Global research output on Rhododendron publications based on Web of Science database: A scientometric study

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Abstract

Purpose: This study aims to conduct a comprehensive analysis of research publications on Rhododendron from the Web of Science Core Collection database.

Methodology: A total of 3082 records from 1989 to 2022 were extracted from the Web of Science Core Collection database. The data analyzed using MS Excel and VOS viewer software was used to determine the most frequent keywords used in the publications.

Findings: The analysis shows that the number of research publications on Rhododendron has been increasing steadily over the years. The year 2022 recorded the highest number of publications (213), indicating growing interest and continued research activity in this specialized area. The top 10 most prolific authors are dominated by individuals from China, with Li Yong leading with 26 publications. The United States Department of Agriculture, Agricultural Research Service, and Mae Fah Luang University ranked second and third, respectively, among the most productive organizations. China emerged as the most prolific country in terms of the number of research publications on Rhododendron, followed by the United States and India. The keywords most frequently occurring in the publications include "rhododendron," "Ericaceae," and "plants," reflecting the central focus of research in this area.

Research limitations: The findings of the study are limited to the data available in the Web of Science Core Collection database from 1989 to 2022.

Originality/Value: The findings contribute to a better understanding of the scientific landscape within this field and can help in shaping future research directions and discoveries related to Rhododendrons.

Keywords: Rhododendron, burans, medicinal plant, Ericaceae, scientometrics, Web of Science.

1. Introduction

Growing plants for therapeutic purposes is a very old practice. The potential of herbs and traditional medicine to cure a wide range of disorders and diseases is being investigated more and more. Rhododendron has been used in traditional medicine for centuries in various regions of the world. The tree's leaves, blossoms, and bark contain several chemicals that are thought to have therapeutic properties. These are valued not only for their medicinal powers, but also for their wood, which is used to build furniture, flooring, and other things.

The name Rhododendron comes from the Greek words Rhodo, which means "rose," and Dendron, which means "tree." The Rhododendron originated in north-central India and is now found throughout the Himalayas from Kashmir to Bhutan, as well as in the hills of Assam and Manipur at elevations of 1200-1400 metres reported by Chauhan (1999). Rhododendron is a Himalayan flowering shrub known for its gorgeous blossoms. The plant is a member of the Ericaceae family, which includes over 1000 species native to Southeast Asia and Northern Australia, as well as temperate Asia, North America, and Europe. The Himalayan ranges from Uttarakhand, Nepal, and Sikkim to Yunnan and Sichuan have the highest species variety, with other notable areas of diversity in Indo–China, Korea, Japan, and Taiwan. Rhododendron, also known as "Lali Guras" in Nepalese, is the national flower of Nepal and the state tree of the Indian state of Uttarakhand, known as Burans.

Lingwan et al. (2023) discovered that phytochemical–rich petals of Rhododendron arboreum one of the species of Rhododendron located in the Himalayan region, popularly known as "Buransh," had antiviral action and combat the virus of COVID-19. The Botanical Survey of India recently published a new report revealing that there are 132 taxa of rhododendrons present in India and that more than 5 of the 45 taxa identified in the report are experiencing significant threats owing to climatic change and anthropogenic pressures. Many authors are working on Rhododendrons to promote conservation and aware researchers and the common man too.

Therefore, this study gives useful insights into the field's existing knowledge landscape, research trends, collaborations, and research gaps. It promotes collaboration and contributes to the conservation and sustainable management of Rhododendron species.

2. Literature review

Córdoba-Tovar et al. (2022) did a review to evaluate the therapeutic potential of plants against COVID-19 and mapped the 10 most studied plants published between 2020 and October 2021. A total of 24,046 articles were retrieved from four databases, PubMed, ScienceDirect, Scopus, and JSTOR. Notably, 2021 saw a remarkable 69% increase in research publications compared to 2020, underscoring the growing interest in exploring the potential of medicinal plants against COVID-19. The predominance of research

from China, as indicated by the 28% share of publications, highlights the country's active participation in medicinal plant exploration in the context of COVID-19.

Yuan and Sun (2022) conducted a study that presents a thorough analysis of 3,872 articles and review papers on blueberry research, utilizing the Web of Science database. The papers, predominantly written in English (97.34%), were authored by 10,102 researchers from 83 countries or territories and affiliated with 2,033 organizations. These publications were found in 770 Journals and three book series. Notably, the top five Journals contributing to blueberry research were HortScience (7.18%), Journal of the American Society for Horticultural Science (7.024%), Journal of Agricultural and Food Chemistry (2.996%), Journal of Economic Entomology (2.505%), and Food Chemistry (2.376%).

Sivankalai et al. (2021) shed light on the research trends utilizing scientometric techniques in the field of Curcuma Longa (medicinal plant) research for a duration of twenty years, from 2000 to 2019. A total of 6087 publication records were yielded from the Web of Science, including Science Index-Expanded (SCIE) and Social Sciences Citation Index (SSCI). India, USA, China, and Iran were the top four contributing countries, with India leading at 24.68 percent of the total literature. Mashhad University of Medical Sciences, Iran, was the leading institution, accounting for 1.8 percent of the papers.

Zhang et al. (2021) conducted a scientometric analysis of the electrochemical analysis of flavonoids to determine research progress and development. Flavonoids are a class of plant secondary metabolites that are found in a wide variety of plant species, including rhododendrons. Published papers from 1998–2020 were retrieved from the SCIE database of the Web of Science on the topic and were analyzed using CiteSpace software. According to the findings, most research papers on this topic were published in the years 2004–05, 2011-13, and 2016-18.

Molina and Bravo (2020) performed a scientometric study on plant species of the Ericaceae family published during the years 2010 to 2020 from the following sources" Science Direct, Scopus, Web of Science, DOAJ, Scielo, SciFinder and specialized journals such as National Library of Medicine and only articles were taken for analysis. 100 articles were selected for the study, out of which 90% of them in English and the remaining 10% were in Spanish. It was found that the genera Vaccinium and Rhododendron are the most studied of the Ericaceae family.

It is very much clear after the literature review that research in the field of medicinal plants is very popular among researchers. Research into plants with medicinal properties can have a significant impact on the medical and healthcare sector, as bioactive compounds with therapeutic potential have been found in many plant species. It is observed that the scientific analysis in the field of Rhododendron has not been done yet.

3. Objectives of the study
The main objectives of the study are:
- To analyze the growth trend of scientific publications on Rhododendron.
- To identify the most prolific authors, journals, and institutions that have contributed to research on Rhododendron.
- To ascertain the year-wise distribution of literature on Rhododendron.
- To determine the most frequent keywords used on Rhododendron.

4. Methodology
This study utilized scientometric techniques to ascertain the impact of global research outputs in the field of Rhododendron publications. The data is extracted from the prominent Web of Science database from 1989 to 2022, as there are no publications before 1989. "Rhododendron" was used as a search query in the field. A total of 3082 records were retrieved. After data extraction, data analysis is done using MS Excel, and data visualization is done using VOS viewer software.

5. Data analysis and interpretation
A total of 3082 records were extracted from the Web of Science Core Collection database published on Rhododendron research predominantly written in the English language (97.56%). Data analyses and interpretation has been done of extracted data to drive meaningful insights based on prescribed objectives within the domain of Rhododendron.

5.1 Growth trend of scientific publications on Rhododendron

Table 1: Growth trend of publications

Year	No. of Publications	% of 3082	Cumulative Publications
2013	111	3.60	111
2014	125	4.05	236
2015	126	4.08	362
2016	143	4.64	505
2017	141	4.57	646
2018	179	5.80	825
2019	183	5.93	1008
2020	194	6.29	1202
2021	206	6.68	1408
2022	213	6.91	1621

Table 1 and Figure 1 demonstrate the growth of publications over the years, showing a general trend of increasing publications with each passing year. There was a gradual increase in the number of publications in the early years from 2013 to 2015 with 111, 125, and 126 publications respectively. In 2017, there was a slight decrease in the

number of publications to 141 from the previous year's count of 143. The highest growth in publications occurred between 2017 and 2018, with a significant increase of 38 publications; this was followed by an increase of 17 publications in 2015–16. From 2018 to 2022, there has been a consistent growth trend in the number of publications, with each year surpassing the previous one. Furthermore, the number of publications increased at a higher rate in 2022, with 213 publications.
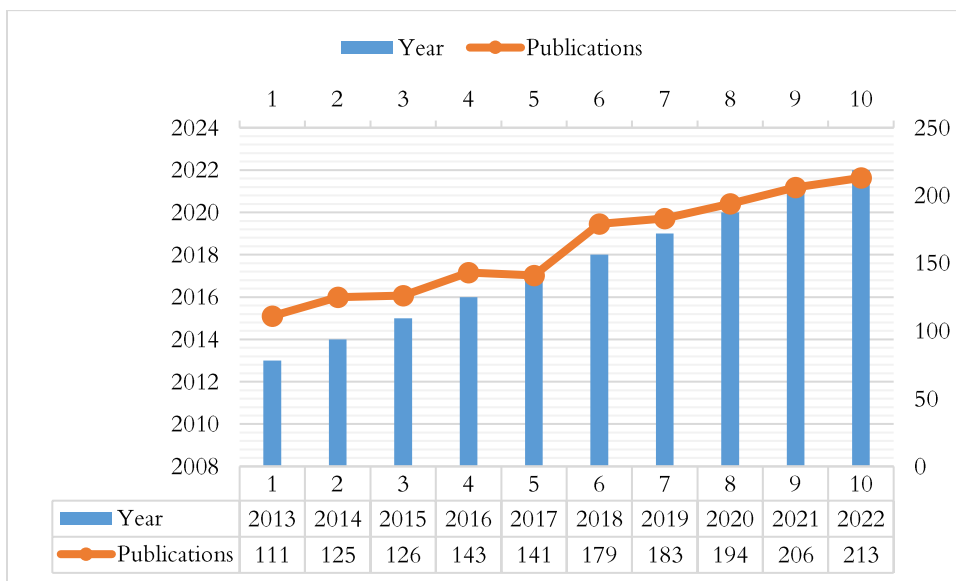

	1	2	3	4	5	6	7	8	9	10
Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Publications	111	125	126	143	141	179	183	194	206	213

Figure 1: Growth trend of publications

5.2 Most prolific authors

Table 2 represents the top 10 most prolific authors among the 9040 authors related to Rhododendron publications. Li, Yong holds the first position with 26 publications, and Yao, Guangmin holds the second position with 20 publications, but the number of citations (425) is slightly higher than that of Li, Yong, which might indicate that Li, Yong is highly prolific, the impact of each individual paper may be relatively moderate compared to Yao, Guangmin's work. Liu, Yun-Bao, and Yu, Shi-Shan have 17 publications each, tied for the third position. Furthermore, the top three most prolific authors are from China, and even the organization is also the same i.e., the Chinese Academy of Medical Sciences, Beijing, China except for the second most prolific author who is from Huazhong University of Science & Technology, Wuhan, China.

Overall, the top 10 most prolific authors are highly productive individuals who have made significant contributions to the field of Rhododendron research.

Table 2: Top 10 most prolific authors

Author	No. of Publications	Citations
Li, Yong	26	411
Yao, Guangmin	20	425
Liu, Yun-Bao	17	319
Yu, Shi-Shan	17	305
Zhang, Hanqi	15	313
Qu, Jing	15	237
Ma, Shuang-gang	14	216
Zhou, Junfei	12	269
Zheng, Guijuan	11	199
Li, Li	11	135

5.3 Most prolific countries

Table 3 provides insight into the top 10 most productive countries out of 93 countries in terms of number of publications on Rhododendron research. China ranks first with 822 publications, USA has the second-highest number of publications (748). India ranks third with a significant number of publications (222), followed by Japan which is in fourth position having 212 publications. Moreover, Germany stands in the fifth position with 132 publications, followed by England with 106 publications. Thailand secures its place in the top 10 along with New Zealand, Saudi Arabia, and Mauritius with 82, 35, 26, and 21 publications respectively.

It has been observed that some countries have a high number of publications, while others make up for it with highly influential and well-cited research. Hence, the top 10 countries play a significant role in advancing global knowledge in this specialized field.

Table 3: Top 10 most prolific countries

Country	No. of Publications	Citations
Peoples R. China	822	12713
USA	748	17745
India	222	3996
Japan	212	3240
Germany	132	4455
England	106	4261
Thailand	82	2883
New Zealand	35	1295
Saudi Arabia	26	1467
Mauritius	21	1522

5.4 Most prolific organizations

Organizations are actively engaged in research and have made notable contributions to the field of Rhododendrons, as shown in Table 4 by their high number of publications. Of the 2344 organizations, the Chinese Academy of Sciences has the highest number of publications with 292 publications, the United States Department of Agriculture, Agricultural Research Service secures the second position in terms of publication count with 72 while Mae Fah Luang University has 69 publications and secures third position. The University of Chinese Academy of Sciences holds the fourth position in terms of publications (56). Chiang Mai University follows closely with 45 publications, which is the same as the US Forest Service. With 35 publications, Virginia Tech formerly Virginia Polytechnic Institute and State University maintains a respectable research output. Guizhou University, Zhongkai University of Agriculture and Engineering, and Guizhou Academy of Agricultural Sciences are also among the top ten most productive organizations with 26, 22, and 14 publications respectively.

Table 4: Top 10 most prolific organizations

Organization	No. of Publications	Citations
Chinese Academy of Sciences	292	5580
United States Department of Agriculture, Agricultural Research Service	72	1737
Mae Fah Luang University	69	1746
University of Chinese Academy of Sciences	56	908
Chiang Mai University	45	1006
US Forest Service	45	1669
Virginia Polytechnic Institute and State University	35	962
Guizhou University	26	624
Zhongkai University of Agriculture and Engineering	22	430
Guizhou Academy of Agricultural Sciences	14	713

5.5 Year–wise distribution of Rhododendrons research

Table 5 represents the year–wise distribution of research publications on Rhododendrons from 1989 to 2022. The number of research publications on rhododendron has shown a general trend of a steady increase over the years. The number of publications started from only 13 in 1989 and gradually increased to 213 in 2022. The maximum number of publications was recorded during the year 2022 with 213 publications, followed by 206 publications in 2021 and 194 in 2020. The years 1989 and 1990 recorded the minimum number of publications with only 13 each.

Table 5: Year–wise publication on Rhododendron

Year	No. of Publications	Year	No. of Publications
1989	13	2006	77
1990	13	2007	99
1991	41	2008	90
1992	28	2009	125
1993	38	2010	118
1994	20	2011	140
1995	45	2012	99
1996	36	2013	111
1997	43	2014	125
1998	33	2015	126
1999	53	2016	143
2000	54	2017	141
2001	50	2018	179
2002	47	2019	183
2003	50	2020	194
2004	73	2021	206
2005	76	2022	213

5.6 Most frequent keywords

Network visualization of the keyword occurrence has shown in Figure 2 which is created with the help of VOS viewer software. This can help identify clusters of related terms and highlight potential research topics and trends within the field. A total of 12,834 keywords were used in the field of rhododendrons across all publications. Of the most frequently used keywords, "rhododendron" is the most frequently used keyword and appears 567 times. This indicates that rhododendron is a central focus of research publications. The keyword "Ericaceae" is the second most frequent term, appearing 278 times, which is also a plant family that includes rhododendrons. The keyword "plants" was the third most frequently used word, appearing 208 times.
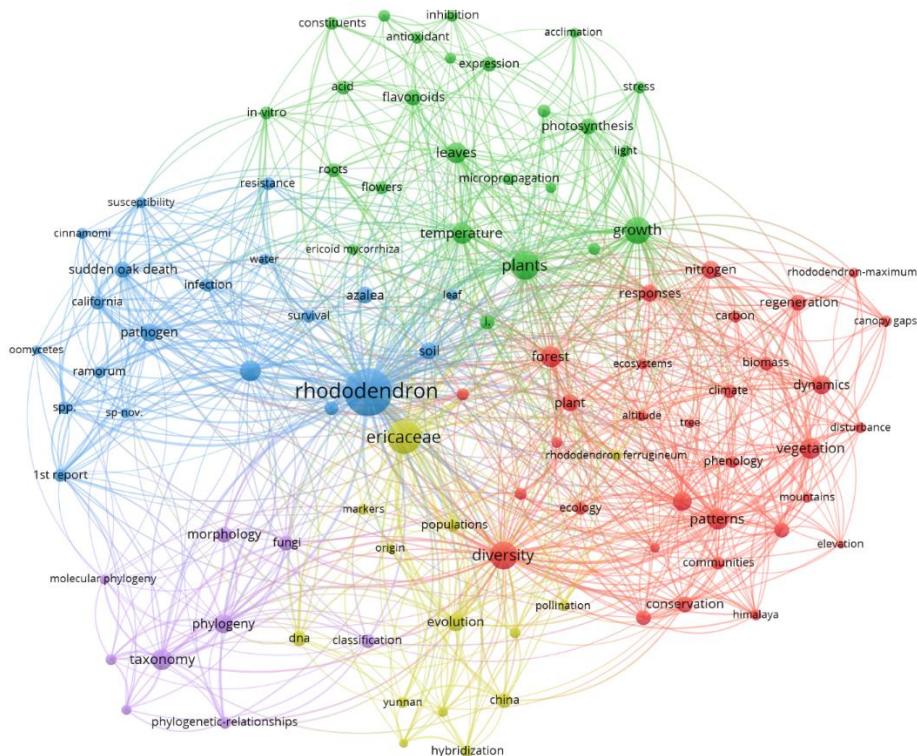
Figure 2: Most frequent keywords

6. Findings and conclusion

Analysis of research publications on rhododendrons from the Web of Science Core Collection database has provided valuable insight into developments and trends in this specialized domain. The findings show that there has been a steady increase in research publications over the years, indicating an active research community focusing on rhododendrons. The growth trend of scientific publications shows a gradual increase in the number of publications in the early years, with a significant increase observed between 2017 and 2018. This growth indicates a continued commitment to the study and understanding of rhododendrons and their related fields. The top 10 most prolific authors have made significant contributions to rhododendron research, with China emerging as a major source of prolific authors. While some authors display high publication numbers, others display more influential work with high citation numbers, indicating a diverse range of research contributions. Furthermore, the top 10 countries with the most publications reflect a global interest in rhododendron research, with China and the United States leading the way. Notably, some countries contribute not only through quantity but also through highly influential and well-cited research.

Organizations also play a pivotal role in the advancement of Rhododendron research, with the Chinese Academy of Sciences taking the lead. The year 2022 records the maximum number of publications in 34 years. Finally, the network visualization of keyword occurrences emphasizes the central focus on "rhododendron" in research publications. "Ericaceae" and "plants" have emerged as other key keywords, reflecting the botanical and taxonomic importance of rhododendrons and the diverse research topics in the field.

Overall, the analysis of research publications on rhododendron provides valuable and meaningful insights into developments and trends in rhododendron research. The contributions of prolific authors, organizations, and countries showcase a global effort to advance knowledge about Rhododendrons. As the body of knowledge on Rhododendrons continues to expand, it is expected to contribute to broader ecological and horticultural understanding and further conservation efforts related to these beautiful and diverse plants.

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Author biography

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