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Bibiliometric Analysis Using Vos viewer With Publish or Perish of Fiber As A Soilless Planting Medium

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ABSTRACT

The use of soilless planting media is currently increasingly in demand because land for agriculture is decreasing as a result of it being used for residential and industrial construction. One of the preferred planting media options is fiber, both natural and synthetic. This research aims to analyze publication trends regarding the use of fiber as a soilless planting medium, using bibliometric methods and mapping with the VOSviewer application. Publication data was taken from Google Scholar between 2019 and 2024, and a total of 942 documents were found during that period. Publication trends regarding the use of fiber as a soil-free planting medium fluctuate, increasing and decreasing every year. The number of documents in 2019 decreased, although not too significantly. But from 2019 to 2023 there was a soaring increase. At the beginning of 2024, interest in research on the use of fiber as a soil-free growing medium will increase rapidly, as shown by the publication of 52 publications at the beginning of the year. The results of three types of mapping show that research on fiber continues to develop along with the various types of fiber used as planting media. Therefore, further research regarding the development of fiber as a soilless growing medium is still relevant and very necessary and could be a driving force for further research to find innovations in this field.

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1. INTRODUCTION

Fiber as a planting medium is an object of research that has attracted a lot of attention from researchers, especially in its development as a soilless planting medium. Fiber is a profitable alternative as a soil-free planting medium because it is more efficient and environmentally friendly. Fiber media is one solution to the shortage of land that is increasingly decreasing. Another advantage of fiber as a planting medium is that fiber can maintain soil moisture, has high porosity making it easier for air exchange and facilitates plant root growth, fiber does not rot easily, has the strength to restrain plant growth, and fiber is easily to obtain, especially natural fibers.

Many previous studies used fiber as a planting medium. Woznicki *et al*. (2024) researched the use of coconut fiber, peat, and wood fiber to grow strawberries. The use of natural fiber materials such as coconut fiber, pineapple leaf fiber, banana stems, and wood fiber for soil-free plant production systems. Nerlich *et al*. (2022) discussed the use of hemp fiber in cultivating tomato plants and discussed the advantages and disadvantages of hemp fiber as a soil-free growing medium. Atzori *et al*. (2021) discussed the nutritional content and plant protection of using biochar, coconut fiber, green compost, and wood fiber as soil-free planting media. Karagöz *et al*. (2022) made a summary regarding the cultivation of ornamental plants without soil and substrates used as media.

Of the many previous studies regarding fiber as a planting medium, no references have been found that have analyzed publication trends regarding the use of fiber as a soilless planting medium, using bibliometric and mapping methods. This trend analysis is important to understand the latest research developments regarding the development of the use of fiber as a soilless planting medium, identify research networks and collaborations on similar topics, can be used in making decisions or policies related to research topics, and inspire new research on research topics. It has something carried out by researchers (Van Nunen *et al*., 2018, Merigó & Yang, 2017, Gaviria-Marin *et al*., 2018, Donthu *et al*., 2020).

This research aims to explore research trends regarding the use of fiber as a soilless planting medium using the Publish or Perish application, as well as mapping research results using the VOSviewer application. In this way, bibliometric data can be revealed and patterns and relationships in bibliometric data can be understood. In addition, this research aims to understand trends, patterns, and impact of scientific publications, identify frequently used keywords, group data into clusters, and obtain geographic information from researchers based on their affiliation.

2. METHOD

In this research, bibliometric analysis is used to understand trends, patterns, and impacts of scientific publications regarding the use of fiber as a soilless growing medium. The analysis was carried out using literature documents and quantitative publications from data on Google Scholar from 2019 - 2024. Document searches were carried out using the keywords fibers as a soilless planting medium in the Google Scholar search engine using the Publish or Perish application which found data of 1000 articles. Article data is extracted to categorize them based on title, author's name, year, number of citations, number of citations per year, and number of author citations. The data is then created in CSV format (*.csv) for Excel format and RIS format (*.ris) for analysis using VOSviewer. Visualization of graphs or maps includes collaboration network maps, keyword maps, and research cluster maps obtained from the results of VOSviewer analysis so that an understanding of patterns and data relationships on the use of fiber as a soilless planting medium is obtained.

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3. RESULTS AND DISCUSSION

3.2. Development of Fiber as a Soilless Planting Medium Publications 2019-2024

Over the last six years (2019-2024), a data search regarding "Fiber as a Soilless Planting Medium" produced a total of 942 articles published internationally. The details are 138 articles in 2019, 118 articles in 2020, 217 articles in 2021, 188 articles in 2022, 229 articles in 2023, and 52 articles in 2024. From the data described above, it can be seen that there has been an increasing and decreasing trend in the number of articles published regarding "Fiber as a Soilless Planting Medium" over the last six years, as seen in **Figure 1**. There has been a decrease in the number of articles by 20 from 2019 to 2020. However, the number of articles increased significantly from 2020 (118 articles) to 2021 (217 articles), reaching a peak in 2023 (229 articles). At the beginning of the 2024 quarter, the number of articles reached 52 articles, indicating a predicted increase in the future. The increasing trend in the number of publications on the topic "Fiber as a Soilless Planting Medium" illustrates that interest and research activities related to this topic are growing along with awareness of the reduction in agricultural land and innovations in cultivating crops without soil using fiber.

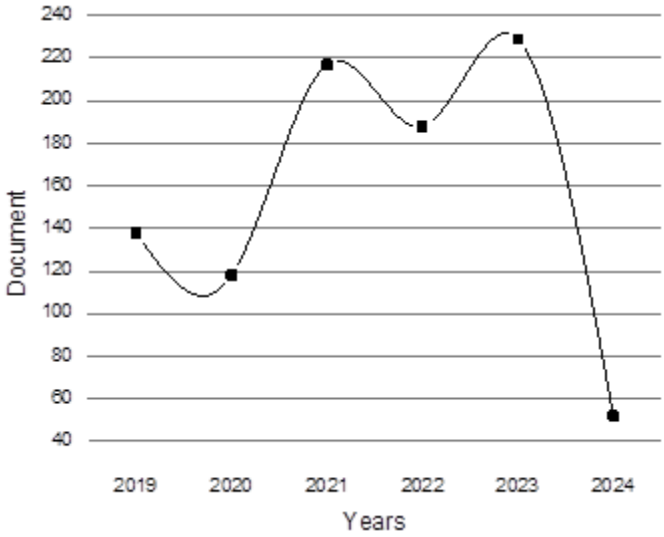

Figure 1. Annual report of publication.

3.2. Trend of Fiber as a Soilless Planting Medium Research Citations 2019-2024

In line with the increasing public interest in the use of fiber as a soilless planting medium, research topics that explore the potential and benefits of fiber as a soilless planting medium also continue to grow, reflected in the many citations of scientific publications discussing this topic. **Table 1** contains the 15 most citations from metadata on Google Scholar. The highest citations are shown from a publication in the form of a book with the title Hydroponic Food Production: A Definitive Guidebook for the Advanced Home Gardener and the Commercial Hydroponic Grower written by HM Resh in 2022 with a total of 1219 citations. Since its publication, it has been updated regularly so that in 2022 the eighth edition will be published. In general, this book provides a guide to hydroponic farming for beginner farmers and commercial farmers. This book consists of 16 chapters, with several chapters discussing the use of fiber media as a planting medium, namely rock wool and coconut fiber.

The second publication that received the most citations (605) was the book entitled Soilless Culture: Theory and Practice: Theory and Practice by Raviv Lieth, J. H., and Bar-Tal in 2019. This book contains 14 chapters that discuss soilless media in detail in each chapter starting from the significance of cultivating plants without soil, root growth, physical and chemical

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characteristics, microbiology, nutrients needed for growth, organic and non-organic components, irrigation, to systems. soilless plant growth design and management. Publication in the form of an article with the title "Natural fiber–reinforced composites: A review on materials, manufacturing, and machinability" published in The Journal of Thermoplastic Composite Materials has the highest number of citations of 365. This article discusses reviews of composites reinforced with natural fibers. Various types of natural fibers are discussed in this article, including the characteristics of natural fibers used as composites, manufacturing processes and parameters, mechanical property characterization, and applications. If we analyze the number of citations per year, the year with the most citations occurred in 2022, which experienced an increase from previous years (2019-2021).

Table 1. Difference Fiber as a Soilless Planting Medium with the most citations.

No	Cites	Authors	Title	Year	Cites Per Year	Cites Per Author	Ref
1	1219	HM Resh	Hydroponic food production: a definitive guidebook for the advanced home gardener and the commercial hydroponic grower	2022	609.5	1219	HM Resh (2022)
2	365	Lotfi *et al*.	Natural fiber–reinforced composites: A review on materials, manufacturing, and machinability	2021	121.67	91	Lotfi *et al*. (2021)
3	299	NS Gruda	Increasing sustainability of growing media constituents and stand-alone substrates in soilless culture systems	2019	59.8	299	Gruda (2019b)
4	166	Treadwell *et al*.	Microgreens: a new specialty crop: HS1164, rev. 9/2020	2020	41.5	42	Treadwell *et al*. (2020)
5	163	Sormunen & Karki	Recycled construction and demolition waste as a possible source of materials for composite manufacturing	2019	32.6	82	Sormunen & Karki (2019)
6	154	Gruda *et al*.	Impacts of protected vegetable cultivation on climate change and adaptation strategies for cleaner production–a review	2019	30.8	51	Gruda *et al*. (2019a)
7	147	T Susca	Green roofs to reduce building energy use? A review on key structural factors of green roofs and their effects on urban climate	2019	29.4	147	Susca (2019)
8	139	Pradhan *et al*.	Greywater recycling in buildings using living walls and green roofs: A review of the applicability and challenges	2019	27.8	46	Pradhan *et al*. (2019)
9	134	Martin, & Molin	Environmental assessment of an urban vertical hydroponic farming system in Sweden	2019	26.8	67	Martin, & Molin (2019)
10	133	Wu *et al*.	Antifungal and plant growth promotion activity of volatile organic compounds produced by Bacillus amyloliquefaciens	2019	26.6	33	Wu *et al*. (2019)

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Table 1 (Continue). Difference Fiber as a Soilless Planting Medium with the most citations.

No	Cites	Authors	Title	Year	Cites Per Year	Cites Per Author	Ref
11	131	Majid *et al*.	Evaluation of hydroponic systems for the cultivation of Lettuce (Lactuca sativa L., var. Longifolia) and comparison with protected soil-based cultivation	2021	43.67	26	Majid *et al*. (2021)
12	119	Velazquez-Gonzalez *et al*.	A review on hydroponics and the technologies associated for medium- and small-scale operations	2022	59.5	40	Velazquez-Gonzalez *et al*. (2022)
13	112	Mahir *et al*.	A brief review on natural fiber used as a replacement for synthetic fiber in polymer composites	2019	22.4	22	Mahir *et al*. (2019)
14	100	Van Os *et al*.	Technical equipment in soilless production systems	2019	20	33	Van Os *et al*. (2019)

3.3. Visualization of Research Data Mapping of Fiber as a Soilless Planting Medium Research

VOSviewer is used to visualize data that includes relationships between elements such as keywords, author names, or journal names in the form of network visuals, overlay visuals, and density visuals. The network visualization (**Figure 2**) depicts a complex structure of relationships between data elements, with nodes representing data elements and lines connecting them. In the visual overlay presented in **Figure 3**, additional colors are used to specifically highlight relationships between elements. Meanwhile, the density visualization in **Figure 4** shows cluster areas and density levels from various perspectives. In this discussion, we will describe each form of VOSviewer visualization of metadata obtained through publish or perish applications. Data in VOSviewer is divided into six clusters, 71 items, 838 links, and 1478 link strengths. The types of items in each cluster are presented in **Table 2**.

Table 2. Types of items in each cluster.

No.	Clusters	Items
1.	Cluster 1	16 items: biochar, chapter, characterization, coin fiber, container, experiment, vegetation, influence, irrigation, mineral, productivity, root, soilless growth medium, soilless plant, soilless production, strawberry.
2.	Cluster 2	13 items: coconut husk, cocopeat, natural fiber, fiber plate, planting medium, potential, product, review, rice husk, seed, soilless agriculture, soilless plant cultivation.
3.	Cluster 3	13 items: bag, challenge, hydroponic, hydroponic, plant cultivation, plant root, planting, sand, soilless plant cultivation, sustainability, technique, water, wood.
4.	Cluster 4	12 items: coco fiber, coconut coir, combination, cucumber, hydroponic system, nutrient solution, peat moss, perlite, pine bark response Rockwool
5.	Cluster 5	10 items: addition, bark, coco coir, coir, compost, food, microgreen, need, soilless plant production, wood fiber.
6.	Cluster 6	7 items: coconut fiber substrate, culture, flower, leave, media component, number, soilless farming.

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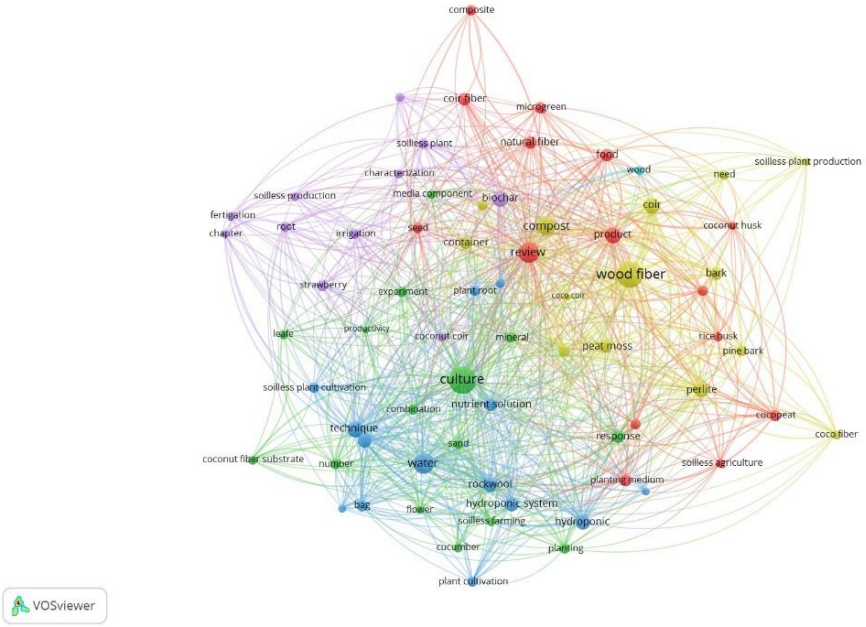

Figure 2. Network visualization based on co-occurrence of terms.

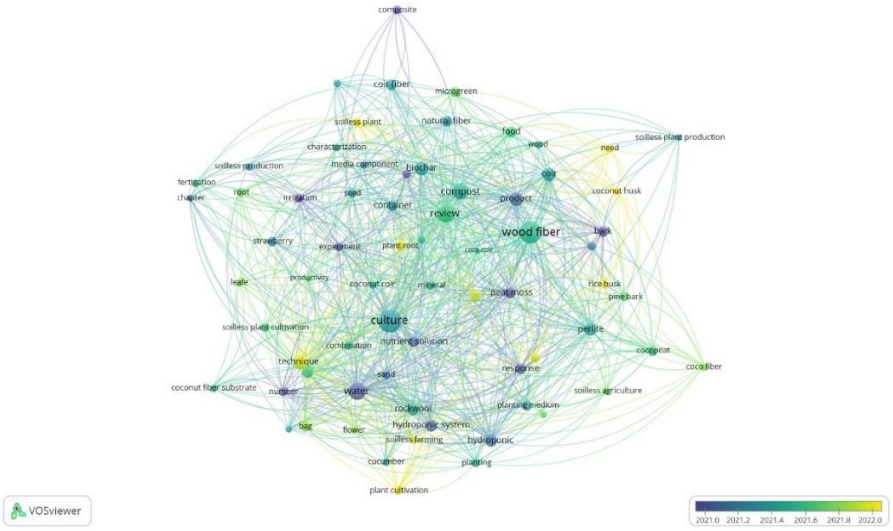

Figure 3. Overlay visualization based on co-occurrence of terms.

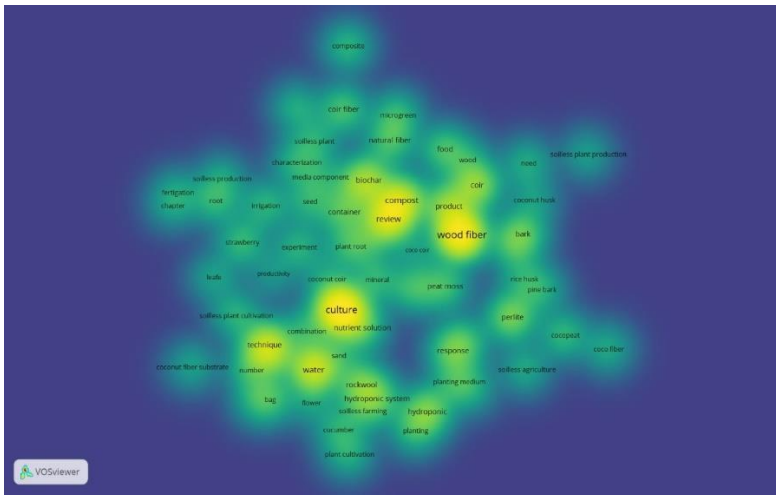

Figure 4. Density visualization based on co-occurrence of terms.

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4. CONCLUSION

This research has succeeded in uncovering research trend data regarding the use of fiber as a soilless planting medium using the Publish or Perish application and has succeeded in creating metadata mapping using the VOSviewer application. Research trends on the topic of using fiber as a soil-free planting medium show that it is still in high demand as shown by the increase in the number of publications every year. The types of fibers that are widely used in metadata maps are still dominated by the use of natural fibers such as coconut fiber, wood fiber, leaf fiber, cotton, and other types of natural fibers. The synthetic fiber that is widely used is rock wool. The development of other types of fiber and analysis of the use of fiber as a planting medium is still wide open for further research and has high potential in the application of fiber-free planting media. Even the development of environmentally friendly composite fibers with certain added value is still rarely found in the discovered metadata network.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

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