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Research and Analysis of Soil Acidification in Paddy Field based on Bibliometrics

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ABSTRACT: In order to discuss the research hotspot and development trends of paddy soil acidification in China in recent years, this research is based on the CNKI database. In this paper, the bibliometrics method is adopted, and the literature is analyzed by using Excel, SPSS and other software. Based on the relevant data collected in the CNKI database, this paper makes statistics on journals from 1991 to 2021, and makes an analysis from five aspects: literature quantity, cited literature, research institutions, fund support and key words. The study of soil acidification in the soil was conducted in the United States of America.

KEYWORDS: paddy soil; soil acidification; bibliometrics; CNKI.

I. INTRODUCTION

Soil acidification is the largest agri-environmental problem facing the world[1]. Globally, acidic soils are mainly distributed in tropical, subtropical and temperate regions, including the ash soil regions of Northern Europe and North America, while soil acidification in China mainly occurs south of the Yangtze River [1] over an area of about 2 million ha [2]. A study by Wang et al. [3] showed that the acidification degree of different soil types was different, and compared to other soil types (such as fluvo-aquic soils and brown soils), the acidification degree of paddy soils was the highest. About 13% of the world's rice grows in acidified soils [4], and some rice soils in southern China have been acidified to varying degrees [5], and more than 30% of rice soils have pH below 5.5, and the area and intensity of acidification are still increasing[6].

Rice is one of the most important food crops in China. Its output accounts for about 32% of China's total grain output [7], and it plays an important role in ensuring food security [8]. It is widely believed that rice is a very acid-tolerant crop, growing normally at pH 5.0-6.0 and even tolerating an acidic environment at pH 4.5 at the seedling stage, but acid tolerance declines in the middle and late stages of reproduction [8]. As the increasingly serious problem of soil acidification, the impact of soil acidification on the growth of rice has gradually attracting attention [8]. Liu et al. [9] concluded that hydrogen ions and their activation products, aluminum, cadmium, and lead plasma, produced by soil acidification in rice fields endanger the growth and development of rice and the quality and safety of rice; Chen [10] came to the conclusion that rice is the cereal crop with the strongest cadmium absorption capacity, and cadmium pollution of rice poses a great threat to human health; Wang Lihong et al. [11] concluded that the combined stress of aluminum and cadmium in acidified soil significantly inhibits the root growth of rice seedlings, thus limiting the growth of rice. The study by Chen Le et al. [12] concluded that the acidification of paddy soil in southern China is not only serious, but also the background values of heavy metals is high, which leads to soil acidification and degradation,

and activation of toxic heavy metals, which seriously affects rice quality and safety; Zhou et al.[13] believed that excessive application of chemical nitrogen fertilizers was an important factor leading to soil acidification in rice fields in southern China, and the contents of total nitrogen and alkali-hydrolyzable nitrogen in the soil were related to pH value. The content of total nitrogen and alkaline soluble nitrogen in soil showed a highly significant negative correlation with pH, and for every 100 mg/kg increase in total nitrogen and alkaline soluble nitrogen content, the pH of rice soil decreased by about 0.1 units. In summary, soil acidification in China's rice fields is more serious and has a great impact on China's rice yield, and scientific and effective methods must be adopted to slow down the acidification of rice soils.

In recent years, with the expansion of paddy field soil acidification area in China, the problem of paddy field soil acidification has become one of the hot spots of research and attention in China, and there is more and more relevant scientific literature. In order to get a systematic and comprehensive understanding of the research status and development trend of soil acidification in rice fields in China, this paper uses bibliometric methods and analyzes the literature using Excel and SPSS software. This research aims to provide an important scientific basis and reference for soil acidification and improvement technology in China.

II. MATERIALS AND METHODS

2.1 Data sources

In order to ensure the accuracy and comprehensiveness of the literature, this study used China Infrastructure Project (CNKI) to search the literature. The time span was from 1991 to 2021, with a total of 30 years. The five core journals, SCI source journals, EI source journals, Peking University Core journals, CSSCI journals and CSCD journals, are selected as the literature source categories; Taking soil acidification, paddy soil+rice yield, soil acidification, acidification management+rice, soil acidification+rice, soil acidification+rice, soil acidification+rice soil, rice soil+yield, early rice+soil acidification, late rice+soil acidification as the key words, after testing, in order to improve the reliability of the literature, after manual screening, the literature that does not match and repeat with the research topic was eliminated.

2.2 Research Methodology

2.2.1 Literature method

We searched and downloaded 95 scientific papers on the topic of "Soil acidification in rice fields" from five core journals, namely SCI-source journals, EI-source journals, Peking University Core, CSSCI, and CSCD, in the Chinese Science and Technology Journal Database (CNKI), and reviewed and analyzed them to lay the foundation for the writing work.

2.2.2 Bibliometric approach

Using SPSS software and mathematical statistics method, the research contents and research topics of scientific papers on rice soil acidification published in core journals from 1991 to 2021 were analyzed, and the research hotspots and important contents of soil acidification in the last thirty years were revealed.

2.2.3 Mathematical and statistical methods

Excel was used to make statistics and sort out the data of paddy soil acidification research papers published in core journals from 1999 to 2021, including the number of documents, cited documents, research institutions, financial support, keywords and so on.

III. RESULTS AND ANALYSIS

3.1 Analysis of the number of articles issued

The number of papers published each year in an academic field can, to a certain extent, represent the trend of attention in this field in recent years [14]. Figure 1 shows the trend of the number of publications on soil acidification in paddy fields in China from 1991 to 2021. As can be seen from the figure, the number of papers on paddy soil acidification is generally on the rise. From 1991 to 2013, the number of papers on paddy soils research in China showed a slow growth trend, and after 2013 it showed a rapid upward trend. More and more articles not only reflect the popularity of this research topic, but also reflect the increasingly serious problem of paddy soil acidification.

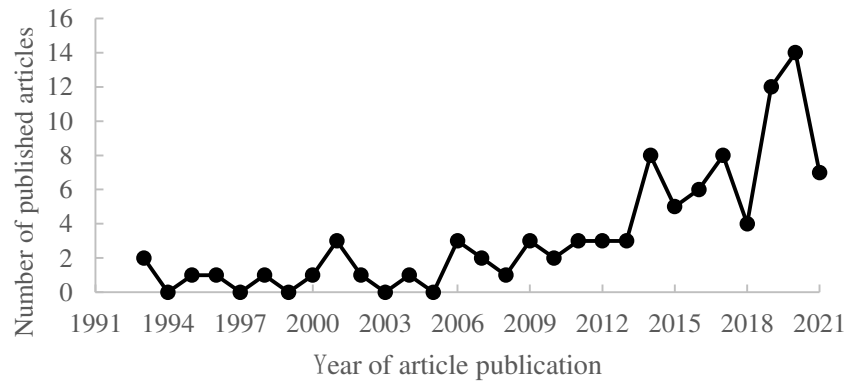


Fig. 1. Number of research publications on soil acidification in rice fields in China, 1991-2021 Change Trend graph

3.2 Analysis of cited literature

Citation times of literature are often used as an index to evaluate the academic level and influence of literature. The more citations, the higher the quality of scientific knowledge production of the paper, and the more original and innovative components of the paper [15-16], and the direct citation of research results in the literature by peers is one of the most important manifestations of the influence of literature [14]. Table 1 provides information on the top 10 most frequently cited literature on soil acidification research in rice fields from 1991-2021. Among them, the most frequently cited article is "Changes of Soil Properties, Rice Yield and Trace Greenhouse Gas Emissions from Paddy Fields" published by Zhang Bin in Chinese Agricultural Sciences, which was cited 262 times, followed by "Soil Acidification in Dongting Lake Area, Hunan Province, China" published by Yu Tao in Geoscience Prospect, which was cited 262 times. The article titled "Soil acidification in Dongting Lake area of Hunan and its effect on soil quality" was cited 146 times by Yu Tao, followed by the article titled "Characteristics and mechanism of soil acidification in Dongting Lake area of Hunan" by Yang Zhongfang, which was cited 134 times in GeoFrontiers. The Pearson correlation analysis showed that there is a positive correlation (correlation coefficient is 0.857) and a significant correlation (bilateral test value is 0.000) between the citation frequency and the number of downloads.

Table 1 Top 10 ranking of frequency of cited literature on soil acidification research in rice fields, 1991-2021

First author	Title	Source	Number of downloads	Frequency of citations
Zhang Bin	Changes in soil properties, rice yield and trace greenhouse gas emissions in paddy fields after application of biomass charcoal	China Agricultural Science	4275	262
Yu Tao	Soil acidification and its effect on soil quality in Dongting Lake, Hunan Province	Geoscientific antecedents	1016	146
Yang Zhongfang	Characterization and mechanism of soil acidification in Dongting Lake, Hunan Province	Geoscientific antecedents	1133	134
Ji Xionghui	Nitrogen utilization and leaching losses of nitrate nitrogen from controlled-release nitrogen fertilizers on paddy soils	Soil Bulletin	896	110
Huang Guoqin	Ecological analysis of rice field crop rotation system	Journal of Soil Science	590	99
Zhou Xiaoyang	Acidification characteristics of typical farmland soils in southern China under long-term fertilization	Journal of Plant Nutrition and Fertilizer	1258	89

First author	Title	Source	Number of downloads	Frequency of citations
Yuan Man Man	Effects of green manure nitrogen fixation and green manure return on rice yield and soil nitrogen characteristics in rice fields in Taihu Lake area	Journal of Soil Science	1023	69
Huang Yibin	Effect of rice-pimple-fish system on soil environment of rice field	Chinese Journal of Ecological Agriculture	262	67
Wang Jidong	Effects of continuous application of different rates of chicken manure N on organic matter accumulation and soil acidification in rice soils	Journal of Plant Nutrition and Fertilizer	1093	63
Wan Shuixia	Effect of Zingiber officinale with chemical fertilizer on soil microbial characteristics and crop yield	Journal of Grass Industry	623	60

3.3 Analysis of the distribution of research institutions and funds

The research capacity of research institutions can be reflected to some extent by the number of articles published by research institutions, and through statistical analysis, we can better measure the research effectiveness and development process of each research institution [17]. Table 1 lists the main research institutions for paddy soil acidification. It can be seen from the table that the main research force are universities and research institutions in Jiangsu province. From 1996 to 2019, Nanjing Agricultural University published 201 articles on paddy soils, including heavy metal pollution in paddy fields, microbial communities in paddy fields, measures to control and improve biomass carbon, measures to return straw to fields, etc., further promoted the research progress of soil acidification in China. Secondly, as can be seen from Table 2, the accumulated large proportion of papers published by university reflect that the research level of paddy field soil acidification in China still needs to be improved. From Table 3, it can be concluded that China is relatively supportive in terms of research funding, which also reflects the importance China attaches to the increasing severity of soil acidification in rice fields and reflects the country's active research and problem-solving attitude toward its problems.

Table 2 Main research institutions and literature statistics on soil acidification research in rice fields

Research Institutions	Province/municipality	Quantity	Percentage of
Nanjing Institute of Soil Science, Chinese Academy of Sciences	Jiangsu	7	7.37%
Jiangxi Agricultural University	Jiangxi	6	6.32%
Nanjing Agricultural University	Jiangsu	6	6.32%
Zhejiang University	Zhejiang	5	5.26%
Hunan Agricultural University	Hunan	5	5.26%

Table 3 Statistics on the distribution of major funds for research on soil acidification in rice fields

Funds	Quantity	Percentage of
National Natural Science Foundation of China	28	29.47%
National Science and Technology Support Program	14	14.74%
National Key R&D Program	6	6.32%

3.4 Research keyword analysis

The dominant idea of a paper is the keyword [18], and the more frequently the keyword appears, the more attention the related topic receives [19]. Table 4 shows the top 15 high-frequency keywords in the research of paddy soil

acidification in China from 1991 to 2021. As can be seen from the table, the research on paddy soil acidification in China has attracted the attention of researchers, taking soil nutrients as the main research content, aiming at increasing rice yield, and most of the related experiments are more oriented to field experiments. "soil quality" and "cadmium pollution" have gradually become high-frequency words, which are more and more favored by researchers. It also reflects the urgent need to solve the problem of soil acidification in paddy fields in China.

Table 4 Top 15 high-frequency keywords for research on soil acidification in rice fields in China, 1991-2021

Keywords	Total number of times	Keywords	Total number of times	Keywords	Total number of times
Soil acidification	39	Field trials	7	Soil quality	6
Paddy soil	35	pH	6	Crop yield	5
Soil Nutrients	11	Soil fertility	6	Cadmium contamination	5
Rice yield	10	Soil fertilization	6	Lime	5
Cation exchange capacity	7	Soil Census	6	Taihu Lake area	5

IV. RESEARCH ON SOIL ACIDIFICATION IN RICE FIELDS

According to the analysis of the above results, the research on paddy soil acidification can be roughly divided into the following four aspects.

Study on soil fertility of paddy fields. Rice soil is a typical hydroponic anthropogenic soil, its soil fertility is an important basis for high quality and high yield of rice, and fertility evaluation is one of the important contents of paddy cultivation and management [20]. Combined with the principles of geographical division, paddy soils in major grain-producing areas in China can be divided into four regions: Northeast China, the middle and lower reaches of the Yangtze River, Southwest China and South China [21]. And in terms of the basic ground strength level, middle and lower reaches of Yangtze River zone > Northeast zone $\geq$ South China zone > Southwest zone [22]. Research of paddy field soil fertility evaluation has always been a focus of people's attention, while the development and evolution of soil fertility is a long-term and complicated process [20]. Therefore, a reasonable method to evaluate soil fertility is necessary to make accurate decisions, optimize arable land resources, and maximize soil productivity [23].

Research on heavy metal pollution in paddy fields. Due to the rapid development of mining and smelting activities, the pollution of heavy metals in soil is becoming more and more serious [24]. Cadmium in soil will enter the food chain through the accumulation of rice seeds, posing a serious health threat to the human central nervous system [25]. Reducing the content of heavy metals in rice is not only related to the quality and safety of rice agricultural products, but also an important part of promoting ecological civilization and maintaining ecological security [26]. However, most researches aim at reducing the content of heavy metal in rice seeds, and often ignoring the effects of these substances on rice yield [27]. However, most researches aim at reducing the content of heavy metal in rice seeds, and often ignoring the effects of these substances on rice yield.

Effect of chemical fertilizer application on acidification of rice soil. Because soil acidification is mainly related to the excessive application of chemical fertilizers, especially nitrogen fertilizers [1,28]. The consumption of nitrogen fertilizer in China ranks first in the world, but the utilization rate of nitrogen fertilizer is low, mostly between 30% and 35% [29-30]. Long-term application of nitrogen fertilizers will not only pollute the atmosphere with NH_3 , NO_x and N_2O , but also cause ecological and environmental problems such as eutrophication of water bodies through leaching and runoff losses of agricultural systems [31], and lead to soil degradation, acidification and fertility decline [32-33]. Therefore, in terms of agricultural measures, the most important thing to prevent soil acidification is to reduce the application of chemical fertilizers, especially nitrogen fertilizers, and to prevent further soil acidification by increasing the application of organic fertilizers and bio fertilizers. For soils that are already acidified, lime is applied in appropriate amounts to improve and raise soil pH [8]. Biochar can improve acid paddy soils, increase soil nutrient content and reduce the availability of heavy metals copper and cadmium in acid soils. The greater the amount, the better the remediation effect [12].

Influence of soil conditioners on rice yield. Soil acidification leads to the decrease of pH value, affects soil biological activity, changes soil nutrient forms, reduces nutrient availability, and has toxic effects on rice roots, seriously affecting the yield increase [34]. In order to alleviate the acidification of paddy soil, soil conditioner and chemical NPK fertilizer are applied in a certain proportion to ensure the early nutrient supply of traditional fertilization mode, and make up for the later nutrient supply shortage, so as to ensure the long-term high and stable yield of rice and alleviate the acidification of paddy soil.

V. CONCLUSION

The overall trend of rice field soil acidification postings in China during 1991-2021 was an upward trend. The research on soil acidification in rice fields in China during 1991-2021 was characterized by a relatively high number of publications from universities, and although universities and research institutes acted as the main force in the research on rice field acidification, the mutual exchange and cooperation between them could be further strengthened.

Research on soil acidification in rice fields can be summarized into four areas: soil fertility in rice fields, heavy metal contamination in rice fields, the effect of fertilizer application, and the effect of soil conditioners.

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REFERENCES

- [1] Guo J H, Liu X J, Zhang Y, Shen J L, Han W X, Zhang W F, Christie P, Goulding K W T, Vitousek P M, Zhang F S. Significant acidification in major Chinese croplands. *Science*, 2010, 327: 1008-1010
- [2] Zhao Qiguo. Degradation of red soils in China. *Soils*, 1995, (6): 281-285 Zhao Q G. The Problems of Red Soil Degradation in China.
- [3] Wang ZG, Zhao YC, Liao QL, Huang B, Sun WM, Qi YB, Shi XC, Yu DS. Spatial and temporal changes in soil pH and its drivers in Jiangsu Province over the past 20 years. *Journal of Ecology*, 2008, 28: 720-727 Wang Z G, Zhao Y C, Liao Q L, Huang B, Shun W X, Qi Y B, Shi X Z, Yu D S. Spatio-temporal variation and associated affecting factors of soil pH in the past 20 years. Spatio-temporal variation and associated affecting factors of soil pH in the past 20 years of Jiangsu Province, China. *Acta Ecol Sin*, 2008, 28: 720-727 (in Chinese with English abstract)
- [4] Wang Li-Hong, Sun Fei, Chen Chun-Mei, Wang Yuanyuan, Liu Yishuai, Zhou Qing. Complex effects of aluminum and cadmium in acidified soil on root growth of rice seedlings[J]. *Journal of Agricultural Environmental Science*, 2013, 32(12): 2511-2512.
- [5] Zhou X Y, Xu M G, Zhou S W, COLINET Gilles. Acidification characteristics of typical agricultural soils in southern China under long-term fertilization. *Journal of Plant Nutrition and Fertilizer*, 2015, 21(6): 1615-1621. Zhou X Y, Xu M G, ZHOU S W, GILLES C. Soil acidification characteristics of typical farmland in south China under long- *Journal of Plant Nutrition and Fertilizer*, 2015, 21(6): 1615-1621. (in Chinese)
- [6] Yu T.Y., Sun X.S., Shi Chengren, Wang Cai-Bin. Research progress on soil acidification hazards and control technologies. *Journal of Ecology*, 2014, 33(11): 3137-3143. Yu T Y, Sun X S, Shi C R, Wang C B. Advances in soil acidification hazards and control techniques. *Chinese Journal of Ecology*, 2014, 33(11): 3137-3143. (in Chinese)
- [7] Department of Rural Socio-Economic Survey, National Bureau of Statistics . China Rural Statistical Yearbook [M]. Department of Rural Social and Economic Investigation, National Bureau of Statistics. China Rural Statistical Yearbook [M]. Beijing: China Statistics Press, 2014.
- [8] Zeng YJ, Zhou QH, Lv WS, Tan XEM, Pan XH, Shi QH. Effect of soil acidification on yield of double-season early and late rice[J]. *Journal of Crop Science*, 2014, 40(05): 899-907.
- [9] Liu Chunsheng, Song Guohan, Shi Yanxi, Yang Shouxiang, Ma Yuzeng, Xiao Yuefang. 2002. Characteristics of acid leaching in brown and brown soils [J]. *Journal of Soil and Water Conservation*, 16(3): 5-8. [Liu C S, Song G H, Shi Y X, Yang S X, Ma Y Z, Xiao Y F. 2002. Characteristics of acid leaching of brown soil and cinnamon soil [J]. *Journal of Soil and Water Conservation*, 16(3): 5-8.]
- [10] Chen Huai-Man. 1996. Heavy metal contamination in soil-plant system [M]. Beijing: Science Press: 71-87. [Chen H M. 1996. Heavy metal contamination in soil-plant system [M]. Beijing: Science Press: 71-87.]

- [11] Chen Le, Zhan Siwei, Liu Mengjie, Zhou Qiancong, Chen Yingchi, Pan Xiaohua, Zeng Yongjun. Effect of biochar on soil properties and effectiveness of heavy metals Cu and Cd in paddy fields with different acidification levels[J]. Journal of Soil and Water Conservation,2020,34(01):358-364.DOI:10.13870/j.cnki.stbcxb.2020.01.051.
- [12] Zhou XY,Zhou SW,Xu MG,Colinet Gilles.Characteristics and factors influencing the evolution of acidification in rice soils in southern China[J]. Chinese Agricultural Science,2015,48(23):4811-4817.
- [13] Zheng Meiyang, Lin Wei, Xu Xi, Peng Yulong, Liu Minhong, Gong Pengfei, Liu Yuedong, Kong Fangyu, Zhang Jiguang. A bibliometric analysis of soil acidification based on CNKI database[J]. Soil,2020,52(04):811-818.DOI:10.13758/j.cnki.tr.2020.04.022.
- [14] Liu Zeyuan,Chen Yue,Hou Haiyan. Scientific knowledge mapping: methods and applications [M]. Beijing:People's Publishing House,2008.
- [15] Zhou Hui,Zhang Guanghong,CAI Hui,Zheng Yingzhi. Analysis of SCI citations of original research results[J]. China Science Foundation,2002(02):23-25.DOI:10.16262/j.cnki.1000-8217.2002.02.008.
- [16] Cao Danyi, Zhong Qi, Qin Jiahui, Cheng Lang, Guo Zhonglu. Research progress on the role of root system on soil erosion control based on knowledge mapping[J]. China Soil and Water Conservation Science,2018,16(06):124-135.DOI:10.16843/j.sswc.2018.06.016.
- [17] Jia Kuankuan, Shu Yingge, Zhang Zhongliang, Wang Yuan, Ren Ming-Hui. A bibliometric analysis of soil acidification in tea plantations based on CNKI database[J]. Chinese Agronomy Bulletin,2021,37(20):119-125.
- [18] Kang Fei, Du Xuejun, Hu Shuwen, Ren Xueqin. Econometric analysis of soil acidification and improvement materials research based on Web of Science and Wanfang Patent[J]. Soil,2021,53(06):1261-1270.DOI:10.13758/j.cnki.tr.2021.06.021.
- [19] Huang Jing, Jiang Xianjun, Zeng Yuehui, Chen Jin, Chai Rushan, Liu Kailou, Zhang Huimin. Research progress of soil fertility evaluation methods and indicators in paddy fields[J]. China Soil and Fertilizer,2017(06):1-8.
- [20] National Agricultural Technology Extension Center, Institute of Agricultural Resources and Zoning, China Agricultural Science. Study on the evolution trend of arable land quality [M]. Beijing: China Agricultural Science and Technology Press, 2008.
- [21] Li JJ. Spatial and temporal evolution characteristics of soil fertility and base land strength of paddy fields in major grain producing areas of China[D]. Guizhou University,2015.
- [22] Mokarram M , Hojati M. Using ordered weight averaging (OWA) aggregation for multi-criteria soil fertility evaluation by GIS (case study: southeast Iran) [J]. Computers and Electronics in Agriculture , 2017 , 132: 1-13.
- [23] Ministry of Environmental Protection, Ministry of Land and Resources. National Soil Pollution Survey Bulletin [R]. Beijing: Ministry of Environmental Protection, Ministry of Land and Resources, 2014.
- [24] Komárek M, Chrastn V, Mihaljevi M. Lead isotopes in environ- mental sciences: a review [J]. Environment International, 2008, 34 (4) : 562-577.
- [25] Tang HT, Li WD, Sun YT, et al . Study on the effect of different foliar fertilizers on the regulation of heavy metal accumulation in rice with mild heavy metal contamination [J]. Hunan Agricultural Science, 2013(1):40 ~ 44.
- [26] Yang W. Tao,Zhang J.,Liao B. Han.Effect of exogenous organic fertilizer on Cd effectiveness in soil and Cd content in rice brown rice under Cd stress[J]. Journal of Guizhou University (Natural Science Edition),2020,37(01):105-111.DOI:10.15958/j.cnki.gdxzbzrb.2020.01.18.
- [27] Li JH. Study on the cause and prevention and control of soil acidification in China. J Agric Catastrophol, 2012, 2(6): 42-45 Li J H. Study on the cause, prevention and control of soil acidification in China. Li J H. Study on the cause, prevention and control of soil acidification in China.
- [28] Yu Fei , Shi Weiming . Analysis of nitrogen fertilizer utilization rates of major grain crops in mainland China in recent 10 years [J]. Journal of Soil Science , 2015, 52(6): 1311-1324. Yu F, Shi W M. Nitrogen use efficiencies of major grain crops in China in recent 10 years [J]. Acta Pedologica Sinica, 2015, 52(6): 1311-1324.
- [29] Tan Yihang , Shen Jianlin , Jiang Bingxin , et al . Effects of straw return and water management on nitrogen uptake and nitrogen fertilizer utilization in double-season rice [J]. Agricultural Modernization Research , 2018, 39(3): 411-419. Tan Y H, Shen J L, Jiang B S, et al. The effects of straw incorporation and water management on nitrogen uptake and nitrogen use efficiency in a double rice cropping system[J].Research of Agricultural Modernization, 2018, 39(3): 411-419.
- [30] Chen X P, Cui Z L, Fan M S, et al. Producing more grain with lower environmental costs[J]. Nature, 2014, 514(7523): 486-489.
- [31] Guo J H, Liu X J, Zhang Y, et al. Significant acidification in major Chinese croplands[J]. Science, 2010, 327: 1008-1010.



- [32] Meng Hongqi , Liu Jing , Xu Minggang , et al. Effect of long-term fertilizer application on pH of typical Chinese farmland surface soils [J]. Soil Journal , 2013, 50(6): 1109-1116. Meng H Q, Liu J, Xu M G, et al. Evolution of pH in topsoils of typical Chinese croplands under long-term fertilization [J]. Acta Sinica Sinica, 2013, 50(6): 1109-1116.
- [33] Yu Tianyi, Sun Xiushan, Shi Chengren, Wang Cai-Bin. Research progress on soil acidification hazards and prevention technologies[J]. Journal of Ecology,2014,33(11):3137-3143.DOI:10.13292/j.1000-4890.20141022.005.
- [34] Wu Zhiqiang, Cai Shuchun, Wu Yun, Song Hongzhi, Tian Guisheng, You Qiuxiang. Effect of different soil conditioners on rice[J]. China Agricultural Extension,2021,37(02):69-71.



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