A Graph Analysis Study on Grape Growth Knowledge

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Abstract: This study aims to construct a knowledge graph for grape growth research, presenting its research progress and knowledge system in a systematic and visual manner. We have collected and organized literature related to grape growth, extracted core keywords, and constructed a knowledge graph in the field of grape growth, covering biological characteristics, growth environment, cultivation management, pest control, yield and quality. Through in-depth analysis of the graph, the correlation and evolutionary trends between core concepts, entity relationships, and research topics were revealed. This study provides a powerful tool for grape growth research, promotes technological progress and industrial development in grape cultivation, and provides reference for other crop growth research.

Keywords: Grape Growth; Knowledge Graph; Graph Analysis

1. Introduction

Grape cultivation has a long history and a large distribution area, with large-scale cultivation worldwide. The growth and development pattern of grapes follows a rhythmic annual cycle with climate change, completing the annual cycle development through the growth and dormancy periods. The growth period includes a series of life activities such as sprouting, growth, flowering, and fruiting occur; each stage of these activities is called the phenological period. The growth cycle of grapes includes six stages: bleeding period (sap flow period), sprouting growth period, flowering period, berry growth period, berry maturity period, new shoot maturity period, and leaf shedding period. Grapes are influenced by various factors such as soil, light, temperature, moisture, seedling cultivation, fertilizer, and shaping during their growth period. Therefore, exploring the influencing factors of grapes and proposing corresponding regulatory measures has important theoretical and practical significance.

Knowledge graph is a new research method in scientific metrology and knowledge metrology. Through data collection, information processing, knowledge measurement, and graphic drawing, the paper presents the development and structure of scientific knowledge in a visual graph, revealing the laws of scientific knowledge and its activities, and demonstrating the evolution and laws of knowledge structure. CiteSpace knowledge visualization software is one of the most important tools for drawing knowledge graphs, developed by Dr. Chen Chaomei from the School of Information Science and Technology at Drexel University in the United States. It has been applied in multiple natural science fields. This paper aims to use CiteSpace III software to visually analyze the related issues of grape growth; The specific usage method and result analysis of the software refer to the CiteSpace manual. [1] Drawing a scientific knowledge graph helps to showcase the development and evolution of knowledge in the research field at different times.

2. Data Sources and Research Tools

2.1 Data Collection

This study selected statistical data sources from papers published on CNKI. On CNKI, the theme word is "grape growth", and the default time period used in the database is from 1983 to 2023. The database was last updated on December 31, 2023, and a total of 2346 literature records were retrieved. Among them, there are 1866 journal articles, 412 thesis articles, 66 conference articles, and 7 newspapers.

2.2. Research Methods

The paper uses the literature information visualization software CiteSpace to draw a

knowledge graph, displaying the distribution of publication volume, provinces, institutions, and authors of grape growth, and analyzing high-frequency vocabulary in this field. The specific usage method and result analysis of the software can refer to the CiteSpace manual.

3. Results and Analysis

3.1. Analysis of Literature Sources

As the main body of macro research, analyzing the publication status of research institutions can help understand the research intensity in the field of grape growth in China. The network graph of cooperation among domestic research institutions in the field of plants interprets the spatial distribution of research forces in this field. This indicates that the research institutions in the field of grape growth in China have weak connections and little cooperation with each other. The University of the Chinese Academy of Sciences has close internal cooperation with many universities, and further academic cooperation needs to be established across regions and universities.

3.2. Author Analysis

The author is the micro research subject conducting scientific work. By studying the literature achievements of the authors and the cooperation among relevant authors, it is helpful to understand the distribution and cooperation of key researchers in the domestic grape research field. In CiteSpace software, the network node type should be checked as "Author".

The network density is at a relatively low level, indicating that the research efforts in the field of grape growth in China are relatively dispersed. Most scholars are in an independent research state, with few academic connections and a lack of broad academic consensus. In the long run, this is not conducive to the sustainable development of domestic grape growth research.

4. Hotspots and Trend Analysis

Keywords are words used to express the research content of a certain literature topic, and their frequency can directly reflect the hot research directions in the field to a certain extent. In CiteSpace, the network node type should be analyzed by selecting "keywords"; Among them, the total frequency of keywords

such as growth and development, wine grapes, and growth regulators is the highest. They all involve the application field of grapes and are a hot research direction in the field of grape growth in China.

CiteSpace software calculates and groups closely related keywords. This process is called keyword clustering. The modularity level value is 0.6733>0.3, and the network contour value is 0.7562>0.5. This indicates that the clustering results of the entire network are reasonable. By analyzing and summarizing, the domestic grape growth field can be divided into three research hotspots: Staphylococcus aureus, grape fruits, and growth and development.

5. Conclusion and Suggestions

This study used CiteSpace visualization software to conduct knowledge graph analysis on 2346 literature on domestic plant research in the CNKI database from 2013 to 2023. Since 1983, the teams of Wang Qingzhai and Meng Guanglong have been exploring the effects of chloramphenicol on the growth, yield, and quality of Beichun grapes. [2] By 2023, the Qin Meimei team will study that reducing the application of chemical fertilizers and increasing the application of organic fertilizers has no significant impact on grape yield, but can reduce the leaching of available nutrients and significantly improve the productivity of chemical fertilizers; On the basis of adding organic fertilizer, adding amino acid water-soluble fertilizer can promote nutrient absorption in the tree, increase grape yield, and significantly improve fruit quality. [3] Based on the analysis of articles over the past 40 years, the following conclusions can be drawn: ① From the perspective of the authors and research institutions, there is close collaboration among scholars in this field, and there is less academic communication among researchers from different teams. The research force is mainly concentrated in universities, with weak connections and scattered cooperation among various research institutions. From the perspective of publishing journals and disciplinary fields, hot journals mainly focus on horticulture, agricultural protection, and plant basic science journals. These are mainly concentrated in *Sino-Overseas Grapevine & Wine*, *Northern Horticulture*, and *Northwest A&F University*. The most closely integrated discipline between applied basic science and

domestic grape growth field. Each discipline should be interconnected and have different research perspectives based on its own characteristics. This has a promoting effect on the development of research in the field of grape growth in China.③ From the perspective of research hotspots and frontiers, the research hotspots in the field of grape growth in China mainly focus on Staphylococcus aureus, grape fruits, and growth and development. The forefront of research involves aspects such as fruit quality, growth and development, and rootstock grafting.

In summary, research in the field of plants in China has achieved certain results at present, forming a research process from macro to micro, from theory to practice. However, in the future, basic scientific research in the field of plants still needs to be conducted from the following three aspects:

From the perspective of research direction, the field of grape growth is showing a diversified development trend in current research. It is necessary to combine relevant knowledge of horticulture, plant physiology, modern agriculture and other related disciplines to study grape growth more widely, promote the development of research in the field of grape growth, and make it play a greater role.

On the research cooperation network, research in the field of plants in China is a vast and complex academic system. Research institutions should continuously strengthen cooperation and academic exchanges across different regions and universities to better promote the development of research in the field of plants in China.

In terms of research topic content, it is necessary to continuously explore and expand the research scope of grape growth in China, and conduct multi angle and diversified research on grape growth domain topics. This will help gradually improve the theoretical framework and knowledge system of domestic grape growth research.

Acknowledgments

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