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Exploring Trends and Patterns in Oilseed Crop Cropping: A Bibliometric Analysis

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Abstract
The study presented here conducts a comprehensive bibliometric analysis of research in the field of oilseed crop cropping patterns, shedding light on its dynamic and interdisciplinary nature. The research spans various dimensions, from publication trends to regional distribution and collaboration networks, offering valuable insights into the ever-evolving landscape of agricultural science. The findings reveal a substantial increase in research output since the early 2000s, reflecting the growing importance of oilseed crops in addressing global challenges related to food security, sustainable agriculture, and renewable energy. Research articles are the predominant medium for disseminating knowledge, demonstrating the active engagement of scholars in empirical studies and knowledge synthesis. A temporal analysis unveils distinct phases in the field's development, highlighting its responsiveness to emerging agricultural and environmental challenges. Moreover, the regional distribution of research articles underscores the global significance of the field, as researchers from various regions collaborate to tackle shared challenges.

Keywords: Oilseed Crops, Cropping Patterns, Agricultural Sustainability, Bibliometric Analysis and Global Food Security

Introduction

The cropping pattern of oilseed crops represents a crucial facet of global agriculture, playing a pivotal role in ensuring both food security and sustainable resource utilization in an ever-evolving world. Oilseeds, including soybeans, sunflowers, canola, and various other plants, are integral components of the global food supply chain, providing not only edible oils but also feedstock for the burgeoning biofuel industry (Huang et al., 2021). The significance of oilseed crops in the agricultural landscape cannot be overstated, as they address a myriad of economic, environmental, and nutritional challenges (Diederichsen et al., 2019). Oilseed crops have emerged as a linchpin of global agriculture, directly contributing to food security by providing edible oils, which constitute a significant portion of daily caloric intake across the world. Additionally, the meal byproduct of oilseed processing is an essential protein source for livestock, playing a crucial role in the production of meat and dairy products (Mahajan et al., 2017). These dual contributions underline the vital importance of oilseed crops in ensuring adequate and balanced nutrition for the growing global population. The ever-increasing demand for edible oils, driven by factors such as population growth, dietary shifts, and urbanization, has intensified the need for sustainable and efficient cropping patterns (Van Erp et al., 2016).

Beyond their role in food production, oilseed crops have a profound impact on the energy sector (Dzotsi et al., 2015). As the world grapples with the challenges of climate change and the depletion of fossil fuel

resources, biofuels have emerged as a promising alternative. Many oilseed crops, such as soybeans and rapeseed, are rich in oil content suitable for biofuel production (Bian et al., 2019). The integration of biofuels into the energy matrix holds the potential to mitigate greenhouse gas emissions and reduce reliance on finite fossil fuels. In this context, optimizing cropping patterns for oilseeds becomes critical not only for food security but also for energy security and environmental sustainability. The economic significance of oilseed crops cannot be overlooked (Chen et al., 2018). Farmers, agribusinesses, and nations alike benefit from the cultivation and trade of oilseeds and their derived products. Understanding the evolving cropping patterns and strategies in oilseed agriculture is essential for ensuring economic stability and growth, particularly for regions heavily dependent on these crops for their agricultural income (Wang et al., 2019).

In the context of a rapidly expanding global population, it is imperative to explore and understand the dynamics of oilseed crop cropping patterns through the lens of literature analysis. This bibliometric analysis aims to delve into the extensive body of literature surrounding the cropping patterns of oilseed crops, discerning the underlying trends, knowledge gaps, and key influencers in this domain. As the global demand for edible oils and biofuels continues to rise, this analysis holds substantial relevance. By assessing the bibliometric landscape, we can identify research trends, knowledge dissemination patterns, and the role of different stakeholders in shaping the discourse on oilseed crop cropping patterns. This comprehensive overview will enable researchers, policymakers, and practitioners to make informed decisions and investments, promoting a more sustainable and secure future for oilseed crop production.

Bibliometric assessment is an approach to analyzing & interpreting bibliographic data, such as publication records, to identify patterns and trends in the literature (Moed 2005). This method was chosen because it allows us to identify the most frequently studied topics, the most productive countries/institutions, and the most cited articles. The bibliometric analysis was conducted using the Scopus database, a widely used database for bibliometric studies. The search was conducted using following keywords:

ALL (("Oilseeds" OR "Oilseed production") AND ("Cropping pattern" OR "Crop rotation" OR "Crop management" OR "Crop diversification") AND (LIMIT-TO (LANGUAGE, "English"))

The bibliometric analysis was conducted using the Biblioshiny software, which is a widely used software for bibliometric studies. The software was used to create visualizations, such as co-word maps, to show the relationships between keywords and phrases used in the articles. It was also used to find nations/institutions which were most productive and the most cited articles.

The detailed methodology for bibliometric search is shown in following table (table 1)

Table 1: Prisma Methodology for literature search

	Remaining	**Removed**
Total Search Result	921	
Limited to English	881	40
Screened (based on Title/ Abstract)	810	71
Finalized for review	**810**	

Result

Document Type

Table 2: Analysis of Document Type

Document type	N	%
Article	672	82.96%
Conference Paper	50	6.17%
Review	42	5.19%
Book Chapter	38	4.69%
Book	2	0.25%
Data Paper	2	0.25%
Short Survey	2	0.25%
Erratum	1	0.12%
Note	1	0.12%

The bibliometric analysis revealed a predominantly article-centric focus, accounting for 82.96% of the total documents, indicating the primary medium for scholarly communication and knowledge dissemination in the field of oilseed crop cropping patterns. Conference papers, reviews, and book chapters, while comparatively smaller in proportion, collectively represent essential contributions. The prevalence of articles suggests an active research community engaging with real-world applications and empirical studies, while the inclusion of conference papers and reviews signifies an inclination toward discussions and assessments of existing literature. The presence of book chapters, books, data papers, and short surveys underscores the holistic approach taken in addressing oilseed crop cropping patterns, with an emphasis on knowledge synthesis and the compilation of comprehensive insights. This diverse document landscape reflects the multifaceted nature of research in this domain, integrating empirical, theoretical, and data-driven contributions to advance the understanding of oilseed crop cropping patterns and foster innovation in sustainable agriculture.

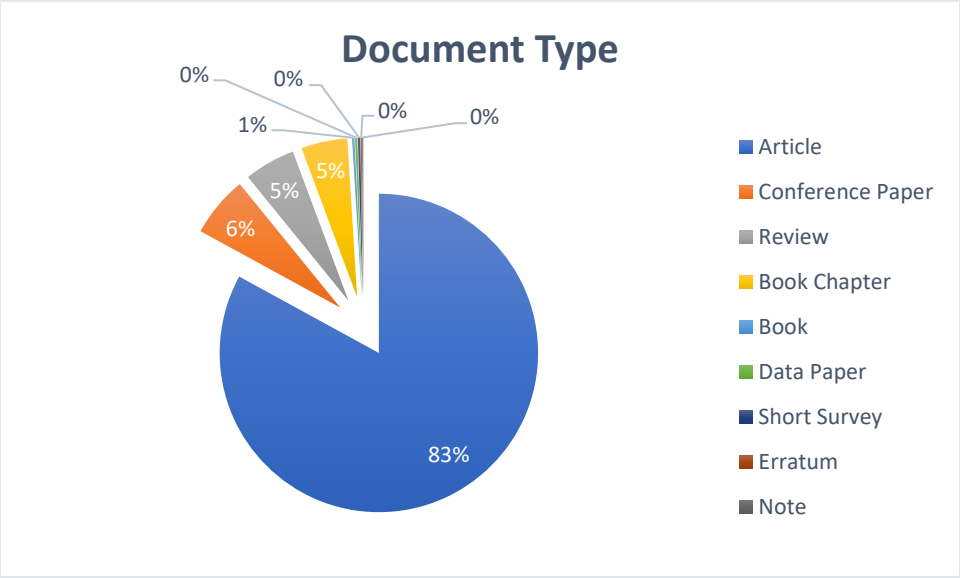

Fig 1: Analysis of Document Type

Yearly Document Production Trend

Table 3: Yearly Document Production Trend

Year	Mean Total Citation per Article	Yearly Document Production	Mean Total Citation per Year	Citable Years
1971	41	1	0.77	53
1981	33	1	0.77	43
1988	1	1	0.03	36
1989	3.5	2	0.1	35
1990	3	1	0.09	34
1991	20	1	0.61	33
1992	39	1	1.22	32
1993	28.67	3	0.92	31
1995	36	2	1.24	29
1996	37.71	7	1.35	28
1997	47	7	1.74	27
1998	33	4	1.27	26
1999	15.11	9	0.6	25
2000	47	11	1.96	24
2001	82.78	9	3.6	23
2002	90.89	9	4.13	22
2003	72.5	16	3.45	21
2004	43.4	10	2.17	20
2005	84.94	18	4.47	19
2006	87.3	10	4.85	18
2007	33.67	15	1.98	17
2008	48.6	20	3.04	16
2009	32.2	20	2.15	15
2010	45.41	27	3.24	14
2011	34.25	28	2.63	13
2012	33.18	34	2.77	12
2013	48.61	36	4.42	11
2014	38	34	3.8	10
2015	52.36	36	5.82	9
2016	20.13	54	2.52	8
2017	20.11	45	2.87	7
2018	17.94	50	2.99	6
2019	15.72	54	3.14	5
2020	14.37	67	3.59	4
2021	8.18	84	2.73	3
2022	3.75	56	1.88	2
2023	0.85	47	0.85	1

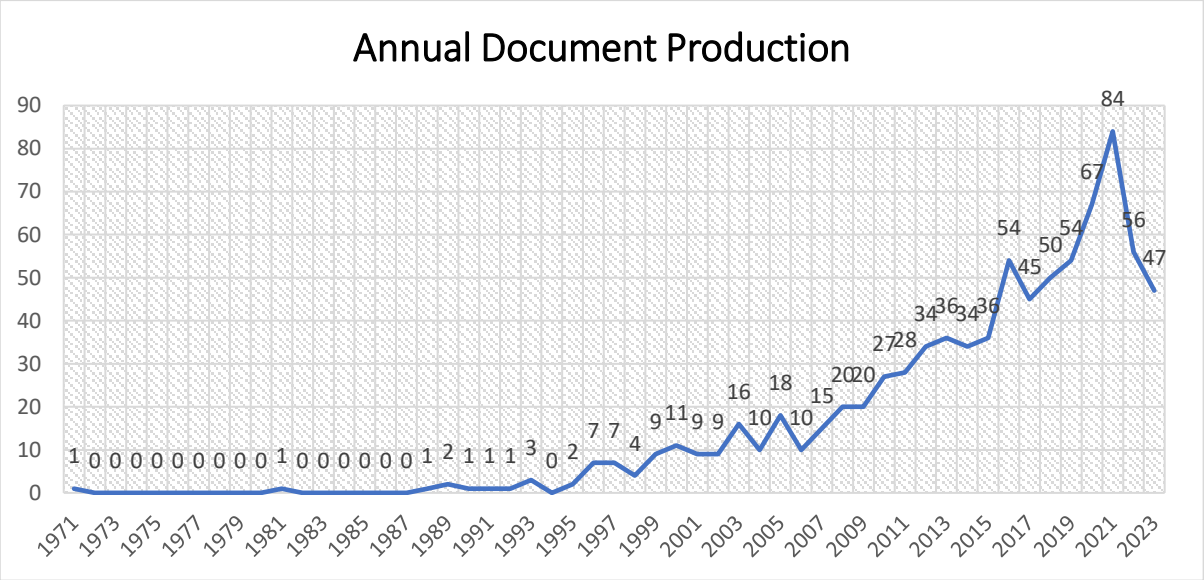

Fig 2: Annual Document Production

The table 3 portrays a compelling temporal evolution in the research activity surrounding oilseed crop cropping patterns. Notably, the earliest years, prior to 1971, reflect a nascent stage with limited scholarly attention, which dramatically changed in subsequent decades. The dataset illustrates a significant upswing in research output, with a particular surge from the early 2000s onwards. The steady increase in the number of articles during this period, with a marked peak in 2021 (84 articles), signifies a growing interest and emphasis on this research domain. This progression can be attributed to factors such as increasing global concerns regarding food security, sustainable agriculture, and renewable energy sources. Furthermore, the higher volume of publications in recent years suggests the adoption of advanced research methodologies, an expanding community of researchers, and an acknowledgment of the multifaceted implications of oilseed crop cropping patterns in the context of modern agriculture and environmental sustainability. This temporal analysis not only underscores the evolving importance of oilseed crop research but also provides insights into the trends that have driven this field's growth, calling for continued focus and investment in this critical area of agricultural and environmental science.

The mean total citations per article exhibits fluctuations over the years, with an early peak in 2002 (90.89) followed by a decrease in subsequent years. This suggests that there was a period of intense interest and citation of research articles in the field, potentially indicating a high-impact phase for oilseed crop cropping pattern research. However, after reaching its zenith, the average citations per article gradually declined. The mean total citations per article tells a similar story, showing a similar peak in 2002 (4.13) and then a gradual decline. The citation per year is indicative of the longevity of citations, with the majority of articles having citations for several years, demonstrating the enduring relevance of the research. The trend highlights the dynamic nature of the field, with periods of intense interest and citation giving way to a more sustained but slightly reduced level of scholarly attention. This interpretation suggests that while the field of oilseed crop cropping patterns has seen periods of intense focus, it continues to be a relevant and influential area of research, attracting citations over an extended timeframe.

Yearly Document Production Trend

Table 3: Most Relevant Journal

Most Relevant Journal	N
AGRICULTURE, ECOSYSTEMS AND ENVIRONMENT	27
EUROPEAN JOURNAL OF AGRONOMY	26
SOIL AND TILLAGE RESEARCH	26
FIELD CROPS RESEARCH	23
CANADIAN JOURNAL OF PLANT SCIENCE	19
INDUSTRIAL CROPS AND PRODUCTS	19
SCIENCE OF THE TOTAL ENVIRONMENT	19
CROP PROTECTION	12
IOP CONFERENCE SERIES: EARTH AND ENVIRONMENTAL SCIENCE	12
AGRONOMY JOURNAL	11

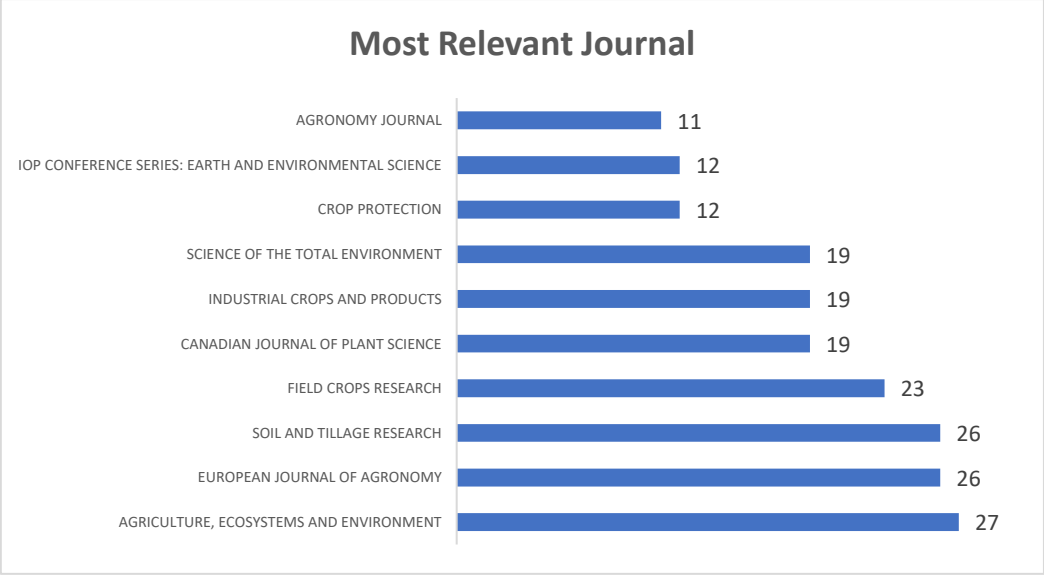

Fig 3: Most Relevant Journal

The data on the most relevant journals for research in oilseed crop cropping patterns highlights several key publications in this field. "Agriculture, Ecosystems and Environment" emerges as the most prominent journal, with 27 articles devoted to this area of research. It is closely followed by "European Journal of Agronomy" and "Soil and Tillage Research," each with 26 articles, reflecting the extensive contributions to the understanding of cropping patterns and sustainable agriculture. "Field Crops Research" and "Canadian Journal of Plant Science" also demonstrate strong representation in the literature with 23 and 19 articles, respectively. Journals such as "Industrial Crops and Products" and "Science of the Total Environment" indicate the interdisciplinary nature of this field, attracting 19 articles each. The diverse range of journals, including "Crop Protection" and "Agronomy Journal," underscores the multi-faceted approach to studying oilseed crop cropping patterns. This distribution of articles across various journals emphasizes the interdisciplinary nature of this field, with contributions from agriculture, environmental

science, and related disciplines, indicating the broad impact of oilseed crop research on sustainable agriculture and environmental stewardship.

Most Impactful Journal

Table 4: Most Relevant Journal

Journal	HI	GI	MI	Total No. of Citations	No. of Publications	TC/year
SOIL AND TILLAGE RESEARCH	19	26	0.655	1598	26	1995
AGRICULTURE, ECOSYSTEMS AND ENVIRONMENT	18	27	0.75	1783	27	2000
EUROPEAN JOURNAL OF AGRONOMY	16	26	0.889	889	26	2006
FIELD CROPS RESEARCH	15	23	0.789	2115	23	2005
CANADIAN JOURNAL OF PLANT SCIENCE	12	19	0.429	607	19	1996
SCIENCE OF THE TOTAL ENVIRONMENT	12	19	1.091	404	19	2013
AGRONOMY JOURNAL	10	11	0.455	895	11	2002
INDUSTRIAL CROPS AND PRODUCTS	10	19	0.357	386	19	1996
JOURNAL OF AGRICULTURAL SCIENCE	10	11	0.37	404	11	1997
WEED RESEARCH	10	10	0.37	317	10	1997

The data presents key bibliometric indicators for various journals in the field of oilseed crop cropping patterns. The "h-index," which measures a journal's impact and recognition, ranges from 10 to 19, with "Soil and Tillage Research" having the highest h-index of 19, indicating significant influence in the field. The "g-index," a measure of the journal's most highly cited articles, spans from 10 to 27, with "Agriculture, Ecosystems and Environment" having the highest g-index of 27. The "m-index," which quantifies the balance between quantity and quality of citations, varies from 0.37 to 1.091, with "Science of the Total Environment" having the highest m-index of 1.091, signifying a strong combination of both highly cited and numerous articles. "Total Citations (TC)" range from 317 to 2115, with "Field Crops Research" garnering the highest total citations of 2115, showcasing its extensive impact in the field. "Number of Publications (NP)" ranges from 10 to 27, and "PY_start" (Publication Year Start) spans from 1995 to 2013, indicating the journals' longevity and engagement with the topic. These metrics collectively provide a comprehensive view of the influence and contributions of various journals in the domain of oilseed crop cropping patterns, reflecting both the quality and quantity of research output.

Most Relevant Author

Table 5: Most Relevant Author

Authors	N	Fractionalized
SIELING K	17	6.53
ZENTNER RP	14	2.92
KAGE H	11	3.76
LI X	11	1.57
CHRISTEN O	10	3.2
COLBACH N	10	2.28
YANG X	10	1.51
GAN Y	9	1.57
HEARD MS	9	0.93
LU J	9	1.24

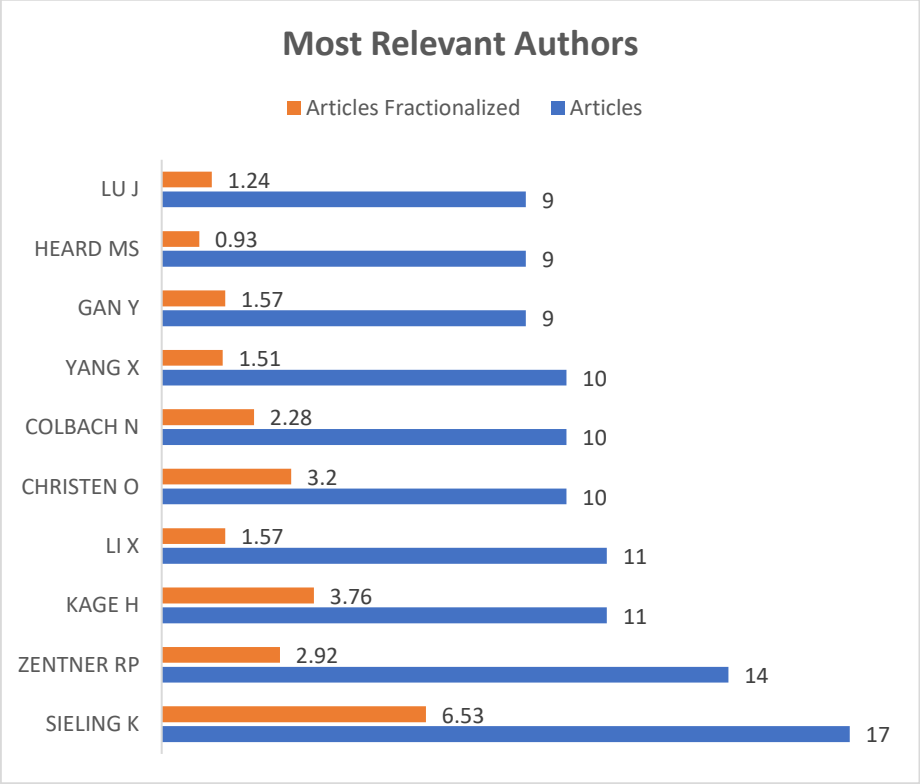

Fig 4: Most Relevant Author

The data on authors and their contributions to research articles in the field of oilseed crop cropping patterns reveals key contributors. K. Sieling emerges as the most prolific author with 17 articles, representing a substantial 6.53% of the total articles. R.P. Zentner follows with 14 articles, contributing 2.92% of the research output. H. Kage and X. Li each have 11 articles, contributing 3.76% and 1.57% of the articles, respectively. Authors such as O. Christen and N. Colbach have 10 articles each, accounting for 3.2% and 2.28% of the total articles. X. Yang, Y. Gan, and M.S. Heard each have 10 articles as well, contributing 1.51%, 1.57%, and 0.93% of the research output, respectively. J. Lu also has 9 articles, representing 1.24%

of the total. These statistics highlight the significant contributions of these authors to the body of knowledge in oilseed crop cropping patterns, with K. Sieling as the most prominent researcher in the field.

Most Productive Country

Table 6: Most Productive Country

Region	N
China	534
USA	488
UK	420
Germany	401
Canada	383
France	314
India	295
Brazil	126
Italy	94
Poland	85

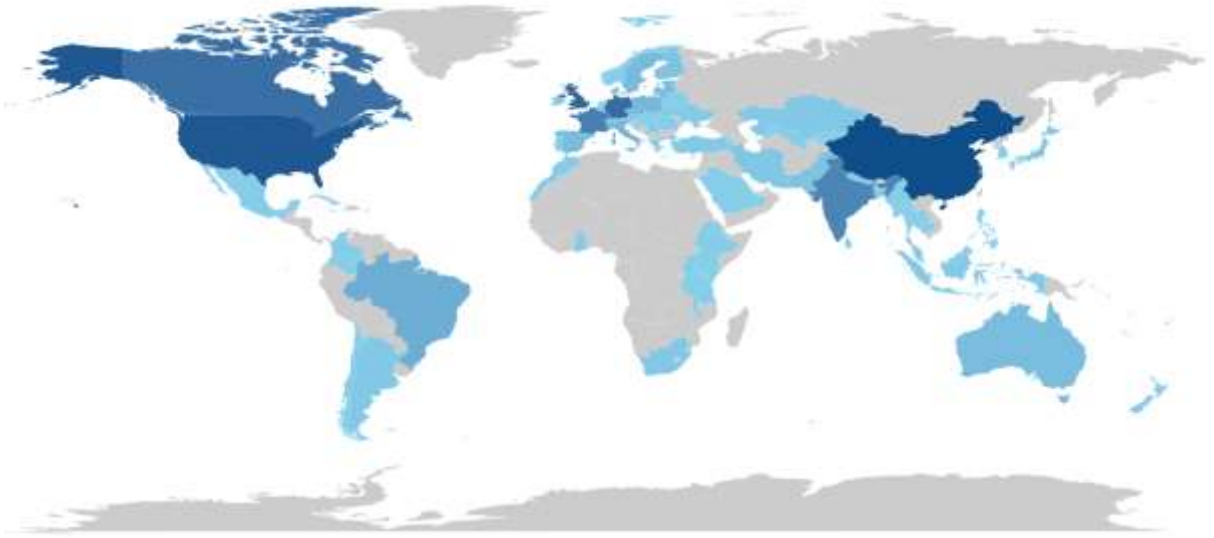

Fig 5: Most Productive Country

The data indicates the regional distribution of research articles in the field of oilseed crop cropping patterns. China is the most prolific contributor, with 534 articles, followed closely by the USA with 488 articles. The UK is also a significant contributor with 420 articles, while Germany and Canada have 401 and 383 articles, respectively. France follows with 314 articles, and India with 295 articles. Brazil, Italy, and Poland contribute with 126, 94, and 85 articles, respectively. This distribution reflects the global nature of research in this field, with a strong presence in countries known for their agricultural and environmental research activities, such as China, the USA, and the UK. The collaborative efforts of researchers from these regions are essential for advancing knowledge and innovations in oilseed crop cropping patterns.

Country wise Collaboration Network

Table 7: Country wise Collaboration Network

From	To	N
China	USA	13
USA	Canada	9
Germany	Denmark	8
United Kingdom	Germany	8
Germany	France	7
Germany	Italy	7
USA	Italy	7
Germany	Czech Republic	6
Italy	Denmark	6
USA	Brazil	6

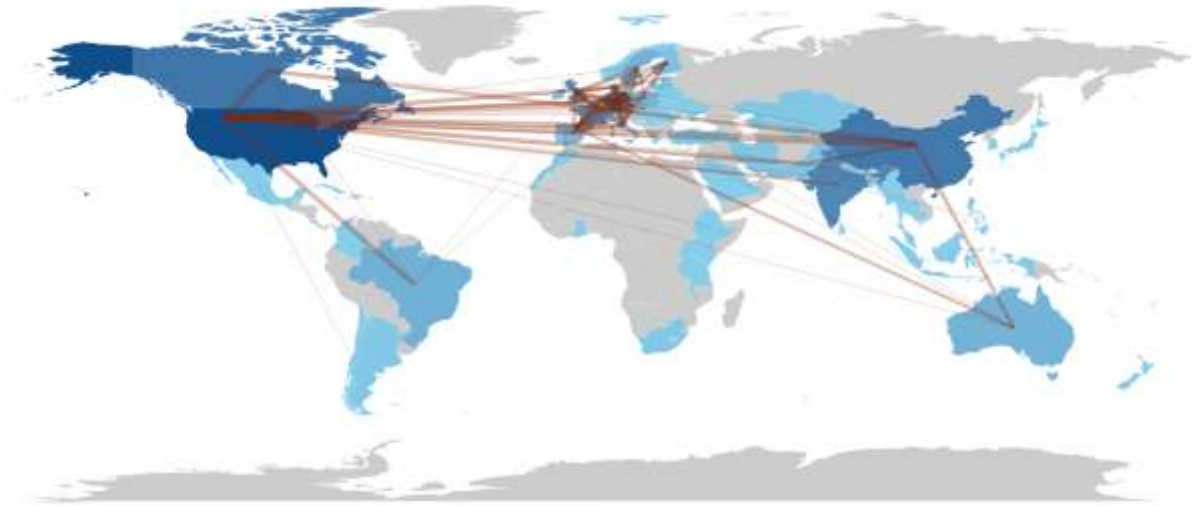

Fig 6: Country wise Collaboration Network

The provided data outlines the international collaboration in the field of oilseed crop cropping patterns, indicating the number of co-authored articles between different countries. Notably, China and the USA lead the way with 13 collaborative articles, demonstrating a strong research partnership between these two major research hubs. The USA also collaborates closely with Canada, contributing to 9 articles, while Germany collaborates with Denmark and the United Kingdom, each yielding 8 co-authored articles. The international reach of German research is further evident with collaborations in France, Italy, and the Czech Republic, with 7, 7, and 6 articles, respectively. Italy and Denmark are also active collaborators, contributing to 6 articles together. The USA and Brazil collaborate on 6 articles, reflecting the international nature of research in this field. Overall, this data underscores the global nature of research on oilseed crop cropping patterns, with countries forming collaborative networks to advance knowledge and innovation in this critical area of agriculture and environmental science.

Social Collaboration Network

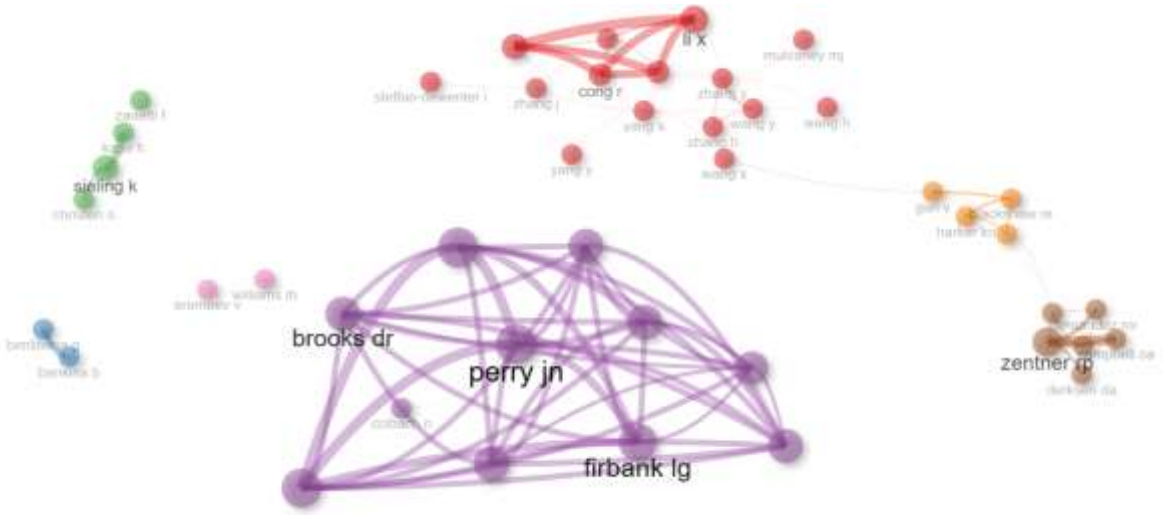

Fig 6: Country wise Collaboration Network

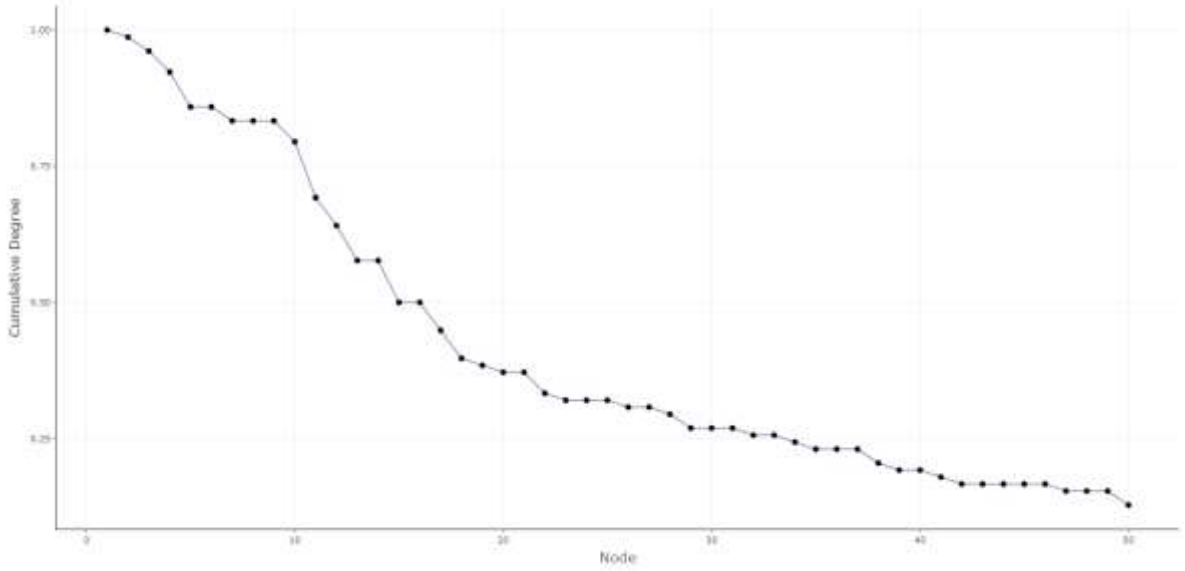

Fig 7: Degree Plot

The network of authors who have worked together on articles about the oilseed cropping patterns. Numerous researchers' names are shown in the diagram (Fig. 7) below; a few are related to one another, while others are not. Clusters of corresponding colors and connecting lines among the writers' names visually represent their interconnectivity. The emergence of these clusters suggests the presence of sub-domains or specialized areas within the broader field that are being explored by these groups. Two major clusters of authors were identified with the highest collaboration. The purple represents the first cluster of authors and authors, namely Perry Jn, Brooks, Firbank, Colbach etc. had the highest co-citation. The color red represents the second cluster of authors, namely Li X, Cong R, Zhang, Yang X, Zhang H etc.

Word Cloud

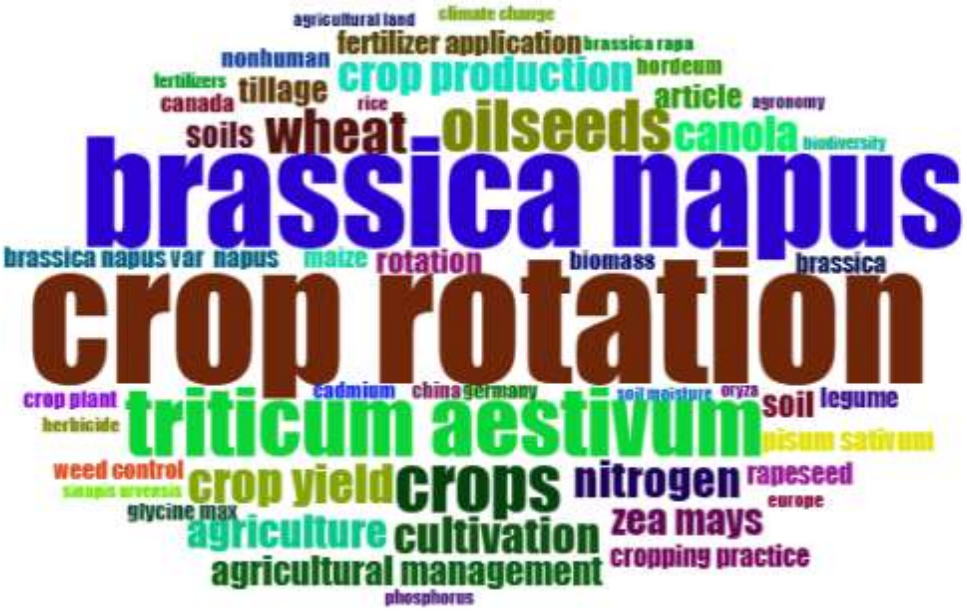

Fig 8: Word Cloud

The frequency of specific terms within the dataset reveals valuable insights into the key focus areas of research in oilseed crop cropping patterns. The high occurrence of crop rotation and brassica napus suggests a strong emphasis on sustainable agricultural practices and the study of specific oilseed crops, with crop rotation indicating a focus on diversified cropping systems. The term Triticum Aestivum reflects a significant interest in wheat, likely in the context of crop rotation strategies with oilseeds. Crop yield and crop production emphasize the core objective of optimizing oilseed crop output, while nitrogen points to research on nutrient management, a crucial factor in crop productivity. Cultivation suggests a focus on agricultural practices, and crops and oilseeds are more general terms indicating the overall emphasis on these agricultural products. This frequency distribution underlines the multifaceted nature of research in oilseed crop cropping patterns, spanning crop management, agronomy, and sustainable agricultural practices, with a particular focus on crop rotation and specific oilseed crops such as brassica napus.

Discussion

The analysis of oilseed crop cropping patterns, as presented in this study, offers valuable insights into the evolving landscape of agricultural research. The bibliometric analysis encompassing various dimensions, from publication trends to collaboration networks, provides a comprehensive understanding of the field's development. One notable trend is the substantial growth in research output over the years, with a pronounced increase in publications since the early 2000s. This upsurge reflects the growing importance of oilseed crops in addressing global challenges such as food security, sustainable agriculture, and renewable energy sources. The expansion of research output is likely a response to the increasing demand for edible oils and biofuels, as well as the need for innovative cropping patterns to enhance productivity and environmental sustainability.

The study's examination of document types reveals that research articles are the predominant medium for disseminating knowledge in the field. This finding is indicative of the active engagement of scholars and

researchers in empirical studies, data-driven research, and the development of practical solutions. Moreover, the presence of conference papers, reviews, and book chapters suggests a comprehensive approach to understanding oilseed crop cropping patterns, involving both academic discussions and knowledge synthesis. The temporal analysis of research output unveils distinct phases in the field's development. The data shows an initial period of limited scholarly attention, followed by a substantial surge in research output, especially in recent years. This evolution is likely a reflection of the field's dynamic nature and its responsiveness to emerging agricultural and environmental challenges. The sustained research activity over the years underlines the field's ongoing relevance, emphasizing its critical role in addressing contemporary agricultural and environmental concerns. Furthermore, the regional distribution of research articles highlights the global nature of research in oilseed crop cropping patterns. China, the USA, and the UK emerge as the primary contributors, which aligns with their prominent roles in agricultural research and development. The diverse representation of countries underscores the field's universal significance, as researchers from various regions collaborate to tackle shared challenges. This study's comprehensive analysis of oilseed crop cropping patterns sheds light on the field's dynamic and interdisciplinary nature. It highlights the increasing global importance of oilseed crops in agriculture and renewable energy production and emphasizes the collaborative efforts of researchers worldwide to advance knowledge and innovations in this critical area. As the demand for sustainable agricultural practices and biofuels continues to grow, the field of oilseed crop cropping patterns is poised for further expansion and innovation.

Implication

Theoretical Implications

The study of oilseed crop cropping patterns holds several significant theoretical implications. Firstly, it contributes to the broader field of agricultural science and environmental sustainability by deepening our understanding of the complex interplay between crop management practices, food security, and environmental stewardship. The observed temporal patterns, with a notable surge in research output, suggest that oilseed crops have become a focal point for addressing contemporary global challenges. This underscores the field's responsiveness to evolving societal and environmental concerns. Furthermore, the prevalence of research articles as the primary document type underscores the empirical nature of studies in this domain. This empirical foundation allows for the development and refinement of theoretical frameworks that elucidate the relationships between cropping patterns, crop yields, and environmental impact. Theoretical models that incorporate these empirical findings can inform more precise and effective strategies for sustainable agriculture. Another theoretical implication pertains to the multidisciplinary nature of research in this field. The extensive collaborations and co-authored articles, as evident in the regional and collaborative analysis, indicate that oilseed crop cropping patterns transcend traditional disciplinary boundaries. This interdisciplinarity opens up opportunities for the integration of diverse theoretical perspectives, thereby enriching the theoretical landscape of agricultural and environmental science.

Practical Implications

The practical implications of research in oilseed crop cropping patterns are profound and have direct applications in agriculture and environmental management. Firstly, the insights gained from this research can inform policymakers and agricultural stakeholders in optimizing crop management strategies. For instance, the emphasis on crop rotation and nutrient management, as indicated by the high frequency of

related terms, suggests practical approaches to enhancing crop yields and minimizing environmental impacts. Moreover, the study's examination of the most relevant journals and prolific authors offers practical guidance to researchers and practitioners seeking sources of credible information and collaboration. By identifying leading journals and influential authors, the study can guide the selection of appropriate platforms for disseminating research and foster productive collaborations. Additionally, the regional distribution analysis underscores the global nature of this field, indicating the necessity for international cooperation in addressing the challenges associated with oilseed crop cropping patterns. Practically, this implies that policymakers and industry stakeholders should engage in cross-border collaboration to develop sustainable agricultural practices and ensure food and energy security on a global scale. The practical implications of research in oilseed crop cropping patterns are far-reaching, influencing not only the optimization of crop management practices but also policy decisions, international collaboration, and sustainable agricultural development. This research has the potential to translate into real-world applications that enhance agricultural productivity while mitigating environmental impact, thus contributing to the global effort to achieve a more sustainable and food-secure future.

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