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Mapping of top papers in the subject category of Soil Science

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Based on the ESI database, this study analyzed 612 top papers in the subject category of soil science from 2009 to 2019, which includes 608 highly cited papers and 17 hot papers, of which 4 are only hot papers and other 13 papers are both hot papers and highly cited papers. Top 5 core journals with higher impact factor ranked as *Soil Biology Biochemistry*, *Geoderma*, *Plant and Soil*, *Catena*, *Soil Tillage Research*. Top 5 countries and regions were Peoples R China, USA, Germany, Australia, France. The study also analysed that top 5 organizations were Chinese Acad Sci, Univ Western Australia, Univ Chinese Acad Sci, INRA, Nanjing Agr Univ. The analysis of all keywords showed that the research was separated in clusters. Therefore, authors can choose their ideal journal with a high impact factor to publish papers in the English language related to this research field.

Keywords: *Bibliometric analysis, Essential science indicators (ESI), Soil science category, Top papers, VOSviewer.*

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1. Introduction

According to the category description, the soil science category contains aspects of the formation, nature, distribution, and utilization of soils, including soil biology and fertility, soil conservation and tillage research, soil contamination and reclamation, soil biochemistry, and soil chemistry and physics (Clarivate 2021, InCites Journal Citation Reports).

Top papers are the sum of hot papers and highly cited papers based on Clarivate Analytics' Essential Science Indicators (ESI). Zhang Nan et al. (2018) analyzed the

highly cited papers of Economics and Business [1]. Noorhidawati et al. (2017) identify Malaysia's highly-cited papers [2]. A bibliometric evaluation of highly cited papers was conducted during the period from 1999 to 2009 in China based on the ESI database [3]. Mapping analysis of top papers during 2008–2018 on the world rice research [4], and high-impact papers presented in the subject category of water resources were analysed [5]. Highly cited papers were analysed in Library and Information Science (LIS) [6], and characterizing the highly cited articles [7]. There are other descriptions for highly cited papers, such as, publications receiving 100 or more citations are considered as highly (or top) cited articles [8-11], and Stavropoulou et al. (2019) searched the Scopus database to identify authors from the UK with extremely highly-cited papers, which are defined as papers with more than 1,000 citations [12].

Bibliometrics technique has been adopted in the subject category of Soil Science, research productivity in soil science in the Philippines [13], research trends on nitrate removal [14], a bibliometric review on carbon cycling research during 1993–2013[15], research on land and soil degradation [16], assessing ecological restoration as a research topic using bibliometric indicators [17], bibliometric analysis of insights into soil remediation [18]. Other subjects are related to grey system theory trends [19], innovation and technology for sustainable mining activity [20], and sustainable development in management sciences [21]. Sun and Yuan have analyzed rice with fertilizer [22], irrigation on rice [23], the top papers in the subject category of green and sustainable science and technology [24], the top papers in world rice research [25], library and information science [26], water Resources [27], agronomy category [28] and scientific research on maize or corn [29-30].

The purpose of this paper was to use bibliometric methods and VOSviewer to analyze ESI papers in the subject category of soil science during 11 years period from 2009 to 2019.

2. Data and Methodology

2.1 *Web of Science (WoS) and Essential Science Indicators (ESI)*

The ESI database has been updated as of March 12, 2020, to cover 11 years, January 1, 2009 – December 31, 2019. Papers counts for ESI are derived from the WoS Core Collection (SCIE and SSCI only). Papers are defined as regular scientific articles and review articles.

2.2 *Data collection and analysis*

Multi-level bibliometric information retrieval was performed on a single day on April 17, 2020 to avoid the bias caused by the daily updating open database. We separated four processes to get and analyse the top papers in the field (Figure 1).

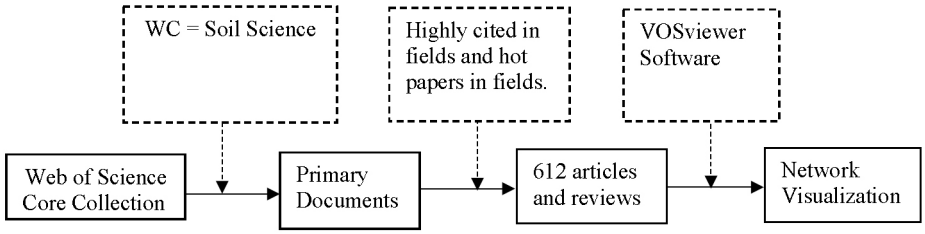

Figure 1

A framework of search criteria for Web of Science category (WC): Soil Science

First, we conducted an advanced search in the WoS Core Collection using the WoS Category (WC) following query: WC= (soil science)

Second, the results were refined by top papers, including highly cited papers in fields and hot papers in fields.

Third, we can get the total top papers including reviews and articles, during the 11 years period of January 1, 2009 – December 31, 2019.

Fourth, the full record and cited references of the included papers were extracted and imported into VOSviewer (Leiden University, Leiden, Netherlands) for further citation analysis.

The "analyze results" of the different index option allows ranking the records by fields according to the record count or the selected field.

2.3 *VOSviewer*

In this work, VOSviewer (version 1.6.15, 2020, Leiden University, Leiden, The Netherlands) was used to show the international collaboration between the authors, organizations, countries and the research trends through all keywords [31]. VOSviewer is widely used for showing maps of global scientific collaboration [32], advances in water use efficiency in agriculture [33], microbiology research topics [34], tourism research on sustainability [35], the creativity of business economics [36], the economics and sociology of wealth inequality [37], arts-based management [38], mapping knowledge domain of urban vitality research [39]. In this paper, default parameter values of the VOSviewer are usually used in the analysis.

3. Results and Discussion

3.1 *Document type and language of publication*

All 612 top papers were SCIE (612), Conference Proceedings Citation Index (CPCI)-Science (21), SSCI (9), Arts and Humanities Citation Index (1), and Book Citation Index-Sciences (1).

Among the 612 top papers, there were research articles (459, 75%), review articles (153, 25%), also proceedings papers (21, 3.431%) and book chapters (1, 0.163%). All of

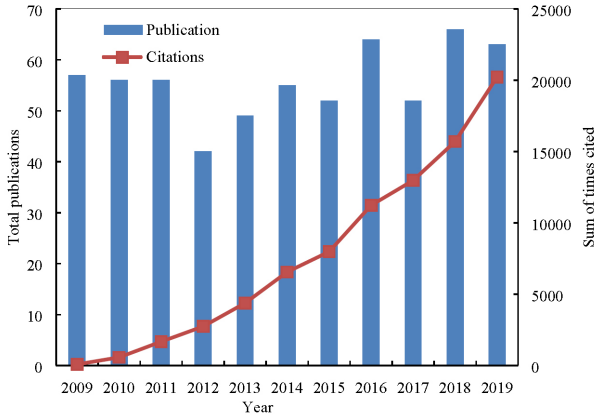

Figure 2

Number of top papers of soil science category per year from 2009 to 2019.

the papers were published in English. There are 17 hot papers and 608 highly cited paper that means 13 papers are both the hot paper and the highly cited papers.

3.2 *Publication output*

Figure 2 shows the research publication trend in the Soil Science category between 2009 and 2019. The average number of publications was 55.64 per year, and the highest value for the top papers was 66 in 2018. Total citations each year were power increased from 2009 to 2019. For the total 612 papers, the *h*-index is 176, and the average citation per item is 146.78.

3.3 *WoS categories and research areas*

Table 1 shows the soil sciences category's WoS categories and research areas. The categories included Soil Science (612 papers, 100% of 612 papers), Agronomy (104, 16.933 %), Plant Sciences (101, 16.503 %), Water Resources (75, 12.255 %), Geosciences Multidisciplinary (71, 11.601 %), Environmental Sciences (31, 5.065 %), Ecology (4, 0.654 %). The research areas included Agriculture (612 papers, 100% of 612 papers), Plant Sciences (101, 16.503 %), Water Resources (75, 12.255 %), Geology (71, 11.601 %), Environmental Sciences Ecology (35, 5719 %). Journals or papers may be classified into two or more categories in the WoS that show the multidisciplinary character of this research field [9-10].

3.4 *Core Journals*

Based on JCR 2018 data (published in 2019), there are 35 Journals of the WoS categories for soil sciences. All 612 publications were published in 29 journals. The top 11 core journals were displayed in Table 2 with total articles, each more than 12 top papers, Journal impact factor as IF 2018 and IF 5 year, rank and Quartile in soil sciences category.

Table 1

WoS Categories and research area for soil science category

Rank	WoS Categories	Total publications	% of 612	Research Areas	Records	% of 612
1	Soil Science	612	100	Agriculture	612	100
2	Agronomy	104	16.99	Plant Sciences	101	16.50
3	Plant Sciences	101	16.50	Water Resources	75	12.26
4	Water Resources	75	12.26	Geology	71	11.60
5	Geosciences Multidisciplinary	71	11.60	Environmental Sciences Ecology	35	5.72
6	Environmental Sciences	31	5.07			
7	Ecology	4	0.65			

The top 5 Journals and top 11 Journals published about 73.203 % and 89.543 % of all the top papers, respectively. *Soil Biology Biochemistry* was the most productive journal with 165 top papers (26.961 %), followed by *Geoderma* (95, 15.523 %), *Plant and Soil* (82, 13.399 %), *Catena* (71, 11.601 %), *Soil Tillage Research* (35, 5.719 %), each published more than 35 top papers. There are 8 journals ranked in Q1 and 3 journals in Q2 for the top 11 journals in Table 2. Citation analysis is not a measurement of scientific quality but reflects its importance [40].

Table 2

Top 11 Journal of soil science category indexed in the WoS during period from 2009 to 2019.

Rank	Journal	TP	Ratio of 612 (%)	IF 2018	IF5 year	QC
1	Soil Biology Biochemistry	165	26.96	5.290	6.065	Q1
2	Geoderma	95	15.52	4.336	4.564	Q1
3	Plant and Soil	82	13.40	3.259	3.761	Q1
4	Catena	71	11.60	3.851	4.149	Q1
5	Soil Tillage Research	35	5.72	4.675	4.662	Q1
6	European Journal of Soil Science	26	4.25	2.818	3.737	Q2
7	Biology and Fertility of Soils	22	3.60	4.829	4.320	Q1
8	Applied Soil Ecology	16	2.61	3.445	3.714	Q1
9	Journal of Plant Nutrition and Soil Science	12	1.96	2.057	2.664	Q2
10	Journal of Soils and Sediments	12	1.96	2.669	3.011	Q2
11	Land Degradation Development	12	1.96	4.275	4.866	Q1

TP: total publication; Ratio of 612 (%); IF 2018 and IF 5years. QC: Quartile in Category of soil science. Data were from the 2018 edition of Journal Citation Reports.

3.5 *Authors co-authorship analysis*

In general, internationally collaborative articles had the highest visibility and scientific impact, followed by inter-institutional collaborative articles, single-country articles and single-author articles, respectively [41]. Of the 2,631 authors, there were 115 authors met the threshold minimum productivity of 3 publications. The largest set of connected items consists of 25 items, while others are not. Authors in the same cluster usually suggested that they studied in a similar field and had close cooperation with each other in Figure 3.

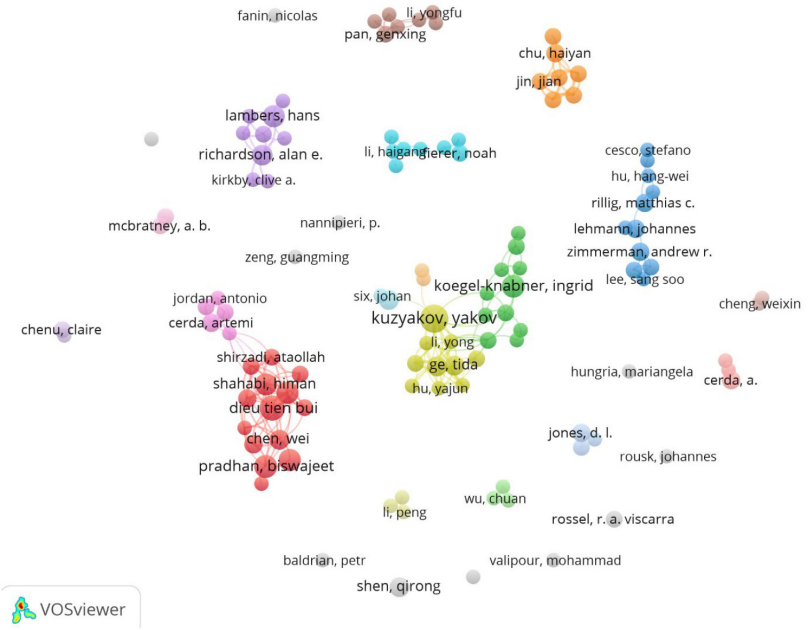

Figure 3

Network visualization map of top authors in soil science category from 2009 to 2019.

The link strength between two nodes refers to the frequency of co-authorship. The total link strength of a node is the sum of the link strengths of this node over all the other nodes. Table 3 show top 9 authors published more than 7 papers and total link strength, citations and average citations.

Table 3

The top 9 most prolific authors published papers in the field of soil science category

Rank	Author	Cluster	Documents	Total link strength	Citations	Avg. citations
1	Kuzyakov, Yakov	4	15	28	2785	185.7
2	Dieu Tien Bui	1	11	34	648	58.9

Contd...

3	Koegel-Knabner, Ingrid	2	9	10	1753	194.8
4	Pradhan, Biswajeet	1	9	13	1295	143.9
5	Binh Thai Pham	1	8	26	389	48.6
6	Lambers, Hans	5	8	12	1348	168.5
7	Pourghasemi, Hamid Reza	1	8	3	610	76.3
8	Shahabi, Himan	1	8	26	380	47.5
9	Richardson, Alan E.	5	7	17	1606	229.4

3.6 *Countries/regions co-authorship analysis*

There are 76 countries contributing the 612 top papers. Table 4 lists the top 10 countries/regions above 30 top papers ranked by the number of total publications, and also list the total link strength, citations and average citations.

Table 4

Top 10 countries/regions publishing top papers in the field of soil science category

Rank	Countries	Records	Cluster	Total link strength	Citations	Avg. citations
1	Peoples R China	161	2	171	16111	100.1
2	USA	158	2	222	27763	175.7
3	Germany	97	1	173	16594	171.1
4	Australia	83	2	179	15970	192.4
5	France	54	1	156	11203	207.5
6	England	48	1	138	9750	203.1
7	Italy	47	1	105	6278	133.6
8	Spain	38	1	63	5495	144.6
9	Netherlands	36	1	109	6221	172.8
10	Iran	31	3	47	2064	66.6

In Figure 4, 38 countries/regions met the 5 thresholds and were divided into 4 clusters. Peoples R China, USA, Germany, Australia and France are the five biggest circles. The first cluster consisted of 15 countries and regions (red color), Germany, France, England, Italy, Spain, Netherlands, Scotland, Sweden, Austria, Denmark, Czech Republic, Poland, Greece, Israel, and Portugal. The second cluster consisted of 9 countries or regions (green color), Peoples R China, USA, Australia, Canada, South Korea, Russia, Pakistan, Kenya, and Mexico. The third cluster consisted of 8 countries (blue color), Iran, Belgium, India, Malaysia, Vietnam, Norway, Japan, and Bangladesh. The fourth cluster consisted of 6 countries and regions (yellow color), New Zealand, Switzerland, Brazil, Wales, Ireland, and Chile.

Figure 4 shows that the Peoples R China and the USA were not only the research center but also closely cooperated with many countries. Nowadays, increasing international exchanges have promoted academic communications [42].

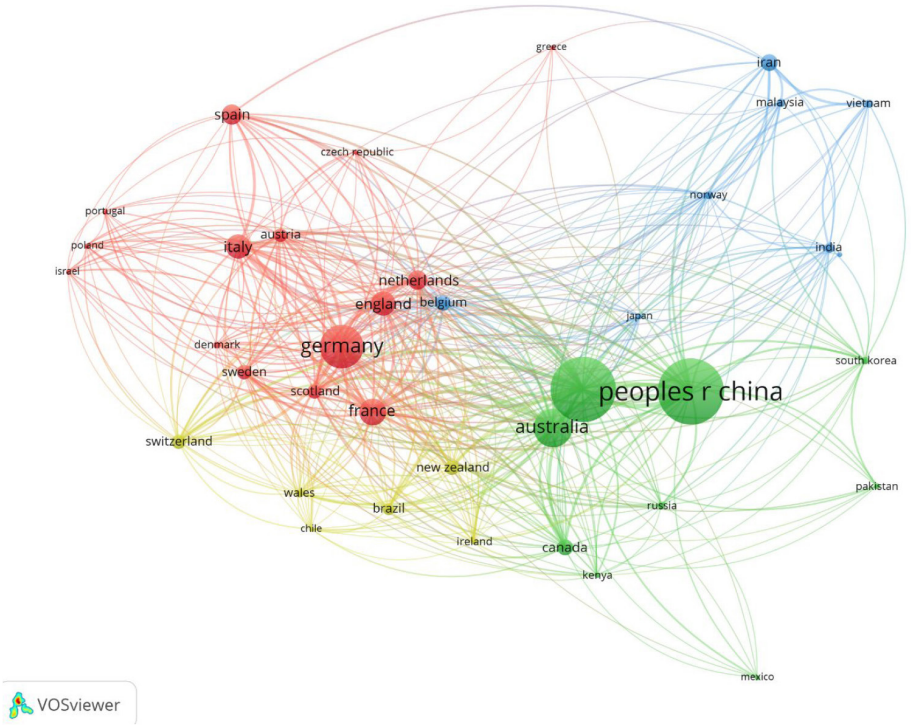

Figure 4

The country co-authorship network of soil science category related top papers from 2009 to 2019.

3.7 *Organizations co-authorship analysis*

All 890 organizations contributed the 612 top papers. Table 5 lists the top 11 organizations above 14 papers ranked by the number of total publications and also shows the total link strength, citations and average citations.

Table 5

Top 11 organizations indexed using the Web of Science

Rank	Organizations	Cluster	Records	Total link strength	Citations	Avg. citations
1	Chinese Academy of Sciences	7	73	62	7268	99.6
2	University of Western Australia	2	21	26	3912	186.3
3	University of Chinese Academy of Sciences	7	19	23	1058	55.7

Contd...

4	Institut Nationale de la Recherche Agronomigue (INRA)	1	18	21	2791	155.1
5	Nanjing Agricultural University	1	17	12	2215	130.3
6	Wageningen University	6	16	23	3090	193.1
7	Colorado State University	5	14	19	2944	210.3
8	Consejo Superior de Investigaciones Científicas (CSIC)	2	14	8	2301	164.4
9	Northwest A&F University	7	14	23	1240	88.6
10	Technical University of Munich	4	14	20	2167	154.8
11	University of Sydney	1	14	10	2282	163.0

There were 68 organizations that met the threshold of 5. In Figure 5, the VOSviewer software divided these 67 institutes into 10 clusters with different colors. The 10 clusters each included 13, 10, 10, 9, 7, 6, 4, 3, 3, and 2 organizations.

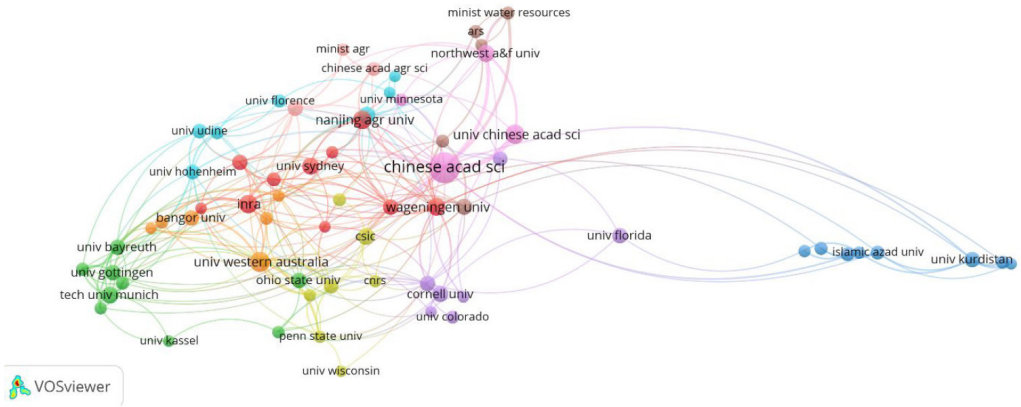

Figure 5

The organizations co-authorship network of soil science category related publications from 2009 to 2019.

3.8 *All Keywords co-occurrence analysis*

Of the 4,250 all keywords, there were only 324 keywords that met the 5 thresholds, which were separated into 6 main clusters on Soil Science (Figure 6). The top 20 all keywords were organic-matter, black carbon, biochar, charcoal, nitrogen, microbial biomass, diversity, carbon, decomposition, biomass, rhizosphere, arbuscular mycorrhizal fungi, management, dynamics, soil organic matter, organic-carbon, carbon sequestration, microbial community, land-use, ph. each keywords occurred more than 25 times.

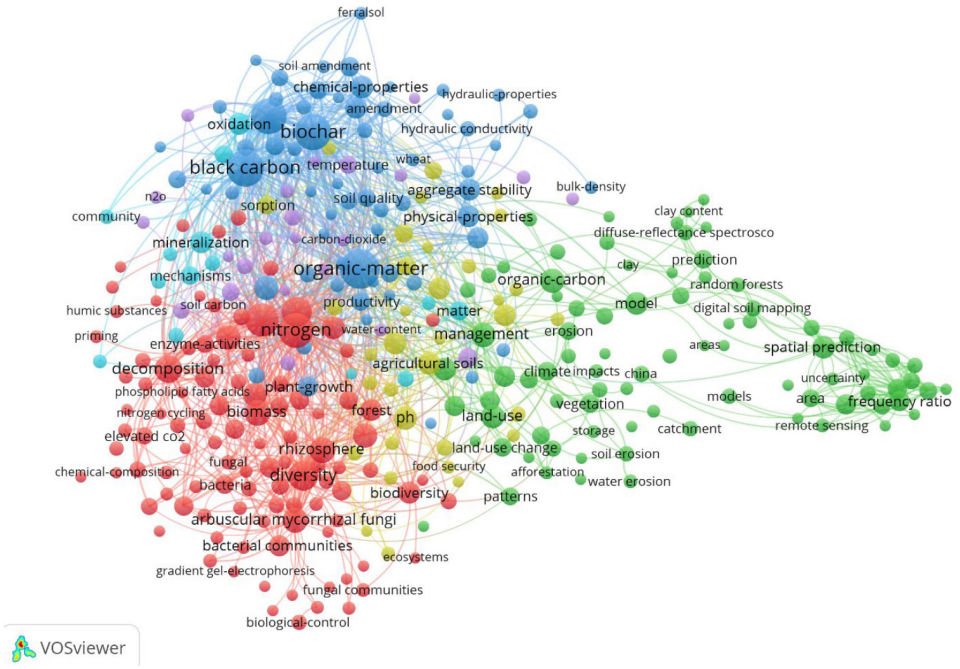

Figure 6

VOSviewer co-occurrence network visualization mapping of most frequent all keywords (minimum of 5 occurrences) in soil science category research from 2009 to 2019.

The same data were then arranged by a soil science category research period as an overlay map (Figure 7). Blue colors indicate earlier research topics, whereas yellow and green colors indicate more recent topics of interest.

Here, about the top twenty, all keywords were listed and ranked in each cluster based on Figure 6.

The first cluster (red) is focused on soil nitrogen, including keyword terms as nitrogen, microbial biomass, diversity, carbon, decomposition, biomass, rhizosphere, arbuscular mycorrhizal fungi, dynamics, soil organic matter, microbial community, biodiversity, bacterial communities, microbial communities, forest soils, plant, community structure, fungi, respiration, bacteria, each all keywords occurred more than 15 times.

The second cluster (green) represents the soil organic-carbon management, keyword terms ranked as management, organic-carbon, land-use, spatial prediction, climate-change, model, sequestration, frequency ratio, GIS, soil organic carbon, logistic-regression, tillage, climate, land-use change, prediction, vegetation, loess plateau, support vector machine, systems, area, each all keywords occurred more than 13 times.

The third cluster (blue) is focused on soil organic matter, including keyword terms such as organic matter, black carbon, biochar, charcoal, carbon sequestration, chemical properties, growth, physical properties, aggregate stability, manure, oxidation, quality,

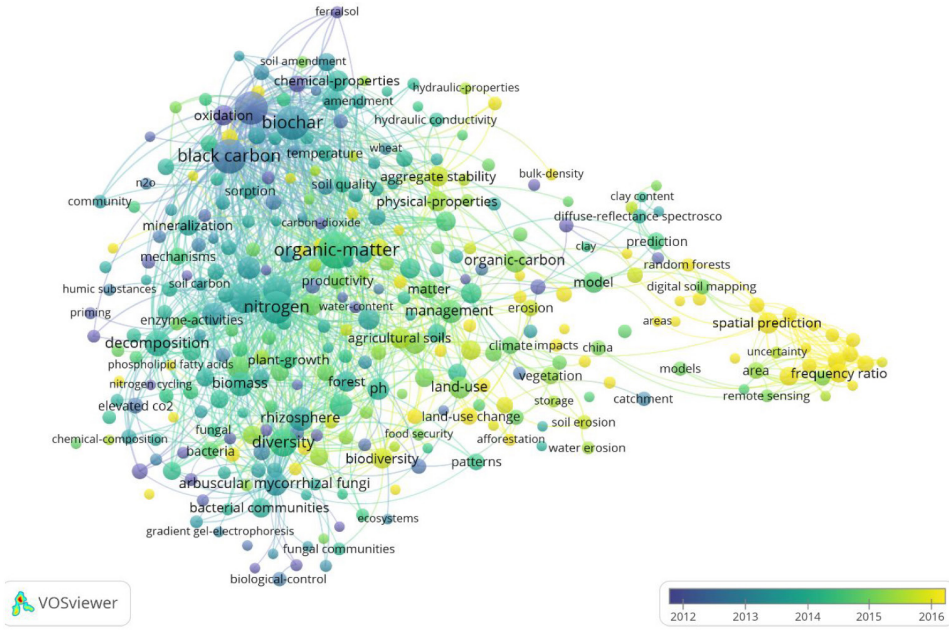

Figure 7

VOSviewer co-occurrence overlay visualization mapping of most frequent all keywords (minimum of 5 occurrences) in soil science category research from 2009 to 2019.

plant growth, pyrolysis, productivity, soil fertility, fertility, soil quality, sustainable agriculture, yield, each all keywords occurred more than 14 times.

The fourth cluster (yellow) represents soil mineralization, keyword terms ranked as mineralization, forest, impact, temperature sensitivity, nitrification, temperature, nitrous-oxide emissions, ammonia-oxidizing bacteria, denitrification, long-term fertilization, paddy soil, turnover, community, grassland soils, nitrous-oxide, soil respiration, terrestrial ecosystems, bacterial-growth, carbon-dioxide, CO_2, each all keywords occurred more than 6 times.

The fifth cluster (violet) is focused on soil characteristic and soil contamination, including keyword terms as pH, agricultural soils, phosphorus, soil, water, adsorption, sorption, availability, bioavailability, identification, contamination, extraction method, abundance, heavy-metals, organic matter, soil pH, amendments, bacterial community, bacterial diversity, cadmium, each all keywords occurred more than 7 times.

The sixth cluster (shallow blue) is focused on soil matter and nitrogen-fertilization, keyword terms ranked as matter, mechanisms, fractions, nitrogen-fertilization, temperate soils, soil microbial biomass, extraction, priming effect, stabilization, subsoil, each all keywords occurred more than 9 times.

3.9 *The most frequently cited articles*

The top 9 papers of total citations more than 600 times [43-51], which the total citations were 1671, 912, 871, 772, 749, 685, 643, 639, 619 times, average citations per year were 167.1, 82.9, 79.2, 70.2, 68.1, 62.3, 64.3, 63.9, 51.6 times. They were from the different journals of *Soil Biology & Biochemistry* (4), *Plant and Soil* (4) and *Advances in Agronomy* (1), and different years of 2009 (1), 2010 (5) and 2011 (3). The annual citations of the nine papers showed a trend to increase during their citation history after the published year. The time dependence of a single paper is called its history. In the beginning year (zero year here), this was lower because all papers appeared in that published year. Figure 8 shows that the citation per year of the nine papers increased till April 17, 2020, but the increase rate is different.

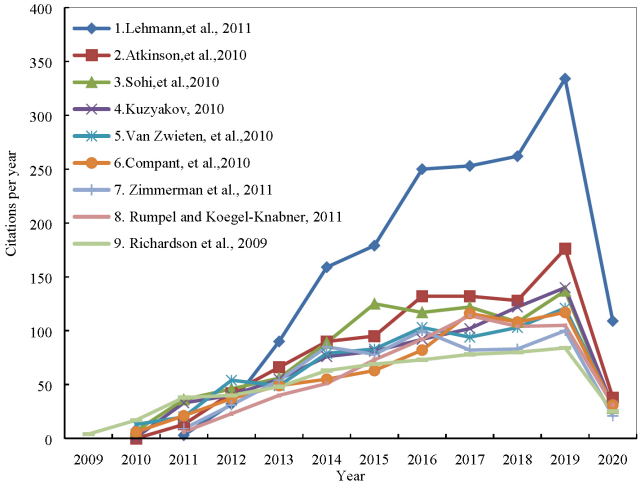

Figure 8

Comparison of the citations of the most nine papers in Table 6 from their initial publications to April 17, 2020

4. Conclusion

The 612 top papers include 608 highly cited papers and 17 hot papers. Results showed that these papers, all written in English, were from 2,631 authors, 890 organizations and 76 countries/territories, listed in 29 journals in the field of Soil Science. Based on the analysis of the network map of VOSviewer, is a cooperation between authors, organizations and countries or regions. The analysis of all keywords showed that these researches were separated into six clusters. This work demonstrates that more top papers come from journals with a higher IF and rank in Category. Visualizations offer exploratory information on the current state of a scientific field or discipline and indicate possible future developments.

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Conflict of Interest

The authors declare that they have no conflict of interest.

References

[1] Zhang, N., Wan, S.S., Wang, P.L., Zhang, P., Wu, Q. A bibliometric analysis of highly cited papers in the field of Economics and Business based on the Essential Science Indicators database. *Scientometrics*, 116, 1039-1053 (2018).

[2] Noorhidawati, A., Aspura, Y.I.M.K., Zahila, M.N., Abrizah, A. Characteristics of Malaysian highly cited papers. *Malaysian Journal of Library and Information Science,* 22(2), 85-99 (2017).

[3] Fu, H.Z., Chuang, K.Y., Wang, M.H., Ho, Y.S. Characteristics of research in China assessed with Essential Science Indicators. *Scientometrics*, 88(3), 841-862 (2011).

[4] Sun, J., Yuan, B.Z. Mapping of the world rice research: A bibliometric analysis of top papers during 2008–2018. *Annals of Library and Information Studies*, 67(1), 56-66 (2020).

[5] Chuang, K.Y., Wang, M.H., Ho, Y.S. High-impact papers presented in the subject category of water resources in the essential science indicators database of the institute for scientific information. *Scientometrics*, 87, 551-562 (2011).

[6] Bauer, J., Leydesdorff, L., Bornmann, L. Highly Cited Papers in Library and Information Science (LIS): Authors, Institutions, and Network Structures. *Journal of the Association for Information Science and Technology*, 67(12), 3095-3100 (2016).

[7] Dorta-González, P., Santana-Jiménez, Y. Characterizing the highly cited articles: A large-scale bibliometric analysis of the top 1% most cited research. *Malaysian Journal of Library and Information Science*, 24(2), 23-39 (2019).

[8] Ho, Y.S. Top-cited articles in chemical engineering in Science Citation Index Expanded: a bibliometric analysis. *Chin. J. Chem. Eng.*, 20, 478-488 (2012).

[9] Elango, B., Ho, Y.S. A bibliometric analysis of highly cited papers from India in Science Citation Index Expanded. *Current Science*, 112(8), 1653-1658 (2017).

[10] Elango, B., Ho, Y.S. Top-cited articles in the field of tribology: A bibliometric analysis. *COLLNET Journal of Scientometrics and Information Management*, 12(2), 289-307 (2018).

[11] Ivanović, L., Ho, Y. S. Highly cited articles in the Education and Educational Research category in the Social Science Citation Index: a bibliometric analysis. *Educational Review,* 71(3), 277-286 (2019).

[12] Stavropoulou, C., Somai, M., Ioannidis, J.P.A. Most UK scientists who publish extremely highly- cited papers do not secure funding from major public and charity funders: A descriptive analysis. *PLoS ONE*, 14(2), e0211460 (2019).

[13] Navarrete, Ian A., Asio, Victor B. Research productivity in soil science in the Philippines. *Scientometrics*, 100, 261-272 (2014).

[14] Huang, W.L., Zhang, B.G., Feng, C.P., Li, M., Zhang, J. Research trends on nitrate removal: a bibliometric analysis. *Desalination and Water Treatment*, 50, 67-77 (2012).

[15] Zhi, W., Yuan, L., Ji, G.D., Liu, Y.S., Cai, Z., Chen, X. A bibliometric review on carbon cycling research during 1993–2013. *Environ Earth Sci*, 74, 6065-6075 (2015).

[16] Escadafal, R., Barbero-Sierra, C., Exbrayat, W., Marques, M.J., Akhtar-Schuster, M., El Haddadi, A., Ruiz, M. First appraisal of the current structure of research on land and soil degradation as evidenced by bibliometric analysis of publications on desertification. *Land Degradation and Development*, 26, 413-422 (2015).

[17] Romanelli, J.P., Fujimoto, J. T., Ferreira, M.D., Milanez, D.H. Assessing ecological restoration as a research topic using bibliometric indicators. *Ecological Engineering*, 120, 311-320 (2018).

[18] Mao, G.Z., Shi, T.T., Zhang, S., Crittenden, J., Guo, S.Y., Du, H.B. Bibliometric analysis of insights into soil remediation. *Journal of Soils and Sediments*, 18, 2520-2534 (2018).

[19] Pan, W.W., Jian, L.R., Liu, T. Grey system theory trends from 1991 to 2018: a bibliometric analysis and visualization. *Scientometrics*, 121, 1407-1434 (2019).

[20] Aznar-Sánchez, J.A., Velasco-Muñoz, J.F., Belmonte-Ureña, L.J., Manzano-Agugliaro, F. Innovation and technology for sustainable mining activity: A worldwide research assessment. *Journal of Cleaner Production*, 221, 38-54 (2019).

[21] Zemigala, M. Tendencies in research on sustainable development in management sciences. *Journal of Cleaner Production,* 218, 796-809 (2019).

[22] Sun, J., Yuan, B.Z. Visualization analysis of research on rice with fertilizer from the 'agronomy' category based on CiteSpace. *Current Science*, 117(9), 1449-1458 (2019).

[23] Sun, J., Yuan, B.Z. A bibliometric analysis of research on rice and irrigation from the 'agronomy' category based on the web of science. *Current Science*, 119(3), 438-446 (2020).

[24] Yuan, B.Z., Sun, J. Bibliometric and mapping of top papers in the subject category of green and sustainable science and technology based on ESI. *COLLNET Journal of Scientometrics and Information Management,* 13(2), 269-289 (2019).

[25] Sun, J., Yuan, B.Z. Mapping of the world rice research: A bibliometric analysis of top papers during 2008–2018. *Annals of Library and Information Studies*, 67(1), 56-66 (2020).

[26] Sun, J., Yuan, B.Z. Bibliometric mapping of top papers in Library and Information Science based on the Essential Science Indicators Database. *Malaysian Journal of Library and Information Science,* 25(2), 61-76 (2020).

[27] Sun, J., Yuan, B.Z. Mapping of top papers in the subject category of Water Resources based on the Essential Science Indicators. *Annals of Library and Information Studies*, 67(2), 90-102 (2020).

[28] Sun, J., Yuan, B. Z. Trend and research status of Agronomy based on the Essential Science Indicators during 2009–2019. *Agronomy Journal,* 113(2), 2184-2194 (2021).

[29] Yuan, B. Z., Sun, J. Bibliometric analysis of research on the maize based on top papers during 2009–2019. *COLLNET Journal of Scientometrics and Information Management*, 14(1), 75-92 (2020).

[30] Yuan, B.Z., Sun, J. Mapping the scientific research on maize or corn: a bibliometric analysis of top papers during 2008–2018. *Maydica,* 65(2), 2020b, M17.

[31] Van Eck, N.J., Waltman, L. Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics,* 84, 523-538 (2010).

[32] Bornmann, L. Is the promotion of research reflected in bibliometric data? A network analysis of highly cited papers on the Clusters of Excellence supported under the Excellence Initiative in Germany. *Scientometrics,* 107, 1041-1061 (2016).

[33] Velasco-Muñoz, Juan F., Aznar-Sánchez, José A., Belmonte-Ureña, Luis J., López-Serrano, María J. Advances in water use efficiency in agriculture: a bibliometric analysis. *Water,* 10, 377 (2018).

[34] Dehdarirad, T., Sotudeh, H., Freer, J. Bibliometric mapping of microbiology research topics (2012–16): a comparison by socioeconomic development and infectious disease vulnerability values. *FEMS Microbiology Letters*, 366, 2019, fnz004.

[35] Niñerola, A., Sánchez-Rebull, M.V., Hernández-Lara, A.B. Tourism Research on Sustainability: A Bibliometric Analysis. *Sustainability,* 11, 1377 (2019).

[36] Castillo-Vergara, M., Alvarez-Marin, A., Placencio-Hidalgo, D. A bibliometric analysis of creativity in the field of business economics. *Journal of Business Research*, 85, 1-9 (2018).

[37] Korom, P. A bibliometric visualization of the economics and sociology of wealth inequality: a world apart? *Scientometrics*, 118, 849-868 (2019).

[38] Ferreira, Fernando A.F. Mapping the field of arts-based management: Bibliographic coupling and cocitation analyses. *Journal of Business Research*, 85, 348-357 (2018).

[39] Shi, J.G., Miao, W., Si, H.Y. Visualization and Analysis of Mapping Knowledge Domain of Urban Vitality Research. *Sustainability,* 11, 988 (2019).

[40] White-Gibson, A., O'Neill, B., Cooper, D., Leonard, M., O'Daly, B. Levels of evidence in pelvic trauma: a bibliometric analysis of the top 50 cited papers. *Irish Journal of Medical Science*, 188, 155-159 (2019).

[41] Wambu, E.W., Ho, Y.S. A bibliometric analysis of drinking water research in Africa. *Water SA,* 42(4), 612-620 (2016).

[42] Tang, M., Liao, H.C., Wan, Z.J., Herrera-Viedma, E., Rosen, Marc A. Ten Years of Sustainability (2009 to 2018): A Bibliometric Overview. *Sustainability,* 10, 1655 (2018).

[43] Lehmann, J., Rillig, Matthias C., Thies, J., Masiello, Caroline A., Hockaday, William C., Crowley, D. Biochar effects on soil biota - A review. *Soil Biology and Biochemistry*, 43(9), 1812-1836 (2011).

[44] Atkinson, Christopher J., Fitzgerald, Jean D., Hipps, Neil A. Potential mechanisms for achieving agricultural benefits from biochar application to temperate soils: a review. *Plant and Soil,* 337(1-2), 1-18 (2010).

[45] Sohi, S. P., Krull, E., Lopez-Capel, E., Bol, R. A review of biochar and its use and function in soil. *Advances in Agronomy*, 105, 47-82 (2010).

[46] Kuzyakov, Yakov. Priming effects: Interactions between living and dead organic matter. *Soil Biology and Biochemistry,* 42(9), 1363-1371 (2010).

[47] Van Zwieten, L., Kimber, S., Morris, S., Chan, K.Y., Downie, A., Rust, J., Joseph, S., Cowie, A. Effects of biochar from slow pyrolysis of paper mill waste on agronomic performance and soil fertility. *Plant and Soil,* 327(1-2), 235-246 (2010).

[48] Compant, S., Clement, C., Sessitsch, A. Plant growth-promoting bacteria in the rhizo- and endosphere of plants: Their role, colonization, mechanisms involved and prospects for utilization. *Soil Biology and Biochemistry,* 42(5), 669-678 (2010).

[49] Zimmerman, Andrew R., Gao, Bin, Ahn, Mi-Youn. Positive and negative carbon mineralization priming effects among a variety of biochar-amended soils. *Soil Biology and Biochemistry*, 43(6), 1169-1179 (2011).

[50] Rumpel, C., Koegel-Knabner, Ingrid. Deep soil organic matter-a key but poorly understood component of terrestrial C cycle. *Plant and Soil,* 338(1-2), 143-158 (2011).

[51] Richardson, Alan E., Barea, Jose-Miguel, McNeill, Ann M., Prigent-Combaret, Claire. Acquisition of phosphorus and nitrogen in the rhizosphere and plant growth promotion by microorganisms. *Plant and Soil,* 321(1-2), 305-339 (2009).