jul. 2023.

BAKER, B. J. et al. Diversity, ecology and evolution of Archaea. *Nature Microbiology*, v. 5, n. 7, p. 887–900, 4 maio 2020.

BENITEZ HURTADO, S. R. et al. Assessing the influence of GDP, globalization, civil liberties, and foreign direct investment on researchers in R&D per country: Dynamic Panel Cointegration Analysis for Latin American countries. *Social Sciences & Humanities Open*, v. 10, p. 100929, 2024.

BRANDT, L. et al. Mineral type and land-use intensity control composition and functions of microorganisms colonizing pristine minerals in grassland soils. *Soil Biology and Biochemistry*, v. 182, p. 109037, jul. 2023.

CHENG, Z. et al. Interactive dynamics between rhizosphere bacterial and viral communities facilitate soybean fitness to cadmium stress revealed by time-series metagenomics. *Soil Biology and Biochemistry*, v. 190, p. 109313, mar. 2024.

CHOUBISA, H. et al. Accelerated chemical space search using a quantum-inspired cluster expansion approach. *Matter*, v. 6, n. 2, p. 605–625, fev. 2023.

DAI, A. et al. Small molecule chemical scaffolds in plant growth regulators for the development of agrochemicals. *Chinese Chemical Letters*, p. 110462, set. 2024.

DARTUS, J. et al. Rate of publication in predatory journals by orthopedic surgeons members of the French orthopedic and traumatology society (SOFCOT): A follow-up note. *Orthopaedics & Traumatology: Surgery & Research*, v. 106, n. 8, p. 1457–1461, dez. 2020.

DE MOURA, J. B. et al. Mycorrhizal fungi arbuscular in organic and conventional sugarcane systems. *Scientific Reports*, v. 14, n. 1, p. 14322, 21 jun. 2024.

DU, X. et al. The synergistic effect of chemical oxidation and microbial activity on improving volatile fatty acids (VFAs) production during the animal wastewater anaerobic digestion process treated with persulfate/biochar. *Science of The Total Environment*, v. 857, p. 159276, jan. 2023.

EREN, A. M.; BANFIELD, J. F. Modern microbiology: Embracing complexity through integration across scales. *Cell*, v. 187, n. 19, p. 5151–5170, set. 2024.

FENG, K. et al. CoBacFM: Core bacteria forecast model for global grassland pH dynamics under future climate warming scenarios. *One Earth*, v. 7, n. 7, p. 1275–1287, jul. 2024.

FERREIRA NERES, D.; WRIGHT, R. C. Pleiotropy, a feature or a bug? Toward co-ordinating plant growth, development, and environmental responses through engineering plant hormone signaling. *Current Opinion in Biotechnology*, v. 88, p. 103151, ago. 2024.

GAO, M. et al. Contamination Status of Novel Organophosphate Esters Derived from Organophosphite Antioxidants in Soil and the Effects on Soil Bacterial Communities. *Environmental Science & Technology*, v. 58, n. 24, p. 10740–10751, 18 jun. 2024.

GHIMIRE, N. et al. Comparative genomics based exploration of xenobiotic degradation patterns in *Glutamicibacter*, *Arthrobacter*, and *Pseudarthrobacter* isolated from diverse ecological habitats. *Heliyon*, v. 10, n. 22, p. e40280, nov. 2024.

HACKMAN, L.; MACK, P.; MÉNARD, H. Behind every good research there are data. What are they and their importance to forensic science. *Forensic Science International: Synergy*, v. 8, p. 100456, 2024.

HAN, J. et al. Enhancing the understanding of ecosystems under innovation management context: Aggregating conceptual boundaries of ecosystems. *Industrial Marketing Management*, v. 106, p. 112–138, out. 2022.

HARTMANN, M.; SIX, J. Soil structure and microbiome functions in agroecosystems. *Nature Reviews Earth & Environment*, v. 4, n. 1, p. 4–18, 22 nov. 2022.

HASAN, M. M. et al. The role of collaborative research network on E-waste studies in North America using a bibliometric approach. *Ecological Informatics*, v. 82, p. 102736, set. 2024.

HU, S. et al. Characteristics of DOM and bacterial community in rural black and odorous water bodies under different dimensions. *Science of The Total Environment*, v. 927, p. 172005, jun. 2024.

JIANG, H. et al. Metagenomic and FT-ICR MS insights into the mechanism for the arsenic biogeochemical cycling in groundwater. *Journal of Hazardous Materials*, v. 476, p. 135047, set. 2024.

KHAN, A.; TOLETI, S. R. Molecular Evolution of Xenobiotic-Degrading Genes and Mobile Genetic Elements in Soil Bacteria. Em: *Microbial Diversity in the Genomic Era*. [s.l.] Elsevier, 2024. p. 731–746.

KHAN, I. K. et al. Determining the optimal number of clusters by Enhanced Gap Statistic in K-mean algorithm. *Egyptian Informatics Journal*, v. 27, p. 100504, set. 2024.

KUMARI, S. et al. Plant hormones and secondary metabolites under environmental stresses: Enlightening defense molecules. *Plant Physiology and Biochemistry*, v. 206, p. 108238, jan. 2024.

LIMA, A. D. R.; SANTOS, B. V.; DA ROCHA, J. L. H. A IMPORTÂNCIA DO TRATAMENTO FITOSSANITÁRIO DA SOJA PARA A IMAGEM DO BRASIL NAS EXPORTAÇÕES. *Revista Fatecnológica da Fatec-Jahu*, v. 18, n. 1, p. 142–154, 13 set. 2024.

MA, X. et al. Collaboration network analysis for the Arctic issues based on a collection of international collaborative events. *Polar Science*, p. 101091, maio 2024.

MAHMUD, M. S. et al. Approximate Clustering Ensemble Method for Big Data. *IEEE Transactions on Big Data*, v. 9, n. 4, p. 1142–1155, 1 ago. 2023.

MAITY, D.; KUNDU, P.; ADHIKARI, S. Isolation and characterization of 4-chlorophenol degrading bacterial strain from pharmaceutical xenobiotic compounds contaminated soil using enrichment technique. *Journal of the Indian Chemical Society*, v. 99, n. 5, p. 100336, maio 2022.

MAROTTA, V. et al. The Welfare Impact of Targeted Advertising Technologies. *Information Systems Research*, v. 33, n. 1, p. 131–151, mar. 2022.

MATEUS ROCHA, T. et al. Qualidade fisiológica de sementes, desempenho a campo e viabilidade econômica da cultura da soja submetida à inoculação de sementes com diferentes produtos biológicos. *Revista de Ciência e Inovação*, v. 10, n. 1, p. 1–21, 24 maio 2024.

PI, K. et al. Soil respiration induces co-emission of greenhouse gases and methylated selenium from

cold-region Mollisols: Significance for selenium deficiency. *Environment International*, v. 188, p. 108758, jun. 2024.

RODRÍGUEZ-ALBARRACÍN, H. S. et al. Soil organic carbon sequestration potential explained by mineralogical and microbiological activity using spectral transfer functions. *Science of The Total Environment*, v. 947, p. 174652, out. 2024.

SUN, C. et al. Core microbiota play important roles in maintaining soil multi-nutrient cycling in lakeshore wetland of plateau lake Caohai. *Land Degradation & Development*, v. 35, n. 4, p. 1308–1319, 28 fev. 2024.

SWEET, L. et al. Writing for publication: The basics. *Women and Birth*, v. 38, n. 2, p. 101878, mar. 2025.

TRIVEDI, P. et al. Plant–microbiome interactions: from community assembly to plant health. *Nature Reviews Microbiology*, v. 18, n. 11, p. 607–621, 12 nov. 2020.

VALERA, C. A. et al. The soil conservation agenda of Brazil: A review of “edge-to-edge” science contributions. *Science of The Total Environment*, v. 954, p. 176355, dez. 2024.

WALL, L. G. et al. Changes of paradigms in agriculture soil microbiology and new challenges in microbial ecology. *Acta Oecologica*, v. 95, p. 68–73, fev. 2019.

WANG, F.; YU, L. The design of advertising text keyword recommendation for internet search engines. *Systems and Soft Computing*, v. 6, p. 200109, dez. 2024.

WANG, X. et al. Molecular simulation of the O<sub>2</sub> diffusion and thermo-oxidative degradation mechanism of carbon-doped boron nitride nanosheets/BTDA-ODA polyimide composites with high O<sub>2</sub> adsorption capacity. *Surfaces and Interfaces*, v. 33, p. 102246, 1 out. 2022.

WANG, Y. et al. Differences in archaeal diversity and potential ecological functions between saline and hypersaline lakes on Qinghai-Tibet Plateau were driven by multiple environmental and non-environmental factors beyond the salinity. *BMC Microbiology*, v. 24, n. 1, p. 153, 4 maio 2024a.

WANG, Y. et al. Algal-derived dissolved organic matter accelerates mercury methylation under

cyanobacterial blooms in the sediment of eutrophic lakes. *Environmental Research*, v. 251, p. 118734, jun. 2024b.

WANG, Y.-F. et al. Biological Interactions Mediate Soil Functions by Altering Rare Microbial Communities. *Environmental Science & Technology*, v. 58, n. 13, p. 5866–5877, 2 abr. 2024c.

WIGLEY, K. et al. Methane cycling in temperate forests. *Carbon Balance and Management*, v. 19, n. 1, p. 37, 22 out. 2024.

WILKINSON, M. D. et al. The FAIR Guiding Principles for scientific data management and stewardship. *Scientific Data*, v. 3, n. 1, p. 160018, 15 mar. 2016.

WINSKEL, M. The pursuit of interdisciplinary whole systems energy research: Insights from the UK Energy Research Centre. *Energy Research & Social Science*, v. 37, p. 74–84, mar. 2018.

XU, S. et al. Effect of cover crop on soil fertility and bacterial diversity in a banana plantation in southwestern China. *Soil and Tillage Research*, v. 240, p. 106092, ago. 2024.

YAN, J. R. et al. Predatory Publishing in Orthopaedic Research. *Journal of Bone and Joint Surgery*, v. 100, n. 21, p. e138, 7 nov. 2018.

YAN, W. et al. Metatranscriptomics-guided genome-scale metabolic reconstruction reveals the carbon flux and trophic interaction in methanogenic communities. *Microbiome*, v. 12, n. 1, p. 121, 5 jul. 2024.

YU, Y. et al. Deciphering the crop-soil-enzyme C:N:P stoichiometry nexus: A 5-year study on manure-induced changes in soil phosphorus transformation and release risk. *Science of The Total Environment*, v. 934, p. 173226, jul. 2024.

ZENG, G. et al. Methane sink of subterranean space in an integrated atmosphere-soil-cave system. *Environmental Research*, v. 252, p. 118904, jul. 2024.

