

Global Research On Hydroponics: A Bibliometric Analysis

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Abstract

This paper analysis the research output of hydroponics publications for the period 1989 - 2020. The data for the study was downloaded from the Web of Science database. The minimum distribution of publications in the year is 1990 14 (0.16%) whereas the maximum distribution is 869 (9.89%) in the year 2020. The most prolific author is Zhang GP 65 (0.75%). The country China contributed 1829 (20.99%) publications and secured first position. The most productive Institution is the Chinese Academy of Sciences 176 (2.02%) publications. The highest number of publications are from the Journal of Plant Nutrition, 351 (4.03%).

Keywords: *Bibliometric Analysis, Hydroponic, Web of Science, Mapping, Agriculture, Hydroculture.*

INTRODUCTION

The availability of land, freshwater, fossil energy, and nutrients is essential to food production (Conijn et al. 2018). The rate at which these resources are consumed or destroyed presently surpasses their global regeneration rate (Van Vuuren et al. 2010). In this context, hydroponics technology of cultivation was introduced to agriculture to overcome these restrictions. Hydroponics (William F. 1937) is a method of growing crops without using traditional soil, using mineral-rich water solutions. It is a division of hydroculture with less water (Dos Santos, J. D. 2013). Crop needs water, sunlight, and nutrients to grow up. Roots absorb nutrients available in the water. John Woodward believed in nine essential elements to plant growth and the technics developed soilless cultivation. (Douglas, j. S. (1975). Paul Otlet first used the term bibliometric in 1934 and defined as "the measurement of all aspects related to the publication and reading of books and document (Rousseau, Ronald (2014), Bibliometric tools have been utilised to trace linkages among academic journal citations. Citation analysis, which entails reviewing an item's referring documents, is used in looking for materials and analyzing their worth (Schaer, Philipp (2013).

OBJECTIVES OF THE STUDY

- To study the year-wise distribution of publications;
- To identify the most prolific authors and language-wise distributions;
- To analyze the institution and country wise distribution of publications;
- To find out the source wise and Web of Science catagories wise distribution of publications;

METHODOLOGY

The data for the study was downloaded from the Web of Science database. The Basic Search option was used to download the data; the key term "Hydophonics" was used to download the data. The study period is 1989-2020, and there are 8712 documents indexed in the database. As the Web of Science has the option only for downloading 500 data simultaneously, the data are downloaded one by one. After downloading the data, the data were analyzed using Microsoft Excel software.

RESULT AND DISCUSSION

Year-wise distribution of publications

Table 1 explains the distribution of publications for the period 1989 to 2020 on the topic of hydroponics research. The table shows that the minimum distribution of publications in the year is 1990 14 (0.16%) whereas the maximum distribution is 869 (9.89%) in the year 2020. There is a fluctuation in distribution of publications from the year 1989 to till the year 2008 after that there is a steady growth in distribution of publications. The average distribution of publications is 272 per year.

Table 1 Year-wise distribution of publications

Sl. No.	Publication Years	Records	%	Cumulative Total
1.	1989	15	0.17	15
2.	1990	14	0.16	29
3.	1991	78	0.90	107
4.	1992	87	1.00	194
5.	1993	82	0.94	276
6.	1994	79	0.91	355
7.	1995	98	1.13	453
8.	1996	89	1.02	542
9.	1997	126	1.45	668
10.	1998	115	1.32	783
11.	1999	140	1.61	923
12.	2000	131	1.50	1054
13.	2001	114	1.31	1168
14.	2002	147	1.69	1315
15.	2003	183	2.10	1498
16.	2004	201	2.31	1699

17.	2005	208	2.39	1097
18.	2006	234	2.69	2141
19.	2007	230	2.64	2371
20.	2008	319	3.66	2690
21.	2009	356	4.09	3046
22.	2010	365	4.19	3411
23.	2011	372	4.27	3783
24.	2012	376	4.32	4159
25.	2013	383	4.40	4542
26.	2014	410	4.71	4952
27.	2015	479	5.50	5431
28.	2016	527	6.05	5958
29.	2017	568	6.52	6526
30.	2018	593	6.81	7119
31.	2019	724	8.31	7843
32.	2020	869	9.98	8712
Total		8712	100.00	

MOST PROLIFIC AUTHOR

Table 2 gives the list of top ten most prolific authors with the number of publications against them. Zhang GP has contributed 65 (0.75%) and secured first position, followed by Wu FB 50 (0.57%), Savvas D 49 (0.56%), Wang Y 44 (0.51%) Ali S 40 (0.46%), Shen QR 39 (0.45%), Yu Xz 37 (0.43%) Zhang J 37 (0.43%), Li Y 35 (0.40%), Wang Q 34 (0.39%).

Table 2 Most Prolific Author

Sl. No.	Author	Records	% of 8712	Rank
1	Zhang GP	65	0.75	1
2	Wu FB	50	0.57	2
3	Savvas D	49	0.56	3
4	Wang Y	44	0.51	4
5	Ali S	40	0.46	5
6	Shen QR	39	0.45	6
7	Yu XZ	37	0.43	7
8	Zhang J	37	0.43	8
9	Li Y	35	0.40	9
10	Wang Q	34	0.39	10

LANGUAGE-WISE DISTRIBUTION

Table 3 shows language wise distribution of publications. 95.78% of authors have contributed their research publications in English language and remaining 4.22% publications published other languages. Portuguese 162 (1.86%), Spanish 56 (0.65%), Japanese, 43 (0.49%), Korean 42 (0.48%) French 20 (0.23%), Chinese 12 (0.14%), German

12 (0.145%), Czech 8 (0.09%), Russian 4 (0.05%), Turkish 3 (0.03%), Dutch 2 (0.025%), Polish 2 (0.02%), Hungarian 1 (0.01%), Italian 1 (0.01%).

Table 3 Language-wise distribution of publications

Sl.No	Language	Record	%
1	English	8344	95.78
2	Portuguese	162	1.86
3	Spanish	56	0.65
4	Japanese	43	0.49
5	Korean	42	0.48
6	French	20	0.23
7	Chinese	12	0.14
8	German	12	0.14
9	Czech	8	0.09
10	Russian	4	0.05
11	Turkish	3	0.03
12	Dutch	2	0.02
13	Polish	2	0.02
14	Hungarian	1	0.01
15	Italian	1	0.01
		8712	100

COUNTRY-WISE DISTRIBUTION

Table 4 explains top ten countries' wise distribution of publications on hydroponics research. The top ten countries contributed 79.58% of publications, whereas the rest of the countries contributed 20.42 % percentage only. The country China contributed 1829 (20.99%) publications and secured first position. USA ranked second with 1695 (19.46%) publications. Japan stood third rank 609 (6.99%) publications. Rest of the country contributor to less than 421 publications.

Table 4 Country-wise distribution of publications

Sl.No	Country	Record	%
1	China	1829	20.99
2	USA	1695	19.46
3	Japan	609	6.99
4	Brazil	560	6.43
5	Germany	451	5.18
6	Spain	421	4.83
7	Italy	378	4.34
8	Australia	345	3.96
9	India	342	3.93
10	France	303	3.48

INSTITUTION WISE DISTRIBUTION

There were 5089 institutions involved in the research in this field. The most productive Institution is Chinese Academy of Sciences 176 (2.02%) publications, followed by Zhejiang University with 252 (2.89%), United States Department of Agriculture USDA with 191 (2.19%), Nanjing Agricultural University with 178 (2.04%), Chinese Academy of Agricultural Sciences with 176 (2.02%), INRAE with 165 (1.89%), State University System of Florida 153 (1.76%), University of Florida with 139 (1.60%), Consejo Superior De Investigaciones Cientificas Csic with 119 (1.37%), University of California System with 117 (1.34%).

Table 5 Institute wise distribution of publications

Sl.No	Institution	Record	%
1	Chinese Academy of Sciences	321	3.69
2	Zhejiang University	252	2.89
3	United States Department of Agriculture USDA	191	2.19
4	Nanjing Agricultural University	178	2.04
5	Chinese Academy of Agricultural Sciences	176	2.02
6	INRAE	165	1.89
7	State University System of Florida	153	1.76
8	University of Florida	139	1.60
9	Consejo Superior De Investigaciones Cientificas Csic	119	1.37
10	University of California System	117	1.34

JOURNAL WISE DISTRIBUTION OF PUBLICATIONS

The distribution of publications in various journals in literature has been given in this table. The highest number of publications are from the Journal of Plant Nutrition 351 (4.03%) of publications, followed by Plant and Soil with 306 (3.51%), Hortscience with 303 (3.48%), Scientia Horticulturae with 185 (2.12%). Environmental Science and Pollution Research 182 (2.09%), Environmental and Experimental Botany with 145 (1.66%), Chemosphere with 140 (1.61%), Frontiers in Plant Science 133 (1.53%), International Journal of Phytoremediation 132 (1.52%), Plant Physiology and Biochemistry 130 (1.49%) of publications.

Table 6 Journal wise distribution of publications

Sl.No	Journal	Record	%
1	Journal of Plant Nutrition	351	4.03
2	Plant and Soil	306	3.51
3	Hortscience	303	3.48
4	Scientia Horticulturae	185	2.12
5	Environmental Science and Pollution Research	182	2.09
6	Environmental and Experimental Botany	145	1.66
7	Chemosphere	140	1.61
8	Frontiers in Plant Science	133	1.53
9	International Journal of Phytoremediation	132	1.52
10	Plant Physiology and Biochemistry	130	1.49

WEB OF SCIENCE CATEGORY WISE DISTRIBUTIONS

Table 7 shows Web of Science subject category; Plant Science publications are 3227 (37.04 %) followed by Environmental Sciences 1914 (21.97%), Agronomy 1302 (14.95%), Horticulture 1061 (12.18%) Soil Science 636 (7.30%) Agriculture Multidisciplinary 492 (5.65%), Engineering Environmental 343 (3.94%), Food Science Technology 340(3.90%), Biotechnology Applied Microbiology 325 (3.73%), Biochemistry Molecular Biology 304 (3.49%).

Table 7 Web of Science category wise distributions

Sl.No	Web of Science Category	Record	%
1	Plant Sciences	3227	37.04
2	Environmental Sciences	1914	21.97
3	Agronomy	1302	14.95
4	Horticulture	1061	12.18
5	Soil Science	636	7.30
6	Agriculture Multidisciplinary	492	5.65
7	Engineering Environmental	343	3.94

8	Food Science Technology	340	3.90
9	Biotechnology Applied Microbiology	325	3.73
10	Biochemistry Molecular Biology	304	3.49

CONCLUSION

This paper analysis the research output of hydroponics publications for the period 1989 -2020. There is a fluctuation in distribution of publications from the year 1989 to till the year 2008 after that there is a steady growth in distribution of publications. The average distribution of publications is 272 per year. The most prolific author is Zhang GP contributed 65 (0.75%) publications and secured first position. 95.78% of authors have contributed their research publications in the English language, and the remaining 4.22% publications published in other languages. The top ten countries contributed 79.58% of publications, whereas the rest of the countries contributed 20.42 % percentage only. The country China contributed 1829 (20.99%) publications and secured first position. The most productive Institution is the Chinese Academy of Sciences 176 (2.02%). The highest number of publications are from the Journal of Plant Nutrition 351 (4.03%), followed by Environmental Sciences 1914 (21.97%).

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