Research Progress of Different Fertilization Models in Farmland Based on Bibliometrics

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Abstract In order to grasp the research status of different fertilization modes in China's farmland more comprehensively, with papers in core journals of Chinese Peking University collected in CNKI database from 2003 to 2022 as the main research object, this paper analyzed the research status of different fertilization modes from the perspectives of annual number of published papers, published journals, keywords and highly cited papers applying the bibliometrics research method. This study provides reference for the research in this field.

Key words CNKI; Core journals; Different fertilization modes; Bibliometrics

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Soil fertility is the basic attribute and essential feature of soil, and serves as an index for measuring the ability of soil to provide nutrients and biomass needed by plants, which can comprehensively reflect the physical, chemical and biological properties of soil[1]. Different fertilization modes will have an important impact on soil fertility and environment. Bibliometrics is to perform systematical analysis on the situation of research fields by paying equal attention to theory and application, and it has the advantages of objectivity, quantification and high macro-efficiency, and is widely used in various fields[2]. In order to accurately understand the research focus and development trend of different fertilization modes in farmland in recent 20 years, based on the bibliometric analysis method, this paper analyzed different fertilization modes in farmland in China with annual number of published papers, published journals, keywords and highly cited papers as the main indicators, so as to make clear the research methods and directions and provide reference for scholars in their research fields.

Materials and Methods

Data source

China Knowledge Network (CNKI) was selected as the statistical source, and the data source only included Chinese literature.

Search method

The advanced retrieval method was selected to search documents within the retrieval scope of academic journals, using "different fertilization modes" as the subject word. The time range was from January 2003 to December 2022, and the source type was academic journals.

Data processing

With the help of advanced retrieval in CNKI database, a total of 473 papers in core journals were retrieved with the subject of "different fertilization modes", and then the data were exported to Microsoft Excel 2021 software for statistical analysis.

Results and Analysis

Distribution of annual number of published papers

The distribution of year and number of published papers can reflect the development process and present situation of the field. The distribution of papers related to different fertilization modes from 2003 to 2022 is shown in Fig. 1, and there were a total of 473 papers, showing an overall upward trend, with an annual average of 23.7 papers. 2003 – 2008 was the initial stage, and the number of papers published was relatively small. In 2009 – 2013, it was a stable stage, with about 25 papers basically. In 2014 – 2022, the number of published papers reached its peak, up to 47. It is because in the early 21st century, people's understanding of fertilizer lagged behind production practice, and production practice lagged behind production experiments and theoretical research. In recent years, with the emphasis on ecological environment protection in China and the new policy of environmentally friendly fertilization, the research on different fertilization modes is increasing.

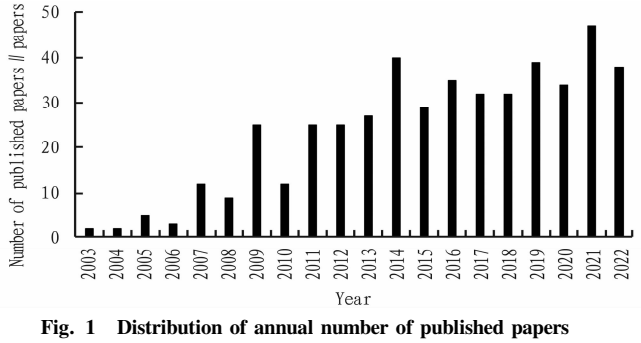

Fig. 1 Distribution of annual number of published papers

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Distribution of papers published in major journals

Dissection of periodicals is helpful to observing the distribution of their research fields, and can be used to analyze the importance attached by Chinese journals to different fertilization models. According to the results of bibliometrics, there were 90 kinds of journals publishing papers in the research field of different fertilization models in China from 2003 to 2022. It can be seen from Table 1 that the journal with the largest number of papers was *Chinese Journal of Soil Science* (74 papers), which was 1.90 times more than *Research of Soil and Water Conservation* (39 papers), which ranked second. In the top 10 journals in terms of number of published papers, journals in the fields of soil, soil and water conservation, agriculture and ecology were all involved.

Table 1 Distribution of the top 10 journals in terms of number of published papers

Rank	Journal	Number of published papers//papers	Percentage to the total number//%
1	*Chinese Journal of Soil Science*	74	7.16
2	*Research of Soil and Water Conservation*	39	3.77
3	*Soils*	37	3.58
4	*Journal of Anhui Agricultural Sciences*	30	2.90
5	*Soil and Fertilizer Sciences in China*	29	2.32
6	*Acta Ecologica Sinica*	24	2.32
7	*Transactions of the Chinese Society of Agricultural Engineering*	24	2.32
8	*Southwest China Journal of Agricultural Sciences*	23	2.22
9	*Journal of Northeast Forestry University*	22	2.21
10	*Journal of Central South University of Forestry & Technology*	20	1.93
Total	–	322	31.14

Distribution of high-frequency keywords

Keywords refer to the words used by a single media when compiling and using search, and are simple words used to express the core content of literature. Through the statistical analysis of keywords, we can quickly understand the subject, hotspot and development trend of the literature. From 2003 to 2022, the total keywords or subject terms in the literature related to different fertilization modes were arranged in descending order, and the top 10 high-frequency keywords were selected for statistical analysis. As shown in Table 2, "organic fertilizer" (64 papers) and "NPK" (20 papers) appear frequently, which shows that rational utilization of organic fertilizer and NPK fertilizer is closely related to different fertilization modes. Different fertilization modes are the key indicators that affect the "fertilizer use efficiency".

Distribution of the top 10 most frequently cited papers

"Citation frequency" refers to the number of times that a paper has been cited by other papers after publication, which is a sign to measure the recognition and influence of the paper, and can also reflect the research direction of the paper in this field to some extent. From 2003 to 2022, the statistics of the top 10 most frequently cited papers on different fertilization models in China are shown in Table 3. These 10 papers were published in nine journals, and the most frequently cited one was from *Chinese Journal of Ecology*, indicating that organic carbon groups and aggregates are hot topics in the field[3]. The top 10 most frequently cited papers mainly focused on the analysis of crop soils such as vegetables, rice, tea and corn, and meanwhile, through positioning experiments, the long-term different fertilization models for red soil and fluvo-aquic soil were studied.

Table 2 Top 10 high-frequency keywords

Rank	Keywords	Frequency
1	Fertilization mode	320
2	Organic fertilizer	64
3	Different fertilization treatments	33
4	Different fertilization	23
5	Different fertilization	21
6	Long-term fertilization	20
7	NPK	20
8	Fertilizer use efficiency	16
9	Custom fertilization	15
10	Spring maize	15

Table 3 Distribution of the top 10 papers in terms of citation frequency in the field of different fertilization modes in China

No.	Title	Authors	Organization of first author	Journal	Citation frequency	Publication Time
1	Organic carbon fractions and aggregate stability in aquatic soil under different fertilization	Yang Changming, Ouyang Zhu, Dong Yuhong	College of environmental science and engineering, Tongji University	*Chinese Journal of Ecology*	208	2005
2	Effects of different fertilization modes on vegetable growth, nitrogen use and nitrogen loss in vegetable fields	Huang Dongfeng; Wang guo; Li Weihua; Qiu Xiaoxuan	Soil and Fertilizer Institute, Fujian Academy of Agricultural Sciences	*Chinese Journal of Applied Ecology*	155	2009

(Continued)

(Table 3)

No.	Title	Authors	Organization of first author	Journal	Citation frequency	Publication Time
3	Effect of model of fertilization on microbial abundance and enzyme activity in oasis farmland soil	Li Chenhua; Jia Zhongjun; Tang Lisong; Wu Yucheng; Li Yan	Fukang Desert Ecosystem Observation and Experiment Station, Chinese Academy of Sciences	*Acta Pedologica Sinica*	127	2012
4	Suitable utilization of fertilizer and soil modifier to ameliorate physicochemical characteristics of saline-alkali soil and increase crop yields	Zhang Mimi; Chen Cheng; Liu Guangming; Yang Jinsong; Yu shipeng	Institute of Soil Science, Chinese Academy of Sciences	*Transactions of the Chinese Society of Agricultural Engineering*	111	2014
5	Effects of Different Fertilization and Mulching Cultivation Methods on Yield and Soil Water Use of Winter Wheat on Weibei Dryland	Xue Cheng; Wang zhaohui; Li fucui; Zhao Hubing; Zhou Ling; Li xiaohan	College of Natural Resources and Environment, Northwest A&F University	*Scientia Agricultura Sinica*	100	2011
6	Effect of long-term fertilization on rice yield and basic soil productivity in red paddy soil under double-rice system	Lu Yanhong; Liao Yulin; Zhou xing; Nie Jun; Xie Jian; Yang zengping	Hunan Soil and Fertilizer Institute	*Acta Pedologica Sinica*	97	2015
7	Effects of the different long-term fertilizations on fractions of organic carbon in fluvo-aquic soil	Tong Xiaogang; Huang Shaomin; Xu minggang; Lu Chang'ai; Zhang Wenju	Key Laboratory of Crop Nutrition and Fertilization, Ministry of Agriculture	*Journal of Plant Nutrition and Fertilizer*	94	2009
8	Effect of fertilization regime on tea yield, nutrient accumulation and soil fertility	Lin Xinjian; Huang Dongfeng; Li Weihua; Wang Limin; Wang Fei; Fan Ping; Qiu xiaoxuan	Soil and Fertilizer Institute, Fujian Academy of Agricultural Sciences	*Chinese Journal of Eco-Agriculture*	90	2012
9	Law of field soil ammonia volatilization in summer maize under different fertilizer patterns	Li Zongxin; Wang Qingcheng; Liu Kaichang; Dong Shuting; Wang kongjun; Zhang Jiwang; Liu Chunxiao	Crop Research Institute, Shandong Academy of Agricultural Sciences	*Acta Ecologica Sinica*	86	2009
10	Effects of different fertilization modes on vegetable yield, nitrate content and nitrogen and phosphorus loss in vegetable fields	Huang Dongfeng; Wang guo; Li Weihua; Qiu xiaoxuan	Soil and Fertilizer Institute, Fujian Academy of Agricultural Sciences	*Journal of Soil and Water Conservation*	85	2008

Conclusions and Prospects

In this paper, the bibliometrics method was applied to statistically analyze core documents in the research field of different fertilization models from 2003 to 2022. There were 473 papers published in this research field, showing an overall upward trend, with an average annual number of 23.7. The journal with the most published papers was Chinese Journal of Soil Science (74 papers), and the keywords with higher frequency were "organic fertilizer" (64 times) and "NPK" (33 times), indicating that rational utilization of organic fertilizer and NPK fertilizer is closely related to different fertilization modes. The most frequently cited one came from *Chinese Journal of Ecology*, which shows that organic carbon groups and aggregates are hot topics in the field. The top 10 most frequently cited papers mainly focused on the analysis of crop soils such as vegetables, rice, tea and corn.

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