Editing Practice

ORIGINAL ARTICLE

Analysis of the characteristics of innovation in highly cited papers: A case study of highly cited papers published in comprehensive agricultural science core journals in China

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ABSTRACT

Background: This paper aims to deepen the understanding of innovation in academic papers among scientific and technical (sci-tech) journal editors and authors and to promote the production of excellent papers and the improvement of academic quality of sci-tech journals. **Methods:** This research conducted a thorough analysis on the innovative features of 57 highly cited papers published on comprehensive agricultural science core Chinese journals from 2011 to 2020, as retrieved from the China National Knowledge Infrastructure (CNKI) database. The CNKI database was also used for auxiliary retrieval and verification of related information. **Results:** The innovative features of highly cited review papers include the application of new technologies, use of novel ideas to solve urgent major problems, and summarization for the latest international research progress. The innovative content of highly cited research papers includes achieving significant new results, opening up broad new fields, creating widely applicable new methods, and using new breakthrough methods. **Conclusion:** Innovation is the soul of scientific research and its resulting papers. When sci-tech journal editors select topics and review papers around these features of innovation, it can contribute to the production of high-quality, high-impact papers and enhance the academic quality of the journals.

Key words: highly cited papers, innovation, features, review paper, research paper

INTRODUCTION

The rapid development of modern scientific and technological (sci-tech) research is inseparable from the swift dissemination of research information. Sci-tech journals serve as the primary vehicles for this information; thus, the quality of their publications directly affects the development of sci-tech research.[1] Impact factor and influence index, based on citation frequency, are currently the main evaluation indicators of the quality and academic standards of sci-tech journals.[2] Highly cited papers contribute significantly to a journal's total citation frequency and play a crucial role in journal evaluation, being considered at the core of enhancing the academic influence of sci-tech journals.[3,4] The number of highly cited papers also reflects a journal's ability to focus on cutting-edge and hot topics, as well as the level of reader attention. Therefore, the publication of high-quality, highly cited papers to further enhance a journal's influence is a common concern among sci-tech journal editors.

Highly cited papers are usually defined as a relatively small number of papers that rank at the top in terms of citation frequency over a set period and within a selected range. Numerous studies have been conducted on highly

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cited papers, mostly focusing on overall distribution characteristics, analyzing features such as citation frequency distribution, publication time distribution, journal distribution, author (institution, title, education, *etc.*) distribution, and subject distribution to explore measures, thereby enhancing the influence of sci-tech journals through manuscript solicitation, commissioned writing, and topic planning.[5–9] The improvement in a sci-tech journal's influence fundamentally depends on the academic content of the journal and its papers.[10] Research on the content features of highly cited papers is scarce. Existing research mainly guides topic planning by analyzing the specific fields involved in the content of highly cited papers,[11,12] but with the rapid development of science and technology, the topic planning of sci-tech journals should also continually adjust to the latest scientific research progress. Research on the specific fields involved in the content of highly cited papers over a certain past period may soon become unsuitable as a basis for future sci-tech journal topic planning.

For development, innovation is using known information to continually break through conventions and discover or generate valuable new things or ideas. Its core lies in novelty, its essence in breakthrough, its foundation in the mastery of existing knowledge and information, and its purpose in promoting economic and social development.[13] As the primary driving force for development, innovation has been placed at the core of national development strategies. Innovation, as an important content feature of academic papers, is widely mentioned; however, it is an abstract concept with discipline-specific connotations that evolves with socioeconomic and sci-tech development. Only by deepening the understanding in conjunction with specific realities can it be correctly grasped and utilized in journal management practice. This study's research object includes papers published in comprehensive agricultural science core journals from 2011 to 2020, which have been cited more than 100 times, to deeply analyze the innovative features of highly cited papers. Through illustrative analysis, it aims to gain an in-depth understanding of the innovative content of highly cited papers among editors and authors of agricultural science and technology journals, improve editors' ability to recognize and review potentially high-impact paper content, provide a reference basis for editors in topic planning and paper review, and thus promote the production of high-impact papers and the improvement of the academic quality of sci-tech journals.

DATA SOURCES AND METHODS

Selection of highly cited papers

Using the journal names (such as *Scientia Agricultura Sinica, Journal of Agricultural Science and Technology, Journal of China Agricultural University, Jiangsu Journal of Agricultural Sciences, Journal of Shenyang Agricultural University, etc.*) from the Comprehensive Agricultural Science Core Journal List in the "A guide to the core journal of China" (2020 edition)[14] as the search item, we searched the China National Knowledge Infrastructure (CNKI) for sci-tech papers published between January 1, 2011, and December 31, 2020. Papers with citation frequencies greater than 100 times in each journal were defined as highly cited. The retrieval date was December 31, 2021.

From 2011 to 2020, 31 comprehensive agricultural science core journals published 217 highly cited papers, with citation frequencies exceeding 100. Using the first-order difference method to eliminate the trend items of the time series,[15] 57 papers were selected as research samples. These included 28 research papers and 29 review papers. The top 10 papers in terms of citation frequency are listed in Table 1.

Research method

Each of the highly cited papers was carefully read and analyzed to identify common features of content innovation, and typical papers were selected as illustrative examples. The CNKI was used for auxiliary retrieval and verification of related information.

RESULTS AND ANALYSIS

Review and research papers are the two main types of research results published in sci-tech journals in the field of agricultural science. The contents of the two types of papers differ significantly in terms of argumentation logic and organizational structure. Therefore, this study discusses the features of content innovation in review and research papers separately.

Features of content innovation in highly cited review papers

The application of new technologies in other disciplines

Every discipline develops through mutual penetration and has transferability. New technologies are generated in the process of development in disciplines such as information science, biological science, chemistry, and physics. When transferred and applied to the field of agriculture, these technologies lead and drive the continuous development of agricultural science. Therefore, content involving the application of new technologies in other disciplines has become one of the features of innovation in highly cited review papers.

A study titled "Application principle and technology progress in using light-emitting diode (LED) light sources in modern agriculture" is about the transfer and application of increasingly sophisticated LED

Table 1: Top 10 highly cited papers in terms of citation frequency

Title	Journal	Citation frequency	Article type	Year of publication	Corresponding author (affiliation)
Advances and prospects in research of biochar utilization in agriculture[16]	*Scientia Agricultura Sinica*	578	Review	2013	Wenfu Chen (Shenyang Agricultural University)
Research progress on application of superoxide dismutase (SOD)[17]	*Journal of Agricultural Science and Technology*	448	Review	2013	Yuanliang Wang (Hunan Agricultural University), Zhiyang Dong (Chinese Academy of Sciences)
Effects of biochar on properties of red soil and ryegrass growth[18]	*Journal of Zhejiang University (Agriculture and Life Sciences)*	444	Research Report	2011	Mingkui Zhang (Zhejiang University)
Research status and development discussion on high-yielding agronomy of mechanized planting rice in China[19]	*Scientia Agricultura Sinica*	394	Review	2014	Hongcheng Zhang (Yangzhou University)
Development and prospect of sweetpotato industry and its technologies in China[20]	*Jiangsu Journal of Agricultural Sciences*	386	Review	2012	Daifu Ma (Xuzhou Agricultural Science Institute)
Innovation and practice of high-yield rice cultivation technology in China[21]	*Scientia Agricultura Sinica*	333	Review	2015	Defeng Zhu (China Rice Research Institute)
The quality analysis of cultivated land in China[22]	*Scientia Agricultura Sinica*	326	Review	2011	Yinjun Chen (Chinese Academy of Agricultural Sciences)
The development and contribution of nitrogenous fertilizer in China and challenges faced by the country[23]	*Scientia Agricultura Sinica*	324	Review	2013	Weifeng Zhang, Fusuo Zhang (China Agricultural University)
Perspectives of research and application of big data on smart agriculture[24]	*Journal of Agricultural Science and Technology*	321	Review	2013	Zhongfu Sun (Chinese Academy of Agricultural Sciences)
Relationships of rice root morphology and physiology with the formation of grain yield and quality and the nutrient absorption and utilization[25]	*Scientia Agricultura Sinica*	319	Review	2011	Jianchang Yang (Yangzhou University)

The retrieval date was December 31, 2021.

technology in physics in the field of agricultural lighting,[26] providing a cost-effective light source for ensuring efficient production in modern agriculture. "Perspectives of research and application of big data on smart agriculture",[24] "Application research of big data promote agricultural modernization",[27] "Recent progresses in research of crop patterns mapping by usingremote sensing",[28] and "Agricultural IOT architecture and application model research"[29] are all highly cited review papers about the application of new information science technologies in the field of agriculture. "Advances and prospects in research of biochar utilization in agriculture" is about the application of pyrolysis technology in chemistry for charcoal production in the field of agriculture.[30]

A summary of the latest research progress

Summarizing the latest and most cutting-edge research progress in a research field is a significant feature of highly cited review papers. The section summarizing the progress of previous research is the main part of a review paper. Summarizing the latest research progress in related fields not only lays a good foundation for the subsequent outlook section of review papers but also provides important support for the informational value of review papers. The latest research progress in a field is often an important source of innovation for citing papers.

Generally, a short interval between the publication of a paper and the publication of the references it cites indicates that the review paper is based on the latest research progress. However, in some fields where research progress is slow or where some issues have been thoroughly researched and subsequent related research is scarce, even references published earlier can represent the most advanced research progress in the field.

Solutions to major and urgent problems with novel ideas

The novelty of ideas is a cornerstone of the academic value of a review paper. An idea, in its original sense, refers to the result of objective existence reflected in human consciousness through thinking activities or formed viewpoints and conceptual systems. The novelty of ideas refers to the new results, new viewpoints, and conceptual systems formed through scientific thinking. The novelty produced through scientific thinking differs from the innovation produced through scientific experiments and is a unique feature of high-quality review papers. The novelty of ideas in review papers is often reflected in the author pointing out existing problems based on the current research status, proposing related suggestions or improvement measures, indicating future research directions, summarizing existing literature, extracting new knowledge points,

proposing new methods, and predicting or speculating new problems and trends. The innovation of highly cited review papers often lies in solving major and urgent problems using novel ideas.

In 2011, China's Twelfth Five-Year Plan for National Economic and Social Development proposed the development idea of "promoting agricultural modernization in parallel with the deepening development of industrialization and urbanization". In 2012, in his speech entitled "Coordinating the Promotion of Urbanization is a Major Strategic Choice for Realizing Modernization", Comrade Li Keqiang pointed out that urbanization is the essence and basic policy of modernization, where China's largest domestic demand potential lies, and ensuring food security is the foundation of urban development. Land use, resource support, and ecological environment issues are major issues that need to be deeply researched in promoting urbanization; he proposed the direction for improving the efficiency of arable land use and pointed out the direction of safe, intensive, green, and low-carbon development.[31]

Against this background, based on the actual needs of the country for agricultural development and previous research results on the effects of biochar on soil physical and chemical properties and crop growth and yield, "Advances and prospects in research of biochar utilization in agriculture" timely pointed out the application potential of biochar in the transformation of medium and low yield fields and low carbon, circular, and sustainable development of agriculture.[30] The paper also recommended directions and suggestions for the development of the biochar industry, innovatively proposing the development path of the biochar industry that is in line with China's national conditions and has Chinese characteristics, which is "based on the recycling of agricultural and forestry waste resources, with straw carbonization and returning to the field as the core, increasing soil input, improving the quality of arable land, reducing straw burning, achieving carbon sequestration and emission reduction and sustainable agricultural development".

Features of content innovation in highly cited research papers

Presence of significant new results

Innovation is the basis for a paper to have publication value. The number of sci-tech papers published each year is increasing; however, those that can achieve high citation counts are usually the few papers that report important new results. The more important the innovative results are, the more papers in related fields can cite them. Far-reaching and significant new findings often result in a paper achieving a high citation rate, thus becoming a clear feature of innovation in highly cited papers.

Quality is an important goal that agricultural production persistently pursues, and quality evaluation is the basis of quality production. "Evaluation indices for apple physicochemical quality"[32] has been cited 202 times in the statistical domain. This paper first clarified a regression equation that could be used for apple fruit quality prediction and simplified the apple quality evaluation indicator system. This new result can be directly applied to the measurement and comparison of the physicochemical quality of apple fruits under different varieties, regions, and detection method conditions. Moreover, it is important in guiding the technological progress of apple cultivation production, improving the efficiency of apple breeding work, enhancing post-harvest storage and transportation, and deep processing methods of apples, as well as certain reference significance for quality-related research on other crops.

The opening up of a new field with broad prospects

Carrying out experimental research in a certain field at an early stage in the country, especially research in a new field with broad application prospects or research that can form a new hotspot, is another feature of the content innovation of research papers. The main feature of new field research papers is that the research content is the first plowing of "virgin land" or fills a disciplinary gap.[33] Research papers produced in pioneering fields, even if there are imperfections, can still promote the establishment and development of new disciplines or theories because they have the nature of transcending the past, pioneering new fields, and high academic value. Such papers are often referred to and cited in subsequent research, owing to their leading roles in new fields.

"Effects of biochar on properties of red soil and ryegrass growth"[18] is one of the earliest studies in China to investigate the impact of wheat straw (agricultural and forestry waste) biochar treatment on soil properties and plant growth. With "biochar" and "biomass charcoal" as the subject words, a search on CNKI revealed that the earliest results on biochar were reported in 1982, but early results on biochar were mostly published in environmental protection, energy, chemical industry, and forestry journals, and the content was mostly focused on the purification function and production process of biochar, mainly involving charcoal and bamboo charcoal. Bamboo charcoal and wood charcoal, due to material source and cost limitations, have difficulty meeting the needs of agricultural production and thus are not suitable for widespread use in the agricultural field. Biochar research based on the concept of returning

agricultural and forestry waste to the field for soil amendment is a new direction for resource recycling of agricultural and forestry waste and soil improvement, which is of great significance for promoting low-carbon, circular, and sustainable development of agriculture. It has, therefore, become a hotspot in agricultural science research in the past decade.

Establishment of broadly applicable new methods

In scientific research, certain methods must be used. The method is the tool and means to understand the world, and the continuous development of science cannot be separated from continuous innovation in methods. These newly established methods provide new tools and means for people to further explore the mysteries of science. The wider the applicability of the new method, the greater the impact of the method. Therefore, papers that establish new broadly applicable methods can achieve high citation rates.

"Establishment of the detecting method on the fruit texture of Dongzao by puncture test" is a paper that established a new method.[34] When "texture analyzer" is used as the subject word to search in CNKI, sorted by publication time in ascending order, the results show that initially, texture analyzers were mostly used for quality determination in food fields such as flour products, dairy products, and meat products. The "Comparison of texture properties of post-harvest apples using texture profile analysis",[35] published in the "*Transactions of the Chinese Society of Agricultural Engineering*" in 2005, was the first domestic report using a texture analyzer to measure the texture of semi-cut apple pulp, with more than 300 citations. However, owing to the small size of Dongzao (difficult to peel and sample) and the fact that it is generally eaten with the peel, the texture characteristics of the peel are an important part of the quality of Dongzao. Thus, the previous texture profile analysis method is not suitable for the texture analysis of small fruits eaten with the peel, such as Dongzao. "Establishment of the detecting method on the fruit texture of Dongzao by puncture test" takes the whole Dongzao fruit as the research object and establishes a texture analysis method widely applicable to small fruits eaten with the peel. Subsequent research on the quality of different varieties of jujube and other small fruits (figs, goji berries, cherries, blueberries, grapes, loquats, plums, sand fruits, water chestnuts, pomegranate seeds, *etc.*) eaten with the peel, cited this paper, resulting in a high citation rate for the paper.

Adoption of new breakthrough methods

In scientific research, the use of new methods is an innovative and bold move, which opens up new horizons and leads to a broader world, often accompanied by a series of progressive innovation results. A breakthrough method is a new method that can overcome inherent limitations and is a more practical innovation. Research papers that adopt new breakthrough methods can be referred to by other researchers in related fields, resulting in new research papers in related fields and thus easily becoming highly cited papers.

"Isolation and identification of a novel flavivirus strain JS804 in Geese"[36] has been cited 160 times in the statistical domain, and it is the first domestic research to apply the sequence-independent, single-primer amplification (SISPA) combined with DNA enzyme treatment to amplify and identify the genes of aquatic bird pathogens. Traditional serological methods and virus culture cannot detect unknown viruses, and conventional molecular biological detection methods often need to know the gene sequence of the pathogen. This method's uniqueness lies in its ability to identify pathogens when the gene sequence of the pathogen is unknown. A search on CNKI with "SISPA" as the subject word shows that only in 2010 were there four related theme results using SISPA technology for the detection and identification of known and unknown viruses infecting humans. The references in this paper are all foreign literature, which also reflects that the paper has adopted a new method. Among the papers citing this paper, there are many studies related to Tembusu virus and parvovirus in chickens, ducks, and geese, indicating that this new method of SISPA combined with DNA enzyme treatment has been widely cited by subsequent related research.

DISCUSSION AND INSIGHTS

Analyzing the innovative features of academic papers can provide a basis for editors to plan topics and review papers. For review papers, when planning topics, attention should be paid to the application of new technologies in other disciplines and the current major problems that urgently need to be solved. During the review process, attention should be paid to whether the paper summarizes the latest research progress, both domestically and abroad, and whether its ideas are novel. For research papers, the focus in topic planning should be on "significant meaning", "broad prospects", and "wide applicability", and the review should pay attention to the innovation in experimental methods and results.

The "newness" of highly cited review papers can be reflected in the summary of progress and outlook sections, while the "newness" of highly cited research papers is often reflected in the results and methods sections. The innovation of a paper can be judged based on whether important new results have been achieved, whether it plays a leading role in related research,

whether it has a substantial promoting effect on industrial development, and whether a new method has been created, improving the accuracy and reliability of research results. New methods include biological, physical, chemical, mathematical, instrumental, original, and field measurement methods, as well as significant improvements in methods, technology integration, technology simplification, and technology substitution.

Editors of sci-tech journals form the backbone of good sci-tech journals, and professional and scholarly editors will be an important force in pushing China's sci-tech journals to a higher level.[37] Although peer review is the main way to evaluate the innovation and scientific nature of a paper,[38] the editors of sci-tech journals also have much to do in judging its value.[39] Editors of sci-tech journals are committed to year-round publication of research papers in specific or several related fields. They not only need to review and edit papers but also need to understand expert review opinions and review the author's modifications based on expert opinions. Through years of continuous accumulation of research in professional fields, continuous learning of scientific literacy from expert opinions, and maintaining close contact and communication with experts, editors of sci-tech journals can also make general judgments about the core value of the manuscript during the initial review. Simultaneously, they can use related information in the paper (introduction, discussion, references, *etc.*), as well as information sources from advanced network databases, and related scientific news (such as the results of major national scientific awards and the initiation of major scientific projects) to predict the innovation of the manuscript.

CONCLUSION

Analyzing the features of academic paper content innovation and deepening the understanding of academic paper innovation can help improve editors' ability to plan topics and review potentially high-impact papers. This is greatly beneficial for doing a good job in sci-tech journals, producing more highly cited papers, and improving journal influence and academic quality. Innovation in the content of academic papers is an important reason for the high number of papers cited. Editors of sci-tech journals can use the features of academic paper content innovation as a reference for organizing, reviewing, and publishing high-level papers, thereby improving their academic quality.

DECLARATIONS

Author contributions

Ma YJ: Conceptualization, Data curation, Methodology, Writing—Original draft, Writing—Review and Editing. The author have read and approve the final version.

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Conflict of interest

The author has no conflicts of interest to declare.

Data sharing

Data used to support the findings of this study are available from the corresponding author upon request.

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